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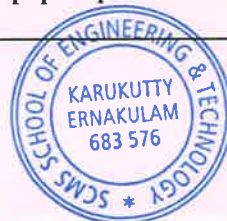## BOOKS/CONFERENCE INDEX 2020-2021

**3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during 2020-2021**
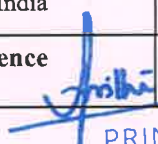
| Sl. No. | Name of the teacher | Title of the book/chapters published | Title of the paper | Title of the proceedings of the conference | Name of the conference | National / International | Calendar Year of publication | ISBN number of the proceeding | Affiliating Institute at the time of publication | Name of the publisher |
|---------|---------------------|--------------------------------------|--------------------|--------------------------------------------|------------------------|--------------------------|------------------------------|-------------------------------|--------------------------------------------------|-----------------------|
| 1 | Jane Theresa | IN Perspective of Contemporary Literatura and Literacy Theories in English | Living in the Wilderness | | | | Sep-20 | ISBN 3789388881052-01130 | SCMS School of Engineering and Technology, Ernakulam, India | Jeeva Publication |
| 2 | Remya Y K | | A Review on studies based on vehicle stability and safety on rural horizontal curves | Proceedings of International Web Conference in Civil Engineering for a Sustainable Planet | Proceedings of International Web Conference in Civil Engineering for a Sustainable Planet | International | Apr-21 | ISSN:2582-3922 | SCMS School of Engineering and Technology, Ernakulam, India | AIJR Proceedings |
| 3 | Sruthy M R | | Salinity reduction in well water using zeolite | IOP Conference Series: Materials Science and Engineering | 6th Biennial International Conference on Emerging Trends in Engineering Science and Technology (ICETEST 2020) 17th-19th December 2020, Kerala, India | International | Dec-20 | ISSN: 1757-8981 | SCMS School of Engineering and Technology, Ernakulam, India | IOP Publishing |

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| 4 | Dr.Akhila M | | Liquefaction resistance improvement of silty sands using cyclic preloading | IOP Conference Series: Materials Science and Engineering | 6th Biennial International Conference on Emerging Trends in Engineering Science and Technology (ICETEST 2020) 17th-19th December 2020, Kerala, India | International | Dec-20 | ISSN: 1757-8981 | SCMS School of Engineering and Technology, Ernakulam, India | IOP Publishing |
| 5 | Dr.Vinod P | Communications in Computer and Information Science book series (CCIS, volume 1366) | Detection of Obfuscated Mobile Malware with Machine Learning and Deep Learning | | Symposium on Machine Learning and Metaheuristics Algorithms, and Applications | | Feb-21 | 978-981-16-0419-5 | SCMS School of Engineering and Technology, Ernakulam, India | Springer Link |
| 6 | Dhanya K A, Binu John | | Twitter sentiments: A machine learning approach | IEEE XPLORE | 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | International | Feb-21 | 978-1-6654-1960-4 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 7 | Susmi Jacob | | Sentiment Analysis using Deep learning | IEEE XPLORE | 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | International | Feb-21 | 978-1-6654-1960-4 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |

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| 8 | Bini Omman | | Pedestrian Counting Using YOLO V3 | IEEE XPLORE | 2021 International Conference on Innovative Trends in Information Technology (ICITIIT) | International | Apr-21 | 978-1-6654-0467-9 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
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| 10 | Sreeja Rajesh | | Modernizing traditional methods of farming using farming robots | SSRN | International Conference on IoT Based Control Networks & Intelligent Systems - ICICNIS 2020 | International | Jan-21 | 1556-5068 | SCMS School of Engineering and Technology, Ernakulam, India | SSRN |
| 11 | Dr. Varun G Menon | | DIO messages and trickle timer analysis of RPL routing protocol for UAV-assisted data collection in IoT | ACM Digital Library | DroneCom '20: Proceedings of the 2nd ACM MobiCom Workshop on Drone Assisted Wireless Communications for 5G and Beyond | International | Sep-20 | 978-1-4503-8105-5 | SCMS School of Engineering and Technology, Ernakulam, India | ACM Digital Library |

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| 13 | Ms. Litty Koshy, Ms. Gayathry S Warrier | | Detection of Recoloring and Copy-Move Forgery in Digital Images | IEEE XPLORE | 2020 Fifth International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN) | International | Dec-20 | 978-1-7281-8818-8 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 14 | Ms. Neenu Sebastian, Ms. Rosebell Paul | | Morphological Operators on Hypergraphs for Colour Image Processing | IEEE XPLORE | 2020 Advanced Computing and Communication Technologies for High Performance Applications (ACCTHPA) | International | Oct-20 | 978-1-7281-6453-3 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 15 | Litty Koshy | | Copy-Move Forgery Detection and Performance Analysis of Feature Detectors | IEEE XPLORE | 2020 International Conference on Communication and Signal Processing (ICCSP) | International | Sep-20 | 978-1-7281-4988-2 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |

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# Copy-Move Forgery Detection and Performance Analysis of Feature Detectors

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Litty Koshy    Department of CSE, SCMS of Engineering and Technology, Kochi

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I. Introduction
II. Proposed System
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V. Block Feature Matching

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reporting, and advanced crime investigation. Digital images can easily be forged with the advancement of image manipulation tools and information technology. The commonly used image forgery technique in digital forensic filed is Copy-move forgery. The two fundamental classifications for identifying copy-move forged images are keypoint-based and block- based method. Block-based strategies have the burden of high computational expense because of the enormous number of image blocks and it fails to deal with different geometric transformations. On the contrary, keypoint-based methodologies can overwhelmed these two draw-backs however are discovered hard to manage smooth locales. As a result, these two methodologies are combined and proposed a effective copy-move forgery detection. Also, we accomplish a comparative study between different keypoint detectors and feature matching algorithms used to determine computational complexity of each.

**Abstract**

Document Sections

I. Introduction

II. Preliminaries

III. Colour Image Representation

IV. Experimental Results

V. Conclusion and Future Works

Authors

Figures

References

**Abstract:**

This article is an extension of morphological operators on hypergraphs to work with colour images. Morphological operators on hypergraphs are useful for binary and grayscale image processing. The preliminary experimental results related to the extension of these operators to colour images is presented in this paper. The results on colour images are promising and is a better alternative for the existing methods.

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# Morphological Operators on Hypergraphs for Colour Image Processing

**Publisher: IEEE**  [ Cite This ]  [ 🗎 PDF ]

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**Abstract**

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Introduction

**Abstract:**

This article is an extension of morphological operators on hypergraphs to work with colour images. Morphological operators on hypergraphs are useful for binary and grayscale image processing. The preliminary experimental results related to the extension of these operators to

# Morphological Operators on Hypergraphs for Colour Image Processing

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## Abstract

This article is an extension of morphological operators on hypergraphs to work with colour images. Morphological operators on hypergraphs are useful for binary and grayscale image processing. The preliminary experimental results related to the extension of these operators to colour images is presented in this paper. The results on colour images are promising and is a better alternative for the existing methods.

**Keywords**: Hypergraph, Mathematical Morphology, Image Processing, Salt and pepper noise.

## 1 Introduction

Mathematical morphology is the first consistent non-linear image analysis theory. Originally it was defined on a set theretic framework and used for processing bianry images and extended to grayscale images. Despite its continuous origin, it was soon recognised that the roots of the theory were in algebraic theory, notably the framework of complete lattices. This allows the theory to be completely adaptable to non-continuous spaces, such as graphs [4], hypergraphs [3] and simplicial complexes [5]. Extending Mathematical Morphology to colour images is an active area of research in image processing [8, 18, 9]. There exists no general admitted extension that permits to perform morphological operations on colour images since there is no natural ordering of vectors [11].

Image filtering is one of the most important operation in image processing. Salt and pepper noise is very common in image processing applications and noise reduction is a very active area of research in image processing [12]. Morphological filtering is one of the most reliable techniques for salt and

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pepper noise reduction [2, 4, 5]. Our objective is to utilise the morphological operators defined on hypergraphs to remove this noise from colour iamges [2, 16].

This paper is organised as follows. In Section 2, we introduce the preliminary definitions from mathematical morphology and morphological operators on hypergraphs. In Section 3, we present the hypergraph representation of a digital image. Experimental results of the operators and filters on a colour image are presented in Section 4. Conclusion and future works are presented in Section 5.

## 2   Preliminaries

### 2.1   Mathematical Morphology

**Definition 1.** [6, 7, 14, 17] Given two lattices $\mathcal{L}_1$ and $\mathcal{L}_2$, any operator $\delta : \mathcal{L}_1 \to \mathcal{L}_2$ that distributes over the supremum and preserves the least element is called a *dilation* (*i.e.* $\forall \varepsilon \subseteq \mathcal{L}_1, \delta(\vee_1 \varepsilon) = \vee_2 \{\delta(X) | X \in \varepsilon\}$). An operator that distributes over the infimum and preserves the greatest element is called an *erosion*.

**Definition 2.** [6, 7, 14] Two operators $\epsilon : \mathcal{L}_1 \to \mathcal{L}_2$ and $\delta : \mathcal{L}_2 \to \mathcal{L}_1$ form an *adjunction* $(\epsilon, \delta)$, if for any $X \in \mathcal{L}_2$ and any $Y \in \mathcal{L}_1$, we have $\delta(X) \leq_1 Y \Leftrightarrow X \leq_2 \epsilon(Y)$, where $\leq_1$ and $\leq_2$ denote the order relations in $\mathcal{L}_1$ and $\mathcal{L}_2$ respectively.

**Definition 3.** [6, 7, 17] Let $\delta$ be any operator on a lattice $\mathcal{L}$, then $\delta$ is

(a) *increasing* if $X \leq Y$ implies $\delta(X) \leq \delta(Y)$;
(b) *extensive* if $\delta(X) \geq X$ for every $X \in \mathcal{L}$;
(c) *anti extensive* if $\delta(X) \leq X$ for every $X \in \mathcal{L}$;
(d) *idempotent* if $\delta^2 = \delta$;
(e) a *morphological filter* if $\delta$ is increasing and idempotent;
(f) an *opening* if $\delta$ is increasing, anti-extensive and idempotent;
(g) a *closing* if $\delta$ is increasing, extensive and idempotent.

### 2.2   Morphological operators on hypergraphs [2, 16]

A hypergraph is denoted as a pair $H = (H^\bullet, H^\times)$ where $H^\bullet$ is a set and $H^\times$ is a family $(e_i)_{i \in I}$ of nonempty subsets of $H^\bullet$. Let $X$ and $Y$ be two hypergraphs. If $X^\bullet \subseteq Y^\bullet$ and $X^\times \subseteq Y^\times$, then $X$ and $Y$ are ordered and it is denoted by $X \subseteq Y$. $X$ is called a subhypergraph of $Y$. Hereafter the workspace is a hypergraph $H = (H^\bullet, H^\times)$ and consider the sets $\mathcal{H}^\bullet$, $\mathcal{H}^\times$ and $\mathcal{H}$ of respectively all subsets of $H^\bullet$, all subsets of $H^\times$ and all subhypergraphs of $\mathcal{H}$.

**Definition 4. (Vertex-Hyperedge Correspondence)** The operators $\delta^\bullet$, $\epsilon^\bullet$ from $\mathcal{H}^\times$ into $\mathcal{H}^\bullet$ and the operators $\delta^\times$, $\epsilon^\times$ from $\mathcal{H}^\bullet$ into $\mathcal{H}^\times$ are defined as follows.

| | $\mathcal{H}^\times \to \mathcal{H}^\bullet$ | $\mathcal{H}^\bullet \to \mathcal{H}^\times$ |
|---|---|---|
| Provide the object with a hypergraph structure | $X^\times \to \delta^\bullet(X^\times)$ such that $(\delta^\bullet(X^\times), X^\times) = \bigwedge \mathcal{H}_{X^\times}$ | $X^\bullet \to \epsilon^\times(X^\bullet)$ such that $(X^\bullet, \epsilon^\times(X^\bullet)) = \bigvee \mathcal{H}_{X^\bullet}$ |
| Provide its complement with a hypergraph structure | $X^\times \to \epsilon^\bullet(X^\times)$ such that $(\epsilon^\bullet(X^\times), \overline{X^\times}) = \bigwedge \mathcal{H}_{\overline{X^\times}}$ | $X^\bullet \to \delta^\times(X^\bullet)$ such that $(\overline{X^\bullet}, \delta^\times(X^\bullet)) = \bigvee \mathcal{H}_{\overline{X^\bullet}}$ |

Table 1: Vertex-hyperedge correspondence

**Property 1.**    1. Operators $\epsilon^\times$ and $\delta^\times$ (resp. $\epsilon^\bullet$ and $\delta^\bullet$) are dual of each other.

2. Both $(\epsilon^\times, \delta^\bullet)$ and $(\epsilon^\bullet, \delta^\times)$ are adjunctions.

3. Operators $\epsilon^\bullet$ and $\epsilon^\times$ are erosions.

4. Operators $\delta^\bullet$ and $\delta^\times$ are dilations.

The following operators are defined on $\mathcal{H}^\bullet$.

**Definition 5.**

(a) Vertex dilation $\delta = \delta^\bullet \circ \delta^\times$ and vertex erosion $\epsilon = \epsilon^\bullet \circ \epsilon^\times$.

(b) Opening $\gamma_1 = \delta \circ \epsilon$ and closing $\phi_1 = \epsilon \circ \delta$.

(c) Half opening $\gamma_{1/2} = \delta^\bullet \circ \epsilon^\times$ and half closing $\phi_{1/2} = \epsilon^\bullet \circ \delta^\times$.

**Property 2.** If $X^\bullet \subseteq H^\bullet$, then $\gamma_1(X^\bullet) \subseteq \gamma_{1/2}(X^\bullet) \subseteq X^\bullet \subseteq \phi_{1/2}(X^\bullet) \subseteq \phi_1(X^\bullet)$.

**Property 3.** The operators $\gamma_{1/2}$ and $\gamma_1$ are openings on $\mathcal{H}^\bullet$ and $\phi_{1/2}$ and $\phi_1$ are closings on $\mathcal{H}^\bullet$

## 2.3   Flat morphological operators on weighted hypergraphs [2]

Let $n$ denote any positive integer and $K = \{0, \ldots, n\}$. Let $E$ be any set. Let $Fun(E)$ denote the set of all maps from $E$ to $K$. Let $k \in K$ and let $F \in Fun(E)$. The $k$ section ($k-$threshold) of $F$ is the subset $\chi_k(F)$ of E where $\chi_k(F) = \{x \in E | F(x) \geq k\}$. Then $Fun(E)$ with the order relation $\leq$ inferred by threshold decomposition from the relation $\subseteq$ on $E$ is a complete lattice .

By threshold decomposition, the lattice $\mathcal{H}$ of all subhypergraphs of $H$ induces a lattice $Fun(H^\bullet) \otimes Fun(H^\times)$ of pairs of functions weighting respectively the vertices and the hyperedges of $H$ such that the simultaneous threshold of these two functions at any given level yields a subhypergraph of $H$.

The operators acting on the lattices $\mathcal{H}^\bullet$, $\mathcal{H}^\times$, or $\mathcal{H}$ are all increasing and, they induce stack operators [1, 10, 13, 15, 19] acting on the lattices $Fun(H^\bullet)$, $Fun(H^\times)$, and $Fun(H^\bullet) \otimes Fun(H^\times)$. This implies that the properties presented for hypergraph operators on the lattices $\mathcal{H}^\bullet$, $\mathcal{H}^\times$, or $\mathcal{H}$ also hold good for operators on the lattices $Fun(H^\bullet)$, $Fun(H^\times)$, and $Fun(H^\bullet) \otimes Fun(H^\times)$.

The following definition is the stack analougues to Definition 3, which locally characteristises $\delta^\bullet, \epsilon^\times, \epsilon^\bullet, \delta^\times$ on weighted hypergraphs.

**Definition 6.** Let $F^{\bullet} \in Fun(H^{\bullet})$ and let $F^{\times} \in Fun(H^{\times})$.

$$\delta^{\bullet}(F^{\times})(x) = \max_{x \in v(e_i)} \{F^{\times}(e_i) \mid e_i \in H^{\times}\} \ \forall \ x \in H^{\bullet}$$

$$\epsilon^{\times}(F^{\bullet})(e_i) = min\{F^{\bullet}(x) \mid x \in v(e_i)\} \ \forall \ e_i \in H^{\times}$$

$$\epsilon^{\bullet}(F^{\times})(x) = \min_{x \in v(e_i)} \{F^{\times}(e_i) \mid e_i \in H^{\times}\} \ \forall \ x \in H^{\bullet}$$

$$\delta^{\times}(F^{\bullet})(e_i) = max\{F^{\bullet}(x) \mid x \in v(e_i)\} \ \forall \ e_i \in H^{\times}$$

This idea is used to define Alternating Sequential Filters on binary and grayscale images represented as uniform hypergraphs. The same idea can be extended to be utilised for colour images also. Further it can also be used to define ASFs on colour images by suitable choice of a partial order on colour images [cite].

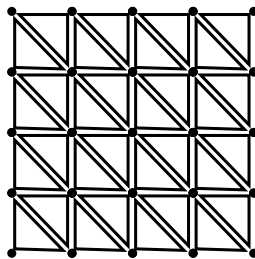# 3   Colour Image Representation



Figure 1: Hypergraph structure used to represent an image.

We represent the RGB components of a colour image by means of a vertex weighted hypergraph. Each pixel correspond to the vertices of the hypergraph and the weights are assigned according to the intensity values of the corresponding pixels. We use the 3-uniform hypergraph presented in Figure 1 to represent the hyperedges. This is because this structure gives the best results for binary and grayscale image filtering applications. The vertex weights are propogated along the hyperedges to obtain the morphological operators, thereby producing the component images [2]. The component images are then combined to generate the resultant colour image.

# 4   Experimental Results

The definitions and results presented in the previous sections are used to obtain the dilated and eroded colour images. This is achieved by propagating the vertex weights of the hypergraphs along

(a) Original image

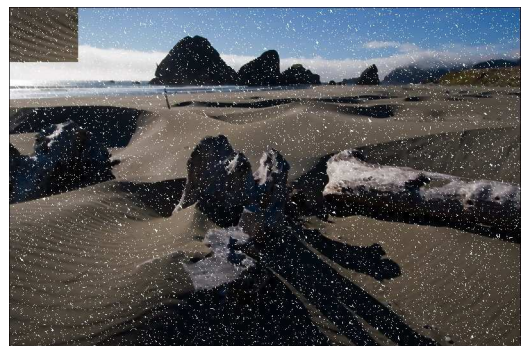(b) Noisy version MSE = 32.72%

(c) Half Opening

(d) Half Closing

(e) Opening

(e) Closing

Figure 2: Illustration of the operators on a colour image.

its hyperedges to obtain the flat morphological operators presented in [2]. Composition of these operators produce the resultant images to generate half opened ($\gamma_{1/2}$), half closed ($\phi_{1/2}$), opened ($\gamma_1$) and closed ($\phi_1$) images as shown in 2 (b) to (e).

By property 2, half opening and half closing of the vertex set of a hypergraph are more close to the original vertex set than that of opening and closing. Moreover both of them are filters and capable of removing noise from the image, where the image is represented as a hypergraph. In this paper we utilise this idea on colour images to illustrate the effectiveness of these operators.



(a) $\gamma_1 \circ \phi_1$ MSE = 3.57%



(b) $\gamma_{1/2} \circ \phi_{1/2}$ MSE = 2.75%

Figure 3: Illustration of colour image filtering.

Figure 2(a) is a colour image taken from [11]. The noisy version of this image added with salt and pepper noise is shown in Figure 2(b). The mean square error (MSE) for this image is 32.72%. The half opened ($\gamma_{1/2}$) image is shown in Figure 2(c). Almost all the salt kind of noise is removed by this operation and causes less damage to the image. Figure 2(d) shows the half closed ($\phi_{1/2}$) image in which the pepper noise is almost completely removed. Figure 2(e) and (f) shows the results of opening ($\gamma_1$) and closing ($\phi_1$) of (b) respectively. Here also the noise is removed but the damage caused to the image is more compared to the previous cases.

The composition $\gamma_{1/2} \circ \phi_{1/2}$ or half closing followed by half opening is an alternating sequential filter (ASF) and capable of removing impulse noise effectively from binary and grayscale images [2]. The result of this operation on the tested colour image in Figure 2(b) is shown in Figure 3(b). The mean square error is reduced to 2.75% in this case. The open-close filter $\gamma_1 \circ \phi_1$ reduces the mean square error to 3.57%.

Experimental results shows that the resultant colour images obtained by half opening and half closing are better than the images obtained by opening and closing operations. This is because half opening and half closing are better approximations to the original image and cause less damage to the image than opening and closing. Thus half opening and half clsing can be used more effectively than opening and closing for colour image denoising. In this work we do not use any partial ordering of colour vectors.

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# 5   Conclusion and future works

The objective of this study is to identify the possibilities of using morphological operators on hypergraphs for colour image processing. Morphological operations like half opening and half closing are not at all possible using traditional morphological image processing using structuring elements. Graph and hypergraph structures to represent digital images allows this kind of operations. The results are required to be tested on a large dataset of colour images inorder to validate the consistency of the proposed method. The initial results are promising and the future works are directed towards a more suitable hypergraph representation of colour images incorporating partial ordering on the colour components. The possiblility of false colours in morphological colour image processing is not completely removed in this method but the effect of which is minimized. Use of partial ordering of colours on hypergraphs is a solution for this problem.

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ORIGINAL PAPER

# Detection and robustness evaluation of android malware classifiers

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Anson Pinhero[1] · K. S. Ajith[1] · P. Mathiyalagan[4]

## Abstract

Android malware attacks are tremendously increasing, and evasion techniques become more and more effective. For this reason, it is necessary to continuously improve the detection performances. With this paper, we wish to pursue this purpose with two contributions. On one hand, we aim at evaluating how improving machine learning-based malware detectors, and on the other hand, we investigate to which extent adversarial attacks can deteriorate the performances of the classifiers. Analysis of malware samples is performed using static and dynamic analysis. This paper proposes a framework for integrating both static and dynamic features trained on machine learning methods and deep neural network. On employing machine learning algorithms, we obtain an accuracy of 97.59% with static features using SVM, and 95.64% is reached with dynamic features using Random forest. Additionally, a 100% accuracy was obtained with CART and SVM using hybrid attributes (on combining relevant static and dynamic features). Further, using deep neural network models, experimental results showed an accuracy of 99.28% using static features, 94.61% using dynamic attributes, and 99.59% by combining both static and dynamic features (also known as multi-modal attributes). Besides, we evaluated the robustness of classifiers against evasion and poisoning attack. In particular comprehensive analysis was performed using permission, APIs, app components and system calls (especially $n$-grams of system calls). We noticed that the performances of the classifiers significantly dropped while simulating evasion attack using static features, and in some cases 100% of adversarial examples were wrongly labelled by the classification models. Additionally, we show that models trained using dynamic features are also vulnerable to attack, however they exhibit more resilience than a classifier built on static features.

**Keywords** Static features · Dynamic features · Hybrid features · Fisher score · Adversarial examples · Attack models

# 1 Introduction

Malicious code is a software intentionally written for bypassing security controls and performing unauthorized actions that are not allowed to the attacker and can cause a damage to the victim. The techniques for analyzing malicious code can be divided into static analysis and dynamic analysis. Static analysis techniques scan the source code and don't require

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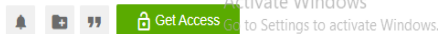
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RESEARCH-ARTICLE

# Intelligent vehicle collision avoidance system using 5G-enabled drone swarms

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## ABSTRACT

The number of vehicular collisions is on a toll worldwide. Despite enforcing stringent laws and incorporating various safety features, the causalities are still on the rise. Existing techniques such as

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collision avoidance...

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# DIO Messages and Trickle Timer analysis of RPL Routing Protocol for UAV-assisted Data Collection in IoT

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## ABSTRACT

Routing protocol for low-power and lossy networks (RPL) is an widely-used IPv6 routing protocol for lossy wireless networks with the power constrained devices in Internet of Things (IoT). It is a proactive protocol that constructs a destination oriented directed acyclic graph (DODAG) rooted at the single destination called the root node that resides at unmanned aerial vehicle (UAV). Specifically, a DODAG is built with the help of different control messages like DODAG information object (DIO), DODAG advertisement object (DAO), and DODAG information solicitation (DIS). As the generation of these messages incur additional energy consumption, RPL uses the Trickle algorithm to dynamically adjust the transmission windows. In this paper, we analyze the effect of the two parameters, namely, `DIO-INTERVAL-MINIMUM` and `DIO-INTERVAL-DOUBLING` that have significant effect on the Trickle algorithm and the rate of message generation. Through experiments, we show that an optimal selection of these parameters saves a significant amount of energy with different parameter settings in UAV-assisted IoT networks.

## CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

## KEYWORDS

Energy-efficiency, Optimization, Routing protocol, RPL, UAV, DODAG

## 1 INTRODUCTION

With the recent advancements in embedded computing and wireless technologies, a variety of physical things are getting connected to the Internet. Typically, the devices are generally constrained in terms of processing power, memory, and energy (battery power), similar to wireless sensor networks (WSNs) and a network of such devices is called a low-power lossy network (LLN). The wireless links interconnecting these devices are characterized by high loss rates and low data rates. To enable communication among such devices, the routing over low-power and lossy network (ROLL) working group has specified the IPv6 routing protocol for LLN, called RPL [6, 10]. The devices running RPL are connected in a tree-like topology and the connections are established forming a destination-oriented directed acyclic (DODAG) graph, where all the nodes are directed towards a common root. These graphs are formed based on an objective function (OF) that defines the metrics and constraints for the nodes running RPL, and helps to compute routes from data generating devices to the root node.

As the devices are battery powered, energy conservation mechanisms becomes crucial to maximize the network lifetime. Although the design of `OF` is central to determining the energy spent for network execution, there are several other RPL parameters that play a significant role. RPL uses
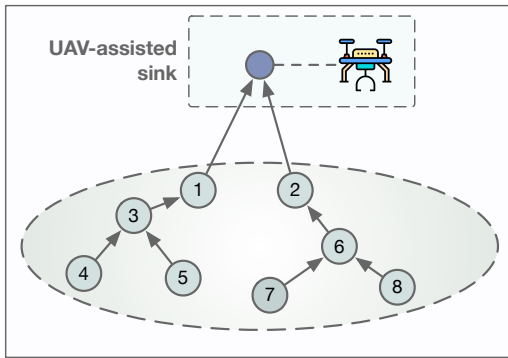
**Figure 1: System model.**

different control messages for topology formation, and frequent generation of such messages that results in higher energy costs. Unmanned aerial vehicle (UAV)-assisted networks have received significant attention in recent years due to the numerous advantages offered in real time surveillance and data collection applications. When deployed with an efficient architecture and well coordinated system, UAV systems that include drones, small air crafts, balloons, would provide reliable and cost-effective communication solutions for numerous real-world scenarios. With the unmanned aerial vehicle (UAV) as a root node, the task of data-collection becomes more challenging as additional control messages are required to maintain network connectivity. The pattern of generation of these control messages can be adapted within a network based on network behavior and requirements. In order to do so, it is important to understand and analyse these factors.

## 2 MOTIVATION AND CONTRIBUTION

Energy consumption is one of the critical issues in LLN. Different networks have different requirements and since RPL is the routing protocol designed to fulfill such requirements, it can be customised according to the network to save more energy and increase lifetime. To do so, understanding the factors within the protocol and how the protocol works is very important.

Therefore, in this paper, the role of parameters related to DODAG information object (DIO) control with a significant impact on the Trickle algorithm and the rate of message generation is analyzed. Through experiments, we show that an optimal selection of these parameters saves a significant amount of energy with different parameter settings for data collection in UAV-assisted IoT networks.

## 3 OVERVIEW OF RPL

The construction of network topology is initiated by the root node. In our system model, the UAVs are responsible

to initiate the topology construction process. The DODAG is formed by nodes joining the graph and this is performed with the help of control messages by exchanging the information. There exists four types of control messages a) DODAG Information Object (DIO), b) Destination Advertisement Object (DAO), c) DODAG Information Solicitation (DIS), and d) and DAO Acknowledgement (DAO-ACK). An algorithm, called as *trickle Timer* [2] is used to suppress the generation of redundant control messages. Since our focus on the DIO message generation and Trickle Timer analysis [2, 4], we omit the discussion of other control messages for brevity. Alternatively, few works [3] have solely focused on optimizing the Trickle algorithm.

### 3.1 DIO Control Messages

To form the DODAG, the root node that resides on the UAV broadcasts the DIO messages. The DIO message mainly contains the following information: a) RPL instance ID, b) version number, c) rank, which is the relative position of a node from the root, d) Mode of Operation (MOP), root preferability (Prf), saves Sequence Number (DTSN), DODAG-ID etc.

All the nodes within the communication range of the root node receive the DIO message, when the root node multicasts the DIO message. Multiple roots might be sending DIO messages at the same time and hence a node might receive DIO messages from multiple roots having different OFs. A node cannot join more than one root at a time to form DODAG, so when a node receives multiple DIO messages, it runs an algorithm within itself to decide which root they want to join. The decision of the node is based upon the metrics defined by the OF of the root node. After a node joins the DODAG, if the node is not a leaf node, it further multicasts the DIO control messages so that other nodes can join the graph. These steps of forming the graph continues until no nodes are found within range or leaf nodes are found [1, 6–8, 8–10]

### 3.2 Trickle Timer Algorithm

For the maintainance and upgradation of topology, control messages need to be generated repeatedly, which consumes a lot of energy. To use the resources efficiently, generation of control messages is suppressed and are generated only when it is necessary. This is done by the Trickle Timer algorithm [5]. The Trickle timer algorithm uses a mechanism to keep a check on the consistency of packet generation pattern of the network. If the pattern is consistent, and does not have any redundant or old data then the Trickle timer reduces the rate of sending DIO control messages exponentially. But in case of any inconsistency in the network, the next DIO message is rescheduled and is sent at the latest time interval.

## 3.3 Parameters of Trickle Timer Algorithm

The parameters that govern the Trickle timer algorithm are: $I_{\min}$, which denotes the minimum time interval between two DIO messages. It is calculated as follows:

$$I_{\min} = 2^{\texttt{DIO-MINIMUM-INTERVAL}} . \tag{1}$$

$I_{\max}$ that represents the maximum time interval between two DIO messages. It is calculated as follows:

$$I_{\max} = I_{\min} \times 2^{\texttt{DIO-INTERVAL-DOUBLINGS}} . \tag{2}$$

The redundancy constant $k$ represents the number of redundant messages. $I$ is size of current time-interval, and the time interval within $I$ is represented using $t$. Lastly, $c$ denotes a counter that is used to control transmissions. The role of these parameters is discussed next in the Trickle timer algorithm.

## 3.4 Trickle Algorithm Rules

(1) In the first interval, $I$ is set to any value with in the range $[I_{\min}, I_{\max}]$.

(2) Reset $c$ to 0 and $I$ is reset to a random point between $[I/2, I]$ at the beginning of an interval.

(3) Increment the counter $c$ for every consistent transmission.

(4) Transmit a DIO message only if the counter $c$ is less than the redundancy constant $k$, otherwise it is suppressed.

(5) When interval $I$ expires, the timer doubles the interval until $I_{\max}$ is reached. After that, the new interval is again started as in Step 2.

(6) In case of an inconsistent transmission and if interval $I$ is greater then $I_{\min}$ the interval timer is reset to $I_{\min}$ and a new interval starts as in Step 2. This is done even if the threshold is not reached.

## 4 PERFORMANCE EVALUATION

To optimize the performance of the protocol in accordance to the network requirements, we need to analyze the DIO message generation pattern, and the working of the Trickle timer algorithm. We carry out different simulations on the Cooja network simulator to evaluate the performance for various choices of parameters. Table: 1 summarizes the default simulation parameters. The performance of RPL for UAV-assisted data collection is performed by setting up a network of 16 randomly deployed nodes, with 15 senders (i.e., IoT devices) and one sink node with mobility (i.e., UAV). Fig. 2 illustrates the node deployment. The behavior of a randomly selected node (we considered node 10) is presented to understand the affect of these parameters on the the network.

As mentioned before, the parameters that determine the operation of the Trickle Timer are $I_{\min}$, $I_{\max}$, where $I_{\min}$ is based on value of min and $I_{\max}$ is dependent on the doubling

### Table 1: Simulation Parameters

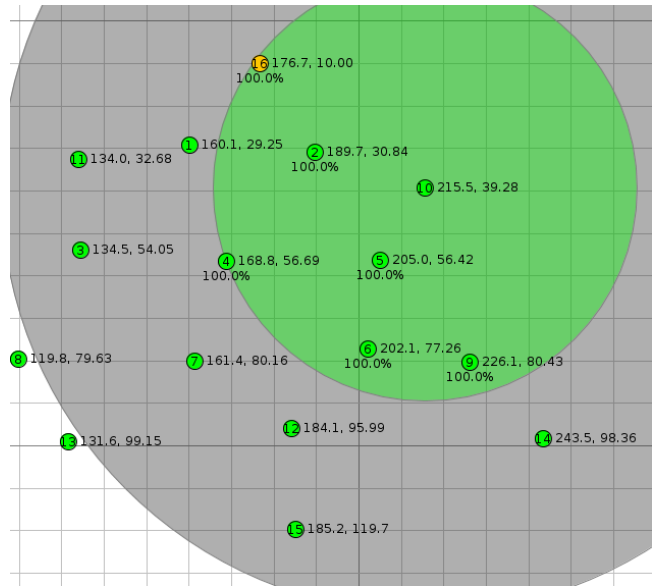| Parameters | Values |
|---|---|
| OS | Contiki master version |
| Simulator | Cooja; |
| Radio Model | Unit Disk Graph Medium |
| OF | Expected Transmission Count (ETX) |
| Number of nodes | 1 server, 15 clients |
| Transmission Reception ratio | 100 percent |
| Sensor | Sky Mote |
| Simulation Time | 1 Hour (approximately) |



Figure 2: The Network set-up with the green circle representing the transmission range of node 10.

factor. The RFC[10] recommends the default values of 12 and 8 for min and doubling, respectively. Also, the default value of $k$ is set to 10. The values of $I_{\min}$ and $I_{\max}$ are calculated as follows.

$$I_{\min} = 2^{\texttt{min}}$$
$$= 2^{12} \text{ ms} = 4096 \text{ ms} = 4 \text{ s} \tag{3}$$
$$I_{\max} = I_{\min} \times 2^{\texttt{doubling}}$$
$$= 4096 \times 2^8 \text{ ms} = 1\,048\,576 \text{ ms} = 17.5 \text{ min} . \tag{4}$$

Thus, if the values of [min, doubling] are [12,8], then the minimum possible interval between two DIO messages is 5 s and maximum possible interval between two DIO messages becomes 17.5 min.

### 4.1 Delay analysis

The performance of the network is dependent on the parameter settings. To find the impact of these parameters, we
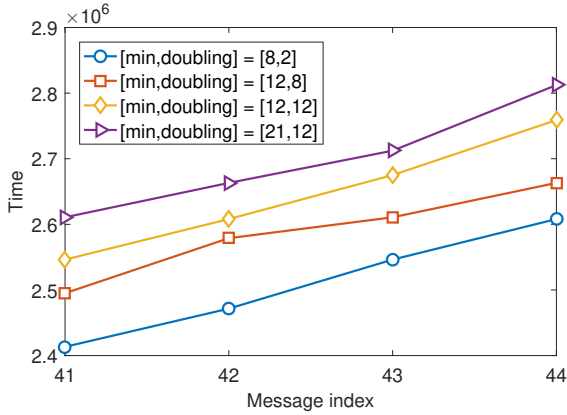
**Figure 3: Total time taken (in millisecond) by each of the five cases to generate the last DIO message within the simulation time-interval.**

compared the relative performance by considering five different pairs of values. For simplicity, we fixed the redundancy constant to $k = 10$ for all the scenarios. The DIO message generated only by the 'node 10' is considered for this study[1]. The five pair of values considered for the comparison are: 1) `min = 12, doubling = 8`, 2) `min = 12, doubling = 12`, 3) `min = 21, doubling =2`, 4) `min = 21, doubling = 12`, and 5) `min = 8, doubling=2`. For each of the above five cases, we run the simulation until the $45^{th}$ DIO message packet is transmitted by the node 10. This allows us to verify for the pair of values for which the network takes the longest time to generate the $45^{th}$ DIO message, and for what pair it take the least time. Considering a fixed time-interval, if fewer number of DIO messages are generated for a given pair of parameter settings, then the energy consumption would be relatively low in comparison to other scenarios.

Fig. 3 presents a comparison among all the five cases. We can see that for a given value of $k$=10, the value pair [`min, doubling`] = [12,12] takes the longest time to generate the $45^{th}$ DIO message packet while [`min, doubling`] = [8,2] required the least time. This means that for values [12,12] the least number of DIO messages are generated per unit time, and hence it uses less energy, while value pair [8,2] generates more DIO messages per unit time and hence expend more energy. It is important to note that, among the five pairs of values considered, the pair [21,12] is the largest value pair and is expected to generates least DIO messages. This is because the interval between messages is longer but it takes less time than the pair [12,12]. This is because of the considered $k$ value. As mentioned in the algorithm *Step4*, if the value of counter $c$ becomes greater then the redundancy

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[1]RPL-DIO-INTERVAL-MIN is referred as 'min' and RPL-DIO-INTERVAL-DOUBLINGS is referred as 'doubling' in short
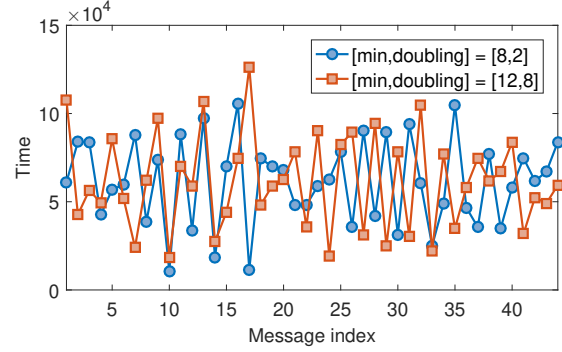


**Figure 4: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[8,2] and [12,8].**



**Figure 5: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [12,12].**

constant $k$, then the message generation is suppressed. Here, although the min was much greater, i.e., `min = 21`, the interval could not increment to the possible threshold as the messages are suppressed when the counter reaches $k = 10$ and a new interval is started.

## 4.2 Time interval

Considering the same five pairs of values as mentioned above, we compare the time interval set by the Trickle timer to generate the DIO messages. The message generation pattern for the values [`min, doubling`]= [8,2], [12,12], [21,2], and [21,12] is compared to the default values as specified in the RFC 6550[10] , i.e., [`min, doubling`]=[12,8]. This helps us to practically understand how the trickle timer algorithm actually manipulates the time intervals between the DIO messages when the network remains unchanged.

Figs. 4, 5, 6, and 7 illustrate the differences in time interval with respect to the message index. We can notice that the largest difference is observed in Fig:5, where the longest time

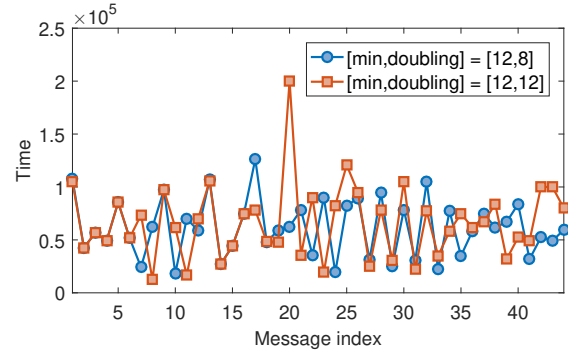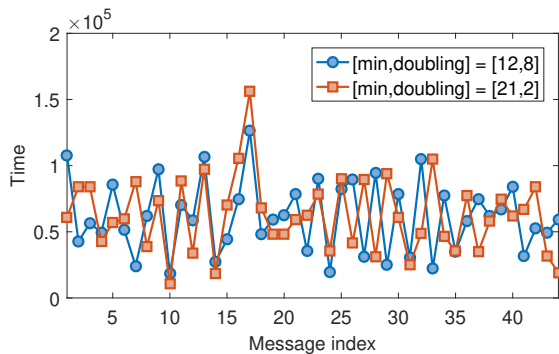**Figure 6: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [21,2].**
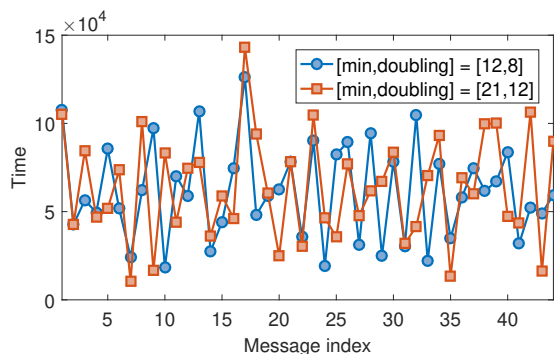


**Figure 7: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [21,12]**

interval is experienced when $I_{max}$ reaches maximum value for the pair [min, doubling]=[12,12] compared to the $I_{max}$ for [min, doubling]=[12,8]. This difference is inline with the Fig: 2, where [min, doubling]= [12,12] value achieves the longest time while [12,8] results in third longest.

Furthermore, the comparison of time-intervals with the value pair [min, doubling] = [12,8] in Fig: 4,6, and 7 did not result in much difference even though the parameter values have a significant differences between them. This is because redundancy constant $k$-value is low, and is not sufficient to achieve such a large $I_{max}$ value. In these three cases, the simulation could never achieve the calculated threshold of $I_{max}$, as the counter expired and subsequently the messages are suppressed. Hence to achieve a much higher $I_{max}$ value, the $k$ value should also be increased.

Therefore, it can be concluded that the optimal values of these parameters vary depending on the network objective and underlying requirements. In case of an UAV root node

with higher mobility, the optimal value for this factors depend on the data generation rate of network nodes. This determines how often the DIO messages are required, how often there is a possibility of a network inconsistency, understanding the behaviour and purpose of the sensors etc.

## 5 CONCLUSION

In this article, we have investigated the performance of RPL routing protocol in low-power lossy IoT networks assisted with an UAV with several constraints. RPL considers constraints and metrics defined using the objective function. The three primary control messages – DIO, DAO, and DIS and their rate of generation determines the power consumption. Therefore, in order to suppress the generation of DIO control message, trickle Timer algorithm uses DIO-INTERVAL-MINIMUM and DIO-INTERVAL-DOUBLING. We have performed an analysis to understand how these parameter affect the energy consumption. Finally, we have shown that optimal values for these parameters according to the network requirement can further optimise the working of the protocol for the data collection in IoT network.

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# Modernizing Traditional Methods of Farming using Farming Robot

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## ABSTRACT

This paper pertains to the study of a prototype which modernizes the agricultural sector. It has the ability to perform basic operations such as irrigation activity and monitoring of plants frequently without much manual labor. In addition to the above-mentioned functionalities, the system is trained for detecting diseases in plants. Agriculture is an area of prime importance in the existence of humanity. It is a process of cultivating land and plants to provide food, fiber, medicines and other products to enhance the quality of life. It is considered to be the main pivoting point in the rise of our civilization. In the proposed system ROFAR, detection of plant disease is achieved with the help of image processing and machine learning methods. Prompt and accurate detection of plant diseases is crucial for the quality and yield of crops. Advanced diagnosis and intervention can lower the cost of plant diseases and trim down the use of unnecessary pesticides. Images of leaves of different plant species were gathered and feature extraction was performed. As a result, the system was able to classify the plants based on its ailments accurately. The ROFAR gathers the images of the plants for disease detection from the field and were given as input to Convolution Neural Network (CNN) which then classifies the images as healthy or infected. The proposed system ROFAR undergoes a training phase and a testing phase. The system is trained by providing various samples of the normal and diseased plants. On completion of training phase, the system can identify any new images of plants as healthy, late blight, viral or bacterial. The system also facilitates the moisture detection in the soil. With these functionalities, crops with better quality and yield can be obtained from the field.

*Keywords:* ROFAR, Convolution Neural Network (CNN), Training phase, Testing phase, moisture detection, late blight, bacterial, Feature extraction.

## 1. Introduction

One of the most promising and upcoming technologies that has the capacity to boost almost all the sectors of the economy, from medical to space sectors is Robotics. However, the sector that is constantly lagging is agriculture. It's due to the fact that many farmers are being used to heavy equipment, tools and conventional agricultural strategies. Although the application of robotics in this sector is slow, it's persistent.

The utilization of technologies that are linked with robotics and automation, can provide important values to both farmers as well as the agricultural sector [1]. These automated bots are being used for conventional applications which includes plant classification, fruit picking, seeding, spraying, etc. Machine-driven agricultural operations introduce many advances to the field improving the overall productivity and efficiency. Automation provides countless perks to farmers or landowners which makes the job performed in a uniform method, with less expense and higher accurately. The processor located at the centre of the Raspberry Pi framework is a Broadcom BCM2835 framework on-chip (SoC) mixed media processor. This indicates by means of a ways most of the framework's segments, consisting of its illustrations and focal preparing units beside the correspondence's equipment and sound, constructed onto that solitary segment beneath the memory chip of 256MB situated at the centre point of the board. The fact that makes BCM2835 different from the processor determined for your workplace or PC is not simply its SoC structure. In addition, it makes use of an Industry Standard Architecture (ISA) which is known as ARM [2]. The significance of water splashing is one of the principal applications performed. Water transports vital supplements within the plant. The

supplements are extracted from the earth and used by the plant. Inadequate water in the plant cells causes the plants to stop growing, so water allows the plant to stand upright. The water carries the disintegrated sugar and various necessary supplements through the plant. So, without the correct equalization of water, the plant is not exclusively undernourished, however it is too physically weak and can't bolster its very own load. Various sorts of plants require various measures of water [3]. With open air plants, we can't manage the plants getting an excess of water if the area gets a great deal of downpour, so we have to ensure that the dirt has the correct seepage, since large amounts of water will influence plant development the same amount as excessively little. Video observing of the plants is additionally of most extreme significance. The programmed plant checking framework had a huge enthusiasm because of the promising applications in rising innovation. Although, this strategy is used to enhance the execution of existing methods or to make and structure new procedures for the growth of plants. The plant checking framework is mainly used for watering the plants and to transmit a couple of parameters for growth of plants. Plant illness recognition is the fundamental utilization of the pack. Plant malady, a weakness in the plant's normal condition that hinders or regulates its vital capabilities. All kinds of flora, wild and evolved alike can suffer from disease [4]. The percentage of plant infections varies from season to season, natural conditions, contact with the pathogen and the crops and assortments developed. Some assortments of the plants are prone to disease outbreaks, while others progressively resistant them. Fossil proof demonstrates that plants were influenced by illness 250 million years back. Loss of yields from plant maladies may likewise result in appetite and starvation, particularly in less-created nations where access to ailment control techniques is restricted and yearly misfortunes of 30 to 50 percent are normal for real harvests. In certain years, misfortunes are a lot more prominent, creating calamitous outcomes for the individuals who rely upon the yield for sustenance. Real ailment flare-ups among sustenance crops have prompted starvations and mass movements since forever [5].

The proposed automated system captures the images of the plants and has a detecting mechanism for classifying the plant as diseased or healthy. A real-time video monitoring system incorporated in the proposed system facilitates the user to be aware of the conditions in the field. In addition to these features humidity of the soil is measured and decision on spraying water to the plants is taken care.

The remainder of the paper is structured as follows: Section 2 deals with Literature Survey. Section 3 describes the Hardware and Software Components used to build the prototype. Section 4 illustrates the proposed model, working principle and the implementation. Section 5 deals with the experimental analysis and the result. Section 6 describes the conclusion. Section 7 describes the future scope of the project. Lastly, Section 8 lists all the references used in this paper.

**Nomenclature**

ABC   Atanasoff Berry Computer
AI   Artificial Intelligence
ANN   Artificial Neural network
ARM   Acorn/Advanced RISC Machine
BCM   Body Control Module
CNN   Convolution Neural Network
DNN   Dynamic Neural Network
GNU   GNU's Not Unix
GPIO   General Purpose Input/output
GUI   Graphical User Interface
IDE   Integrated Development Environment
IDLE   Integrated Development and Learning Environment
IoT   internet of Things
ISA   Industry Standard Architecture
ML   Machine Learning
(N;P;K)   (Nitrogen; Phosphorus; Potassium)
PC   Personal Computer
pH   Potential of Hydrogen
RFB   Remote Frame Buffer convention

SoC    System on a Chip
VNC    Virtual Networking Computing

## 2. Literature Survey

### 2.1. Algorithm for Line Follower Robots to Follow Critical Paths with Minimum Number of Sensors

The main challenge faced in the area of robotics is that going along a specified path [6]. Either the path could be designed by the user or it could sense a particular color and move along that path. When specified by the user's intermediate counters for stopping and turning could be initially kept precise. However, each color has its own threshold, and the robot senses its movement with respect to the color. This paper discusses line follower robots, their configuration and inculcates a concept for the robot to move along curves, junctions and 90-degree bends. Therefore, the line follower robots are autonomous, having the ability to follow and detect a line ensuring the base to an efficient system. The project employs Arduino Uno as the main circuit board for the robot and four sensors for following the path. The robot uses 4 IR sensors $S_{LL}$, $S_L$, $S_R$ and $S_{RR}$ arranged on a straight path for detecting the line as shown in the Fig. 1. The sensors $S_{LL}$ and $S_{RR}$ are used to perform 90-degree rotation on left of right respectively.
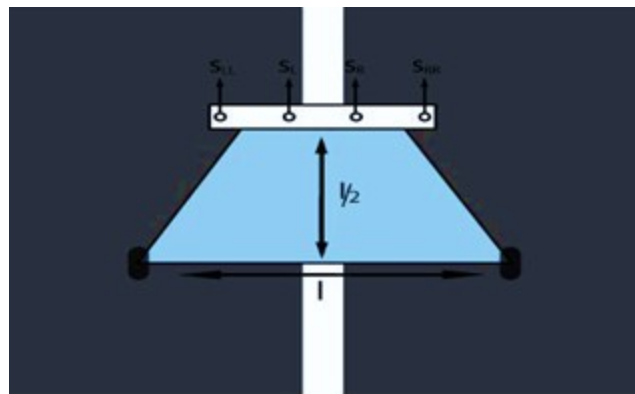


*Fig. 1- Robot sensor diagram*

If any of the sensors deviate from its original position, then the robot corrects itself by moving along right or left. If any of the two sensors come on the white line, then a 90-degree turn is done according to the algorithm. Therefore, based on two main algorithms it can follow the path given to it. When implemented the robot also must account for obstacles in its path and proper halts in the junctions to do the specific jobs that it aims to do. The paper resembles such an algorithm for following the path with precision and proper configuration of the sensors. A prototype built by J S Tan et. al. known as Jackbot Mark1 is a cheaper, light weight and small robot that has an ability to move and carry load incorporating obstacle detection, line following algorithms [7]. Mehran Pakdaman et. al. discussed various technical problems that could arise in any line following robot [8]. The challenges involved while navigating in a constrained environment like greenhouse and polytunnels are addressed using an autonomous row following robot [9,10].

### 2.2. Design and Implementation of Semi-Autonomous Anti-Pesticide Spraying and Insect Repellent Mobile Robot for Agricultural Applications

The authors discuss on the application of robots in agriculture. It focuses on designing a robot called "x-bot" which is an insect repellent robot and a pesticide sprayer [11]. The main problem with the manual spraying of pesticides is the over spraying causing harm to both plants and humans. Thus, the robot is designed to overcome this problem. An additional unit of insect repelling mechanism with the help of a sonar is also built and attached to the robot. The robot body is Lynx Motion Rover Kit with 3D

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printed acrylic chassis and four dc motors are used to drive the robot. Arduino Mega Microcontroller is the control unit with diaphragm pump to spray pesticide and solar panel attached buzzer to repel insects. Proportional Integrative Derivative algorithm is employed to control the robot and as the robot reaches each of its spots, pesticide is sprayed at a precise amount. Alongside the insect repellent is also done. In addition, the ultrasonic sensors are calibrated by the neural networks.

## 2.3. Design of automatic nutrition supply system using IoT technique in modern cities

Today, the main problem faced by Terrace Gardening is the lack of time for the planters to look after the garden on a regular basis [12]. The one available solution is by employing smart farming which modernizes the current conventional methods of farming in modern cities. Modernizing includes automation of almost every process in the area of farming. This paper discusses the automated system by applying the concept of IoT. The primary objective of this study is to provide the plants with the necessary nutrients, such as potassium, phosphorus, nitrogen and calcium, which is computed from the data provided by the sensors. The pH value of the soil is taken by the pH sensor attached to the Raspberry Pi. The pH value is processed along with the Humidity sensor. Value of the humidity sensor is considered on the basis that when Humidity increases the chance of plants to get caught by disease is high and the rate of growth of plants will be low and vice versa. Therefore, based on these values and calculations the nutrients are supplied to plants. The authors developed an automatic nutrient supply system which is capable of passing nutrients mixed with water automatically to the plants as required thus reducing the human labor to a great extent. Measurement of the pH of the solution provides data about the nutrient's availability in the soil. The quantity of fertilizer is supplied according to the requirement of the crops. This system could help in the better use of fertilizer and to enhance the quality of soil. The limitations to this system are, absence of weed detection and control mechanism, seed plantation and the system is immobile in nature. Sajjad Yaghoubi et. al. suggested an autonomous robot that aims to reduce manpower and to improve the quality and productivity of farming [13].

## 2.4. Real-time Video Monitoring and Micro-Parameters measurement using Sensor Networks for Efficient Farming

One of the main challenges faced in the area of farming is that there is no system that monitors the field which gives the advantage to the farmer to monitor the farm on a real-time basis [14]. The solution to this problem is to design a Robot that can monitor the system on a real-time basis which is equipped with a camera along with a Robotic arm and sensors that helps to monitor the plant growth. The robotic arm is used to measure and manage agricultural parameters. The robotic design in this study is composed of sensor, control, camera, planning subsystem and a system comprising an online image and video transmitter. The constituent of potassium, phosphorus and nitrogen present in the soil is measured in order to depict the amount of fertilizer required by the soil. This mechanism also aids in managing the content measurement while preparing the fertilizer. The primary goal of this design is the reduction in the number of nodes required for the conventional measurement schemes. There are mainly two blocks. One block indicates the transmitter, which is actually, the Robot and the other block depicts the receiver. The System is employed to design, develop and optimize a feasible solution to agricultural control and monitoring. The proposed system utilizes sensors for Micro parameter measurement (K, P, N), Humidity measurement, Soil moisture, Motion detection, temperature detection, Soil PH for maintaining agricultural environment. It also includes Agricultural Parameters measurement and Real-time Video Monitoring using Sensor Networks for Precision Agriculture. After the proper measurement of K, P, N content from soil it will be easy to figure out the fertilizer combinations. On implantation, it is found that System results in the designing, development and optimization of a feasible solution for application to agricultural control and monitoring. The limitations to this system are, absence of weed detection and control mechanism, seed plantation and the inability to supply nutrients and water to the plants.

## 2.5. Design of automatic nutrition supply system using IoT technique in modern cities

The most prominent troubles faced in farming is that much vegetation are laid low with sickness. Every 12 months illness of the plant, fungal and viruses' attacks result in crop losses as much as 30% of the overall production [15]. The plant disease control mechanism relies upon speedy, correct detection and identification of the diseases. The paper discusses correctly figuring out the

disease with the help of an artificial neural network. The different image processing performed on the input image are image enhancement and image segmentation. The Fig 2 shows the block diagram of plant disease detection and depicts the various texture feature values that are computed from the processed image. The classification of text image is performed at last by giving the extracted feature values as an input to the pertained artificial neural network (ANN). Finally, the predicted result (disease) is sent to the person.
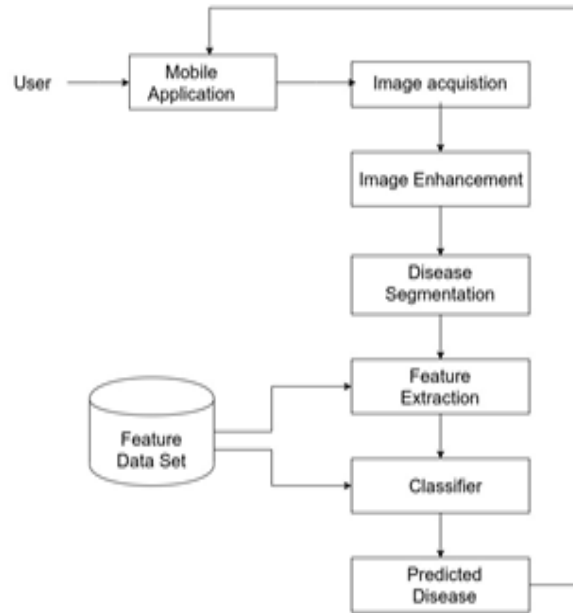
*Fig. 2: Block diagram of plant disease detection*

The network used is a feed forward neural network of two layers with one hidden layer, in which number of neurons for hidden layer is 10. The method specified in the system can be used to design a plant disease detector for farmers for the early detection of plant disease infection and providing a cure remotely.

## 2.6. Design and development of Automatic weed detection and smart herbicide sprayer robot

Traditional method of destroying the weeds in a crop plantation is achieved by spraying herbicides throughout the plantation [16]. This has a bad effect on food crops and yield. This paper discusses the image processing algorithm which captures the images of plantations and the herbicides sprayed only on the weeds on identifying the weeds from the image. By this method, the wastage of herbicides can be reduced to a great extent thus making the weed control system smarter. The color images will be converted to binary images and the green parts of the image are extracted. Total amount of white pixels is found out, if it is above threshold then that region is weed. In this arrangement, a container filled with herbicide is fitted with water pump motors which is attached to the spray nozzles. In this experiment Ragi plants (narrow) are taken as the plantation crops and any other plants as weeds (broad leaves). In the absence of plants on the region of interest, the processed image will encounter only black pixels with few small stray groups of white pixels. On identifying narrow leaves, the number of white pixels could be greater than case 1 but less than threshold. If there are broad leaves the count of white pixels will be greater than threshold. Herbicide will be sprayed on this region since its weed. This approach is dependent on the quality of the lighting conditions required for capturing images which is one of the disadvantages faced by smart weed control robots. By incorporating targeted spraying on the weeds, wastage of herbicides can be reduced to a great extent [17-21].

## 3. Hardware and Software Components

### 3.1. Algorithm for Line Follower Robots to Follow Critical Paths with Minimum Number of Sensors

The Raspberry Pi, (Fig. 3) is intended to run a working framework called GNU/Linux—from this point forward alluded to just as Linux. In contrast to Windows or OS X, Linux is open source: it's convenient to download the source code for the whole working framework and add whatever improvements you want. Nothing is hidden, and all progressions are made in full perspective on people in general. This open source improvement attribute has enabled Linux to be immediately transformed to keep running on the Raspberry Pi, a process known as porting. At the time of this composition, a few adaptations of Linux known as appropriations have been ported to the Raspberry Pi's BCM2835 chip, including Debian, Fedora Remix and Arch Linux. The different appropriations take into account various requirements, but still they all are open source.



*Fig. 3: Raspberry Pi*

Since its demonstration, Python has developed in ubiquity on the account of what is viewed as a reasonable and expressive grammar created with an importance on guaranteeing that code is meaningful. Python is an abnormal state language. This means Python code is written in generally prominent English, making the Pi with directions in a way that rushes to learn and simple to pursue. This is in checked difference to low-level accent, similar to constructing agent, which are nearer to how the PC "considers" yet practically inconceivable for a human to pursue without involvement. The abnormal state nature and clear language structure of Python makes it a gainful instrument for any individual who needs to figure out how to program. Another option is to make use of a coordinated improvement condition (IDE, for example, IDLE, which gives Python-explicit usefulness that is absent from a standard content manager, including punctuation checking, investigating offices and the capacity to run your program without leaving the supervisor. The VNC watcher is seen as the primary programming device utilized for the venture. At registration, Virtual Network Computing (VNC) is a graphical workspace that shares a framework which uses the Remote Frame Buffer (RFB) convention to remotely control another PC. It transmits the mouse and console occasions starting with one PC then onto the next, handing off the graphical screen refreshes back the other way, over a system [22]. It is stage free, there are customers and servers for some, GUI-based running frameworks and for Java. Meanwhile, several clients can interact with a VNC server. Common applications for this innovation include remote expert assistance and capturing work PC logs from home PC or vice versa. There are several versions of VNC that offer their own particular utility, For example, some efficient for Microsoft Windows or offering record exchange (not part of VNC legitimate), etc. Many are perfect (without their additional highlights) with VNC appropriate as in a watcher, as of one type can bind to a server of another. Others depend on the VNC code, but don't work well with standard VNC. In the typical strategy for an activity, a watcher interacts with a port on the server (default port: 5900). On the other hand, (depending on usage) a program can bind to the server (default port: 5800). Also, a server can interact with a watcher in "listen mode" on port 5500. The correct position of the listen mode is that the server site does not need to configure its firewall to allow access on port 5800 (or 5900), the obligation is the watcher, which is useful if the server site does not have PC capability and the watcher client is progressively competent.

The ROFAR system is shown in Fig. 4. The camera component is connected to one of the USB-A ports in the raspberry pi. For the dc motor connection, a L293D motor driver is used. For that import the time module and the GPIO pins. The output pin is comprised of Pin 22, 18 and 16. The enable pin of L293D is connected to the pin 22 of raspberry pi in order to enhance the

motor's running time. The motor is turned off when low. Motor 1 and Motor 2 are input pins. The IR sensors are powered by +5V pin to enable the movement of the kit. Next, utilizing the black wire, the ground pins are connected to the ground of IR sensor and motor driver module. With the help of the yellow wire, the output pins of the sensors both 1 and 2 are connected to the GPIO pins and 3 respectively. The motors are operated using four pins (AB, A, B). These four pins are connected from GPIO 14, 4, 17 and 18 respectively. The white and orange wire collectively are used to form the connection for a single motor. Such that, there are two pairs for two motors. The motor driver module L293D is used to which the two motors are connected and is powered using a power bank. We have to ensure that the ground of the Raspberry Pi is connected to that of the power bank, only then our connection will work. Rest of the part is done from the user's system.
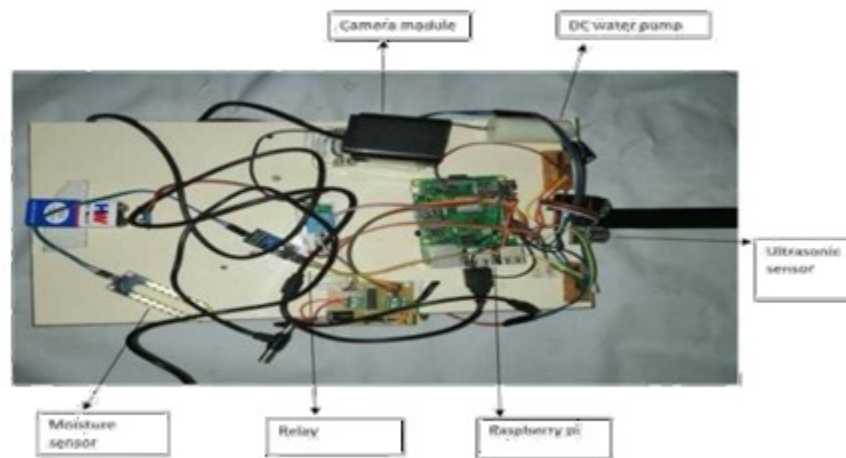


*Fig. 4: ROFAR system*

The raspberry pi is remotely accessed by the VNC viewer. There are mainly two python files accessed for the working one is named robot.py and the other named mail.py. The image of the plant is taken by the camera and is sent to the respective mail id set in the program.

## 4. Proposed Model

The proposed venture is completed for the most part by the raspberry pack and the plant leaf recognition by utilizing profound learning techniques in AI. Ongoing video observing is likewise included alongside the unit. The unit likewise showers the plant with water basically or by estimating the dampness of the dirt. At the point when the unit arrives near a plant it captures the images of the leaves and is sent back to a separate framework for malady recognition. The framework marks the plants with classes healthy(h), late-blight(l), viral(v) or bacterial(b). The robot then pursues a dark line utilizing the line following idea with the goal that it catches and plays out the splashing capacity up and down the way of the robot.

### 4.1. Line following Concept

The game plan of the plants is structured dependent on the way of the robot. The robot moves along the dark line taking the picture of the plants and in the meantime watering the plants. The robot distinguishes a line as a basic line and pursue basic line following calculation if both of its external sensors are on dark surface. Over a white surface and the other way around and goes through it. It takes a shot at the reflection property of light. At the point when infrared light falls on a white surface, it gets reflected completely. Then again, when it falls on the dark or dim surface, it gets assimilated all things considered. The measure of reflected light will be extremely less.

## *4.2. Water Spraying*

Soil Moisture Sensor measures the moisture level of soil and gives the dirt condition either wet or dry. On the off chance that the soil content is decreased beneath the predefined esteem it will send the flag water will begin to siphon. Generally, plant spots in order to water the plants by utilizing separation esteems from Ultrasonic Sensor. The water content in soil will be detected by the soil dampness sensors. A dirt moisture test is made up of several soil moisture sensors. A regular kind of soil moisture sensor in commercial use is a Frequency space sensor, for example, a capacitance sensor. An alternative sensor, the neutron moisture check, uses the intermediary properties of water for neutrons. Soil moisture content might be changed by means of its impact on the dielectric constant by estimating the capacitance between two cathodes embedded in the dirt. Where soil moisture prevails as free water (e.g., in sandy soils), the dielectric constant rightly corresponds to the moisture content. The test is ordinarily given a recurrence excitation to allow estimation of the dielectric constant. The readout from the test isn't straight with water content and is impacted by soil type and soil temperature. Consequently, cautious alignment is required, and long-haul security of the adjustment is faulty.

## *4.3. Disease detection of plants*

The robot can recognize the plant leaf sicknesses by employing AI systems. One of the main tasks was to correctly identify the illness affected leaf and can discover the sort of malady by utilizing profound learning strategy in ML (Fig. 5).

The main modules included are:

- Data set: data set of plant leaves are collected which contains labelled images.
- Data resizing: images are resized which is to be given as input to the neural network.
- Training: the resized data set is used to train the neural network. The training data consist of 4000 plants which are classified as h, l, v, b.
- Testing: the testing data set contains both healthy and unhealthy leaf images. After testing images are classified as healthy or unhealthy



**Fig. 5: Processing plant leaf**
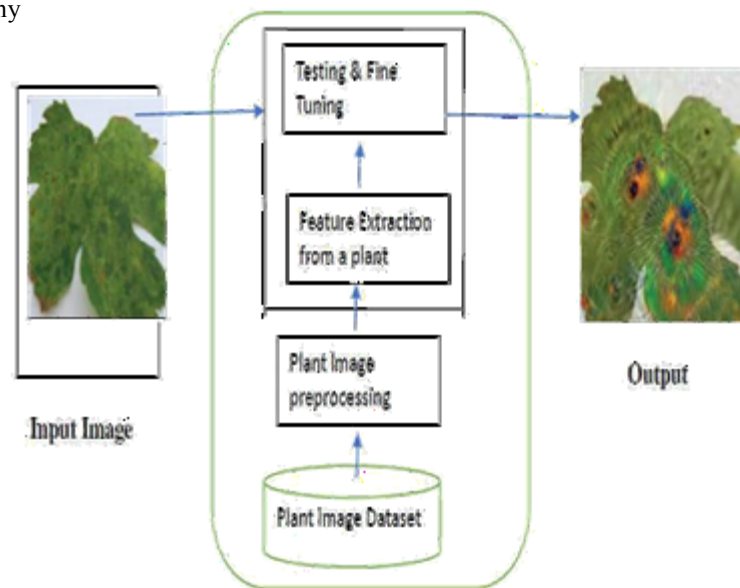
The testing generates a result either as healthy or diseased by comparing the input image with the known image data set and returns the result with a percentage of accuracy. The input data will be images of data that is the plants. There are two categories in leaf images which are healthy or unhealthy and there are four class labels: healthy(h), late-blight(l), viral(v), bacterial(b) [23].

Also, there are 4000 training images each with resolution 256x256. The input training data as well as testing data will be converted into a numpy array with input filename and its label. The label will be in the one hot encoded format. Cv2, numpy, os, tqdm libraries are imported for data resizing. The image is resized into the resolution 50*50 by using the packages in imported libraries. The training process involves creating a DNN and then passing the train data for training the network [24]. Here the tensor flow framework is used to create a neural network. The input data shape is in the form of (50,50,3), then the first layer which is the input layer to the neural network will have the same shape. There are a total of 6 hidden layers mentioned with the input size as well as the activation function that's being used. The last layer is where the fitting or converging takes place and we finally get output in that layer. It is fully connected. Here we are using two activation functions [25] 'relu' and 'softmax', 'relu' means Rectified Linear Unit [26]. This is mainly used in hidden layers in neural networks. 'softmax' is used to calculate the probability of the class labels in the output layer [27]. Dropout function is used in the fully connected layer to avoid the overfitting of the input data. Training and testing done by using 'model.fit' function. In supervised training, both the inputs and the actual outputs need to be provided. The neural network process the input and produces output. The output which is generated is compared with the desired output. If any errors in the output, it will back propagate. Feature extraction in a neural network is explained by the concept of convolution. Convolution is considered as the main building block of a CNN [28]. By Convolution we mean the mathematical mixture of two functions to produce a third function. With respect to Convolution Neural Network (CNN), the convolution is executed by the mechanism of sliding the filter or kernel over the input data. Matrix multiplication is accomplished at each location and the sum of the results are added on to the feature map. The region of our filter is also called the receptive field which is named after the neuron cells. The size of this filter is 3x3 [29].

In the testing stage, we will have a plant leaf image without label, meaning we won't know which class (h,l,v,b) the image will fall into. The already trained saved model will be loaded and then the test image will be then passed as input to the already trained model. The model based on what features it has learned will output the class which it belongs to with the help of 'model. Predict' function. By adding a new type of plant to the image data set, we can detect almost all types of diseases. we do not need external hardware devices The system will generate output with approximately 90% accuracy and the system can be fine-tuned any time for any new types of diseases, simply by adding the new disease leaf images.

## 4.4. Working Principle

The module is mainly divided into two. The first is a kit that performs function such as image capturing, water spraying and real time video monitoring. The second module is the diseases detection part that classifies plants based on diseases using an Artificial Neural Network. The kit moves along the black line by the black line following the algorithm and stops at each position when an obstacle is encountered which it recognizes as a plant. Fig 6 demonstrates the same.
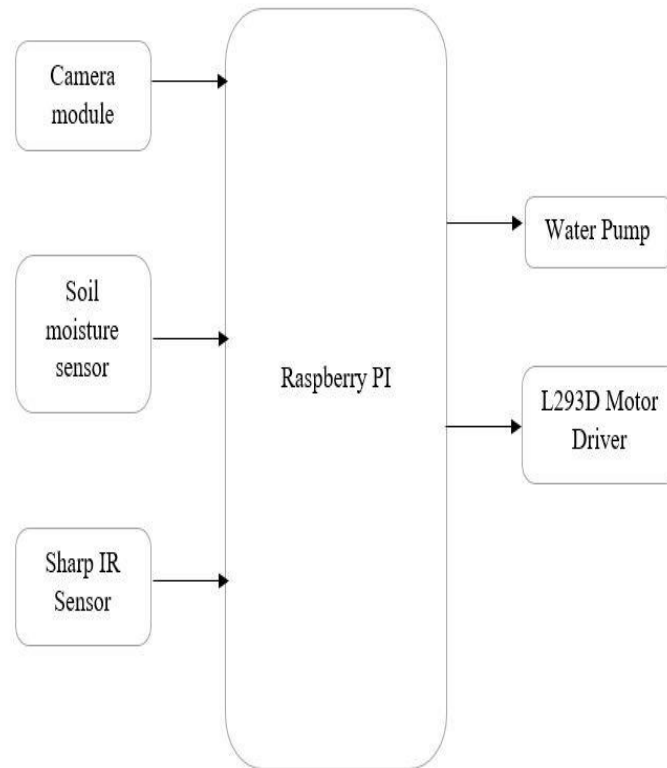
*Fig. 6: Block diagram of robotic kit*

The camera attached to the module captures the images and at the same time humidity of the soil is detected. On encountering the humidity value below the threshold value, water is sprayed to the plant. A real time video streaming is also provided to the user. The captured image is sent to the user's system through mail and the image is given as an input to the plant disease detection algorithm using the Convolutional Neural Network of the system which classifies the image as healthy, late blight, viral and bacterial. The heart of the system is Raspberry Pi and the corresponding function and application is done with the help of a VNC viewer. The L293D motor driver helps to convert the signals from the raspberry pi to the dc motors.
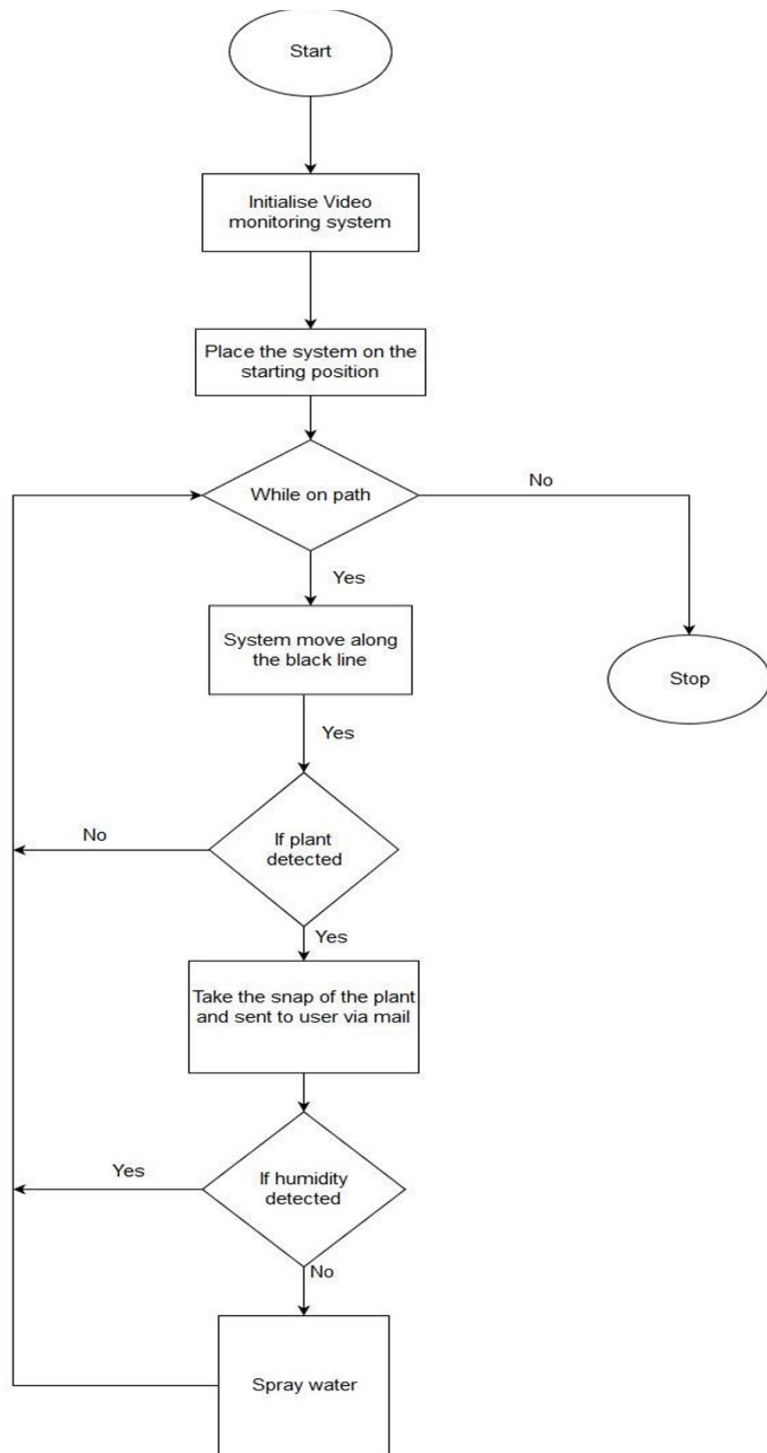
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*Fig 7: System Flowchart*

## 5. Experimental Analysis

The black line following algorithm is employed in guiding the robot in the correct path. It's working is similar to that of Line following robots as depicted in Fig.8. The Line Following robot is one that identifies a black path [30]. The two IR sensors are kept in between the black line. If it detects a white line it stops. If it encounters an object it recognizes it as a plant and the image of the leaf is sent.



*Fig. 8: Black line following adaptation*

The water spraying is done uniformly for each plant as it encounters a plant. Water spraying also depends on the moisture of the soil. If there is moisture content it does not spray water. Along with this the video streaming is also done along the path till the end. Based on the leaf image captured by the system a table for the image and the corresponding result incurred for the leaf the table is depicted as shown below Table 1.

*Table 1 - Captured leaf image Analysis.*

| Captured leaf image | Leaf name | Expected result | Experimental Result |
|---|---|---|---|
|  | Tomato leaf | Late blight | late blight (correct) |
|  | Tomato leaf | Healthy | Healthy (correct) |

| | | | |
|---|---|---|---|
|  | Mango leaf | Healthy | Healthy (correct) |
|  | Money plant | Late blight | Bacterial (wrong) |
|  | Tomato leaf | Viral | Viral (correct) |
|  | Tomato leaf | Bacterial | Bacterial (correct) |

The raspberry pi console and video streaming as shown in Fig 9 and 10 respectively.



**Fig 9. Raspberry Pi Console**          **Fig 10. Video Streaming**

For a live plant the training was completed in 96.65 seconds and the test result was that it was bacterial.

## 6. Conclusion

Agriculture is one of our most important sectors for providing food, feed and fuel necessary for our existence. Autonomous kits are playing an important role in this field. In the present scenario, a wide range of such kits are available to perform different applications on various levels of agricultural process. The proposed system ROFAR concentrates mainly on disease detection and

it accurately distinguishes plants based on diseases. By inculcating new species of plants to image data set, we can detect almost all types of diseases. The system will generate an output with approximately 90% accuracy. The system can be fine-tuned any time for any new type of diseases, simply by adding the new disease leaf images. Most detection systems can detect fungal diseases only, but our system detects almost all. With this system there is no need for farmers to be present at that time and he/she could perfectly detect the diseases if it is present in the plants

## 7. Future Scope

We have to keep in mind that a learning curve will be present as the technologies improve in their operation capacity and sensitivity. The industrial trends appear to be moving towards large-scale efforts, so kits like this should be continuously developed. The kit designed by us, if further developed, could also do the necessary function for treatment of the detected diseases among plants. Thus, the fully autonomous kit could be developed. By making use of a gripper circuit the kit can dip the moisture sensor into each plant at each position to measure the moisture content.

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# A study on various thermographic methods for the detection of diseases

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*Abstract—* **Fever is a common symptom for various infectious diseases that are reporting nowadays in a massive amount like COVID-19, Ebola and so on that will directly affect our whole human cells and are showing a lot of chromosomal aberrations too. Since there was not a unique way are to predict how these diseases will affect our body both physically and mentally, since they can create some aftereffects in future too, there should be a suitable system which will efficiently detect these type of pandemic. In all these situations thermal screening had emerged as a remedial method for the detection of temperature variations. Among this Infrared thermography had been used as the best and effective method for fever screening. This survey presents some of the important papers which discussed how Infrared thermography can be effectively utilized for the detection of these epidemics by analyzing the temperature variations done in fever screening. Infrared thermography (IRT) is a method which uses an imaging scheme that gives you an image which is a thermal diagram that shows the temperature variations of various intensities. IRT uses the basic working principle from Stefan–Boltzmann Law, where the relationship between the temperature and the emissive power is established and the camera which is the infrared camera will capture this infrared energy and is converted into corresponding electronic signals. This paper gives a brief idea about various techniques used for fever screening which can be used to detect various diseases.**

*Keywords— Infrared thermography, Fever screening, COVID-19, thermogram, temperature, image processing.*

## I. INTRODUCTION

In December 2019, COVID has vanquished our everyday life measure by detailing its first case from the Huanan fish market in Wuhan, Hubei, China. Scientists had recognized a novel Covid (SARS-CoV-2, additionally alluded to as COVID-19) from affirmed contaminated pneumonia patients [1]. Also, later on, COVID has changed its structure to extremely intense respiratory conditions (SARS) and the Middle East respiratory disorder (MERS). By April 13, 2020, instances of COVID-19 which was affirmed had surpassed 1,800,000. The World Health Organization (WHO) has proclaimed COVID-19 as both a pandemic just as a general

wellbeing crisis of worldwide concern. By April 13, 2020, cases of COVID-19 which was confirmed had exceeded 1,800,000. The World Health Organization (WHO) has declared COVID-19 as both a pandemic as well as a public health emergency of international concern.

Infrared Thermography had wide range of applications like Non-Destructive Material Testing for interior analysis of material layers, Thermography in Aerospace where making high end machines, in Chemical industries for monitoring chemical reactions and so many other areas. Where the area focussed by this research paper was Thermography in Medicine.

In like manner, fever is the key manifestation of a few pestilences like extreme intense respiratory disorder (SARS) in 2003, flu A (H1N1) in 2009, Ebola infection sickness (EVD) in 2014, and Covid illness 2019 (COVID-19). As a safety measure government has implemented fever screening as a countermeasure for preventing these disease to its extreme for the people who are crossing international as well as national borders and in places like hospitals, malls, railway stations, and in all places where the crowd assembles fever screening is the one and only remedial measure to detect these diseases.

This research paper provides an idea regarding the momentum situation, where how to focus viably and productively utilize image processing techniques for the recognition of different ailments which contribute to COVID-19 detection. Secondly, since the virus was showing variations of symptoms a single symptom called fever cannot be relayed for identifying the virus. So the research paper gives a comparative study of different types of disease symptoms that can be a cause for the detection of corona virus. Third factor was the sensors, since the images were captured by IR cameras an equal focus was given on various sensors used by different methods. The disease mainly focused by the research paper are fever detection, respiratory infections, thyroid, osteo based problems, diabetes, blood flow analysis and cancer detection.

## II. BACKGROUND

Image Processing is one of the recent trends in analyzing a digital image where the images were grouped as pixels. In this survey the images were concentrated mainly to thermal images. Thermal images were obtained using a thermal camera in which an array of thermophile sensors were embedded in the lens of camera. These sensors will be of varying resolutions which captures the image. The thermal images obtained will be gray scale images and the RGB coloring model was incorporated to identify each areas based on thermal variations. Infrared Thermography (IRT) comes under infrared imaging science. Radiation in the long-infrared scope of the electromagnetic range (about 9,000–14,000 nanometers or 9–14 μm) is identified by thermographic cameras and produces pictures of that radiation which are named as thermograms. There is a wide scope of utilizations for thermography which can be utilized in a few conditions as an analytic instrument, for arranging the treatment and assessing the impacts of treatment. Thermography can be joined with other imaging strategies and Artificial Intelligence ideas, play a vital role essentially in the adaptation of numerous ailments [2]. Infrared radiations are emitted by all objects above absolute zero, which is stated in black body radiation law. These infrared radiations lie in the range of 0.75–1000 micrometers [3]. Thermography utilizes a non-obtrusive, non-contact strategy that utilizes the warmth from your body to help in making the conclusion of a large group of medical care conditions. So this method was completely safe since it uses no radiations.

## III. LITERATURE SURVEY

### A. Clinical evaluation of fever-screening thermography

In the research paper, a clinical study of over 596 subjects has been conducted [4]. They made an experimental set up to capture the thermal image where they used a tripod to obtain a full face. The graphical user interface was developed with MATLAB and two IRTs. The analysis was for the duration of fifteen minutes, where four measurement readings were taken. For limiting the impact of outside temperature each subject was asked to meet a relaxation time of 15 minutes and all initial humidity factors were defined properly. Temperature readings were taken on each stage, focusing on the region's facial and forehead so that two IRTs were used. In each round of capturing the image, the webcam acquires a standard color image and the IRTs will acquire three consecutive frames that were reduced to the midpoint from which a solitary mean temperature image was obtained. As the last stage, thermal images of sublingual tissue were captured by instructing them to open their mouth. To establish a reference temperature, oral thermometry was used and the corresponding temperature readings were taken from the region of study. The two temperature measurements will help to modulate two models, a fast model and a monitor model were formulated. The monitor model had an accuracy of ±1. From the monitor mode, the oral temperature measurements average value was calculated and the final reference temperature was developed. As a subsequent stage facial district depiction and temperature counts were finished. Here temperature from several facial areas was compressed. For the delineation of facial key points, a new approach called image registration was done. This technique uses a matching method by which facial landmarks are mapped to thermal images which will give the main facial points whose temperature measurements are to be recorded.

The calculated values of temperature which are recorded from the selected regions were compared with the reference and from this, the pairwise differences were recorded. Based on this data, the final result was generated which shows the temperature measurement values of the five regions of interest.

Advantages: Gives an efficient method for monitoring temperature especially in the region inner canthi region. Provides a better system performance.
Further enhancement: The effect of puzzling elements identifying with between subject and ecological fluctuation can be remembered for clinical investigation.

### B. Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument

This study aims at establishing a modest and efficient temperature screening instrument. The methodology uses an AMG8833 thermal camera. The camera is connected to an Arduino by a 12C bus. The picture caught by the camera which is essentially the IR camera is in the form of 64 individual pixels and the pixel values are stored in the Random Access Memory (RAM) of the camera. The IR camera and its in-constructed sensor, which is corresponding to the surrounding temperature and sensor work in sustained, uninterrupted mode. Numerous methods were done to obtain the temperature of the subject which is under study like considering the normal room temperature, pixel offset cancelling, and normalization and thereby compensating the emissivity of the object. The temperature values in the form of an 8X8 matrix were generated which will give the resultant values for analysis by running an Arduino program. And an efficient image can be developed by adding an extra feature, a thin film transistor LED to the original setup.
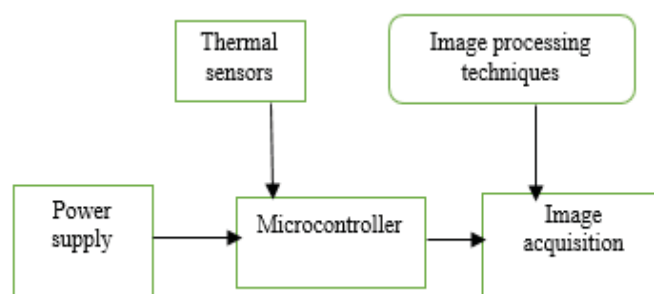


Fig. 1. Steps in Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument .

In a microcontroller, a sensor and display module is attached, which senses thermal data by AMG8833. An

Arduino IDE captures the thermal images and the images are saved in an SD card which is inserted in the display module. Fig. 1, demonstrate the general working of the proposed method. To this image processing operations are carried out to detect abnormalities in image regions [5].

Advantages: Able to develop an economical, compact easily carrying thermal camera.
Further enhancement: Uses a low pixel ratio when compared to other high quality thermal imaging cameras. The analysis can be made more understandable if the resolution can be increased to 64X64 pixels.

### C. A low cost thermal imaging system for medical diagnostic applications

This system uses an infrared sensor which belongs to Melexis IR sensors and it is a thermophile based one. It also constitutes a microcontroller and other hardware related components. The infrared sensor is a completely aligned 16x4 pixels industry-standard IR cluster. It has two chips: an IR array and the 24AA02 (256x8 EEPROM) chip which are embedded into a single sensor. The sensor has a committed low noise chopper-settled enhancer and is quick ADC incorporated which contains 64 IR pixels. By employing a Proportional to Absolute temperature sensor, ambient temperature measurement of the chip is integrated. The temperature sensations in the form of recorded thermal values of both the infrared and proportional to absolute temperature sensors are stored on an internal RAM. The pixel array had a versatile frame rate and every pixel is designed in such a manner that they are cohesively combined with an amplifier and an Analog to Digital convertor. The remaining hardware part contains the control unit which is connected with a triggered mode and an adjustable digital interface [6].

The thermal sensor captures the image as a 16X4 matrix, which is an array of pixels. A microcontroller module calculates the temperature value of each pixel and it will read the calibration values and raw temperature data from the sensor's EEPROM and RAM. With these calculated values microcontrollers calculate the corresponding temperature values of each pixel. A PC will read the serial data and divide the temperature values into different ranges which is an RGB value. During analysis, different variants of temperature recordings were taken, from which an average temperature value was calculated as a unique measurement [7].

Advantages: This framework there use no direct contact with the object so it is safe. It has no radiation too.
Further enhancement: This mechanism can be improved to be used for certain diagnostic applications.

### D. Screening for Fever by Remote-sensing Infrared Thermographic Camera

In this model, three different infrared cameras were used. In all these cameras they use a similar system such that they can detect a temperature difference of 0.1. For the measurement of accurate temperature readings, a program was designed in such a way that the parameters for taking correct readings are incorporated in this program like, the object whose temperature has to recorded was at which particular distance from the infrared camera and the surrounding environmental parameters for each dataset. The temperature readings from several points were recorded and the maximum infrared temperature was taken from all these measured temperature values. Six different regions in the body were taken for temperature measurements and two referential measurements were taken. For every person, the IRT measurements and normal body temperature were taken and the same process was repeated after fifteen minutes where they are asked to do exercise. Then by using correlation and regression analysis the two readings, the IRT and ambient body temperatures were analyzed. Finally, the classification was done as false-positive in which the temperature shows a considerable change above the reference value and as false-negative where the temperature is within the normal range [8].

Advantages: This method give an accurate result even if the person whose temperature has been captured was moving.
Further enhancement: Additional research can be done for various factors like texture, the application of external makeup and other biological factors.

### E. Multi-person fever screening using a thermal and a visual camera

This method involves the fusion of an ordinary visual camera, which gives a clear identifiable image, and an infrared camera that can record the correct temperature measurements of the object which was under investigation. The existing system uses a Forward-looking Infrared Camera (FLIR) of 640x512 pixels resolution and an image capturing camera which belongs to Microsoft LifeCam Studio. The visual camera selected was of higher resolution and has a very high frame rate. Recognized appearances where set apart with rectangular boxes that make use of various inclinations of shadings. Three colors are selected in which each has its own temporal meanings and they are yellow, red, and green. If the measured temperature value shows not much robustness it was recorded with a yellow color gradient. Green is for ordinary ambient temperature and if the recorded temperature was above a referential value that should be considered as a high-risk zone hence indicated in red color. By using a sliding window technique and Random Forest classification the face detection was done smoothly.

The basic working of the proposed system is depicted in Fig.2. In the face, the main area of focus was the corners of the eyes and these features where extracted using random forest repressors. Thermal image coordinators are obtained from the thermal image coordinates of the transformed visual images of corner positions of the eye. For face detection, a modified version of standard Viola-Jones faces detection is

used [9]. Then the image is processed with a course of binary classifiers at all sensible positions and scales. If all these stages were fulfilled completely the image will be identified as a face. After the detection of faces, a multi-face tracker was used that will detect faces in a new frame, irrespective of what happens before. And a multi-target tracker will associates the multi-frame face detection. Once the detection of face is completed, as a problem of regression eye corner detection was performed. This technique will forge a regression tree based estimator. With an ensemble, the prominence point position is measured with regression tree focused on binary standards for pixel correlations. The precision of this system highly reliant on the dimension of rectangle where the calculation was conducted. A rectangle selection of small dimension would reduce the risk factor than with large dimensions even though the localization was more stable. In this view the eye corner detection algorithm was prominent where a key point dimension selection of window can be selected. This method was performed on a recursive basis till the output was obtained. The orientations of camera were focused to obtain a high orientation image. The actual orientations and speed of objects were detected using Kalman filters. By analyzing the assignment matrix, the auction algorithm which is an association method was developed [10]. Thus, the estimation of temperature is generally insensitive toward a wrong surrounding temperature. A bias factor was estimated to consider if the ambient temperature shows a variation than the referential value [11].
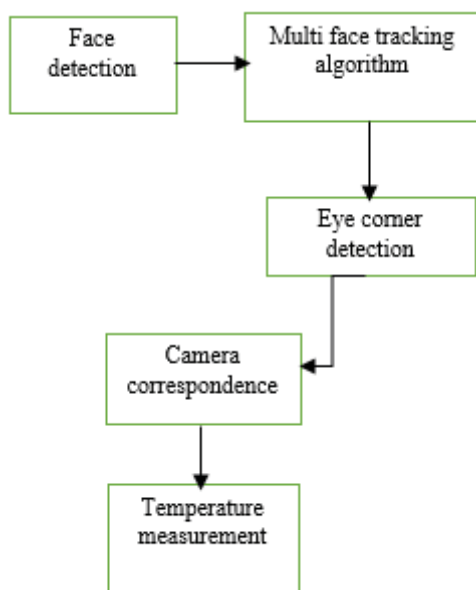


Fig. 2. Steps in Multi-person fever screening using a thermal and a visual camera

Advantages: Multiple persons can be fever screened at the same time. This method can be used at the airport thus saving a lot of time.

Further enhancement: For identifying glasses in the images obtained by IR camera, a detection algorithm can be developed. Cameras can be properly calibrated to produce a single optical axis.

*F. Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device*

This research paper [12] discuss an aberrant breathing detection which uses a deep learning technique. The method incorporates the combination of RGB and thermal videos which are acquired using a dual-mode camera. With the aid of a portable and intelligent screening device, RGB and thermal videos were obtained. For achieving this a FLIR one thermal camera was used which collaborate two cameras one is for taking RGB and the other for thermal. As a part of the respiratory study, the face regions of the videos were focussed, and by a face detection method, the nose and forehead areas were extracted. By using a time series analysis of the breathing data the respiratory patterns of test cases are obtained. There is a chance of occurring temperature fluctuations due to the normal breathing process and the usage of a mask may hide many of the facial features. For avoiding those defects a method where two parallel placed RGB and infrared cameras are placed which capture the images of face and mask regions. An algorithm for the detection of face which is covered by a mask is based on the pyramid box model suggested by Tang et al. [13]. This method makes use of the tactics like the Gaussian pyramid box in deep learning and by implementing a Gaussian pyramid algorithm. After this, the masked areas are extracted and the area from RGB is portrayed as thermal. As most of the calculations are based on the region of interest, as the next step of developing a tracking method was used which analyses the images which is having a mask and that without a mask as the temperature variations cannot be effectively captured while having a mask. As a foremost step for the final classification which systematizes the respiratory condition between a healthy and infected person, a BiGRU-AT neural network is used. Being a time series data the classification uses a bidirectional Gated Recurrent Unit with an attention layer is used. For processing time-series data a Recurrent Neural Network (RNN) was used. RNN is a feed-forward neural network that had an internal memory. Since RNN can remember past data it encounters a problem of vanishing gradient problem. So as a remedy another network called Long Short Term Memory (LSTM) will resolve this problem [14]. The bidirectional recurrent neural network will intensify the interrelation between the context of sequence and a bidirectional GRU will provide more statistics regarding periodic sequence. While performing the respiratory data analysis, the complete waveform in time sequence is considered and there may be a chance of immediate acceleration occurring. So by the discussed networks, these features may enfeeble because the time series data are given one by one which can generate a larger error. To avoid that an attention layer is affixed.

Advantages: Accurate and robust respiratory data detection algorithm was obtained.

Disadvantages: Limitation in the angle of the camera during measurement.

Further enhancement: Can use a more efficient algorithm that reduces the effect on breathing conditions by wearing various masks. To ensure high detection accuracy on respiratory infections.

*G. Non-contact monitoring of human respiration using infrared thermography and machine learning*

The Respiration Rate (RR) varies under different contexts. So the breathing waveforms under varying circumstances where obtained. As the first step volunteers were selected for study [15] and with the support of an A325 Infrared camera [16] thermal images were captured. The ROI was nostrils and they were selected by a FLIR software [17]. For efficient tracking of nostrils, Vahid Kazemi et al., proposed a tracking algorithm and this was used [18]. This algorithm uses an ensemble of Regression tree which gives decisions by comparing the threshold differences between the intensities of two pixels. But this will spawn the drawback that pixel differences may be large. Due to the influence of numerous environmental conditions, the breathing waveform obtained was having a low signal to noise ratio. Since the signals involve a number of noise contents, it has to be get filtered with the help of a low pass IIR filter. Breaths per minute (BPM) is an important variable for tracking our health. For this calculation, this work proposes a Breath detection algorithm where two counters are initialized to zero in which one counter will count the number of abnormal breaths and the other will count the normal breath. Here a normal and abnormal breath was obtained by analyzing the actual signal with the measurement of background noise ratio where the duration of the breath cycle is compared with a threshold value. For the classification between a normal and abnormal breath, a K-Nearest Neighbour (k-NN) classifier was used [19]. And the analysis of data points that are given to the k-NN classifier is tracked using the t-Stochastic Neighbour embedding algorithm. The information which is getting looked at was separated into training and testing information and the training dataset was again partitioned with the help of a cross-validation technique as training and validation datasets.

Advantages: Efficient Breath detection algorithm was implemented.

Disadvantage: For checking the validation accuracy it uses different k values.

Further enhancement: Instead of checking for different k values other classifiers can be considered such as Support Vector Machines and so on.

*H. Detecting Fever in Polish Children by Infrared Thermography*

Since the immune system of children is under development they may be more prone to sickness. So there should be an efficient method to detect fever in children. So this research paper gives a method in fever detection especially in children who were within an age span from 1 to 17 years [20]. In this research, three types of FLIR IR cameras were used. The temperature from four regions of interest was considered axilla, ear, eye, and forehead. For the analysis, both temperatures taken from an ordinary clinical thermometer and thermographic measurements were considered. During the analysis, the forehead temperature and the temperature taken from the ear especially focussing on the tympanic region are not reliable because of various factors. Physical exercise can cause a huge impact on the variation of forehead temperature and for ear, the variations in the ear channel, the occurrence of ear wax and all will affect the temperature. But there occurs a good similarity between the eyes especially the inner canthus region and axilla region. So by using software the region of interest was located. The temperature readings were taken which can trigger an audible alarm. During the analysis, the temperature values from different recordings should be considered by taking an average value and the temperature value of single pixel should not be considered. But the parameters that affect the temperature measurement should be optimal so some standardization technique is very crucial. Also, to acquire the greatest number of pixels inside the located interested regions the picture should fit the frame.

Advantages: Accuracy is more especially in the axilla and eye areas.

Disadvantages: For optimizing the parameters, standardization techniques are required.

*I. Early Detection of Diabetes using Thermography and Artificial Neural Networks*

This work will confer a method for early identification of diabetes by combining thermal imaging with a neural network technique where the training of the network was in the similar way the human brain will function [21]. Thermography is an effective tool in the diagnosis of many diseases like diabetics, fever screening, breast cancer detection, and so on [22, 23]. Initially pre-processing of thermal images were done to reduce noise and regions of interest were extracted to which a neural network model was applied to obtain the status of the patient. Thermal imaging has emerged as a prominent tool in the field of medicine for the early detection of various diseases as most of the diseases will start with a variation in temperature as the beginning symptom [24, 25]. This study makes use of a FLIR thermal camera which will record the images of thermal distributions on the patient foot. The temperature values obtained from various points from the patient's foot are mapped to a matrix representation and were later stored on a personal computer for data analysis. As the thermal images are captured and data is given to a personal computer the next step is the implementation of the Artificial Intelligence (AI) model which has a data-driven approach. An artificial neural network [26] is an efficient way of computation which consists of different number of layers like input, hidden and output layers. And by an activation function which is a mathematical

function the inputs which are given to hidden and output layers are summed to generate the desired output [27]. For data analysis, MATLAB was used which can provide more accuracy by using different MATLAB functions. Two sets of data was used in the case study analysis of which one can be used for training and the other for testing. This method uses an artificial neural network where the number of hidden layers were three and the input layer uses four input variables. For analyzing different ANN model Root Mean Square Error was used.

Advantages: Early detection of diabetes.
Disadvantages: Used a three hidden layer network since it fits the model.
Further enhancement: Can use improved artificial intelligence tools for improving the performance of the existing system.

*J. A Non-Invasive Human Temperature Screening System with Multiple Detection Points*

By using a 2D thermal imaging camera there are some limitations in identifying the temperature in periorbital areas which makes it difficult to compare with the reference values [28, 29]. So to avoid this difficulty the research paper [30] suggests several image processing techniques that select human faces for the maximum skin temperature. This system proposes a non-contact temperature screening system on a real-time basis. By using an inherent 2D space a quite number of people can be maintained from the infrared thermal camera at a considerable distance. And the others will be directed to stand a few distances behind the currently analyzing people. Then the focal length of the lens will be adjusted that focus the maximum number of people whose temperature is screened. And the camera will be able to capture thermal images of people who are walking at a normal speed. For monitoring the fluctuations of surrounding temperature an outside temperature and humidity sensors are interfaced with the existing system. For the good capturing of images the thermal imaging camera of the FLIR system was used and the lens should be focussed at a particular degree along the vertical and horizontal axes. So the selection of camera lens is an issue. Then by restricting the number of people in front of the camera the thermal images are captured and the next step is face detection. So a face searching technique in one image frame is used to detect the faces [31]. For that, several image processing techniques were done on the captured thermal image like morphological processing, hole filling, and so on and coordinates of the face were obtained. A field test was used to capture the efficiency of the camera for detecting multiple faces at a time. The result shows that the system can trace the real-time display of the maximum skin temperature.

Furthermore, on remunerating, the worries it was evident that on the core body temperature once the aggravation from the general climate, the temperature esteem got from the thermal imaging camera has less variation. At the point when the temperature limit level and the balance temperature esteem

are fittingly picked Hyperthermic patients can be related to 100% accuracy. The choice of the number of human countenances on the thermal image marginally influences the framework speed which has a rate of 7 milliseconds for one face, and up to 10 milliseconds for four appearances.

Advantages: System introduces a real-time display system in which the maximum skin temperature can be monitored. There is less fluctuation in the temperature value obtained from the thermal imaging camera.
For febrile detection the proposed system can give 100% efficiency.
Future works: By embedding an outside temperature and relative humidity sensor to the ThermScreen framework, the estimation connection with aural temperature information can be improved.

*K. Thermographic analysis of thyroid diseases*

In this work [32], a FLIR infrared camera which is of the model ThermaCAM S65 system was used for handling thermal images. The camera was working in a programmed self-adjustment mode and the patients were treated under conducive conditions [33, 34]. For the detection of the thyroid, the region of interest was captured by considering the camera calibrations and proper orientations. The cytological study was conducted and the smears were identified and these results were compared with the results of ultrasonography. The result analysis gives a massive contribution to the detection of disease based on detecting hyperthyroid and hypothyroid by the temperature variations. The analysis clearly shows that the comparison of thyroid disease type with the mean skin temperature shows the pieces of evidence of temperature variations. By using this method a clear classification of good and affected thyroid nodules can be detected [35].

Advantages: Uses the least invasive and low cost method for the detection of thyroid nodules.
Further enhancement: For predicting thyroid pathologies, the temperature gradient of thermograms can be used.

*L. Dynamic Infrared Thermography Study of Blood Flow Relative to Lower Limp Position*

For the proper heat distribution within the body, blood flow plays a very crucial role. This research paper discusses how infrared thermography can be used in the analysis of blood flow in the lower limp positions [36]. For the easy understanding of the temperature behaviour of skin, dynamic infrared thermography is used [37]. And for relating the vascularity of tissues, temperature measurements of the human leg were acquired [38]. By using a FLIR T440 thermographic camera, dynamic thermography of lower limp was obtained. It has a focal plane array of 320X240 pixels and for absolute temperature measurements depends on emissivity, ambient temperature, relative humidity, and distance [39]. Temperature variations of five distinct points of limp were recorded. During

analysis, the average temporal temperature restorations of the foot from both vertical and horizontal positions were considered. The spots which show a temperature difference gives a faster return to thermal balance.

Advantages: Dynamic thermographic study gives a clear detection of temperature variations in lower limp regions.
Disadvantages: The heat transfer mechanism was affected by the opposite gravity of blood flow.

*M. A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection*

In this method [40] a physiology-based approach was used so that the area of selection was the human face. The face consists of hot and cold tissues which can be modelled as a collection of these two normal distributions [41]. In this study, using a thermal camera five different angular positions were selected and images were captured. The region of interest was the medial canthal area of the human face and the temperature variations were recorded. For detecting a minor flow of motion of the object an Optical Flow Algorithm was used which provides higher accuracy for temperature detection [42]. For better performance, this method makes use of a Parabolic Regression and Radial Basis Function Network. An algorithm known as the Adaptive Network-Based Fuzzy Interferences System has been used for this purpose [43]. Then the thermal images will be classified using the Image Classification Pre-processing module. Fig. 3 shows the basic working model of the discussed system.

Thermal image capturing

↓

Optical Flow Algorithm

↓

Adaptive Network-Based Fuzzy Interference System
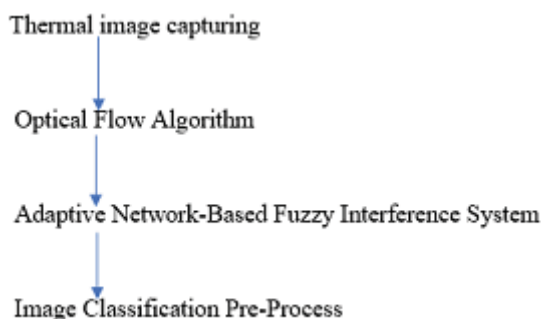
↓

Image Classification Pre-Process

Fig. 3. Flow diagram of A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection.

Advantages: This system gives a good performance especially in hospitals, airports and other places where huge crowd assembles for effectively recording the temperature of person who are in motion.
Further enhancement: Can integrate more crowd, for thermal screening system which can be utilized in public areas like airports and hospitals to reduce the rate of transmissible infectious diseases.

*N. Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor*

This research paper provides a tool for breast cancer detection by Infrared thermography [44]. For establishing the method the image acquisition basically the thermogram images were taken using the thermographic sensors. To this captured image, image processing algorithms were applied to obtain the breast area segmentation. Thermographic image acquisition will in either static or dynamic form and the different images of a single patient from different orientations were taken [45, 46]. The image acquired was processed for the avoidance of background noises and thresholding using Otsu's method was done to the required thermogram [47]. From the preprocessed image the area of interest was segmented and since the paper focused on breast cancer detection, two regions where the right and left breast images were segmented from the initial thermographic image. The automatic segmentation module does all the related task of segmenting the images into different separate independent images so that the temperature variations can be done more effectively. For identifying the temporal variations on the right and left breast it was necessary to convert the grayscale values to their corresponding thermal intensities. The thermographic values are represented in a matrix format. Average temperature values are estimated, and the region with a temperature greater than the referential temperature was detected as infected areas. For detecting the tumor areas, regions with the highest temperature values were used and segmentation of these regions using the watershed technique was used [48]. By using the same segmentation technique apart from the cancer detection another phenomenon called Angiogenesis was also able to be detected.

Advantages: Is an effective method for the analysis of women of varying age group and health situations.
Further enhancement: The automatic segmentation method used can be modified to set the target values for attaining thermal stabilization.

*O. Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography*

Osteoarthritis is a common degenerative disease that is most frequently occurring in people nowadays [49, 50]. This research paper presents an idea for identifying knee osteoarthritis with the aid of IR thermography [51]. This disease will be affecting knees, so they are the region of interest. Images of the knee were captured using an infrared thermal imaging system. Based on certain predefined parameter settings, the thermographic image obtained was later processed for the patella- centering procedure. During the first step, the left and right knees were compared and in the second step, the sub-regions temperature variations were obtained. After the segmentation and sub-regional segmentation then the feature extraction and classification were done. During the feature extraction module, the sub-

regions were evaluated and the defective portions and normal portions were identified. The statistical features were calculated using histogram analysis and the entropy features were calculated [52]. By using the feature extraction method the features were extracted and these were given as the input to the classification module and the classifier used in the proposed method is a classification by Support Vector Machine (SVM) [53]. SVM gives an efficient classification for the diagnosis of knee Osteoarthritis.

Advantages: Method was a cost-effective tool that can easily detect various diseases that too the chronic ones.
When compared to other medical imaging techniques the proposed method was especially desirable to be highly useful in the detection of rheumatism and most geriatric-related issues.
Further enhancement: Further analysis should also be carried out to ensure the accurate quantitative portrayal of specific anatomical positions in a thermal image using techniques such as CT and MRI multi-image fusion, which would dramatically increase the precision of the screening procedure.

## IV. ANALYSIS AND DISCUSSIONS

As a comparative study most research papers give a better explanation for detection of diseases in an efficient way. The major classification tools used were K-means classifiers, artificial neural networks and in common most of the research papers used thermal sensors for disease detection. An important factor which influence the performance of temperature measurement was the thermal camera resolution. As the resolution varies the thermal image capture was influenced. Fig. 4 describes the influence of pixel resolution on thermal distributions.
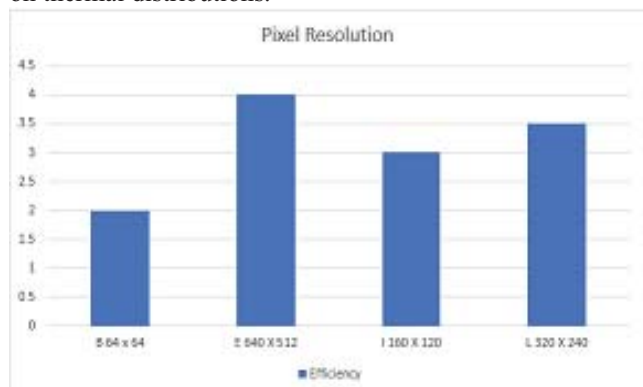


Fig. 4.  Pixel ratio and efficiency

Performance analysis of various research work based on sensitivity and specificity was depicted by TABLE I. Based on the selection of various sensors and the number of sensors the efficiency of thermal detection was also improving.

TABLE I.    COMPARISION OF VARIOUS METHODS BASED ON SENSITIVITY AND SPECIFICITY

| RESEARCH WORK | SENSITIVITY (%) | SPECIFICITY (%) |
|---|---|---|
| *Screening for Fever by Remote-sensing Infrared Thermographic Camera* | 83 | 88 |
| *Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device* | 83.69 | 90.23 |
| *Non-contact monitoring of human respiration using infrared thermography and machine learning* | 98.76 | 99.07 |
| *A Non-Invasive Human Temperature Screening System with Multiple Detection Points* | 81.69 | 79.09 |
| *A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection* | 96 | 85.6 |
| *Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor* | 80.95 | 89.43 |
| *Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography* | 85.72 | 85.51 |

TABLE II gives a comparative study on various methods discussed and the advantages, disadvantages and various methods used by different research papers. So in all the research works, the thermal images were captured and various image processing techniques were used for the efficient detection of diseases where the focus was on thermal screening. This survey will give a better study for COVID-19 detection since the primary symptoms were fever, osteobased problems and thyroid variations. Based on the selection of various sensors and the number of sensors the efficiency of thermal detection was also improving.

TABLE II.  COMPARISION OF VARIOUS METHODS

| Research paper | Year | Method | Sensor Used | Disease Type |
|---|---|---|---|---|
| *Clinical evaluation of fever-screening thermography* | 2020 | Image registration | IRT Sensor | Fever screening |
| *Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument* | 2020 | Image processing techniques with microcontroller unit. | AMG8833 IR Sensor | Fever screening |
| *A low cost thermal imaging system for medical diagnostic applications* | 2018 | Image processing techniques with microcontroller unit. | 24AA02 | Fever screening |
| *Screening for Fever by Remote-sensing Infrared Thermographic Camera* | 2020 | Correlation and regression techniques. | IRT Sensor | Fever screening |
| *Multi-person fever screening using a thermal and a visual camera* | 2015 | RGB color variations, Sliding window technique and Random Forest Classification. | FLIR A65 | Fever screening |
| *Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device* | 2020 | Face detection method using deep learning. | FLIR ONE | Respiratory |
| *Non-contact monitoring of human respiration using infrared thermography and machine learning* | 2020 | Nostril tracking algorithm, Neighbour embedding algorithm. | A325 | Respiratory |
| *Detecting Fever in Polish Children by Infrared Thermography* | 2008 | Feature extraction and thermal image classification. | FLIR | Fever screening |
| *Early Detection of Diabetes using Thermography and Artificial Neural Networks* | 2017 | Image processing with neural network. | IRT Sensor | Diabetes |
| *A Non-Invasive Human Temperature Screening System with Multiple Detection Points* | 2008 | Morphological processing. | FLIR A-20M | Fever screening |
| *Thermographic analysis of thyroid diseases* | 2012 | Cytological study for thyroid detection using image processing. | ThermaCAM S65 | Thyroid detection |
| *Dynamic Infrared Thermography Study of Blood Flow Relative to Lower Limp Position* | 2015 | Thermal image detection for limp region. | FLIR T440 | Blood flow analysis |
| *A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection* | 2015 | Optical Flow Algorithm, Parabolic Regression and Radial Basis Function Network. | IRT Sensor | Fever screening |
| *Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor* | 2017 | Image processing algorithm, Otsu's method. | FLIR A-300 | Cancer detection |
| *Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography* | 2006 | Segmentation, histogram analysis and SVM Classifier. | FLIR SC620 | Osteoarthritis |

So based on the relevance of the application to be developed, the sensors can be chosen. For critical application where the minute details are to be captured focus should be placed on the selection of sensors rather than cost. Whereas if the application needs only substantial features then cost can be given top priority.

## V. CONCLUSION

Here a comparative study of various thermometric methods is done to find an effective system especially in the fever screening scenario that can be used for COVID-19 detection. So when two separate cameras were used in the analysis, a thermal camera for temperature measurements and an ordinary visual camera for image capture most of the system face synchronization problems. And the correct correlation of the optical axis is also a factor that affects efficient calculations. Thus by considering all these factors a low cost, easy to use thermal imaging system was hence developed so that with the help of image processing techniques combined with other

detection and classification methods an efficient disease detection method can be developed.

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# Pedestrian Counting Using Yolo V3

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## Abstract

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I. Introduction

II. Related Techniques

III. Methodology

IV. Experimental Result

V. Conclusion

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box and allot a class label as a person based on YOLO v3. In YOLO v3 the features are learned, divides the image cells and each cell says a bounding box and entity classification directly. There could be more than one bounding box per person, but the system makes use of non-maximum suppression to reduce the number of bounding boxes to one per person. Finally, the number of persons in the image and video are calculated using the count of the bounding boxes. The dataset used for static pedestrian detection is the INRIAdataset and ShanghaiTech dataset. Yolo_Mark is used for marking bounding boxes of persons and gets its annotation files using 243 images from the INRIA dataset. Darknet is used as the framework for implementing YOLOv3. From INRIA Dataset 120 images are used for testing purposes. Testing on the INRIA dataset resulted in an accuracy of 96.1%. From the Shanghai tech-B, dataset 56 images are used for testing. Testing resulted in an accuracy of 87.3%.

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# Sentiment Analysis Using Deep Learning

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P C Shilpa ; Rissa Shereen ; Susmi Jacob ; P Vinod   **All Authors**

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**Abstract**    **Abstract:**

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communicate using mistreatment text through social media applications such as Facebook, Twitter etc. In this paper, we propose a sentimental classification of multitude of tweets. Here, we use deep learning techniques to classify the sentiments of an expression into positive or negative emotions. The positive emotions are further classified into enthusiasm, fun, happiness, love, neutral, relief, surprise and negative emotions are classified into anger, boredom, emptiness, hate, sadness, worry. We experimented and evaluated the method using Recurrent Neural Networks and Long short-term memory on three different datasets to show how to achieve high emotion classification accuracy. A through evaluation shows that the system gains emotion prediction on LSTM model with 88.47% accuracy for positive/negative classification and 89.13% and 91.3% accuracy for positive and negative subclass respectively.

III. System
      Architecture

IV. Methodology

V. Experiments

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# Twitter Sentiments: A Machine Learning Approach

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*Abstract*—Sentiment evaluation is the problem of examining texts,critiques, mind and conditioned emotional response published with the aid of various users in microblogging systems. Twitter is one of the maximum extensively used micro running a blog systems and has proved to be the biggest source of statistics.Twitter can give a clear cut view about the current trends. A big dataset of tweets is used to perform sentiment evaluation. The tweets are labeled into two classes, positive and negative. There are various techniques which can be utilised to perform this task. In this paper we aim to perform a comparison between a multilayer perceptron and a factorization machine for classification of tweets in the Sentiment 140 dataset. We apply this approach using two different lexical resources namely AFFIN dictionary and SentiWordNet. The generated models are compared based on the lexicon used as well as the classifier adopted (multilayer perceptron or factorization machine) for their accuracy and training time.

*Index Terms*—Micro-blogging platform, multilayer perceptron, factoristation machine,AFFIN dictionary,SentiWordNet

## I. INTRODUCTION

Artificial Intelligence (AI) deals with making computers work like humans. This is accomplished by observing human ways of thinking and decision making and applying the outcomes to develop software and systems comparable to human capabilities. AI has been utilized in numerous fields like speech recognition, hand writing recognition, gaming and robotics. Natural Language Processing (NLP) which is a subfield of AI has a range of techniques for the purpose of obtaining human-like language processing for different tasks or applications [1]. It is an effort to get computers closer to human level understanding of language. Sentiment Analysis falls under NLP. It is a process by which all the content can be evaluated to represent the ideas, beliefs and opinions of the public. It can be accomplished at various degrees like document, section, paragraph and phrase level. With the upward push of social networking tendencies there was a surge of online generated content material. Many people proportion their thoughts and opinions on microblogging websites. Twitter is one of the broadly followed micro blogging platform for expression of opinion and experience. It was created and launched in the year 2006 [2]. It evolved as a golden platform for companies to disclose about their brands and success. Twitter users include a variety of users ranging from regular users, celebrities, politicians, entrepreneurs, veterans and other persons of influence. The primary advantages of performing sentiment analysis encompass scalability and real time evaluation. Efficiency and cost effectiveness of processing large huge data contributes to scalability. Real time analysis is performing analysis on real time data which can be tweets that are tweeted in a certain scenarios or even critical situations. Sentiment analysis systems help the companies to get meaning of the sea of data by automating business process which saves long hours of manual data processing.

One of the main challenges identified in this area is the use of unstructured text format. As people express opinions in different manner sentiment analysis can be challenging. Fake comments by users, context dependencies of opinions also cause an issue. By using lexicon based approaches unstructured data can be processed more efficiently and context dependencies can be overcome by machine learning techniques.

Rest of the paper is prepared as follows. In segment II we talk related works on sentiment evaluation of micro blog data. In segment III we present our proposed methodology. Segment IV and V discuss consequences and conclusions.

## II. RELATED WORKS

### A. FEATURE EXTRACTION

For sentiment evaluation the unique feature of textual content or documents needs to be represented as a feature vector. The subsequent functions may be used for the same.

*1) Term Presence or Term Frequency:* In Pang et al (2002) [3], it is said that this is one pointer that makes sentiment analysis distinct from other text classification errands. The terms can be unigrams, bigrams or on the other hand other higher request n-grams. Barnaghi et al [4] used unigrams and bigrams and applied Term Frequency Inverse Document Frequency(TF-IDF) to find weight of features and thereby selecting the ones with the largest weight. This method has been proved to be efficient in this field.

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Abstract

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# Liquefaction resistance improvement of silty sands using cyclic preloading

**Akhila M[1,3], Rangaswamy K[2] and Sankar N[2]**

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**Abstract**. Liquefaction induced damages are plenty and cause various levels of destruction to civil engineering infrastructure. It is possible to prevent liquefaction-induced hazards by understanding the mechanism and adopting some improvement techniques or design the structure to resist the soil liquefaction. In the present study, the influence of cyclic preloading on the liquefaction resistance of sand-silt mixtures is analyzed by conducting undrained cyclic triaxial tests on the cylindrical samples reconstituted at medium dense conditions ($D_r$ = 50%). All samples were tested at an effective confining pressure of 100 kPa by varying the cyclic stress ratios (CSR) in the range of 0.127 to 0.178 using a sinusoidal waveform of frequency 1 Hz. The results are presented in the forms of the pore pressure build-up, axial strain variation and liquefaction resistance curves. Test results indicate that the liquefaction resistance of silty sands is increased substantially with the application of preload under drained conditions.

## 1. Introduction

Liquefaction induced damages are plenty and cause various levels of destruction to civil engineering infrastructure. It is possible to prevent liquefaction-induced hazards by understanding the mechanism and adopting some improvement techniques or design the structure to resist the soil liquefaction. The first possibility is to avoid the construction on liquefiable soil deposits as far as possible. However, it is mandatory to utilize the available land for the various infrastructure developments due to scarcity in the availability of land even it does not satisfy the required properties. Hence, the second option is to make the structure resistant to liquefaction by adopting deep foundations. Nevertheless, the deep pile foundations may not prevent liquefaction damages in all cases. Piles are causing to deflect in liquefaction susceptibility zones. Hence, the third option is liquefaction mitigation which involves improving the strength, density, and drainage characteristics of the soil. The selection of the most appropriate ground improvement method for a particular application could depend on many factors including the type of soil, level, and magnitude of improvement to be attained, required depth and extent of the area to be covered. This paper presents an experimental study regarding the applicability of preloading for the improvement of liquefaction resistance.

## 2. Literature review

Preloading of the soils occurs naturally (for eg., erosion, the flow of groundwater, etc) or artificially (purposeful preloading to improve the soil properties, demolition of structures, etc). A few researchers have analyzed the liquefaction resistance of preloaded soils. The details are given in Table 1.

# Salinity reduction in well water using zeolite

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**Abstract**. Saline water intrusion is one of the global issues, which increases the demand for freshwater around the coastal region. The saline content in drinking water makes so many health impacts on human beings. There are many new technologies available for reducing salinity such as desalination, membrane technologies, reverse osmosis, etc. But these are expensive too. There is a need for cost-effective treatment which is suitable for domestic purpose in coastal regions. In this paper, a new technique is introduced which reduces the saline content in groundwater by installing this barrier device in wells of coastal regions. A non-woven Geo textile along with natural zeolite is used as a filter cum adsorption unit. Tests results show a decrease in electrical conductivity and total dissolved solids with an increase in filter thickness for all selected salt concentrations irrespective of the adsorbent materials used viz., natural zeolite and thermally activated natural zeolite. This indicated a reduction in chloride ions as the only salt added to the water samples tested was commercial salt. Authors suggest that a thermally activated zeolite filter could be a possible cost-effective, efficient and easy solution for increasing saline water intrusion issues in coastal drinking water wells.

## 1. Introduction

Saltwater intrusion, which is the induced flow of saline or brackish water into freshwater, is an ever-increasing problem in coastal areas. Seawater intrusion is often regarded as the only factor causing saltwater contamination. But, there are seven other causes of salinity in groundwater like tidal and storm surges, pollution from agricultural land, etc [1].Once saltwater intrusion occurs, the changes in the aquifer may be permanent or may take many years to recover.

Saline water intrusion impacts are associated primarily with losses of freshwater resources and contamination of water supply wells, and only a few studies consider adverse ecological impacts directly linked to saline water intrusion. Environmental degradation arising from this is commonly linked to the application of high salinity groundwater in agriculture, resulting in modified soil chemistry and reduced soil fertility [2]. While the direct and indirect intrusion of salinity in fresh groundwater affects human well-being, its serious implications on population health must be clearly understood. Owing to the use of saltwater, numerous diseases including skin ailments, hair fall, diarrhoea, gastric diseases, and high blood pressure are suffered.

A lot of techniques have been used to manage/control salt/seawater intrusion and protect groundwater resources. The principle is basically to reduce the volume of saltwater intrusion and increase the volume of freshwater. Mahesha [3] and Rastogi et al. [4] combined the methods of injection of freshwater and extraction of saline water to increase the volume of freshwater and to reduce the volume of saltwater pose effective but the setback is the cost factor involved in the construction and maintenance of the wells. Several of these methods are costly and some might not be

# A Review on Studies Based on Vehicle Stability and Safety on Rural Horizontal Curves

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## ABSTRACT

All over the world India bangs the top most position in crash deaths. Nearly 1.2 lakh people die every year on Indian roads. Crashes involving rolloverand lateral skidding are now responsible for almost 1/3 of all highway vehicle occupant fatalities. So, rollovers and skidding are more serious than other types of crashes. One of the major reasons for such incidents is vehicle instability at curves due to its inconsistent geometric design. This necessitates a review on current design guidelines followed in India. Many researchers have pointed out drawbacks of current design approach and a few have identified various influential factors which are significant in curve design to reduce rollover and lateral skidding. When some researchers conducted field studies to measure vehicle stability at selected curves, some carried out computer simulations. There are efforts to incorporate vehicular characteristics in curve design which is much appreciable. This paper aims to project efforts made by researchers to reduce vehicle instability at horizontal curves. Moreover, gaps in these research works and scope for further research are highlighted.

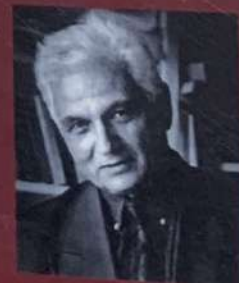**Keywords:** crash, rollover, skidding, vehicle stability

## 1 Introduction

As per Ministry of Road Transport and Highways, New Delhi (MORTH), about 15% of road crashes on highways occur at horizontal curves among which 8% is due to vehicle overturning or lateral skidding. A closer look at the crash statistics records of a few years reveals that road crashes involving vehicle overturning and lateral skidding are increasing drastically, especially heavy vehicle crashes. Several studies are conducted to identify the factors causing road crashes and prevent them. Crashes are multi causal and are affected by numerous factors like geometric design, traffic volume, traffic composition, variation in speed between vehicles of the same class and different classes, weather, motivation for travelling, driver's attentiveness and so on (Aljanahi et al., 1999).

James McKnightet. al., 2008 conducted 'Large Truck Crash Causation Study' for 967 crashes, with 1,127 large trucks, 959 non-truck motor vehicles, 251 fatalities, and 1,408 injuries. The identified causes are misjudged speed, insecure loading, inattentiveness, loss of steering control, vehicle characteristics like tire, brake and suspension. Numerous research works are carried out by researchers across the world to identify influence of geometry on crash rate. Yingxue Zhang et al, 2009 identified curve radius, width, superelevation, transition curve and sight distance have important effect on traffic accidents. According to Sunanda Dissanayake and

# PERSPECTIVES ON CONTEMPORARY LITERATURE AND LITERARY THEORIES IN ENGLISH

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# PERSPECTIVES ON CONTEMPORARY LITERATURE AND LITERARY THEORIES IN ENGLISH

Editor :

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# Living in the Wilderness

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## Abstract

Nature makes us feel alive and energetic. It has the power to bring our mind, body, and soul back to life. Nature's healing powers are absolutely amazing. It is therapeutic for everyone and is open to both the rich and the poor. Recognizing Nature's healing power, many people travel to places around the world that offer consolation and comfort. Nature is not just around us, it's within us as well. This provides an unexplained sense of calm consciousness. Several studies are now available that show nature's psychological benefits. All the research points the fact that the closer we find ourselves to nature, the happier we feel. Nature is, in fact, a strong antidepressant.

The paper is about the consoling power of nature experienced by the characters when they are in the natural settings in the novel *The Tree of Man* written by Patrick White. The study is an eco-psychological re-reading of the text which will allow readers to witness how the environment becomes an inevitable part of human life that reflects the interconnectedness of all that the nature has created. The escape to nature has another appeal besides its beauty and tranquillity. Ecological interactions touch an individual's physical, spiritual, emotional and psychological facets of life. Eco psychology is a modern social and intellectual movement aimed at recognizing and harmonizing the relationship between people and the Earth. The emerging field of eco-psychology shows how our human psyches are closely bound to the elemental earth.

Earth centred faiths strives to honour the strength of nature's consoling power. This eco psychological study shows how the text demonstrates the character's harmonious and balanced eco human bonding. It shows how far identities of characters are shaped by the surroundings in which they live. The study describes how the ecological lifestyle is an encompassing transformation that touches every facets of an individual's life. The experiences encountered by the characters in the novel shows how the experiences in life with the natural environment move them towards a greater appreciation and concern for the natural world. Thus the paper studies *The Tree of Man* as an ecological writing with a literature of hope.

## Keywords-

## Living in the Wilderness

I wandered lonely as a cloud
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host, of golden daffodils;
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze.

(William Wordsworth)

The paper is about the consoling power of nature experienced by the characters when they are with the natural setting in the novel *The Tree of Man* written by Patrick White. The study is an eco psychological re-reading of the text which will allow readers to witness how the environment becomes an inevitable part of human life that reflects the interconnectedness of all that the nature has created. The escape to nature has another appeal besides its beauty and tranquillity. It is freely available to the poor as well as to the rich. Ecological interactions touch an individual's physical, spiritual, emotional and psychological facets of life. Eco psychology is a modern social and intellectual movement aimed at recognizing and harmonizing the relationship between people and the Earth. The emerging field of eco psychology is showing how our human psyches are closely bound to the elemental earth.

Earth centred faiths strives to honour the strength of nature's consoling power. This eco psychological study shows how the text demonstrates the character's harmonious and balanced eco human bonding. It shows how far identities of characters are shaped by the surroundings in which they live. The study describes how the ecological lifestyle is an encompassing transformation that touches every facets of an individual's life. The experiences encountered by the characters in the novel shows how the experiences in life with the natural environment move them towards a greater appreciation and concern for the natural world. Thus the paper studies *The Tree of Man* as an ecological writing with a literature of hope.

In the novel, the characters sufferings in life get consoled as they get along with nature. When they remain in both wild and domesticated environments, most often in places of natural beauty, there are revelatory experiences awakening their wisdom and modesty. Experiences with the destructive sides of nature can test the commitment of ecological followers to provide a powerful reminder that a turn of earth is not peace, safety, or limitless abundance. In its natural cycles and changing ecology, the environment offers great stability, but this constancy is not fully chaos-free. Biophilia, the love of nature and living things, is an essential part of the human condition. Those who spend extensive time in the environment observe to respect the extreme spontaneity of nature.

Patrick White's novel evokes a diversity of landscapes that often enter into the texture of the novel's narrative. He is quite a few steps ahead of the other contemporary writers. His works reveal the depth of his understanding of Australia as a region and its atmosphere. White considers it not only as a land of mystical values but also as a separate entity in human life. The depth in which he depicts the landscape of the Australian nation, reality encounters with nature thereby resulting in idiosyncratic revelations makes his works stand apart from other writers. Patrick White's *The Tree of Man* evokes a diversity of landscapes that often enter into the texture of the novel's narrative.

People are less stressed when they are with nature. Eco criticism helps us to realize that all living organisms are connected when we step into nature. Nature gives comfort to all troubles. The word '

tree ' in this novel's title stands for the search for growth of Stan, for the unbounded life. Stan was a person who loves to be with nature. The novel begins with the description of two big trees as:

A cart drove between the two big stringy barks and stopped. These were the dominant trees in that part of the bush, rising above the involved scrub with the simplicity of true grandeur    (1)

The novel is a beautiful evocative description of the nature. Patrick White has paid a lot of attention to the nature that surrounds his protagonist Stan Parker. "He smelled the smell of green wood. The name of this man was Stan Parker."(5 White) It is a suburban drama that tells a story of the lives and fortunes of the Parker family over many decades. Stan is a son of blacksmith and an educated mother. Stan's mother expects him to be a teacher or a preacher. After the death of the parents of Stan Parker, he decided to begin a new life. Stan had no intention of remaining in the confining atmosphere of the Australian bush town where he grew up. "At Willow Creek, God bent the trees till they streamed in the wind like beards. In the streets of towns the open windows, on the dusty roads the rooted trees, filled him with the melancholy longing for permanence."(13)

He leaves his hometown and travels to an unsettled area outside Sydney, where he has inherited some property. He manages to makes out a house in the woods and starts farming. Stan had come to the woods in search of peace. "Stan Parker began to tear the bush apart. His first tree fell through the white silence with a valley of leaves...Many days passed in this way, the man clearing his land...Seen through the trees; it was a plain but honest house that the man had built."(17)

White's heroes suffer from alienation when they are in the midst of human society. Stan loved living in the woods devoid of all the rush of the busy world. He wanted a peaceful life in the calm and soothing nature. Stan is a lonely man whose most outstanding characteristic is his quality of being silent. He loved to be part of nature and wished to settle his life there. Many days passed in this way, Stan clearing his land. At last he built his house amongst the woods. "Seen through the trees, it was a plain but honest house that the man has built."(17)

One day Stan brought with him a woman. Her name was Amy Fibbens. Stan's union with Amy Fibbens played a key role in shaping his goal and his efforts to achieve it. When they came to the place where Stan's house stood, they were on the outskirts of the town, where they could smell sheep, and of water drying in a mud hole. The place was home to incredible scenery and delicate ecosystems. Stan's cart jolts through the windy countryside "The girl lazily smiled at the landscape, holding her hat."(25) It was a long ride through the bush road. The travel through the woods consoled her ill thoughts.

The girl sat with her eyes on the road. She was not concerned, as at odd moments, her husband was afraid she might be. Because in her complete ignorance of life, as it is lived and the complete poverty of the life she had lived, she was not sure but that might have to submit thus, interminably bolt upright in a cart. Life was perhaps a distances of stones and sun and wind, sand coloured and monotonous."(26)

Amy always had a feeling that Stan remains distanced from her. Her only relief is observed from the surrounding she lives. This consoling power of nature has brought Amy Parker to live in the midst of the beauty of nature. Amy Parker had grown greedy for love. She had not succeeded in keeping her husband with her all the time. She had promised herself in moments of indulgence that she would achieve this at some future date. But she fails every time. Amy's only relief was the moments she had with the nature. Amy loved animals and enjoyed planting trees. "She should plant the white rose,

where the slope of the land was still restless from the jagged stumps of felled trees."(28) The nature which surrounded her spoke to her in its silence from her consoling depths.

"She walked slowly on, taking care of herself, and the harsh blue of her wooden jacket flickered through the evening colours of the garden, the colour of moss, almost of foreboding, and her skirt in passing stirred up an intolerable scent of rosemary and thyme that lingered after she had gone."(57)

The Parkers continued their life. When Stan leaves the house into the woods he can still hear the voice of Amy when he was alone in nature. To discover what life actually is, the more humble Stan Parker turns to Nature. Stan's greatest strength is his endurance. His mind can withstand pain and torture to the degree that it can help him achieve his goal. Other people came to live in that place after few years and there is a rose bush now, growing against the veranda, a white rose, of which Amy had thought and spoken to Stan, and which he had brought to her from the town.

The major event that took place was a great flood, which fortunately did not destroy their farm. The still air became more charged the closer they got to the centre of the storm, the sky darker. The storm continued most of the days: "The whole earth was in motion and streaming trees, and was in danger of being carried with it."(47)

The constant rain that swells into the flood of Wallonia, causes trouble to people's lives, and Stan is brought to the point that he understands how weak man is. He joins other volunteers and helps rescue settlers stranded by the flood.

The great trees had broken off, two or three fell". "He remembered the face of his mother before her burial, when the skull disclosed what the eyes had always hidden; some fear that the solidity of things around her was not assured. But on the dissolved world of flowing water, under the drifting trees, it was obvious that solidity is not. (73)

Stan learns to humble himself from his surroundings and to embrace continuous changes as the only solidity. Two children are born to the Parkers, a daughter, Thelma, and a son, Ray. Later, during a raging bushfire, Stan rescues Madeleine from the burning manor house. World War I begins soon after the great fire, and Stan enlists in the army. After Stan returns from the battlefields of France, he once more works his farm while his wife carries out her domestic duties faithfully and his children grow into adults. "One was born. One lived". (104) Stan felt that staying isolated in the nature is the only way to consolation. It reflects one's self confidence. He admires the land which gives shape to his life. Also he is also looking for a sense that lies beyond the visible environment. The solitary life in nature helps to develop internally from which a person eventually must reach the innermost core of his own being. "Society, as such, fills him with discomfort and it has always remained an "unrealized ambition". (186) Stan feels the land is an indomitable power, bringing misery, suffering and desolation. These ecstatic experiences faced with the nature makes a person stronger.

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## BOOKS/CONFERENCE INDEX 2020-2021

3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during 2020-2021

| Sl. No. | Name of the teacher | Title of the book/chapters published | Title of the paper | Title of the proceedings of the conference | Name of the conference | National / International | Calendar Year of publication | ISBN number of the proceeding | Affiliating Institute at the time of publication | Name of the publisher |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Jane Theresa | IN Perspective of Contemporary Literature and Literary Theories in English | Living in the Wilderness | | | | Sep-20 | ISBN 37893888105 2-01130 | SCMS School of Engineering and Technology, Ernakulam, India | Jeeva Publication |
| 2 | Remya Y K | | A Review on studies based on vehicle stability and safety on rural horizontal curves | Proceedings of International Web Conference in Civil Engineering for a Sustainable Planet | Proceedings of International Web Conference in Civil Engineering for a Sustainable Planet | International | Apr-21 | ISSN:2582-3922 | SCMS School of Engineering and Technology, Ernakulam, India | AIJR Proceedings |
| 3 | Sruthy M R | | Salinity reduction in well water using zeolite | IOP Conference Series: Materials Science and Engineering | 6th Biennial International Conference on Emerging Trends in Engineering Science and Technology (ICETEST 2020) 17th-19th December 2020, Kerala, India | International | Dec-20 | ISSN: 1757-8981 | SCMS School of Engineering and Technology, Ernakulam, India | IOP Publishing |

| No. | Author | Title | Journal / Book Series | Conference | Level | Date | ISSN / ISBN | Institution | Publisher |
|---|---|---|---|---|---|---|---|---|---|
| 4 | Dr.Akhila M | Liquefaction resistance improvement of silty sands using cyclic preloading | IOP Conference Series: Materials Science and Engineering | 6th Biennial International Conference on Emerging Trends in Engineering Science and Technology (ICETEST 2020) 17th-19th December 2020, Kerala, India | International | Dec-20 | ISSN: 1757-8981 | SCMS School of Engineering and Technology, Ernakulam, India | IOP Publishing |
| 5 | Dr.Vinod P | Detection of Obfuscated Mobile Malware with Machine Learning and Deep Learning | Communications in Computer and Information Science book series (CCIS, volume 1366) | Symposium on Machine Learning and Metaheuristics Algorithms, and Applications | | Feb-21 | 978-981-16-0419-5 | SCMS School of Engineering and Technology, Ernakulam, India | Springer Link |
| 6 | Dhanya K A, Binu John | Twitter sentiments: A machine learning approach | IEEE XPLORE | 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | International | Feb-21 | 978-1-6654-1960-4 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 7 | Susmi Jacob | Sentiment Analysis using Deep learning | IEEE XPLORE | 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | International | Feb-21 | 978-1-6654-1960-4 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |

| No. | Author | Title | Database | Conference/Proceedings | Type | Date | ISBN/ISSN | Institution | Publisher |
|---|---|---|---|---|---|---|---|---|---|
| 8 | Bini Omman | Pedestrian Counting Using YOLO V3 | IEEE XPLORE | 2021 International Conference on Innovative Trends in Information Technology (ICITIIT) | International | Apr-21 | 978-1-6654-0467-9 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 9 | Sreeja Rajesh | A study on various thermographic methods for the detection of diseases | IEEE XPLORE | 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | International | Mar-21 | 978-1-6654-1960-4 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 10 | Sreeja Rajesh | Modernizing traditional methods of farming using farming robots | SSRN | International Conference on IoT Based Control Networks & Intelligent Systems - ICICNIS 2020 | International | Jan-21 | 1556-5068 | SCMS School of Engineering and Technology, Ernakulam, India | SSRN |
| 11 | Dr. Varun G Menon | DIO messages and trickle timer analysis of RPL routing protocol for UAV-assisted data collection in IoT | ACM Digital Library | DroneCom '20: Proceedings of the 2nd ACM MobiCom Workshop on Drone Assisted Wireless Communications for 5G and Beyond | International | Sep-20 | 978-1-4503-8105-5 | SCMS School of Engineering and Technology, Ernakulam, India | ACM Digital Library |

| Sl. No | Name | Title | Publisher | Conference / Proceedings | Level | Date | ISBN | Affiliation | Publisher |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Dr.Sunil Jacob | Intelligent vehicle collision avoidance system using 5G-enabled drone swarms | ACM Digital Library | DroneCom '20: Proceedings of the 2nd ACM MobiCom Workshop on Drone Assisted Wireless Communications for 5G and Beyond | International | Sep-20 | 978-1-4503-8105-5 | SCMS School of Engineering and Technology, Ernakulam, India | ACM Digital Library |
| 13 | Ms. Litty Koshy, Ms. Gayathry S Warrier | Detection of Recoloring and Copy-Move Forgery in Digital Images | IEEE XPLORE | 2020 Fifth International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN) | International | Dec-20 | 978-1-7281-8818-8 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 14 | Ms. Neenu Sebastian, Ms. Rosebell Paul | Morphological Operators on Hypergraphs for Colour Image Processing | IEEE XPLORE | 2020 Advanced Computing and Communication Technologies for High Performance Applications (ACCTHPA) | International | Oct-20 | 978-1-7281-6453-3 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |
| 15 | Litty Koshy | Copy-Move Forgery Detection and Performance Analysis of Feature Detectors | IEEE XPLORE | 2020 International Conference on Communication and Signal Processing (ICCSP) | International | Sep-20 | 978-1-7281-4988-2 | SCMS School of Engineering and Technology, Ernakulam, India | IEEE |

**Total number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during 2020-2021**    **15**

Conferences  >  2020 International Conference   ❓

# Copy-Move Forgery Detection and Performance Analysis of Feature Detectors

**Publisher: IEEE**   [ Cite This ]   [ 📄 PDF ]

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I. Introduction

II. Proposed System

III. Segmentation

IV. Keypoint Extraction

V. Block Feature Matching

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Metrics

reporting, and advanced crime investigation. Digital images can easily be forged with the advancement of image manipulation tools and information technology. The commonly used image forgery technique in digital forensic filed is Copy-move forgery. The two fundamental classifications for identifying copy-move forged images are keypoint-based and block-based method. Block-based strategies have the burden of high computational expense because of the enormous number of image blocks and it fails to deal with different geometric transformations. On the contrary, keypoint-based methodologies can overwhelmed these two draw-backs however are discovered hard to manage smooth locales. As a result, these two methodologies are combined and proposed a effective copy-move forgery detection. Also, we accomplish a comparative study between different keypoint detectors and feature matching algorithms used to determine computational complexity of each.

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Abstract

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III. Colour Image
Representation

IV. Experimental
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V. Conclusion and
Future Works

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**Abstract:**

This article is an extension of morphological operators on hypergraphs to work with colour images. Morphological operators on hypergraphs are useful for binary and grayscale image processing. The preliminary experimental results related to the extension of these operators to colour images is presented in this paper. The results on colour images are promising and is a better alternative for the existing methods.

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# Morphological Operators on Hypergraphs for Colour Image Processing

**Publisher: IEEE**   Cite This    📄 PDF

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Abstract

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Introduction

# Morphological Operators on Hypergraphs for Colour Image Processing

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## Abstract

This article is an extension of morphological operators on hypergraphs to work with colour images. Morphological operators on hypergraphs are useful for binary and grayscale image processing. The preliminary experimental results related to the extension of these operators to colour images is presented in this paper. The results on colour images are promising and is a better alternative for the existing methods.

**Keywords**: Hypergraph, Mathematical Morphology, Image Processing, Salt and pepper noise.

## 1 Introduction

Mathematical morphology is the first consistent non-linear image analysis theory. Originally it was defined on a set theretic framework and used for processing bianry images and extended to grayscale images. Despite its continuous origin, it was soon recognised that the roots of the theory were in algebraic theory, notably the framework of complete lattices. This allows the theory to be completely adaptable to non-continuous spaces, such as graphs [4], hypergraphs [3] and simplicial complexes [5]. Extending Mathematical Morphology to colour images is an active area of research in image processing [8, 18, 9]. There exists no general admitted extension that permits to perform morphological operations on colour images since there is no natural ordering of vectors [11].

Image filtering is one of the most important operation in image processing. Salt and pepper noise is very common in image processing applications and noise reduction is a very active area of research in image processing [12]. Morphological filtering is one of the most reliable techniques for salt and

---

pepper noise reduction [2, 4, 5]. Our objective is to utilise the morphological operators defined on hypergraphs to remove this noise from colour iamges [2, 16].

This paper is organised as follows. In Section 2, we introduce the preliminary definitions from mathematical morphology and morphological operators on hypergraphs. In Section 3, we present the hypergraph representation of a digital image. Experimental results of the operators and filters on a colour image are presented in Section 4. Conclusion and future works are presented in Section 5.

## 2 Preliminaries

### 2.1 Mathematical Morphology

**Definition 1.** [6, 7, 14, 17] Given two lattices $\mathcal{L}_1$ and $\mathcal{L}_2$, any operator $\delta : \mathcal{L}_1 \to \mathcal{L}_2$ that distributes over the supremum and preserves the least element is called a *dilation* (*i.e.* $\forall \varepsilon \subseteq \mathcal{L}_1, \delta(\vee_1 \varepsilon) = \vee_2 \{\delta(X) | X \in \varepsilon\}$). An operator that distributes over the infimum and preserves the greatest element is called an *erosion*.

**Definition 2.** [6, 7, 14] Two operators $\epsilon : \mathcal{L}_1 \to \mathcal{L}_2$ and $\delta : \mathcal{L}_2 \to \mathcal{L}_1$ form an *adjunction* $(\epsilon, \delta)$, if for any $X \in \mathcal{L}_2$ and any $Y \in \mathcal{L}_1$, we have $\delta(X) \leq_1 Y \Leftrightarrow X \leq_2 \epsilon(Y)$, where $\leq_1$ and $\leq_2$ denote the order relations in $\mathcal{L}_1$ and $\mathcal{L}_2$ respectively.

**Definition 3.** [6, 7, 17] Let $\delta$ be any operator on a lattice $\mathcal{L}$, then $\delta$ is

(a) *increasing* if $X \leq Y$ implies $\delta(X) \leq \delta(Y)$;
(b) *extensive* if $\delta(X) \geq X$ for every $X \in \mathcal{L}$;
(c) *anti extensive* if $\delta(X) \leq X$ for every $X \in \mathcal{L}$;
(d) *idempotent* if $\delta^2 = \delta$;
(e) a *morphological filter* if $\delta$ is increasing and idempotent;
(f) an *opening* if $\delta$ is increasing, anti-extensive and idempotent;
(g) a *closing* if $\delta$ is increasing, extensive and idempotent.

### 2.2 Morphological operators on hypergraphs [2, 16]

A hypergraph is denoted as a pair $H = (H^\bullet, H^\times)$ where $H^\bullet$ is a set and $H^\times$ is a family $(e_i)_{i \in I}$ of nonempty subsets of $H^\bullet$. Let $X$ and $Y$ be two hypergraphs. If $X^\bullet \subseteq Y^\bullet$ and $X^\times \subseteq Y^\times$, then $X$ and $Y$ are ordered and it is denoted by $X \subseteq Y$. $X$ is called a subhypergraph of $Y$. Hereafter the workspace is a hypergraph $H = (H^\bullet, H^\times)$ and consider the sets $\mathcal{H}^\bullet$, $\mathcal{H}^\times$ and $\mathcal{H}$ of respectively all subsets of $H^\bullet$, all subsets of $H^\times$ and all subhypergraphs of $\mathcal{H}$.

**Definition 4. (Vertex-Hyperedge Correspondence)** The operators $\delta^\bullet$, $\epsilon^\bullet$ from $\mathcal{H}^\times$ into $\mathcal{H}^\bullet$ and the operators $\delta^\times$, $\epsilon^\times$ from $\mathcal{H}^\bullet$ into $\mathcal{H}^\times$ are defined as follows.

|  | $\mathcal{H}^\times \to \mathcal{H}^\bullet$ | $\mathcal{H}^\bullet \to \mathcal{H}^\times$ |
|---|---|---|
| Provide the object with a hypergraph structure | $X^\times \to \delta^\bullet(X^\times)$ such that $(\delta^\bullet(X^\times), X^\times) = \bigwedge \mathcal{H}_{X^\times}$ | $X^\bullet \to \epsilon^\times(X^\bullet)$ such that $(X^\bullet, \epsilon^\times(X^\bullet)) = \bigvee \mathcal{H}_{X^\bullet}$ |
| Provide its complement with a hypergraph structure | $X^\times \to \epsilon^\bullet(X^\times)$ such that $(\epsilon^\bullet(X^\times), \overline{X^\times}) = \bigwedge \mathcal{H}_{\overline{X^\times}}$ | $X^\bullet \to \delta^\times(X^\bullet)$ such that $(\overline{X^\bullet}, \delta^\times(X^\bullet)) = \bigvee \mathcal{H}_{\overline{X^\bullet}}$ |

Table 1: Vertex-hyperedge correspondence

**Property 1.** 1. Operators $\epsilon^\times$ and $\delta^\times$ (resp. $\epsilon^\bullet$ and $\delta^\bullet$) are dual of each other.

2. Both $(\epsilon^\times, \delta^\bullet)$ and $(\epsilon^\bullet, \delta^\times)$ are adjunctions.

3. Operators $\epsilon^\bullet$ and $\epsilon^\times$ are erosions.

4. Operators $\delta^\bullet$ and $\delta^\times$ are dilations.

The following operators are defined on $\mathcal{H}^\bullet$.

**Definition 5.**

(a) Vertex dilation $\delta = \delta^\bullet \circ \delta^\times$ and vertex erosion $\epsilon = \epsilon^\bullet \circ \epsilon^\times$.

(b) Opening $\gamma_1 = \delta \circ \epsilon$ and closing $\phi_1 = \epsilon \circ \delta$.

(c) Half opening $\gamma_{1/2} = \delta^\bullet \circ \epsilon^\times$ and half closing $\phi_{1/2} = \epsilon^\bullet \circ \delta^\times$.

**Property 2.** If $X^\bullet \subseteq H^\bullet$, then $\gamma_1(X^\bullet) \subseteq \gamma_{1/2}(X^\bullet) \subseteq X^\bullet \subseteq \phi_{1/2}(X^\bullet) \subseteq \phi_1(X^\bullet)$.

**Property 3.** The operators $\gamma_{1/2}$ and $\gamma_1$ are openings on $\mathcal{H}^\bullet$ and $\phi_{1/2}$ and $\phi_1$ are closings on $\mathcal{H}^\bullet$

## 2.3 Flat morphological operators on weighted hypergraphs [2]

Let $n$ denote any positive integer and $K = \{0, \ldots, n\}$. Let $E$ be any set. Let $Fun(E)$ denote the set of all maps from $E$ to $K$. Let $k \in K$ and let $F \in Fun(E)$. The $k$ section ($k-$threshold) of $F$ is the subset $\chi_k(F)$ of E where $\chi_k(F) = \{x \in E | F(x) \geq k\}$. Then $Fun(E)$ with the order relation $\leq$ inferred by threshold decomposition from the relation $\subseteq$ on $E$ is a complete lattice .

By threshold decomposition, the lattice $\mathcal{H}$ of all subhypergraphs of $H$ induces a lattice $Fun(H^\bullet) \otimes Fun(H^\times)$ of pairs of functions weighting respectively the vertices and the hyperedges of $H$ such that the simultaneous threshold of these two functions at any given level yields a subhypergraph of $H$.

The operators acting on the lattices $\mathcal{H}^\bullet$, $\mathcal{H}^\times$, or $\mathcal{H}$ are all increasing and, they induce stack operators [1, 10, 13, 15, 19] acting on the lattices $Fun(H^\bullet)$, $Fun(H^\times)$, and $Fun(H^\bullet) \otimes Fun(H^\times)$. This implies that the properties presented for hypergraph operators on the lattices $\mathcal{H}^\bullet$, $\mathcal{H}^\times$, or $\mathcal{H}$ also hold good for operators on the lattices $Fun(H^\bullet)$, $Fun(H^\times)$, and $Fun(H^\bullet) \otimes Fun(H^\times)$.

The following definition is the stack analougues to Definition 3, which locally characteristises $\delta^\bullet, \epsilon^\times, \epsilon^\bullet, \delta^\times$ on weighted hypergraphs.

3

**Definition 6.** Let $F^\bullet \in Fun(H^\bullet)$ and let $F^\times \in Fun(H^\times)$.

$$\delta^\bullet(F^\times)(x) = \max_{x \in v(e_i)} \{F^\times(e_i) \mid e_i \in H^\times\} \ \forall \ x \in H^\bullet$$

$$\epsilon^\times(F^\bullet)(e_i) = min\{F^\bullet(x) \mid x \in v(e_i)\} \ \forall \ e_i \in H^\times$$

$$\epsilon^\bullet(F^\times)(x) = \min_{x \in v(e_i)} \{F^\times(e_i) \mid e_i \in H^\times\} \ \forall \ x \in H^\bullet$$

$$\delta^\times(F^\bullet)(e_i) = max\{F^\bullet(x) \mid x \in v(e_i)\} \ \forall \ e_i \in H^\times$$

This idea is used to define Alternating Sequential Filters on binary and grayscale images represented as uniform hypergraphs. The same idea can be extended to be utilised for colour images also. Further it can also be used to define ASFs on colour images by suitable choice of a partial order on colour images [cite].
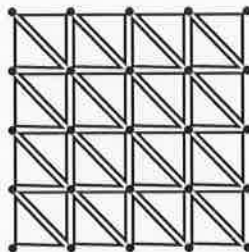
## 3   Colour Image Representation



Figure 1: Hypergraph structure used to represent an image.

We represent the RGB components of a colour image by means of a vertex weighted hypergraph. Each pixel correspond to the vertices of the hypergraph and the weights are assigned according to the intensity values of the corresponding pixels. We use the 3-uniform hypergraph presented in Figure 1 to represent the hyperedges. This is because this structure gives the best results for binary and grayscale image filtering applications. The vertex weights are propogated along the hyperedges to obtain the morphological operators, thereby producing the component images [2]. The component images are then combined to generate the resultant colour image.

## 4   Experimental Results

The definitions and results presented in the previous sections are used to obtain the dilated and eroded colour images. This is achieved by propagating the vertex weights of the hypergraphs along

(a) Original image

(b) Noisy version MSE = 32.72%

(c) Half Opening

(d) Half Closing

(e) Opening

(e) Closing

Figure 2: Illustration of the operators on a colour image.

its hyperedges to obtain the flat morphological operators presented in [2]. Composition of these operators produce the resultant images to generate half opened ($\gamma_{1/2}$), half closed ($\phi_{1/2}$), opened ($\gamma_1$) and closed ($\phi_1$) images as shown in 2 (b) to (e).

By property 2, half opening and half closing of the vertex set of a hypergraph are more close to the original vertex set than that of opening and closing. Moreover both of them are filters and capable of removing noise from the image, where the image is represented as a hypergraph. In this paper we utilise this idea on colour images to illustrate the effectiveness of these operators.



(a) $\gamma_1 \circ \phi_1$ MSE = 3.57%          (b)$\gamma_{1/2} \circ \phi_{1/2}$ MSE = 2.75%

Figure 3: Illustration of colour image filtering.

Figure 2(a) is a colour image taken from [11]. The noisy version of this image added with salt and pepper noise is shown in Figure 2(b). The mean square error (MSE) for this image is 32.72%. The half opened ($\gamma_{1/2}$) image is shown in Figure 2(c). Almost all the salt kind of noise is removed by this operation and causes less damage to the image. Figure 2(d) shows the half closed ($\phi_{1/2}$) image in which the pepper noise is almost completely removed. Figure 2(e) and (f) shows the results of opening ($\gamma_1$) and closing ($\phi_1$) of (b) respectively. Here also the noise is removed but the damage caused to the image is more compared to the previous cases.

The composition $\gamma_{1/2} \circ \phi_{1/2}$ or half closing followed by half opening is an alternating sequential filter (ASF) and capable of removing impulse noise effectively from binary and grayscale images [2]. The result of this operation on the tested colour image in Figure 2(b) is shown in Figure 3(b). The mean square error is reduced to 2.75% in this case. The open-close filter $\gamma_1 \circ \phi_1$ reduces the mean square error to 3.57%.

Experimental results shows that the resultant colour images obtained by half opening and half closing are better than the images obtained by opening and closing operations. This is because half opening and half closing are better approximations to the original image and cause less damage to the image than opening and closing. Thus half opening and half clsing can be used more effectively than opening and closing for colour image denoising. In this work we do not use any partial ordering of colour vectors.

6

# 5 Conclusion and future works

The objective of this study is to identify the possibilities of using morphological operators on hypergraphs for colour image processing. Morphological operations like half opening and half closing are not at all possible using traditional morphological image processing using structuring elements. Graph and hypergraph structures to represent digital images allows this kind of operations. The results are required to be tested on a large dataset of colour images inorder to validate the consistency of the proposed method. The initial results are promising and the future works are directed towards a more suitable hypergraph representation of colour images incorporating partial ordering on the colour components. The possiblility of false colours in morphological colour image processing is not completely removed in this method but the effect of which is minimized. Use of partial ordering of colours on hypergraphs is a solution for this problem.

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ORIGINAL PAPER

# Detection and robustness evaluation of android malware classifiers

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## Abstract

Android malware attacks are tremendously increasing, and evasion techniques become more and more effective. For this reason, it is necessary to continuously improve the detection performances. With this paper, we wish to pursue this purpose with two contributions. On one hand, we aim at evaluating how improving machine learning-based malware detectors, and on the other hand, we investigate to which extent adversarial attacks can deteriorate the performances of the classifiers. Analysis of malware samples is performed using static and dynamic analysis. This paper proposes a framework for integrating both static and dynamic features trained on machine learning methods and deep neural network. On employing machine learning algorithms, we obtain an accuracy of 97.59% with static features using SVM, and 95.64% is reached with dynamic features using Random forest. Additionally, a 100% accuracy was obtained with CART and SVM using hybrid attributes (on combining relevant static and dynamic features). Further, using deep neural network models, experimental results showed an accuracy of 99.28% using static features, 94.61% using dynamic attributes, and 99.59% by combining both static and dynamic features (also known as multi-modal attributes). Besides, we evaluated the robustness of classifiers against evasion and poisoning attack. In particular comprehensive analysis was performed using permission, APIs, app components and system calls (especially $n$-grams of system calls). We noticed that the performances of the classifiers significantly dropped while simulating evasion attack using static features, and in some cases 100% of adversarial examples were wrongly labelled by the classification models. Additionally, we show that models trained using dynamic features are also vulnerable to attack, however they exhibit more resilience than a classifier built on static features.

**Keywords** Static features · Dynamic features · Hybrid features · Fisher score · Adversarial examples · Attack models

# 1 Introduction

Malicious code is a software intentionally written for bypassing security controls and performing unauthorized actions that are not allowed to the attacker and can cause a damage to the victim. The techniques for analyzing malicious code can be divided into static analysis and dynamic analysis. Static analysis techniques scan the source code and don't require

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RESEARCH ARTICLE

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# Intelligent vehicle collision avoidance system using 5G-enabled drone swarms

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## ABSTRACT

The number of vehicular collisions is on a toll worldwide. Despite enforcing stringent laws and incorporating various safety features, the causalities are still on the rise. Existing techniques such as

# DIO Messages and Trickle Timer analysis of RPL Routing Protocol for UAV-assisted Data Collection in IoT

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## ABSTRACT

Routing protocol for low-power and lossy networks (RPL) is an widely-used IPv6 routing protocol for lossy wireless networks with the power constrained devices in Internet of Things (IoT). It is a proactive protocol that constructs a destination oriented directed acyclic graph (DODAG) rooted at the single destination called the root node that resides at unmanned aerial vehicle (UAV). Specifically, a DODAG is built with the help of different control messages like DODAG information object (DIO), DODAG advertisement object (DAO), and DODAG information solicitation (DIS). As the generation of these messages incur additional energy consumption, RPL uses the Trickle algorithm to dynamically adjust the transmission windows. In this paper, we analyze the effect of the two parameters, namely, `DIO-INTERVAL-MINIMUM` and `DIO-INTERVAL-DOUBLING` that have significant effect on the Trickle algorithm and the rate of message generation. Through experiments, we show that an optimal selection of these parameters saves a significant amount of energy with different parameter settings in UAV-assisted IoT networks.

## CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

## KEYWORDS

Energy-efficiency, Optimization, Routing protocol, RPL, UAV, DODAG

## 1 INTRODUCTION

With the recent advancements in embedded computing and wireless technologies, a variety of physical things are getting connected to the Internet. Typically, the devices are generally constrained in terms of processing power, memory, and energy (battery power), similar to wireless sensor networks (WSNs) and a network of such devices is called a low-power lossy network (LLN). The wireless links interconnecting these devices are characterized by high loss rates and low data rates. To enable communication among such devices, the routing over low-power and lossy network (ROLL) working group has specified the IPv6 routing protocol for LLN, called RPL [6, 10]. The devices running RPL are connected in a tree-like topology and the connections are established forming a destination-oriented directed acyclic (DODAG) graph, where all the nodes are directed towards a common root. These graphs are formed based on an objective function (OF) that defines the metrics and constraints for the nodes running RPL, and helps to compute routes from data generating devices to the root node.

As the devices are battery powered, energy conservation mechanisms becomes crucial to maximize the network lifetime. Although the design of OF is central to determining the energy spent for network execution, there are several other RPL parameters that play a significant role. RPL uses
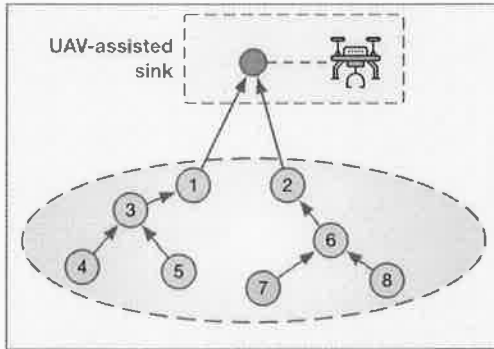
**Figure 1: System model.**

different control messages for topology formation, and frequent generation of such messages that results in higher energy costs. Unmanned aerial vehicle (UAV)-assisted networks have received significant attention in recent years due to the numerous advantages offered in real time surveillance and data collection applications. When deployed with an efficient architecture and well coordinated system, UAV systems that include drones, small air crafts, balloons, would provide reliable and cost-effective communication solutions for numerous real-world scenarios. With the unmanned aerial vehicle (UAV) as a root node, the task of data-collection becomes more challenging as additional control messages are required to maintain network connectivity. The pattern of generation of these control messages can be adapted within a network based on network behavior and requirements. In order to do so, it is important to understand and analyse these factors.

## 2 MOTIVATION AND CONTRIBUTION

Energy consumption is one of the critical issues in LLN. Different networks have different requirements and since RPL is the routing protocol designed to fulfill such requirements, it can be customised according to the network to save more energy and increase lifetime. To do so, understanding the factors within the protocol and how the protocol works is very important.

Therefore, in this paper, the role of parameters related to DODAG information object (DIO) control with a significant impact on the Trickle algorithm and the rate of message generation is analyzed. Through experiments, we show that an optimal selection of these parameters saves a significant amount of energy with different parameter settings for data collection in UAV-assisted IoT networks.

## 3 OVERVIEW OF RPL

The construction of network topology is initiated by the root node. In our system model, the UAVs are responsible

to initiate the topology construction process. The DODAG is formed by nodes joining the graph and this is performed with the help of control messages by exchanging the information. There exists four types of control messages a) DODAG Information Object (DIO), b) Destination Advertisement Object (DAO), c) DODAG Information Solicitation (DIS), and d) and DAO Acknowledgement (DAO-ACK). An algorithm, called as *trickle Timer* [2] is used to suppress the generation of redundant control messages. Since our focus on the DIO message generation and Trickle Timer analysis [2, 4], we omit the discussion of other control messages for brevity. Alternatively, few works [3] have solely focused on optimizing the Trickle algorithm.

### 3.1 DIO Control Messages

To form the DODAG, the root node that resides on the UAV broadcasts the DIO messages. The DIO message mainly contains the following information: a) RPL instance ID, b) version number, c) rank, which is the relative position of a node from the root, d) Mode of Operation (MOP), root preferability (Prf), saves Sequence Number (DTSN), DODAG-ID etc.

All the nodes within the communication range of the root node receive the DIO message, when the root node multicasts the DIO message. Multiple roots might be sending DIO messages at the same time and hence a node might receive DIO messages from multiple roots having different OFs. A node cannot join more than one root at a time to form DODAG, so when a node receives multiple DIO messages, it runs an algorithm within itself to decide which root they want to join. The decision of the node is based upon the metrics defined by the OF of the root node. After a node joins the DODAG, if the node is not a leaf node, it further multicasts the DIO control messages so that other nodes can join the graph. These steps of forming the graph continues until no nodes are found within range or leaf nodes are found [1, 6–8, 8–10]

### 3.2 Trickle Timer Algorithm

For the maintainance and upgradation of topology, control messages need to be generated repeatedly, which consumes a lot of energy. To use the resources efficiently, generation of control messages is suppressed and are generated only when it is necessary. This is done by the Trickle Timer algorithm [5]. The Trickle timer algorithm uses a mechanism to keep a check on the consistency of packet generation pattern of the network. If the pattern is consistent, and does not have any redundant or old data then the Trickle timer reduces the rate of sending DIO control messages exponentially. But in case of any inconsistency in the network, the next DIO message is rescheduled and is sent at the latest time interval.

## 3.3 Parameters of Trickle Timer Algorithm

The parameters that govern the Trickle timer algorithm are: $I_{min}$, which denotes the minimum time interval between two DIO messages. It is calculated as follows:

$$I_{min} = 2^{\texttt{DIO-MINIMUM-INTERVAL}} . \tag{1}$$

$I_{max}$ that represents the maximum time interval between two DIO messages. It is calculated as follows:

$$I_{max} = I_{min} \times 2^{\texttt{DIO-INTERVAL-DOUBLINGS}} . \tag{2}$$

The redundancy constant $k$ represents the number of redundant messages. $I$ is size of current time-interval, and the time interval within $I$ is represented using $t$. Lastly, $c$ denotes a counter that is used to control transmissions. The role of these parameters is discussed next in the Trickle timer algorithm.

## 3.4 Trickle Algorithm Rules

(1) In the first interval, $I$ is set to any value with in the range $[I_{min}, I_{max}]$.
(2) Reset $c$ to 0 and $I$ is reset to a random point between $[I/2, I]$ at the beginning of an interval.
(3) Increment the counter $c$ for every consistent transmission.
(4) Transmit a DIO message only if the counter $c$ is less than the redundancy constant $k$, otherwise it is suppressed.
(5) When interval $I$ expires, the timer doubles the interval until $I_{max}$ is reached. After that, the new interval is again started as in Step 2.
(6) In case of an inconsistent transmission and if interval $I$ is greater then $I_{min}$ the interval timer is reset to $I_{min}$ and a new interval starts as in Step 2. This is done even if the threshold is not reached.

## 4 PERFORMANCE EVALUATION

To optimize the performance of the protocol in accordance to the network requirements, we need to analyze the DIO message generation pattern, and the working of the Trickle timer algorithm. We carry out different simulations on the Cooja network simulator to evaluate the performance for various choices of parameters. Table: 1 summarizes the default simulation parameters. The performance of RPL for UAV-assisted data collection is performed by setting up a network of 16 randomly deployed nodes, with 15 senders (i.e., IoT devices) and one sink node with mobility (i.e., UAV). Fig. 2 illustrates the node deployment. The behavior of a randomly selected node (we considered node 10) is presented to understand the affect of these parameters on the the network.

As mentioned before, the parameters that determine the operation of the Trickle Timer are $I_{min}$, $I_{max}$, where $I_{min}$ is based on value of min and $I_{max}$ is dependent on the doubling

### Table 1: Simulation Parameters

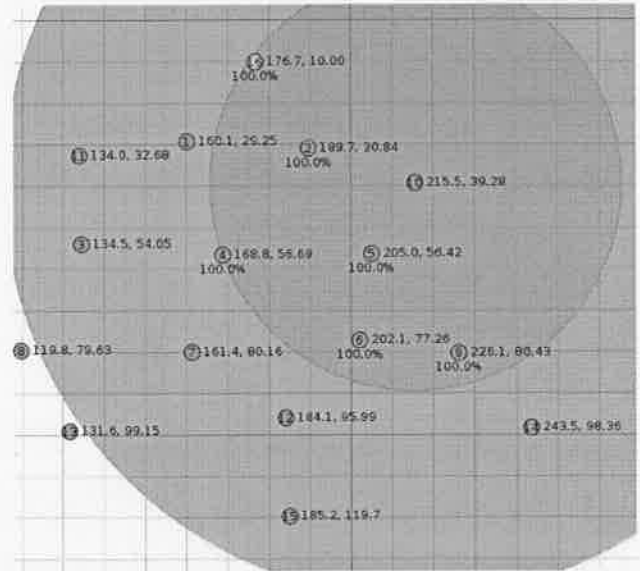| Parameters | Values |
|---|---|
| OS | Contiki master version |
| Simulator | Cooja; |
| Radio Model | Unit Disk Graph Medium |
| OF | Expected Transmission Count (ETX) |
| Number of nodes | 1 server, 15 clients |
| Transmission Reception ratio | 100 percent |
| Sensor | Sky Mote |
| Simulation Time | 1 Hour (approximately) |



**Figure 2: The Network set-up with the green circle representing the transmission range of node 10.**

factor. The RFC[10] recommends the default values of 12 and 8 for min and doubling, respectively. Also, the default value of $k$ is set to 10. The values of $I_{min}$ and $I_{max}$ are calculated as follows.

$$I_{min} = 2^{\texttt{min}}$$
$$= 2^{12}\,\text{ms} = 4096\,\text{ms} = 4\,\text{s} \tag{3}$$
$$I_{max} = I_{min} \times 2^{\texttt{doubling}}$$
$$= 4096 \times 2^8\,\text{ms} = 1\,048\,576\,\text{ms} = 17.5\,\text{min}. \tag{4}$$

Thus, if the values of [min, doubling] are [12,8], then the minimum possible interval between two DIO messages is 5 s and maximum possible interval between two DIO messages becomes 17.5 min.

## 4.1 Delay analysis

The performance of the network is dependent on the parameter settings. To find the impact of these parameters, we
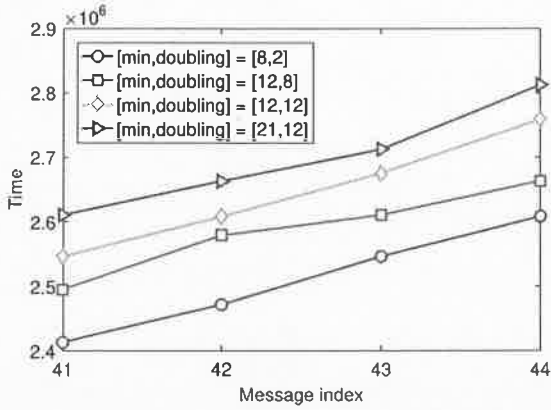
Figure 3: Total time taken (in millisecond) by each of the five cases to generate the last DIO message within the simulation time-interval.

compared the relative performance by considering five different pairs of values. For simplicity, we fixed the redundancy constant to $k = 10$ for all the scenarios. The DIO message generated only by the 'node 10' is considered for this study[1]. The five pair of values considered for the comparison are: 1) min = 12, doubling = 8, 2) min = 12, doubling = 12, 3) min = 21, doubling =2, 4) min = 21, doubling = 12, and 5)min = 8, doubling=2. For each of the above five cases, we run the simulation until the $45^{th}$ DIO message packet is transmitted by the node 10. This allows us to verify for the pair of values for which the network takes the longest time to generate the $45^{th}$ DIO message, and for what pair it take the least time. Considering a fixed time-interval, if fewer number of DIO messages are generated for a given pair of parameter settings, then the energy consumption would be relatively low in comparison to other scenarios.

Fig. 3 presents a comparison among all the five cases. We can see that for a given value of $k$=10, the value pair [min, doubling] = [12,12] takes the longest time to generate the $45^{th}$ DIO message packet while [min, doubling] = [8,2] required the least time. This means that for values [12,12] the least number of DIO messages are generated per unit time, and hence it uses less energy, while value pair [8,2] generates more DIO messages per unit time and hence expend more energy. It is important to note that, among the five pairs of values considered, the pair [21,12] is the largest value pair and is expected to generates least DIO messages. This is because the interval between messages is longer but it takes less time than the pair [12,12]. This is because of the considered $k$ value. As mentioned in the algorithm *Step4*, if the value of counter $c$ becomes greater then the redundancy

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[1]RPL-DIO-INTERVAL-MIN is referred as 'min' and RPL-DIO-INTERVAL-DOUBLINGS is referred as 'doubling' in short
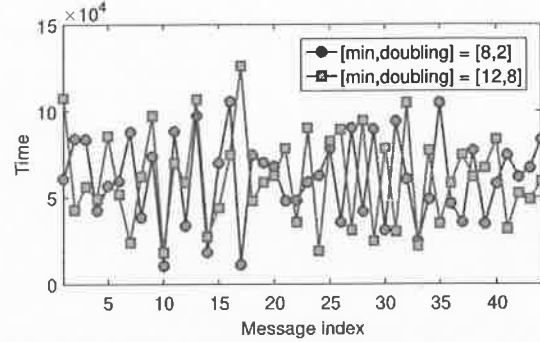


Figure 4: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[8,2] and [12,8].



Figure 5: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [12,12].

constant $k$, then the message generation is suppressed. Here, although the min was much greater, i.e., min = 21, the interval could not increment to the possible threshold as the messages are suppressed when the counter reaches $k = 10$ and a new interval is started.

## 4.2 Time interval

Considering the same five pairs of values as mentioned above, we compare the time interval set by the Trickle timer to generate the DIO messages. The message generation pattern for the values [min, doubling]= [8,2], [12,12], [21,2], and [21,12] is compared to the default values as specified in the RFC 6550[10] , i.e., [min, doubling]=[12,8]. This helps us to practically understand how the trickle timer algorithm actually manipulates the time intervals between the DIO messages when the network remains unchanged.

Figs. 4, 5, 6, and 7 illustrate the differences in time interval with respect to the message index. We can notice that the largest difference is observed in Fig:5, where the longest time

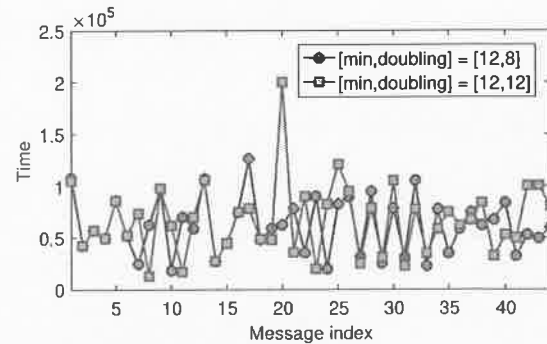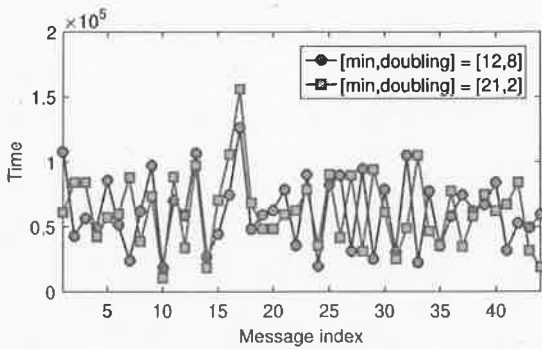Figure 6: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [21,2].
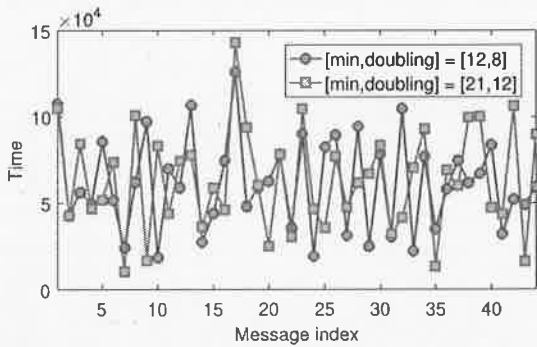


Figure 7: Performance comparison in terms of time taken for generation of DIO message for [min,doubling]=[12,8] and [21,12]

interval is experienced when $I_{max}$ reaches maximum value for the pair [min, doubling]=[12,12] compared to the $I_{max}$ for [min, doubling]=[12,8]. This difference is inline with the Fig: 2, where [min, doubling]= [12,12] value achieves the longest time while [12,8] results in third longest.

Furthermore, the comparison of time-intervals with the value pair [min, doubling] = [12,8] in Fig: 4,6, and 7 did not result in much difference even though the parameter values have a significant differences between them. This is because redundancy constant $k$-value is low, and is not sufficient to achieve such a large $I_{max}$ value. In these three cases, the simulation could never achieve the calculated threshold of $I_{max}$, as the counter expired and subsequently the messages are suppressed. Hence to achieve a much higher $I_{max}$ value, the $k$ value should also be increased.

Therefore, it can be concluded that the optimal values of these parameters vary depending on the network objective and underlying requirements. In case of an UAV root node

with higher mobility, the optimal value for this factors depend on the data generation rate of network nodes. This determines how often the DIO messages are required, how often there is a possibility of a network inconsistency, understanding the behaviour and purpose of the sensors etc.

## 5 CONCLUSION

In this article, we have investigated the performance of RPL routing protocol in low-power lossy IoT networks assisted with an UAV with several constraints. RPL considers constraints and metrics defined using the objective function. The three primary control messages – DIO, DAO, and DIS and their rate of generation determines the power consumption. Therefore, in order to suppress the generation of DIO control message, trickle Timer algorithm uses DIO-INTERVAL-MINIMUM and DIO-INTERVAL-DOUBLING. We have performed an analysis to understand how these parameter affect the energy consumption. Finally, we have shown that optimal values for these parameters according to the network requirement can further optimise the working of the protocol for the data collection in IoT network.

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# Modernizing Traditional Methods of Farming using Farming Robot

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## ABSTRACT

This paper pertains to the study of a prototype which modernizes the agricultural sector. It has the ability to perform basic operations such as irrigation activity and monitoring of plants frequently without much manual labor. In addition to the above-mentioned functionalities, the system is trained for detecting diseases in plants. Agriculture is an area of prime importance in the existence of humanity. It is a process of cultivating land and plants to provide food, fiber, medicines and other products to enhance the quality of life. It is considered to be the main pivoting point in the rise of our civilization. In the proposed system ROFAR, detection of plant disease is achieved with the help of image processing and machine learning methods. Prompt and accurate detection of plant diseases is crucial for the quality and yield of crops. Advanced diagnosis and intervention can lower the cost of plant diseases and trim down the use of unnecessary pesticides. Images of leaves of different plant species were gathered and feature extraction was performed. As a result, the system was able to classify the plants based on its ailments accurately. The ROFAR gathers the images of the plants for disease detection from the field and were given as input to Convolution Neural Network (CNN) which then classifies the images as healthy or infected. The proposed system ROFAR undergoes a training phase and a testing phase. The system is trained by providing various samples of the normal and diseased plants. On completion of training phase, the system can identify any new images of plants as healthy, late blight, viral or bacterial. The system also facilitates the moisture detection in the soil. With these functionalities, crops with better quality and yield can be obtained from the field.

*Keywords:* ROFAR, Convolution Neural Network (CNN), Training phase, Testing phase, moisture detection, late blight, bacterial, Feature extraction.

## 1. Introduction

One of the most promising and upcoming technologies that has the capacity to boost almost all the sectors of the economy, from medical to space sectors is Robotics. However, the sector that is constantly lagging is agriculture. It's due to the fact that many farmers are being used to heavy equipment, tools and conventional agricultural strategies. Although the application of robotics in this sector is slow, it's persistent.

The utilization of technologies that are linked with robotics and automation, can provide important values to both farmers as well as the agricultural sector [1]. These automated bots are being used for conventional applications which includes plant classification, fruit picking, seeding, spraying, etc. Machine-driven agricultural operations introduce many advances to the field improving the overall productivity and efficiency. Automation provides countless perks to farmers or landowners which makes the job performed in a uniform method, with less expense and higher accurately. The processor located at the centre of the Raspberry Pi framework is a Broadcom BCM2835 framework on-chip (SoC) mixed media processor. This indicates by means of a ways most of the framework's segments, consisting of its illustrations and focal preparing units beside the correspondence's equipment and sound, constructed onto that solitary segment beneath the memory chip of 256MB situated at the centre point of the board. The fact that makes BCM2835 different from the processor determined for your workplace or PC is not simply its SoC structure. In addition, it makes use of an Industry Standard Architecture (ISA) which is known as ARM [2]. The significance of water splashing is one of the principal applications performed. Water transports vital supplements within the plant. The

supplements are extracted from the earth and used by the plant. Inadequate water in the plant cells causes the plants to stop growing, so water allows the plant to stand upright. The water carries the disintegrated sugar and various necessary supplements through the plant. So, without the correct equalization of water, the plant is not exclusively undernourished, however it is too physically weak and can't bolster its very own load. Various sorts of plants require various measures of water [3]. With open air plants, we can't manage the plants getting an excess of water if the area gets a great deal of downpour, so we have to ensure that the dirt has the correct seepage, since large amounts of water will influence plant development the same amount as excessively little. Video observing of the plants is additionally of most extreme significance. The programmed plant checking framework had a huge enthusiasm because of the promising applications in rising innovation. Although, this strategy is used to enhance the execution of existing methods or to make and structure new procedures for the growth of plants. The plant checking framework is mainly used for watering the plants and to transmit a couple of parameters for growth of plants. Plant illness recognition is the fundamental utilization of the pack. Plant malady, a weakness in the plant's normal condition that hinders or regulates its vital capabilities. All kinds of flora, wild and evolved alike can suffer from disease [4]. The percentage of plant infections varies from season to season, natural conditions, contact with the pathogen and the crops and assortments developed. Some assortments of the plants are prone to disease outbreaks, while others progressively resistant them. Fossil proof demonstrates that plants were influenced by illness 250 million years back. Loss of yields from plant maladies may likewise result in appetite and starvation, particularly in less-created nations where access to ailment control techniques is restricted and yearly misfortunes of 30 to 50 percent are normal for real harvests. In certain years, misfortunes are a lot more prominent, creating calamitous outcomes for the individuals who rely upon the yield for sustenance. Real ailment flare-ups among sustenance crops have prompted starvations and mass movements since forever [5].

The proposed automated system captures the images of the plants and has a detecting mechanism for classifying the plant as diseased or healthy. A real-time video monitoring system incorporated in the proposed system facilitates the user to be aware of the conditions in the field. In addition to these features humidity of the soil is measured and decision on spraying water to the plants is taken care.

The remainder of the paper is structured as follows: Section 2 deals with Literature Survey. Section 3 describes the Hardware and Software Components used to build the prototype. Section 4 illustrates the proposed model, working principle and the implementation. Section 5 deals with the experimental analysis and the result. Section 6 describes the conclusion. Section 7 describes the future scope of the project. Lastly, Section 8 lists all the references used in this paper.

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**Nomenclature**

ABC   Atanasoff Berry Computer
AI   Artificial Intelligence
ANN   Artificial Neural network
ARM   Acorn/Advanced RISC Machine
BCM   Body Control Module
CNN   Convolution Neural Network
DNN   Dynamic Neural Network
GNU   GNU's Not Unix
GPIO   General Purpose Input/output
GUI   Graphical User Interface
IDE   Integrated Development Environment
IDLE   Integrated Development and Learning Environment
IoT   internet of Things
ISA   Industry Standard Architecture
ML   Machine Learning
(N;P;K)   (Nitrogen; Phosphorus; Potassium)
PC   Personal Computer
pH   Potential of Hydrogen
RFB   Remote Frame Buffer convention

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SoC   System on a Chip
VNC   Virtual Networking Computing

## 2. Literature Survey

### 2.1. Algorithm for Line Follower Robots to Follow Critical Paths with Minimum Number of Sensors

The main challenge faced in the area of robotics is that going along a specified path [6]. Either the path could be designed by the user or it could sense a particular color and move along that path. When specified by the user's intermediate counters for stopping and turning could be initially kept precise. However, each color has its own threshold, and the robot senses its movement with respect to the color. This paper discusses line follower robots, their configuration and inculcates a concept for the robot to move along curves, junctions and 90-degree bends. Therefore, the line follower robots are autonomous, having the ability to follow and detect a line ensuring the base to an efficient system. The project employs Arduino Uno as the main circuit board for the robot and four sensors for following the path. The robot uses 4 IR sensors $S_{LL}$, $S_L$, $S_R$ and $S_{RR}$ arranged on a straight path for detecting the line as shown in the Fig. 1. The sensors $S_{LL}$ and $S_{RR}$ are used to perform 90-degree rotation on left of right respectively.
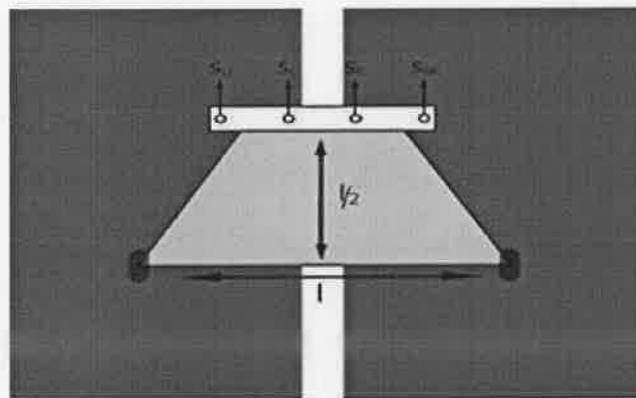


*Fig. 1- Robot sensor diagram*

If any of the sensors deviate from its original position, then the robot corrects itself by moving along right or left. If any of the two sensors come on the white line, then a 90-degree turn is done according to the algorithm. Therefore, based on two main algorithms it can follow the path given to it. When implemented the robot also must account for obstacles in its path and proper halts in the junctions to do the specific jobs that it aims to do. The paper resembles such an algorithm for following the path with precision and proper configuration of the sensors. A prototype built by J S Tan et. al. known as Jackbot Mark 1 is a cheaper, light weight and small robot that has an ability to move and carry load incorporating obstacle detection, line following algorithms [7]. Mehran Pakdaman et. al. discussed various technical problems that could arise in any line following robot [8]. The challenges involved while navigating in a constrained environment like greenhouse and polytunnels are addressed using an autonomous row following robot [9,10].

### 2.2. Design and Implementation of Semi-Autonomous Anti-Pesticide Spraying and Insect Repellent Mobile Robot for Agricultural Applications

The authors discuss on the application of robots in agriculture. It focuses on designing a robot called "x-bot" which is an insect repellent robot and a pesticide sprayer [11]. The main problem with the manual spraying of pesticides is the over spraying causing harm to both plants and humans. Thus, the robot is designed to overcome this problem. An additional unit of insect repelling mechanism with the help of a sonar is also built and attached to the robot. The robot body is Lynx Motion Rover Kit with 3D

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printed acrylic chassis and four dc motors are used to drive the robot. Arduino Mega Microcontroller is the control unit with diaphragm pump to spray pesticide and solar panel attached buzzer to repel insects. Proportional Integrative Derivative algorithm is employed to control the robot and as the robot reaches each of its spots, pesticide is sprayed at a precise amount. Alongside the insect repellent is also done. In addition, the ultrasonic sensors are calibrated by the neural networks.

## 2.3. Design of automatic nutrition supply system using IoT technique in modern cities

Today, the main problem faced by Terrace Gardening is the lack of time for the planters to look after the garden on a regular basis [12]. The one available solution is by employing smart farming which modernizes the current conventional methods of farming in modern cities. Modernizing includes automation of almost every process in the area of farming. This paper discusses the automated system by applying the concept of IoT. The primary objective of this study is to provide the plants with the necessary nutrients, such as potassium, phosphorus, nitrogen and calcium, which is computed from the data provided by the sensors. The pH value of the soil is taken by the pH sensor attached to the Raspberry Pi. The pH value is processed along with the Humidity sensor. Value of the humidity sensor is considered on the basis that when Humidity increases the chance of plants to get caught by disease is high and the rate of growth of plants will be low and vice versa. Therefore, based on these values and calculations the nutrients are supplied to plants. The authors developed an automatic nutrient supply system which is capable of passing nutrients mixed with water automatically to the plants as required thus reducing the human labor to a great extent. Measurement of the pH of the solution provides data about the nutrient's availability in the soil. The quantity of fertilizer is supplied according to the requirement of the crops. This system could help in the better use of fertilizer and to enhance the quality of soil. The limitations to this system are, absence of weed detection and control mechanism, seed plantation and the system is immobile in nature. Sajjad Yaghoubi et. al. suggested an autonomous robot that aims to reduce manpower and to improve the quality and productivity of farming [13].

## 2.4. Real-time Video Monitoring and Micro-Parameters measurement using Sensor Networks for Efficient Farming

One of the main challenges faced in the area of farming is that there is no system that monitors the field which gives the advantage to the farmer to monitor the farm on a real-time basis [14]. The solution to this problem is to design a Robot that can monitor the system on a real-time basis which is equipped with a camera along with a Robotic arm and sensors that helps to monitor the plant growth. The robotic arm is used to measure and manage agricultural parameters. The robotic design in this study is composed of sensor, control, camera, planning subsystem and a system comprising an online image and video transmitter. The constituent of potassium, phosphorus and nitrogen present in the soil is measured in order to depict the amount of fertilizer required by the soil. This mechanism also aids in managing the content measurement while preparing the fertilizer. The primary goal of this design is the reduction in the number of nodes required for the conventional measurement schemes. There are mainly two blocks. One block indicates the transmitter, which is actually, the Robot and the other block depicts the receiver. The System is employed to design, develop and optimize a feasible solution to agricultural control and monitoring. The proposed system utilizes sensors for Micro parameter measurement (K, P, N), Humidity measurement, Soil moisture, Motion detection, temperature detection, Soil PH for maintaining agricultural environment. It also includes Agricultural Parameters measurement and Real-time Video Monitoring using Sensor Networks for Precision Agriculture. After the proper measurement of K, P, N content from soil it will be easy to figure out the fertilizer combinations. On implantation, it is found that System results in the designing, development and optimization of a feasible solution for application to agricultural control and monitoring. The limitations to this system are, absence of weed detection and control mechanism, seed plantation and the inability to supply nutrients and water to the plants.

## 2.5. Design of automatic nutrition supply system using IoT technique in modern cities

The most prominent troubles faced in farming is that much vegetation are laid low with sickness. Every 12 months illness of the plant, fungal and viruses' attacks result in crop losses as much as 30% of the overall production [15]. The plant disease control mechanism relies upon speedy, correct detection and identification of the diseases. The paper discusses correctly figuring out the

disease with the help of an artificial neural network. The different image processing performed on the input image are image enhancement and image segmentation. The Fig 2 shows the block diagram of plant disease detection and depicts the various texture feature values that are computed from the processed image. The classification of text image is performed at last by giving the extracted feature values as an input to the pertained artificial neural network (ANN). Finally, the predicted result (disease) is sent to the person.
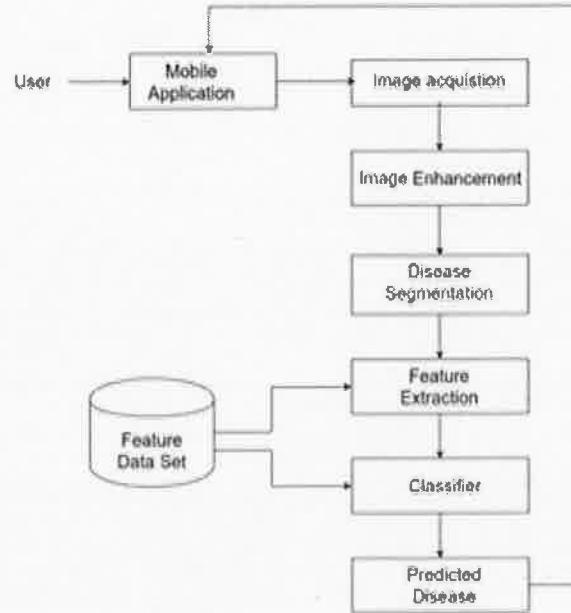


*Fig. 2: Block diagram of plant disease detection*

The network used is a feed forward neural network of two layers with one hidden layer, in which number of neurons for hidden layer is 10. The method specified in the system can be used to design a plant disease detector for farmers for the early detection of plant disease infection and providing a cure remotely.

## 2.6. Design and development of Automatic weed detection and smart herbicide sprayer robot

Traditional method of destroying the weeds in a crop plantation is achieved by spraying herbicides throughout the plantation [16]. This has a bad effect on food crops and yield. This paper discusses the image processing algorithm which captures the images of plantations and the herbicides sprayed only on the weeds on identifying the weeds from the image. By this method, the wastage of herbicides can be reduced to a great extent thus making the weed control system smarter. The color images will be converted to binary images and the green parts of the image are extracted. Total amount of white pixels is found out, if it is above threshold then that region is weed. In this arrangement, a container filled with herbicide is fitted with water pump motors which is attached to the spray nozzles. In this experiment Ragi plants (narrow) are taken as the plantation crops and any other plants as weeds (broad leaves). In the absence of plants on the region of interest, the processed image will encounter only black pixels with few small stray groups of white pixels. On identifying narrow leaves, the number of white pixels could be greater than case 1 but less than threshold. If there are broad leaves the count of white pixels will be greater than threshold. Herbicide will be sprayed on this region since its weed. This approach is dependent on the quality of the lighting conditions required for capturing images which is one of the disadvantages faced by smart weed control robots. By incorporating targeted spraying on the weeds, wastage of herbicides can be reduced to a great extent [17-21].

## 3. Hardware and Software Components

### *3.1. Algorithm for Line Follower Robots to Follow Critical Paths with Minimum Number of Sensors*

The Raspberry Pi, (Fig. 3) is intended to run a working framework called GNU/Linux—from this point forward alluded to just as Linux. In contrast to Windows or OS X, Linux is open source: it's convenient to download the source code for the whole working framework and add whatever improvements you want. Nothing is hidden, and all progressions are made in full perspective on people in general. This open source improvement attribute has enabled Linux to be immediately transformed to keep running on the Raspberry Pi, a process known as porting. At the time of this composition, a few adaptations of Linux known as appropriations have been ported to the Raspberry Pi's BCM2835 chip, including Debian, Fedora Remix and Arch Linux. The different appropriations take into account various requirements, but still they all are open source.
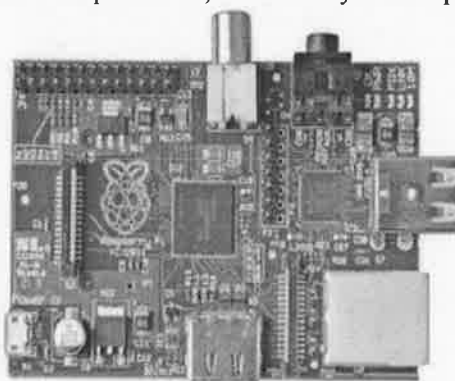
*Fig. 3: Raspberry Pi*

Since its demonstration, Python has developed in ubiquity on the account of what is viewed as a reasonable and expressive grammar created with an importance on guaranteeing that code is meaningful. Python is an abnormal state language. This means Python code is written in generally prominent English, making the Pi with directions in a way that rushes to learn and simple to pursue. This is in checked difference to low-level accent, similar to constructing agent, which are nearer to how the PC "considers" yet practically inconceivable for a human to pursue without involvement. The abnormal state nature and clear language structure of Python makes it a gainful instrument for any individual who needs to figure out how to program. Another option is to make use of a coordinated improvement condition (IDE, for example, IDLE, which gives Python-explicit usefulness that is absent from a standard content manager, including punctuation checking, investigating offices and the capacity to run your program without leaving the supervisor. The VNC watcher is seen as the primary programming device utilized for the venture. At registration, Virtual Network Computing (VNC) is a graphical workspace that shares a framework which uses the Remote Frame Buffer (RFB) convention to remotely control another PC. It transmits the mouse and console occasions starting with one PC then onto the next, handing off the graphical screen refreshes back the other way, over a system [22]. It is stage free, there are customers and servers for some, GUI-based running frameworks and for Java. Meanwhile, several clients can interact with a VNC server. Common applications for this innovation include remote expert assistance and capturing work PC logs from home PC or vice versa. There are several versions of VNC that offer their own particular utility, For example, some efficient for Microsoft Windows or offering record exchange (not part of VNC legitimate), etc. Many are perfect (without their additional highlights) with VNC appropriate as in a watcher, as of one type can bind to a server of another. Others depend on the VNC code, but don't work well with standard VNC. In the typical strategy for an activity, a watcher interacts with a port on the server (default port: 5900). On the other hand, (depending on usage) a program can bind to the server (default port: 5800). Also, a server can interact with a watcher in "listen mode" on port 5500. The correct position of the listen mode is that the server site does not need to configure its firewall to allow access on port 5800 (or 5900), the obligation is the watcher, which is useful if the server site does not have PC capability and the watcher client is progressively competent.

The ROFAR system is shown in Fig. 4. The camera component is connected to one of the USB-A ports in the raspberry pi. For the dc motor connection, a L293D motor driver is used. For that import the time module and the GPIO pins. The output pin is comprised of Pin 22, 18 and 16. The enable pin of L293D is connected to the pin 22 of raspberry pi in order to enhance the

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motor's running time. The motor is turned off when low. Motor 1 and Motor 2 are input pins. The IR sensors are powered by +5V pin to enable the movement of the kit. Next, utilizing the black wire, the ground pins are connected to the ground of IR sensor and motor driver module. With the help of the yellow wire, the output pins of the sensors both 1 and 2 are connected to the GPIO pins and 3 respectively. The motors are operated using four pins (AB, A, B). These four pins are connected from GPIO 14, 4, 17 and 18 respectively. The white and orange wire collectively are used to form the connection for a single motor. Such that, there are two pairs for two motors. The motor driver module L293D is used to which the two motors are connected and is powered using a power bank. We have to ensure that the ground of the Raspberry Pi is connected to that of the power bank, only then our connection will work. Rest of the part is done from the user's system.
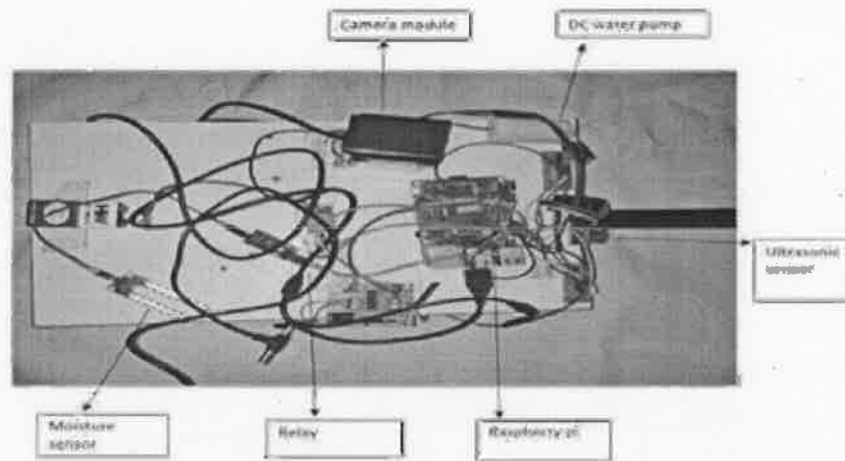


*Fig. 4: ROFAR system*

The raspberry pi is remotely accessed by the VNC viewer. There are mainly two python files accessed for the working one is named robot.py and the other named mail.py. The image of the plant is taken by the camera and is sent to the respective mail id set in the program.

## 4. Proposed Model

The proposed venture is completed for the most part by the raspberry pack and the plant leaf recognition by utilizing profound learning techniques in AI. Ongoing video observing is likewise included alongside the unit. The unit likewise showers the plant with water basically or by estimating the dampness of the dirt. At the point when the unit arrives near a plant it captures the images of the leaves and is sent back to a separate framework for malady recognition. The framework marks the plants with classes healthy(h), late-blight(l), viral(v) or bacterial(b). The robot then pursues a dark line utilizing the line following idea with the goal that it catches and plays out the splashing capacity up and down the way of the robot.

### 4.1. Line following Concept

The game plan of the plants is structured dependent on the way of the robot. The robot moves along the dark line taking the picture of the plants and in the meantime watering the plants. The robot distinguishes a line as a basic line and pursue basic line following calculation if both of its external sensors are on dark surface. Over a white surface and the other way around and goes through it. It takes a shot at the reflection property of light. At the point when infrared light falls on a white surface, it gets reflected completely. Then again, when it falls on the dark or dim surface, it gets assimilated all things considered. The measure of reflected light will be extremely less.

## 4.2. Water Spraying

Soil Moisture Sensor measures the moisture level of soil and gives the dirt condition either wet or dry. On the off chance that the soil content is decreased beneath the predefined esteem it will send the flag water will begin to siphon. Generally, plant spots in order to water the plants by utilizing separation esteems from Ultrasonic Sensor. The water content in soil will be detected by the soil dampness sensors. A dirt moisture test is made up of several soil moisture sensors. A regular kind of soil moisture sensor in commercial use is a Frequency space sensor, for example, a capacitance sensor. An alternative sensor, the neutron moisture check, uses the intermediary properties of water for neutrons. Soil moisture content might be changed by means of its impact on the dielectric constant by estimating the capacitance between two cathodes embedded in the dirt. Where soil moisture prevails as free water (e.g., in sandy soils), the dielectric constant rightly corresponds to the moisture content. The test is ordinarily given a recurrence excitation to allow estimation of the dielectric constant. The readout from the test isn't straight with water content and is impacted by soil type and soil temperature. Consequently, cautious alignment is required, and long-haul security of the adjustment is faulty.

## 4.3. Disease detection of plants

The robot can recognize the plant leaf sicknesses by employing AI systems. One of the main tasks was to correctly identify the illness affected leaf and can discover the sort of malady by utilizing profound learning strategy in ML (Fig. 5).

The main modules included are:

- Data set: data set of plant leaves are collected which contains labelled images.
- Data resizing: images are resized which is to be given as input to the neural network.
- Training: the resized data set is used to train the neural network. The training data consist of 4000 plants which are classified as h, l, v, b.
- Testing: the testing data set contains both healthy and unhealthy leaf images. After testing images are classified as healthy or unhealthy



**Fig. 5: Processing plant leaf**
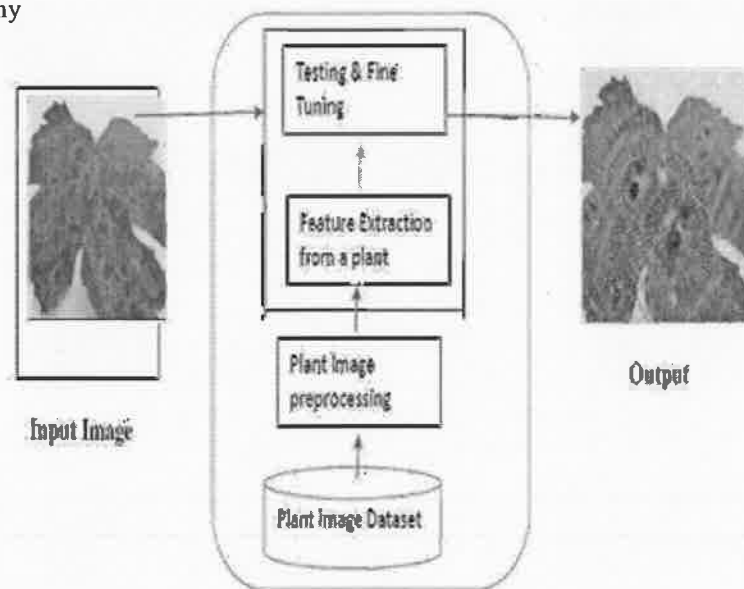
The testing generates a result either as healthy or diseased by comparing the input image with the known image data set and returns the result with a percentage of accuracy. The input data will be images of data that is the plants. There are two categories in leaf images which are healthy or unhealthy and there are four class labels: healthy(h), late-blight(l), viral(v), bacterial(b) [23].

Also, there are 4000 training images each with resolution 256x256. The input training data as well as testing data will be converted into a numpy array with input filename and its label. The label will be in the one hot encoded format. Cv2, numpy, os, tqdm libraries are imported for data resizing. The image is resized into the resolution 50*50 by using the packages in imported libraries. The training process involves creating a DNN and then passing the train data for training the network [24]. Here the tensor flow framework is used to create a neural network. The input data shape is in the form of (50,50,3), then the first layer which is the input layer to the neural network will have the same shape. There are a total of 6 hidden layers mentioned with the input size as well as the activation function that's being used. The last layer is where the fitting or converging takes place and we finally get output in that layer. It is fully connected. Here we are using two activation functions [25] 'relu' and 'softmax', 'relu' means Rectified Linear Unit [26]. This is mainly used in hidden layers in neural networks. 'softmax' is used to calculate the probability of the class labels in the output layer [27]. Dropout function is used in the fully connected layer to avoid the overfitting of the input data. Training and testing done by using 'model.fit' function. In supervised training, both the inputs and the actual outputs need to be provided. The neural network process the input and produces output. The output which is generated is compared with the desired output. If any errors in the output, it will back propagate. Feature extraction in a neural network is explained by the concept of convolution. Convolution is considered as the main building block of a CNN [28]. By Convolution we mean the mathematical mixture of two functions to produce a third function. With respect to Convolution Neural Network (CNN), the convolution is executed by the mechanism of sliding the filter or kernel over the input data. Matrix multiplication is accomplished at each location and the sum of the results are added on to the feature map. The region of our filter is also called the receptive field which is named after the neuron cells. The size of this filter is 3x3 [29].

In the testing stage, we will have a plant leaf image without label, meaning we won't know which class (h,l,v,b) the image will fall into. The already trained saved model will be loaded and then the test image will be then passed as input to the already trained model. The model based on what features it has learned will output the class which it belongs to with the help of 'model.Predict' function. By adding a new type of plant to the image data set, we can detect almost all types of diseases. we do not need external hardware devices The system will generate output with approximately 90% accuracy and the system can be fine-tuned any time for any new types of diseases, simply by adding the new disease leaf images.

## 4.4. Working Principle

The module is mainly divided into two. The first is a kit that performs function such as image capturing, water spraying and real time video monitoring. The second module is the diseases detection part that classifies plants based on diseases using an Artificial Neural Network. The kit moves along the black line by the black line following the algorithm and stops at each position when an obstacle is encountered which it recognizes as a plant. Fig 6 demonstrates the same.

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*Fig. 6: Block diagram of robotic kit*

The camera attached to the module captures the images and at the same time humidity of the soil is detected. On encountering the humidity value below the threshold value, water is sprayed to the plant. A real time video streaming is also provided to the user. The captured image is sent to the user's system through mail and the image is given as an input to the plant disease detection algorithm using the Convolutional Neural Network of the system which classifies the image as healthy, late blight, viral and bacterial. The heart of the system is Raspberry Pi and the corresponding function and application is done with the help of a VNC viewer. The L293D motor driver helps to convert the signals from the raspberry pi to the dc motors.

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Fig 7: System Flowchart

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## 5. Experimental Analysis

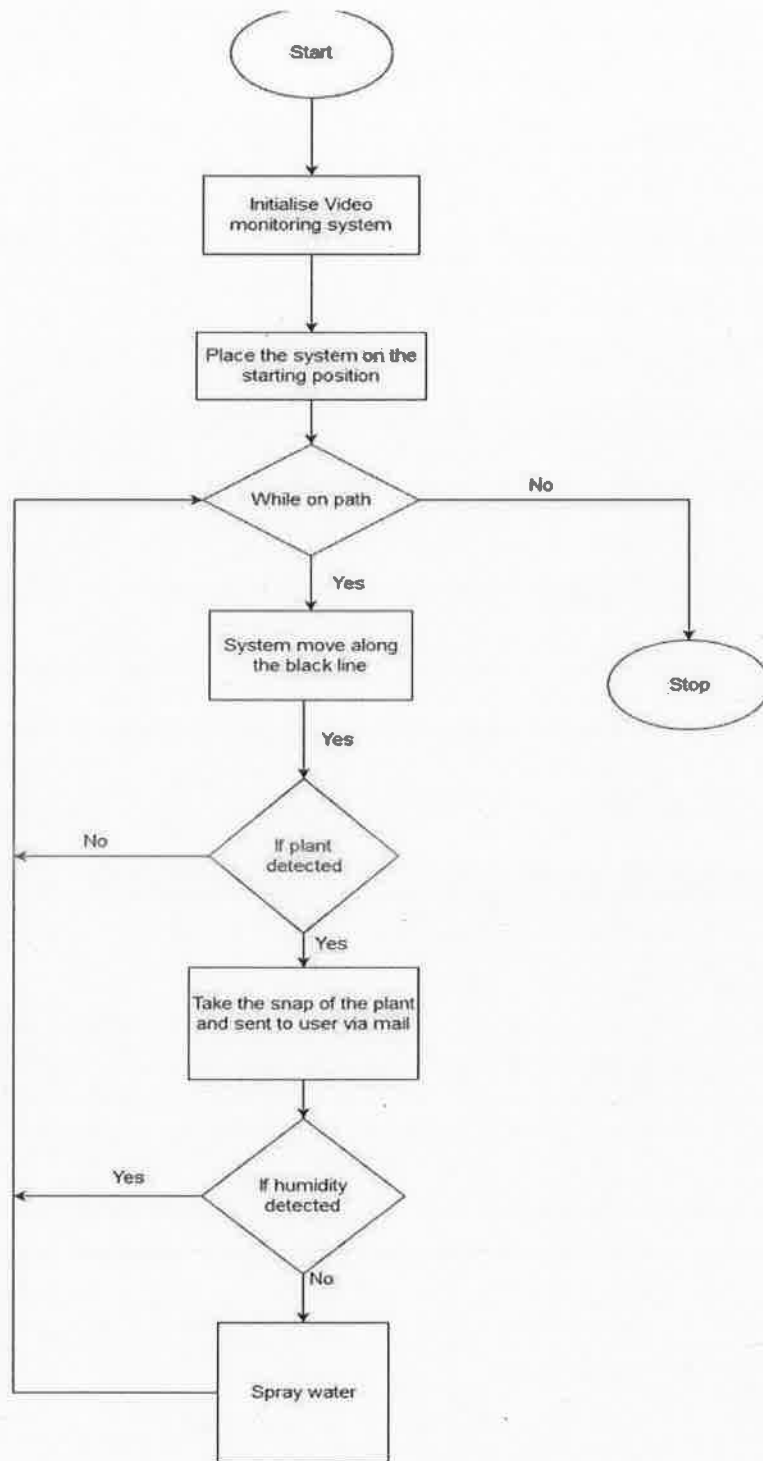The black line following algorithm is employed in guiding the robot in the correct path. It's working is similar to that of Line following robots as depicted in Fig.8. The Line Following robot is one that identifies a black path [30]. The two IR sensors are kept in between the black line. If it detects a white line it stops. If it encounters an object it recognizes it as a plant and the image of the leaf is sent.



*Fig. 8: Black line following adaptation*

The water spraying is done uniformly for each plant as it encounters a plant. Water spraying also depends on the moisture of the soil. If there is moisture content it does not spray water. Along with this the video streaming is also done along the path till the end. Based on the leaf image captured by the system a table for the image and the corresponding result incurred for the leaf the table is depicted as shown below Table 1.

*Table 1 - Captured leaf image Analysis.*

| Captured leaf image | Leaf name | Expected result | Experimental Result |
|---|---|---|---|
|  | Tomato leaf | Late blight | late blight (correct) |
|  | Tomato leaf | Healthy | Healthy (correct) |

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| | | | |
|---|---|---|---|
|  | Mango leaf | Healthy | Healthy (correct) |
|  | Money plant | Late blight | Bacterial (wrong) |
|  | Tomato leaf | Viral | Viral (correct) |
|  | Tomato leaf | Bacterial | Bacterial (correct) |

The raspberry pi console and video streaming as shown in Fig 9 and 10 respectively.



*Fig 9. Raspberry Pi Console*

*Fig 10. Video Streaming*

For a live plant the training was completed in 96.65 seconds and the test result was that it was bacterial.

## 6. Conclusion

Agriculture is one of our most important sectors for providing food, feed and fuel necessary for our existence. Autonomous kits are playing an important role in this field. In the present scenario, a wide range of such kits are available to perform different applications on various levels of agricultural process. The proposed system ROFAR concentrates mainly on disease detection and

it accurately distinguishes plants based on diseases. By inculcating new species of plants to image data set, we can detect almost all types of diseases. The system will generate an output with approximately 90% accuracy. The system can be fine-tuned any time for any new type of diseases, simply by adding the new disease leaf images. Most detection systems can detect fungal diseases only, but our system detects almost all. With this system there is no need for farmers to be present at that time and he/she could perfectly detect the diseases if it is present in the plants

## 7. Future Scope

We have to keep in mind that a learning curve will be present as the technologies improve in their operation capacity and sensitivity. The industrial trends appear to be moving towards large-scale efforts, so kits like this should be continuously developed. The kit designed by us, if further developed, could also do the necessary function for treatment of the detected diseases among plants. Thus, the fully autonomous kit could be developed. By making use of a gripper circuit the kit can dip the moisture sensor into each plant at each position to measure the moisture content.

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# A study on various thermographic methods for the detection of diseases

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*Abstract*— Fever is a common symptom for various infectious diseases that are reporting nowadays in a massive amount like COVID-19, Ebola and so on that will directly affect our whole human cells and are showing a lot of chromosomal aberrations too. Since there was not a unique way are to predict how these diseases will affect our body both physically and mentally, since they can create some aftereffects in future too, there should be a suitable system which will efficiently detect these type of pandemic. In all these situations thermal screening had emerged as a remedial method for the detection of temperature variations. Among this Infrared thermography had been used as the best and effective method for fever screening. This survey presents some of the important papers which discussed how Infrared thermography can be effectively utilized for the detection of these epidemics by analyzing the temperature variations done in fever screening. Infrared thermography (IRT) is a method which uses an imaging scheme that gives you an image which is a thermal diagram that shows the temperature variations of various intensities. IRT uses the basic working principle from Stefan–Boltzmann Law, where the relationship between the temperature and the emissive power is established and the camera which is the infrared camera will capture this infrared energy and is converted into corresponding electronic signals. This paper gives a brief idea about various techniques used for fever screening which can be used to detect various diseases.

*Keywords*— *Infrared thermography, Fever screening, COVID-19, thermogram, temperature, image processing.*

## I. INTRODUCTION

In December 2019, COVID has vanquished our everyday life measure by detailing its first case from the Huanan fish market in Wuhan, Hubei, China. Scientists had recognized a novel Covid (SARS-CoV-2, additionally alluded to as COVID-19) from affirmed contaminated pneumonia patients [1]. Also, later on, COVID has changed its structure to extremely intense respiratory conditions (SARS) and the Middle East respiratory disorder (MERS). By April 13, 2020, instances of COVID-19 which was affirmed had surpassed 1,800,000. The World Health Organization (WHO) has proclaimed COVID-19 as both a pandemic just as a general wellbeing crisis of worldwide concern. By April 13, 2020, cases of COVID-19 which was confirmed had exceeded 1,800,000. The World Health Organization (WHO) has declared COVID-19 as both a pandemic as well as a public health emergency of international concern.

Infrared Thermography had wide range of applications like Non-Destructive Material Testing for interior analysis of material layers, Thermography in Aerospace where making high end machines, in Chemical industries for monitoring chemical reactions and so many other areas. Where the area focussed by this research paper was Thermography in Medicine.

In like manner, fever is the key manifestation of a few pestilences like extreme intense respiratory disorder (SARS) in 2003, flu A (H1N1) in 2009, Ebola infection sickness (EVD) in 2014, and Covid illness 2019 (COVID-19). As a safety measure government has implemented fever screening as a countermeasure for preventing these disease to its extreme for the people who are crossing international as well as national borders and in places like hospitals, malls, railway stations, and in all places where the crowd assembles fever screening is the one and only remedial measure to detect these diseases.

This research paper provides an idea regarding the momentum situation, where how to focus viably and productively utilize image processing techniques for the recognition of different ailments which contribute to COVID-19 detection. Secondly, since the virus was showing variations of symptoms a single symptom called fever cannot be relayed for identifying the virus. So the research paper gives a comparative study of different types of disease symptoms that can be a cause for the detection of corona virus. Third factor was the sensors, since the images were captured by IR cameras an equal focus was given on various sensors used by different methods. The disease mainly focused by the research paper are fever detection, respiratory infections, thyroid, osteo based problems, diabetes, blood flow analysis and cancer detection.

## II. BACKGROUND

Image Processing is one of the recent trends in analyzing a digital image where the images were grouped as pixels. In this survey the images were concentrated mainly to thermal images. Thermal images were obtained using a thermal camera in which an array of thermophile sensors were embedded in the lens of camera. These sensors will be of varying resolutions which captures the image. The thermal images obtained will be gray scale images and the RGB coloring model was incorporated to identify each areas based on thermal variations. Infrared Thermography (IRT) comes under infrared imaging science. Radiation in the long-infrared scope of the electromagnetic range (about 9,000–14,000 nanometers or 9–14 μm) is identified by thermographic cameras and produces pictures of that radiation which are named as thermograms. There is a wide scope of utilizations for thermography which can be utilized in a few conditions as an analytic instrument, for arranging the treatment and assessing the impacts of treatment. Thermography can be joined with other imaging strategies and Artificial Intelligence ideas, play a vital role essentially in the adaptation of numerous ailments [2]. Infrared radiations are emitted by all objects above absolute zero, which is stated in black body radiation law. These infrared radiations lie in the range of 0.75–1000 micrometers [3]. Thermography utilizes a non-obtrusive, non-contact strategy that utilizes the warmth from your body to help in making the conclusion of a large group of medical care conditions. So this method was completely safe since it uses no radiations.

## III. LITERATURE SURVEY

### A. Clinical evaluation of fever-screening thermography

In the research paper, a clinical study of over 596 subjects has been conducted [4]. They made an experimental set up to capture the thermal image where they used a tripod to obtain a full face. The graphical user interface was developed with MATLAB and two IRTs. The analysis was for the duration of fifteen minutes, where four measurement readings were taken. For limiting the impact of outside temperature each subject was asked to meet a relaxation time of 15 minutes and all initial humidity factors were defined properly. Temperature readings were taken on each stage, focusing on the region's facial and forehead so that two IRTs were used. In each round of capturing the image, the webcam acquires a standard color image and the IRTs will acquire three consecutive frames that were reduced to the midpoint from which a solitary mean temperature image was obtained. As the last stage, thermal images of sublingual tissue were captured by instructing them to open their mouth. To establish a reference temperature, oral thermometry was used and the corresponding temperature readings were taken from the region of study. The two temperature measurements will help to modulate two models, a fast model and a monitor model were formulated. The monitor model had an accuracy of ±1. From the monitor mode, the oral temperature measurements average value was calculated and the final reference temperature was developed. As a subsequent stage facial district depiction and temperature counts were finished. Here temperature from several facial areas was compressed. For the delineation of facial key points, a new approach called image registration was done. This technique uses a matching method by which facial landmarks are mapped to thermal images which will give the main facial points whose temperature measurements are to be recorded.

The calculated values of temperature which are recorded from the selected regions were compared with the reference and from this, the pairwise differences were recorded. Based on this data, the final result was generated which shows the temperature measurement values of the five regions of interest.

Advantages: Gives an efficient method for monitoring temperature especially in the region inner canthi region. Provides a better system performance.
Further enhancement: The effect of puzzling elements identifying with between subject and ecological fluctuation can be remembered for clinical investigation.

### B. Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument

This study aims at establishing a modest and efficient temperature screening instrument. The methodology uses an AMG8833 thermal camera. The camera is connected to an Arduino by a 12C bus. The picture caught by the camera which is essentially the IR camera is in the form of 64 individual pixels and the pixel values are stored in the Random Access Memory (RAM) of the camera. The IR camera and its in-constructed sensor, which is corresponding to the surrounding temperature and sensor work in sustained, uninterrupted mode. Numerous methods were done to obtain the temperature of the subject which is under study like considering the normal room temperature, pixel offset cancelling, and normalization and thereby compensating the emissivity of the object. The temperature values in the form of an 8X8 matrix were generated which will give the resultant values for analysis by running an Arduino program. And an efficient image can be developed by adding an extra feature, a thin film transistor LED to the original setup.
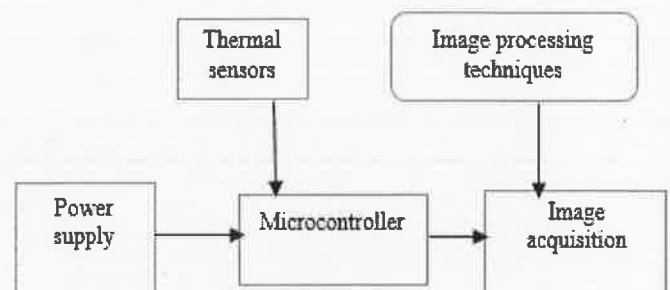


Fig. 1. Steps in Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument .

In a microcontroller, a sensor and display module is attached, which senses thermal data by AMG8833. An

Arduino IDE captures the thermal images and the images are saved in an SD card which is inserted in the display module. Fig. 1, demonstrate the general working of the proposed method. To this image processing operations are carried out to detect abnormalities in image regions [5].

Advantages: Able to develop an economical, compact easily carrying thermal camera.
Further enhancement: Uses a low pixel ratio when compared to other high quality thermal imaging cameras. The analysis can be made more understandable if the resolution can be increased to 64X64 pixels.

### C. A low cost thermal imaging system for medical diagnostic applications

This system uses an infrared sensor which belongs to Melexis IR sensors and it is a thermophile based one. It also constitutes a microcontroller and other hardware related components. The infrared sensor is a completely aligned 16x4 pixels industry-standard IR cluster. It has two chips: an IR array and the 24AA02 (256x8 EEPROM) chip which are embedded into a single sensor. The sensor has a committed low noise chopper-settled enhancer and is quick ADC incorporated which contains 64 IR pixels. By employing a Proportional to Absolute temperature sensor, ambient temperature measurement of the chip is integrated. The temperature sensations in the form of recorded thermal values of both the infrared and proportional to absolute temperature sensors are stored on an internal RAM. The pixel array had a versatile frame rate and every pixel is designed in such a manner that they are cohesively combined with an amplifier and an Analog to Digital convertor. The remaining hardware part contains the control unit which is connected with a triggered mode and an adjustable digital interface [6].

The thermal sensor captures the image as a 16X4 matrix, which is an array of pixels. A microcontroller module calculates the temperature value of each pixel and it will read the calibration values and raw temperature data from the sensor's EEPROM and RAM. With these calculated values microcontrollers calculate the corresponding temperature values of each pixel. A PC will read the serial data and divide the temperature values into different ranges which is an RGB value. During analysis, different variants of temperature recordings were taken, from which an average temperature value was calculated as a unique measurement [7].

Advantages: This framework there use no direct contact with the object so it is safe. It has no radiation too.
Further enhancement: This mechanism can be improved to be used for certain diagnostic applications.

### D. Screening for Fever by Remote-sensing Infrared Thermographic Camera

In this model, three different infrared cameras were used. In all these cameras they use a similar system such that they can detect a temperature difference of 0.1. For the measurement of accurate temperature readings, a program was designed in such a way that the parameters for taking correct readings are incorporated in this program like, the object whose temperature has to recorded was at which particular distance from the infrared camera and the surrounding environmental parameters for each dataset. The temperature readings from several points were recorded and the maximum infrared temperature was taken from all these measured temperature values. Six different regions in the body were taken for temperature measurements and two referential measurements were taken. For every person, the IRT measurements and normal body temperature were taken and the same process was repeated after fifteen minutes where they are asked to do exercise. Then by using correlation and regression analysis the two readings, the IRT and ambient body temperatures were analyzed. Finally, the classification was done as false-positive in which the temperature shows a considerable change above the reference value and as false-negative where the temperature is within the normal range [8].

Advantages: This method give an accurate result even if the person whose temperature has been captured was moving.
Further enhancement: Additional research can be done for various factors like texture, the application of external makeup and other biological factors.

### E. Multi-person fever screening using a thermal and a visual camera

This method involves the fusion of an ordinary visual camera, which gives a clear identifiable image, and an infrared camera that can record the correct temperature measurements of the object which was under investigation. The existing system uses a Forward-looking Infrared Camera (FLIR) of 640x512 pixels resolution and an image capturing camera which belongs to Microsoft LifeCam Studio. The visual camera selected was of higher resolution and has a very high frame rate. Recognized appearances where set apart with rectangular boxes that make use of various inclinations of shadings. Three colors are selected in which each has its own temporal meanings and they are yellow, red, and green. If the measured temperature value shows not much robustness it was recorded with a yellow color gradient. Green is for ordinary ambient temperature and if the recorded temperature was above a referential value that should be considered as a high-risk zone hence indicated in red color. By using a sliding window technique and Random Forest classification the face detection was done smoothly.

The basic working of the proposed system is depicted in Fig.2. In the face, the main area of focus was the corners of the eyes and these features where extracted using random forest repressors. Thermal image coordinators are obtained from the thermal image coordinates of the transformed visual images of corner positions of the eye. For face detection, a modified version of standard Viola-Jones faces detection is

used [9]. Then the image is processed with a course of binary classifiers at all sensible positions and scales. If all these stages were fulfilled completely the image will be identified as a face. After the detection of faces, a multi-face tracker was used that will detect faces in a new frame, irrespective of what happens before. And a multi-target tracker will associates the multi-frame face detection. Once the detection of face is completed, as a problem of regression eye corner detection was performed. This technique will forge a regression tree based estimator. With an ensemble, the prominence point position is measured with regression tree focused on binary standards for pixel correlations. The precision of this system highly reliant on the dimension of rectangle where the calculation was conducted. A rectangle selection of small dimension would reduce the risk factor than with large dimensions even though the localization was more stable. In this view the eye corner detection algorithm was prominent where a key point dimension selection of window can be selected. This method was performed on a recursive basis till the output was obtained. The orientations of camera were focused to obtain a high orientation image. The actual orientations and speed of objects were detected using Kalman filters. By analyzing the assignment matrix, the auction algorithm which is an association method was developed [10]. Thus, the estimation of temperature is generally insensitive toward a wrong surrounding temperature. A bias factor was estimated to consider if the ambient temperature shows a variation than the referential value [11].
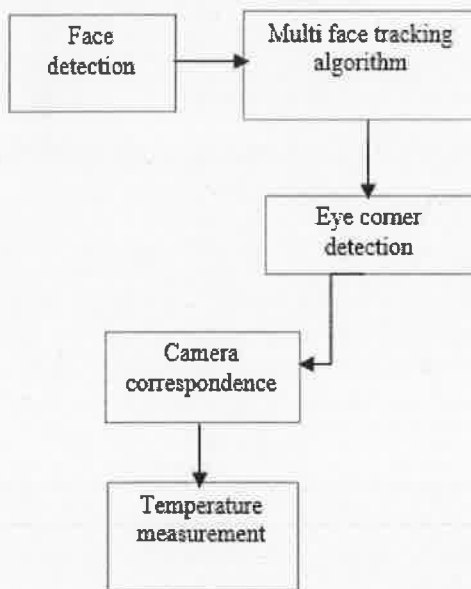


Fig. 2. Steps in Multi-person fever screening using a thermal and a visual camera

Advantages: Multiple persons can be fever screened at the same time. This method can be used at the airport thus saving a lot of time.

Further enhancement: For identifying glasses in the images obtained by IR camera, a detection algorithm can be developed. Cameras can be properly calibrated to produce a single optical axis.

*F. Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device*

This research paper [12] discuss an aberrant breathing detection which uses a deep learning technique. The method incorporates the combination of RGB and thermal videos which are acquired using a dual-mode camera. With the aid of a portable and intelligent screening device, RGB and thermal videos were obtained. For achieving this a FLIR one thermal camera was used which collaborate two cameras one is for taking RGB and the other for thermal. As a part of the respiratory study, the face regions of the videos were focussed, and by a face detection method, the nose and forehead areas were extracted. By using a time series analysis of the breathing data the respiratory patterns of test cases are obtained. There is a chance of occurring temperature fluctuations due to the normal breathing process and the usage of a mask may hide many of the facial features. For avoiding those defects a method where two parallel placed RGB and infrared cameras are placed which capture the images of face and mask regions. An algorithm for the detection of face which is covered by a mask is based on the pyramid box model suggested by Tang et al. [13]. This method makes use of the tactics like the Gaussian pyramid box in deep learning and by implementing a Gaussian pyramid algorithm. After this, the masked areas are extracted and the area from RGB is portrayed as thermal. As most of the calculations are based on the region of interest, as the next step of developing a tracking method was used which analyses the images which is having a mask and that without a mask as the temperature variations cannot be effectively captured while having a mask. As a foremost step for the final classification which systematizes the respiratory condition between a healthy and infected person, a BiGRU-AT neural network is used. Being a time series data the classification uses a bidirectional Gated Recurrent Unit with an attention layer is used. For processing time-series data a Recurrent Neural Network (RNN) was used. RNN is a feed-forward neural network that had an internal memory. Since RNN can remember past data it encounters a problem of vanishing gradient problem. So as a remedy another network called Long Short Term Memory (LSTM) will resolve this problem [14]. The bidirectional recurrent neural network will intensify the interrelation between the context of sequence and a bidirectional GRU will provide more statistics regarding periodic sequence. While performing the respiratory data analysis, the complete waveform in time sequence is considered and there may be a chance of immediate acceleration occurring. So by the discussed networks, these features may enfeeble because the time series data are given one by one which can generate a larger error. To avoid that an attention layer is affixed.

Advantages: Accurate and robust respiratory data detection algorithm was obtained.

Disadvantages: Limitation in the angle of the camera during measurement.

Further enhancement: Can use a more efficient algorithm that reduces the effect on breathing conditions by wearing various masks. To ensure high detection accuracy on respiratory infections.

## G. Non-contact monitoring of human respiration using infrared thermography and machine learning

The Respiration Rate (RR) varies under different contexts. So the breathing waveforms under varying circumstances where obtained. As the first step volunteers were selected for study [15] and with the support of an A325 Infrared camera [16] thermal images were captured. The ROI was nostrils and they were selected by a FLIR software [17]. For efficient tracking of nostrils, Vahid Kazemi et al., proposed a tracking algorithm and this was used [18]. This algorithm uses an ensemble of Regression tree which gives decisions by comparing the threshold differences between the intensities of two pixels. But this will spawn the drawback that pixel differences may be large. Due to the influence of numerous environmental conditions, the breathing waveform obtained was having a low signal to noise ratio. Since the signals involve a number of noise contents, it has to be get filtered with the help of a low pass IIR filter. Breaths per minute (BPM) is an important variable for tracking our health. For this calculation, this work proposes a Breath detection algorithm where two counters are initialized to zero in which one counter will count the number of abnormal breaths and the other will count the normal breath. Here a normal and abnormal breath was obtained by analyzing the actual signal with the measurement of background noise ratio where the duration of the breath cycle is compared with a threshold value. For the classification between a normal and abnormal breath, a K-Nearest Neighbour (k-NN) classifier was used [19]. And the analysis of data points that are given to the k-NN classifier is tracked using the t-Stochastic Neighbour embedding algorithm. The information which is getting looked at was separated into training and testing information and the training dataset was again partitioned with the help of a cross-validation technique as training and validation datasets.

Advantages: Efficient Breath detection algorithm was implemented.

Disadvantage: For checking the validation accuracy it uses different k values.

Further enhancement: Instead of checking for different k values other classifiers can be considered such as Support Vector Machines and so on.

## H. Detecting Fever in Polish Children by Infrared Thermography

Since the immune system of children is under development they may be more prone to sickness. So there should be an efficient method to detect fever in children. So this research paper gives a method in fever detection especially in children who were within an age span from 1 to 17 years [20]. In this research, three types of FLIR IR cameras were used. The temperature from four regions of interest was considered axilla, ear, eye, and forehead. For the analysis, both temperatures taken from an ordinary clinical thermometer and thermographic measurements were considered. During the analysis, the forehead temperature and the temperature taken from the ear especially focussing on the tympanic region are not reliable because of various factors. Physical exercise can cause a huge impact on the variation of forehead temperature and for ear, the variations in the ear channel, the occurrence of ear wax and all will affect the temperature. But there occurs a good similarity between the eyes especially the inner canthus region and axilla region. So by using software the region of interest was located. The temperature readings were taken which can trigger an audible alarm. During the analysis, the temperature values from different recordings should be considered by taking an average value and the temperature value of single pixel should not be considered. But the parameters that affect the temperature measurement should be optimal so some standardization technique is very crucial. Also, to acquire the greatest number of pixels inside the located interested regions the picture should fit the frame.

Advantages: Accuracy is more especially in the axilla and eye areas.

Disadvantages: For optimizing the parameters, standardization techniques are required.

## I. Early Detection of Diabetes using Thermography and Artificial Neural Networks

This work will confer a method for early identification of diabetes by combining thermal imaging with a neural network technique where the training of the network was in the similar way the human brain will function [21]. Thermography is an effective tool in the diagnosis of many diseases like diabetics, fever screening, breast cancer detection, and so on [22, 23]. Initially pre-processing of thermal images were done to reduce noise and regions of interest were extracted to which a neural network model was applied to obtain the status of the patient. Thermal imaging has emerged as a prominent tool in the field of medicine for the early detection of various diseases as most of the diseases will start with a variation in temperature as the beginning symptom [24, 25]. This study makes use of a FLIR thermal camera which will record the images of thermal distributions on the patient foot. The temperature values obtained from various points from the patient's foot are mapped to a matrix representation and were later stored on a personal computer for data analysis. As the thermal images are captured and data is given to a personal computer the next step is the implementation of the Artificial Intelligence (AI) model which has a data-driven approach. An artificial neural network [26] is an efficient way of computation which consists of different number of layers like input, hidden and output layers. And by an activation function which is a mathematical

function the inputs which are given to hidden and output layers are summed to generate the desired output [27]. For data analysis, MATLAB was used which can provide more accuracy by using different MATLAB functions. Two sets of data was used in the case study analysis of which one can be used for training and the other for testing. This method uses an artificial neural network where the number of hidden layers were three and the input layer uses four input variables. For analyzing different ANN model Root Mean Square Error was used.

Advantages: Early detection of diabetes.
Disadvantages: Used a three hidden layer network since it fits the model.
Further enhancement: Can use improved artificial intelligence tools for improving the performance of the existing system.

## J. A Non-Invasive Human Temperature Screening System with Multiple Detection Points

By using a 2D thermal imaging camera there are some limitations in identifying the temperature in periorbital areas which makes it difficult to compare with the reference values [28, 29]. So to avoid this difficulty the research paper [30] suggests several image processing techniques that select human faces for the maximum skin temperature. This system proposes a non-contact temperature screening system on a real-time basis. By using an inherent 2D space a quite number of people can be maintained from the infrared thermal camera at a considerable distance. And the others will be directed to stand a few distances behind the currently analyzing people. Then the focal length of the lens will be adjusted that focus the maximum number of people whose temperature is screened. And the camera will be able to capture thermal images of people who are walking at a normal speed. For monitoring the fluctuations of surrounding temperature an outside temperature and humidity sensors are interfaced with the existing system. For the good capturing of images the thermal imaging camera of the FLIR system was used and the lens should be focussed at a particular degree along the vertical and horizontal axes. So the selection of camera lens is an issue. Then by restricting the number of people in front of the camera the thermal images are captured and the next step is face detection. So a face searching technique in one image frame is used to detect the faces [31]. For that, several image processing techniques were done on the captured thermal image like morphological processing, hole filling, and so on and coordinates of the face were obtained. A field test was used to capture the efficiency of the camera for detecting multiple faces at a time. The result shows that the system can trace the real-time display of the maximum skin temperature.

Furthermore, on remunerating, the worries it was evident that on the core body temperature once the aggravation from the general climate, the temperature esteem got from the thermal imaging camera has less variation. At the point when the temperature limit level and the balance temperature esteem

are fittingly picked Hyperthermic patients can be related to 100% accuracy. The choice of the number of human countenances on the thermal image marginally influences the framework speed which has a rate of 7 milliseconds for one face, and up to 10 milliseconds for four appearances.

Advantages: System introduces a real-time display system in which the maximum skin temperature can be monitored. There is less fluctuation in the temperature value obtained from the thermal imaging camera.
For febrile detection the proposed system can give 100% efficiency.
Future works: By embedding an outside temperature and relative humidity sensor to the ThermScreen framework, the estimation connection with aural temperature information can be improved.

## K. Thermographic analysis of thyroid diseases

In this work [32], a FLIR infrared camera which is of the model ThermaCAM S65 system was used for handling thermal images. The camera was working in a programmed self-adjustment mode and the patients were treated under conducive conditions [33, 34]. For the detection of the thyroid, the region of interest was captured by considering the camera calibrations and proper orientations. The cytological study was conducted and the smears were identified and these results were compared with the results of ultrasonography. The result analysis gives a massive contribution to the detection of disease based on detecting hyperthyroid and hypothyroid by the temperature variations. The analysis clearly shows that the comparison of thyroid disease type with the mean skin temperature shows the pieces of evidence of temperature variations. By using this method a clear classification of good and affected thyroid nodules can be detected [35].

Advantages: Uses the least invasive and low cost method for the detection of thyroid nodules.
Further enhancement: For predicting thyroid pathologies, the temperature gradient of thermograms can be used.

## L. Dynamic Infrared Thermography Study of Blood Flow Relative to Lower Limp Position

For the proper heat distribution within the body, blood flow plays a very crucial role. This research paper discusses how infrared thermography can be used in the analysis of blood flow in the lower limp positions [36]. For the easy understanding of the temperature behaviour of skin, dynamic infrared thermography is used [37]. And for relating the vascularity of tissues, temperature measurements of the human leg were acquired [38]. By using a FLIR T440 thermographic camera, dynamic thermography of lower limp was obtained. It has a focal plane array of 320X240 pixels and for absolute temperature measurements depends on emissivity, ambient temperature, relative humidity, and distance [39]. Temperature variations of five distinct points of limp were recorded. During

analysis, the average temporal temperature restorations of the foot from both vertical and horizontal positions were considered. The spots which show a temperature difference gives a faster return to thermal balance.

Advantages: Dynamic thermographic study gives a clear detection of temperature variations in lower limp regions.
Disadvantages: The heat transfer mechanism was affected by the opposite gravity of blood flow.

*M. A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection*

In this method [40] a physiology-based approach was used so that the area of selection was the human face. The face consists of hot and cold tissues which can be modelled as a collection of these two normal distributions [41]. In this study, using a thermal camera five different angular positions were selected and images were captured. The region of interest was the medial canthal area of the human face and the temperature variations were recorded. For detecting a minor flow of motion of the object an Optical Flow Algorithm was used which provides higher accuracy for temperature detection [42]. For better performance, this method makes use of a Parabolic Regression and Radial Basis Function Network. An algorithm known as the Adaptive Network-Based Fuzzy Interferences System has been used for this purpose [43]. Then the thermal images will be classified using the Image Classification Pre-processing module. Fig. 3 shows the basic working model of the discussed system.

Thermal image capturing

Optical Flow Algorithm

Adaptive Network-Based Fuzzy Interference System

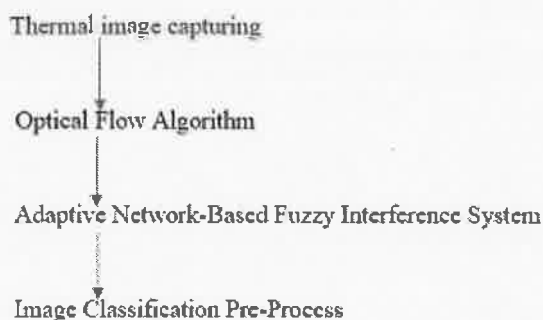Image Classification Pre-Process

Fig. 3. Flow diagram of A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection.

Advantages: This system gives a good performance especially in hospitals, airports and other places where huge crowd assembles for effectively recording the temperature of person who are in motion.
Further enhancement: Can integrate more crowd, for thermal screening system which can be utilized in public areas like airports and hospitals to reduce the rate of transmissible infectious diseases.

*N. Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor*

This research paper provides a tool for breast cancer detection by Infrared thermography [44]. For establishing the method the image acquisition basically the thermogram images were taken using the thermographic sensors. To this captured image, image processing algorithms were applied to obtain the breast area segmentation. Thermographic image acquisition will in either static or dynamic form and the different images of a single patient from different orientations were taken [45, 46]. The image acquired was processed for the avoidance of background noises and thresholding using Otsu's method was done to the required thermogram [47]. From the preprocessed image the area of interest was segmented and since the paper focused on breast cancer detection, two regions where the right and left breast images were segmented from the initial thermographic image. The automatic segmentation module does all the related task of segmenting the images into different separate independent images so that the temperature variations can be done more effectively. For identifying the temporal variations on the right and left breast it was necessary to convert the grayscale values to their corresponding thermal intensities. The thermographic values are represented in a matrix format. Average temperature values are estimated, and the region with a temperature greater than the referential temperature was detected as infected areas. For detecting the tumor areas, regions with the highest temperature values were used and segmentation of these regions using the watershed technique was used [48]. By using the same segmentation technique apart from the cancer detection another phenomenon called Angiogenesis was also able to be detected.

Advantages: Is an effective method for the analysis of women of varying age group and health situations.
Further enhancement: The automatic segmentation method used can be modified to set the target values for attaining thermal stabilization.

*O. Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography*

Osteoarthritis is a common degenerative disease that is most frequently occurring in people nowadays [49, 50]. This research paper presents an idea for identifying knee osteoarthritis with the aid of IR thermography [51]. This disease will be affecting knees, so they are the region of interest. Images of the knee were captured using an infrared thermal imaging system. Based on certain predefined parameter settings, the thermographic image obtained was later processed for the patella- centering procedure. During the first step, the left and right knees were compared and in the second step, the sub-regions temperature variations were obtained. After the segmentation and sub-regional segmentation then the feature extraction and classification were done. During the feature extraction module, the sub-

regions were evaluated and the defective portions and normal portions were identified. The statistical features were calculated using histogram analysis and the entropy features were calculated [52]. By using the feature extraction method the features were extracted and these were given as the input to the classification module and the classifier used in the proposed method is a classification by Support Vector Machine (SVM) [53]. SVM gives an efficient classification for the diagnosis of knee Osteoarthritis.

Advantages: Method was a cost-effective tool that can easily detect various diseases that too the chronic ones.
When compared to other medical imaging techniques the proposed method was especially desirable to be highly useful in the detection of rheumatism and most geriatric-related issues.
Further enhancement: Further analysis should also be carried out to ensure the accurate quantitative portrayal of specific anatomical positions in a thermal image using techniques such as CT and MRI multi-image fusion, which would dramatically increase the precision of the screening procedure.

## IV. ANALYSIS AND DISCUSSIONS

As a comparative study most research papers give a better explanation for detection of diseases in an efficient way. The major classification tools used were K-means classifiers, artificial neural networks and in common most of the research papers used thermal sensors for disease detection. An important factor which influence the performance of temperature measurement was the thermal camera resolution. As the resolution varies the thermal image capture was influenced. Fig. 4 describes the influence of pixel resolution on thermal distributions.
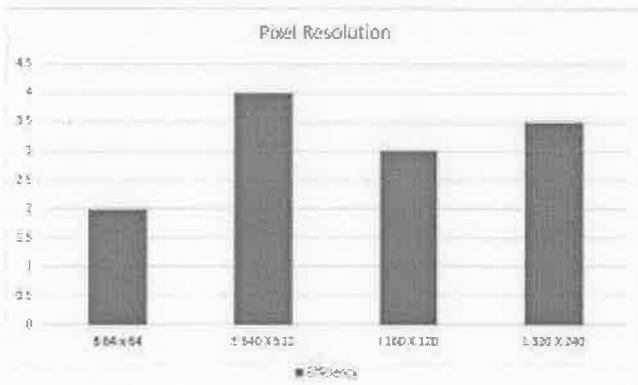


Fig. 4. Pixel ratio and efficiency

Performance analysis of various research work based on sensitivity and specificity was depicted by TABLE I. Based on the selection of various sensors and the number of sensors the efficiency of thermal detection was also improving.

TABLE I. COMPARISION OF VARIOUS METHODS BASED ON SENSITIVITY AND SPECIFICITY

| RESEARCH WORK | SENSITIVITY (%) | SPECIFICITY (%) |
|---|---|---|
| Screening for Fever by Remote-sensing Infrared Thermographic Camera | 83 | 88 |
| Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device | 83.69 | 90.23 |
| Non-contact monitoring of human respiration using infrared thermography and machine learning | 98.76 | 99.07 |
| A Non-Invasive Human Temperature Screening System with Multiple Detection Points | 81.69 | 79.09 |
| A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection | 96 | 85.6 |
| Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor | 80.95 | 89.43 |
| Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography | 85.72 | 85.51 |

TABLE II gives a comparative study on various methods discussed and the advantages, disadvantages and various methods used by different research papers. So in all the research works, the thermal images were captured and various image processing techniques were used for the efficient detection of diseases where the focus was on thermal screening. This survey will give a better study for COVID-19 detection since the primary symptoms were fever, osteobased problems and thyroid variations. Based on the selection of various sensors and the number of sensors the efficiency of thermal detection was also improving.

TABLE II.     COMPARISION OF VARIOUS METHODS

| Research paper | Year | Method | Sensor Used | Disease Type |
|---|---|---|---|---|
| *Clinical evaluation of fever-screening thermography* | 2020 | Image registration | IRT Sensor | Fever screening |
| *Development of Low-cost Thermal Imaging System as a Preliminary Screening Instrument* | 2020 | Image processing techniques with microcontroller unit. | AMG8833 IR Sensor | Fever screening |
| *A low cost thermal imaging system for medical diagnostic applications* | 2018 | Image processing techniques with microcontroller unit. | 24AA02 | Fever screening |
| *Screening for Fever by Remote-sensing Infrared Thermographic Camera* | 2020 | Correlation and regression techniques. | IRT Sensor | Fever screening |
| *Multi-person fever screening using a thermal and a visual camera* | 2015 | RGB color variations, Sliding window technique and Random Forest Classification. | FLIR A65 | Fever screening |
| *Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections Such As Covid-19 on Portable Device* | 2020 | Face detection method using deep learning. | FLIR ONE | Respiratory |
| *Non-contact monitoring of human respiration using infrared thermography and machine learning* | 2020 | Nostril tracking algorithm, Neighbour embedding algorithm. | A325 | Respiratory |
| *Detecting Fever in Polish Children by Infrared Thermography* | 2008 | Feature extraction and thermal image classification. | FLIR | Fever screening |
| *Early Detection of Diabetes using Thermography and Artificial Neural Networks* | 2017 | Image processing with neural network. | IRT Sensor | Diabetes |
| *A Non-Invasive Human Temperature Screening System with Multiple Detection Points* | 2008 | Morphological processing. | FLIR A-20M | Fever screening |
| *Thermographic analysis of thyroid diseases* | 2012 | Cytological study for thyroid detection using image processing. | ThermaCAM S65 | Thyroid detection |
| *Dynamic Infrared Thermography Study of Blood Flow Relative to Lower Limp Position* | 2015 | Thermal image detection for limp region. | FLIR T440 | Blood flow analysis |
| *A Study on Implementing Physiology-Based Approach and Optical Flow Algorithm to Thermal Screening System for Flu Detection* | 2015 | Optical Flow Algorithm, Parabolic Regression and Radial Basis Function Network. | IRT Sensor | Fever screening |
| *Supportive Noninvasive Tool for the Diagnosis of Breast Cancer Using a Thermographic Camera as Sensor* | 2017 | Image processing algorithm, Otsu's method. | FLIR A-300 | Cancer detection |
| *Automated Analysis Method for Screening Knee Osteoarthritis using Medical Infrared Thermography* | 2006 | Segmentation, histogram analysis and SVM Classifier. | FLIR SC620 | Osteoarthritis |

So based on the relevance of the application to be developed, the sensors can be chosen. For critical application where the minute details are to be captured focus should be placed on the selection of sensors rather than cost. Whereas if the application needs only substantial features then cost can be given top priority.

## V. CONCLUSION

Here a comparative study of various thermometric methods is done to find an effective system especially in the fever screening scenario that can be used for COVID-19 detection. So when two separate cameras were used in the analysis, a thermal camera for temperature measurements and an ordinary visual camera for image capture most of the system face synchronization problems. And the correct correlation of the optical axis is also a factor that affects efficient calculations. Thus by considering all these factors a low cost, easy to use thermal imaging system was hence developed so that with the help of image processing techniques combined with other

detection and classification methods an efficient disease detection method can be developed.

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# Pedestrian Counting Using Yolo V3

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**Abstract**

- I.  Introduction
- II.  Related Techniques
- III.  Methodology
- IV.  Experimental Result
- V.  Conclusion

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Keywords

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**Abstract:**

box and allot a class label as a person based on YOLO v3. In YOLO v3 the features are learned, divides the image cells and each cell says a bounding box and entity classification directly. There could be more than one bounding box per person, but the system makes use of non-maximum suppression to reduce the number of bounding boxes to one per person. Finally, the number of persons in the image and video are calculated using the count of the bounding boxes. The dataset used for static pedestrian detection is the INRIAdataset and ShanghaiTech dataset. Yolo_Mark is used for marking bounding boxes of persons and gets its annotation files using 243 images from the INRIA dataset. Darknet is used as the framework for implementing YOLOv3. From INRIA Dataset 120 images are used for testing purposes. Testing on the INRIA dataset resulted in an accuracy of 96.1%. From the Shanghai tech-B, dataset 56 images are used for testing. Testing resulted in an accuracy of 87.3%.

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# Sentiment Analysis Using Deep Learning

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III. System Architecture

IV. Methodology

V. Experiments

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Metrics

communicate using mistreatment text through social media applications such as Facebook, Twitter etc. In this paper, we propose a sentimental classification of multitude of tweets. Here, we use deep learning techniques to classify the sentiments of an expression into positive or negative emotions. The positive emotions are further classified into enthusiasm, fun, happiness, love, neutral, relief, surprise and negative emotions are classified into anger, boredom, emptiness, hate, sadness, worry. We experimented and evaluated the method using Recurrent Neural Networks and Long short-term memory on three different datasets to show how to achieve high emotion classification accuracy. A through evaluation shows that the system gains emotion prediction on LSTM model with 88.47% accuracy for positive/negative classification and 89.13% and 91.3% accuracy for positive and negative subclass respectively.

# Twitter Sentiments: A Machine Learning Approach

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*Abstract*—Sentiment evaluation is the problem of examining texts, critiques, mind and conditioned emotional response published with the aid of various users in microblogging systems. Twitter is one of the maximum extensively used micro running a blog systems and has proved to be the biggest source of statistics. Twitter can give a clear cut view about the current trends. A big dataset of tweets is used to perform sentiment evaluation. The tweets are labeled into two classes, positive and negative. There are various techniques which can be utilised to perform this task. In this paper we aim to perform a comparison between a multilayer perceptron and a factorization machine for classification of tweets in the Sentiment 140 dataset. We apply this approach using two different lexical resources namely AFFIN dictionary and SentiWordNet. The generated models are compared based on the lexicon used as well as the classifier adopted (multilayer perceptron or factorization machine) for their accuracy and training time.

*Index Terms*—Micro-blogging platform, multilayer perceptron, factoristation machine, AFFIN dictionary, SentiWordNet

## I. INTRODUCTION

Artificial Intelligence (AI) deals with making computers work like humans. This is accomplished by observing human ways of thinking and decision making and applying the outcomes to develop software and systems comparable to human capabilities. AI has been utilized in numerous fields like speech recognition, hand writing recognition, gaming and robotics. Natural Language Processing (NLP) which is a subfield of AI has a range of techniques for the purpose of obtaining human-like language processing for different tasks or applications [1]. It is an effort to get computers closer to human level understanding of language. Sentiment Analysis falls under NLP. It is a process by which all the content can be evaluated to represent the ideas, beliefs and opinions of the public. It can be accomplished at various degrees like document, section, paragraph and phrase level. With the upward push of social networking tendencies there was a surge of online generated content material. Many people proportion their thoughts and opinions on microblogging websites. Twitter is one of the broadly followed micro blogging platform for expression of opinion and experience. It was created and launched in the year 2006 [2]. It evolved as a golden

platform for companies to disclose about their brands and success. Twitter users include a variety of users ranging from regular users, celebrities, politicians, entrepreneurs, veterans and other persons of influence. The primary advantages of performing sentiment analysis encompass scalability and real time evaluation. Efficiency and cost effectiveness of processing large huge data contributes to scalability. Real time analysis is performing analysis on real time data which can be tweets that are tweeted in a certain scenarios or even critical situations. Sentiment analysis systems help the companies to get meaning of the sea of data by automating business process which saves long hours of manual data processing.

One of the main challenges identified in this area is the use of unstructured text format. As people express opinions in different manner sentiment analysis can be challenging. Fake comments by users, context dependencies of opinions also cause an issue. By using lexicon based approaches unstructured data can be processed more efficiently and context dependencies can be overcome by machine learning techniques.

Rest of the paper is prepared as follows. In segment II we talk related works on sentiment evaluation of micro blog data. In segment III we present our proposed methodology. Segment IV and V discuss consequences and conclusions.

## II. RELATED WORKS

### A. FEATURE EXTRACTION

For sentiment evaluation the unique feature of textual content or documents needs to be represented as a feature vector. The subsequent functions may be used for the same.

*1) Term Presence or Term Frequency:* In Pang et al (2002) [3], it is said that this is one pointer that makes sentiment analysis distinct from other text classification errands. The terms can be unigrams, bigrams or on the other hand other higher request n-grams. Barnaghi et al [4] used unigrams and bigrams and applied Term Frequency Inverse Document Frequency(TF-IDF) to find weight of features and thereby selecting the ones with the largest weight. This method has been proved to be efficient in this field.

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Abstract

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# Liquefaction resistance improvement of silty sands using cyclic preloading

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**Abstract.** Liquefaction induced damages are plenty and cause various levels of destruction to civil engineering infrastructure. It is possible to prevent liquefaction-induced hazards by understanding the mechanism and adopting some improvement techniques or design the structure to resist the soil liquefaction. In the present study, the influence of cyclic preloading on the liquefaction resistance of sand-silt mixtures is analyzed by conducting undrained cyclic triaxial tests on the cylindrical samples reconstituted at medium dense conditions ($D_r$ = 50%). All samples were tested at an effective confining pressure of 100 kPa by varying the cyclic stress ratios (CSR) in the range of 0.127 to 0.178 using a sinusoidal waveform of frequency 1 Hz. The results are presented in the forms of the pore pressure build-up, axial strain variation and liquefaction resistance curves. Test results indicate that the liquefaction resistance of silty sands is increased substantially with the application of preload under drained conditions.

## 1. Introduction

Liquefaction induced damages are plenty and cause various levels of destruction to civil engineering infrastructure. It is possible to prevent liquefaction-induced hazards by understanding the mechanism and adopting some improvement techniques or design the structure to resist the soil liquefaction. The first possibility is to avoid the construction on liquefiable soil deposits as far as possible. However, it is mandatory to utilize the available land for the various infrastructure developments due to scarcity in the availability of land even it does not satisfy the required properties. Hence, the second option is to make the structure resistant to liquefaction by adopting deep foundations. Nevertheless, the deep pile foundations may not prevent liquefaction damages in all cases. Piles are causing to deflect in liquefaction susceptibility zones. Hence, the third option is liquefaction mitigation which involves improving the strength, density, and drainage characteristics of the soil. The selection of the most appropriate ground improvement method for a particular application could depend on many factors including the type of soil, level, and magnitude of improvement to be attained, required depth and extent of the area to be covered. This paper presents an experimental study regarding the applicability of preloading for the improvement of liquefaction resistance.

## 2. Literature review

Preloading of the soils occurs naturally (for eg., erosion, the flow of groundwater, etc) or artificially (purposeful preloading to improve the soil properties, demolition of structures, etc). A few researchers have analyzed the liquefaction resistance of preloaded soils. The details are given in Table 1.

# Salinity reduction in well water using zeolite

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Abstract. Saline water intrusion is one of the global issues, which increases the demand for freshwater around the coastal region. The saline content in drinking water makes so many health impacts on human beings. There are many new technologies available for reducing salinity such as desalination, membrane technologies, reverse osmosis, etc. But these are expensive too. There is a need for cost-effective treatment which is suitable for domestic purpose in coastal regions. In this paper, a new technique is introduced which reduces the saline content in groundwater by installing this barrier device in wells of coastal regions. A non-woven Geo textile along with natural zeolite is used as a filter cum adsorption unit. Tests results show a decrease in electrical conductivity and total dissolved solids with an increase in filter thickness for all selected salt concentrations irrespective of the adsorbent materials used viz., natural zeolite and thermally activated natural zeolite. This indicated a reduction in chloride ions as the only salt added to the water samples tested was commercial salt. Authors suggest that a thermally activated zeolite filter could be a possible cost-effective, efficient and easy solution for increasing saline water intrusion issues in coastal drinking water wells.

## 1. Introduction
Saltwater intrusion, which is the induced flow of saline or brackish water into freshwater, is an ever-increasing problem in coastal areas. Seawater intrusion is often regarded as the only factor causing saltwater contamination. But, there are seven other causes of salinity in groundwater like tidal and storm surges, pollution from agricultural land, etc [1].Once saltwater intrusion occurs, the changes in the aquifer may be permanent or may take many years to recover.

Saline water intrusion impacts are associated primarily with losses of freshwater resources and contamination of water supply wells, and only a few studies consider adverse ecological impacts directly linked to saline water intrusion. Environmental degradation arising from this is commonly linked to the application of high salinity groundwater in agriculture, resulting in modified soil chemistry and reduced soil fertility [2]. While the direct and indirect intrusion of salinity in fresh groundwater affects human well-being, its serious implications on population health must be clearly understood. Owing to the use of saltwater, numerous diseases including skin ailments, hair fall, diarrhoea, gastric diseases, and high blood pressure are suffered.

A lot of techniques have been used to manage/control salt/seawater intrusion and protect groundwater resources. The principle is basically to reduce the volume of saltwater intrusion and increase the volume of freshwater. Mahesha [3] and Rastogi et al. [4] combined the methods of injection of freshwater and extraction of saline water to increase the volume of freshwater and to reduce the volume of saltwater pose effective but the setback is the cost factor involved in the construction and maintenance of the wells. Several of these methods are costly and some might not be

# A Review on Studies Based on Vehicle Stability and Safety on Rural Horizontal Curves

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## ABSTRACT

All over the world India bangs the top most position in crash deaths. Nearly 1.2 lakh people die every year on Indian roads. Crashes involving rolloverand lateral skidding are now responsible for almost 1/3 of all highway vehicle occupant fatalities. So, rollovers and skidding are more serious than other types of crashes. One of the major reasons for such incidents is vehicle instability at curves due to its inconsistent geometric design. This necessitates a review on current design guidelines followed in India. Many researchers have pointed out drawbacks of current design approach and a few have identified various influential factors which are significant in curve design to reduce rollover and lateral skidding. When some researchers conducted field studies to measure vehicle stability at selected curves, some carried out computer simulations. There are efforts to incorporate vehicular characteristics in curve design which is much appreciable. This paper aims to project efforts made by researchers to reduce vehicle instability at horizontal curves. Moreover, gaps in these research works and scope for further research are highlighted.

Keywords: crash, rollover, skidding, vehicle stability

## 1 Introduction

As per Ministry of Road Transport and Highways, New Delhi (MORTH), about 15% of road crashes on highways occur at horizontal curves among which 8% is due to vehicle overturning or lateral skidding. A closer look at the crash statistics records of a few years reveals that road crashes involving vehicle overturning and lateral skidding are increasing drastically, especially heavy vehicle crashes. Several studies are conducted to identify the factors causing road crashes and prevent them. Crashes are multi causal and are affected by numerous factors like geometric design, traffic volume, traffic composition, variation in speed between vehicles of the same class and different classes, weather, motivation for travelling, driver's attentiveness and so on (Aljanahi et al., 1999).

James McKnightet. al., 2008 conducted 'Large Truck Crash Causation Study' for 967 crashes, with 1,127 large trucks, 959 non-truck motor vehicles, 251 fatalities, and 1,408 injuries. The identified causes are misjudged speed, insecure loading, inattentiveness, loss of steering control, vehicle characteristics like tire, brake and suspension. Numerous research works are carried out by researchers across the world to identify influence of geometry on crash rate. Yingxue Zhang et al, 2009 identified curve radius, width, superelevation, transition curve and sight distance have important effect on traffic accidents. According to Sunanda Dissanayake and

# PERSPECTIVES ON CONTEMPORARY LITERATURE AND LITERARY THEORIES IN ENGLISH

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# PERSPECTIVES ON CONTEMPORARY LITERATURE AND LITERARY THEORIES IN ENGLISH

# Living in the Wilderness

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## Abstract

Nature makes us feel alive and energetic. It has the power to bring our mind, body, and soul back to life. Nature's healing powers are absolutely amazing. It is therapeutic for everyone and is open to both the rich and the poor. Recognizing Nature's healing power, many people travel to places around the world that offer consolation and comfort. Nature is not just around us, it's within us as well. This provides an unexplained sense of calm consciousness. Several studies are now available that show nature's psychological benefits. All the research points the fact that the closer we find ourselves to nature, the happier we feel. Nature is, in fact, a strong antidepressant.

The paper is about the consoling power of nature experienced by the characters when they are in the natural settings in the novel *The Tree of Man* written by Patrick White. The study is an eco-psychological re-reading of the text which will allow readers to witness how the environment becomes an inevitable part of human life that reflects the interconnectedness of all that the nature has created. The escape to nature has another appeal besides its beauty and tranquillity. Ecological interactions touch an individual's physical, spiritual, emotional and psychological facets of life. Eco psychology is a modern social and intellectual movement aimed at recognizing and harmonizing the relationship between people and the Earth. The emerging field of eco-psychology shows how our human psyches are closely bound to the elemental earth.

Earth centred faiths strives to honour the strength of nature's consoling power. This eco psychological study shows how the text demonstrates the character's harmonious and balanced eco human bonding. It shows how far identities of characters are shaped by the surroundings in which they live. The study describes how the ecological lifestyle is an encompassing transformation that touches every facets of an individual's life. The experiences encountered by the characters in the novel shows how the experiences in life with the natural environment move them towards a greater appreciation and concern for the natural world. Thus the paper studies *The Tree of Man* as an ecological writing with a literature of hope.

# Living in the Wilderness

I wandered lonely as a cloud
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host, of golden daffodils;
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze.

(William Wordsworth)

The paper is about the consoling power of nature experienced by the characters when they are with the natural setting in the novel *The Tree of Man* written by Patrick White. The study is an eco psychological re-reading of the text which will allow readers to witness how the environment becomes an inevitable part of human life that reflects the interconnectedness of all that the nature has created. The escape to nature has another appeal besides its beauty and tranquillity. It is freely available to the poor as well as to the rich. Ecological interactions touch an individual's physical, spiritual, emotional and psychological facets of life. Eco psychology is a modern social and intellectual movement aimed at recognizing and harmonizing the relationship between people and the Earth. The emerging field of eco psychology is showing how our human psyches are closely bound to the elemental earth.

Earth centred faiths strives to honour the strength of nature's consoling power. This eco psychological study shows how the text demonstrates the character's harmonious and balanced eco human bonding. It shows how far identities of characters are shaped by the surroundings in which they live. The study describes how the ecological lifestyle is an encompassing transformation that touches every facets of an individual's life. The experiences encountered by the characters in the novel shows how the experiences in life with the natural environment move them towards a greater appreciation and concern for the natural world. Thus the paper studies *The Tree of Man* as an ecological writing with a literature of hope.

In the novel, the characters sufferings in life get consoled as they get along with nature. When they remain in both wild and domesticated environments, most often in places of natural beauty, there are revelatory experiences awakening their wisdom and modesty. Experiences with the destructive sides of nature can test the commitment of ecological followers to provide a powerful reminder that a turn of earth is not peace, safety, or limitless abundance. In its natural cycles and changing ecology, the environment offers great stability, but this constancy is not fully chaos-free. Biophilia, the love of nature and living things, is an essential part of the human condition. Those who spend extensive time in the environment observe to respect the extreme spontaneity of nature.

Patrick White's novel evokes a diversity of landscapes that often enter into the texture of the novel's narrative. He is quite a few steps ahead of the other contemporary writers. His works reveal the depth of his understanding of Australia as a region and its atmosphere. White considers it not only as a land of mystical values but also as a separate entity in human life. The depth in which he depicts the landscape of the Australian nation, reality encounters with nature thereby resulting in idiosyncratic revelations makes his works stand apart from other writers. Patrick White's *The Tree of Man* evokes a diversity of landscapes that often enter into the texture of the novel's narrative.

People are less stressed when they are with nature. Eco criticism helps us to realize that all living organisms are connected when we step into nature. Nature gives comfort to all troubles. The word

tree ' in this novel's title stands for the search for growth of Stan, for the unbounded life. Stan was a person who loves to be with nature. The novel begins with the description of two big trees as:

A cart drove between the two big stringy barks and stopped. These were the dominant trees in that part of the bush, rising above the involved scrub with the simplicity of true grandeur    (1)

The novel is a beautiful evocative description of the nature. Patrick White has paid a lot of attention to the nature that surrounds his protagonist Stan Parker. "He smelled the smell of green wood. The name of this man was Stan Parker."(5 White) It is a suburban drama that tells a story of the lives and fortunes of the Parker family over many decades. Stan is a son of blacksmith and an educated mother. Stan's mother expects him to be a teacher or a preacher. After the death of the parents of Stan Parker, he decided to begin a new life. Stan had no intention of remaining in the confining atmosphere of the Australian bush town where he grew up. "At Willow Creek, God bent the trees till they streamed in the wind like beards. In the streets of towns the open windows, on the dusty roads the rooted trees, filled him with the melancholy longing for permanence."(13)

He leaves his hometown and travels to an unsettled area outside Sydney, where he has inherited some property. He manages to makes out a house in the woods and starts farming. Stan had come to the woods in search of peace. "Stan Parker began to tear the bush apart. His first tree fell through the white silence with a valley of leaves...Many days passed in this way, the man clearing his land...Seen through the trees; it was a plain but honest house that the man had built."(17)

White's heroes suffer from alienation when they are in the midst of human society. Stan loved living in the woods devoid of all the rush of the busy world. He wanted a peaceful life in the calm and soothing nature. Stan is a lonely man whose most outstanding characteristic is his quality of being silent. He loved to be part of nature and wished to settle his life there. Many days passed in this way, Stan clearing his land. At last he built his house amongst the woods. "Seen through the trees, it was a plain but honest house that the man has built."(17)

One day Stan brought with him a woman. Her name was Amy Fibbens. Stan's union with Amy Fibbens played a key role in shaping his goal and his efforts to achieve it. When they came to the place where Stan's house stood, they were on the outskirts of the town, where they could smell sheep, and of water drying in a mud hole. The place was home to incredible scenery and delicate ecosystems. Stan's cart jolts through the windy countryside "The girl lazily smiled at the landscape, holding her hat."(25) It was a long ride through the bush road. The travel through the woods consoled her ill thoughts.

The girl sat with her eyes on the road. She was not concerned, as at odd moments, her husband was afraid she might be. Because in her complete ignorance of life, as it is lived and the complete poverty of the life she had lived, she was not sure but that might have to submit thus, interminably bolt upright in a cart. Life was perhaps a distances of stones and sun and wind, sand coloured and monotonous."(26)

Amy always had a feeling that Stan remains distanced from her. Her only relief is observed from the surrounding she lives. This consoling power of nature has brought Amy Parker to live in the midst of the beauty of nature. Amy Parker had grown greedy for love. She had not succeeded in keeping her husband with her all the time. She had promised herself in moments of indulgence that she would achieve this at some future date. But she fails every time. Amy's only relief was the moments she had with the nature. Amy loved animals and enjoyed planting trees. "She should plant the white rose,

where the slope of the land was still restless from the jagged stumps of felled trees."(28) The nature which surrounded her spoke to her in its silence from her consoling depths.

"She walked slowly on, taking care of herself, and the harsh blue of her wooden jacket flickered through the evening colours of the garden, the colour of moss, almost of foreboding, and her skirt in passing stirred up an intolerable scent of rosemary and thyme that lingered after she had gone."(57)

The Parkers continued their life. When Stan leaves the house into the woods he can still hear the voice of Amy when he was alone in nature. To discover what life actually is, the more humble Stan Parker turns to Nature. Stan's greatest strength is his endurance. His mind can withstand pain and torture to the degree that it can help him achieve his goal. Other people came to live in that place after few years and there is a rose bush now, growing against the veranda, a white rose, of which Amy had thought and spoken to Stan, and which he had brought to her from the town.

The major event that took place was a great flood, which fortunately did not destroy their farm. The still air became more charged the closer they got to the centre of the storm, the sky darker. The storm continued most of the days: "The whole earth was in motion and streaming trees, and was in danger of being carried with it."(47)

The constant rain that swells into the flood of Wallonia, causes trouble to people's lives, and Stan is brought to the point that he understands how weak man is. He joins other volunteers and helps rescue settlers stranded by the flood.

The great trees had broken off, two or three fell". "He remembered the face of his mother before her burial, when the skull disclosed what the eyes had always hidden; some fear that the solidity of things around her was not assured. But on the dissolved world of flowing water, under the drifting trees, it was obvious that solidity is not. (73)

Stan learns to humble himself from his surroundings and to embrace continuous changes as the only solidity. Two children are born to the Parkers, a daughter, Thelma, and a son, Ray. Later, during a raging bushfire, Stan rescues Madeleine from the burning manor house. World War I begins soon after the great fire, and Stan enlists in the army. After Stan returns from the battlefields of France, he once more works his farm while his wife carries out her domestic duties faithfully and his children grow into adults. "One was born. One lived". (104) Stan felt that staying isolated in the nature is the only way to consolation. It reflects one's self confidence. He admires the land which gives shape to his life. Also he is also looking for a sense that lies beyond the visible environment. The solitary life in nature helps to develop internally from which a person eventually must reach the innermost core of his own being. "Society, as such, fills him with discomfort and it has always remained an "unrealized ambition". (186) Stan feels the land is an indomitable power, bringing misery, suffering and desolation. These ecstatic experiences faced with the nature makes a person stronger.

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