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MANAGEMENT CHALLENGES AND OPPORTUNITIES

During and after Pandemic Situations

Narendra Kumar
Arjun Gupta

Management Challengesa and Opportunities

During and After Pandemic Situations

MANAGEMENT CHALLENGES AND OPPORTUNITIES

During and after Pandemic Situations

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Preface

World have seen many calamities in the past but those all were natural phenomena. A calamity again struck the world in the end of year 2019. If media reports are to be believed this calamity aka Covid-19 pandemic was man-made however the source of the pandemic is yet to be identified. Many of the commoners in current generation in India never even heard the word pandemic before the beginning of covid-19. The scale and magnitude of this pandemic was never thought by anyone. Media reports said that world is struck by pandemic in every hundred years however very few is living to tell the tale of last pandemic happened in year 1918.What current generation is facing could have not been imagined by anyone. The way a human think and act it is changed in the pandemic situation. Companies have to adapt in new situation to work and sell their products/services. Pandemic have affected the life of everyone. This book tried to explore this pandemic phenomenon.

First paper by Dr. Thimmaiah Bayavanda Chinnappa studied the best customer relationship management practices in tourism industry. Tourism industry is source of income for many people thus the paper tried to explore the best suited customer relationship practices to enhance revenue through tourism.

Second paper by Dr. Pradeepta Benerjee and Mr. Somnath Mukhuti studied the impact of covid-19 on Bank Nifty. Stock market is one of the indicators of any country's GDP growth. Country like India where service sector contributes more than 50% to GDP banking needs to be strong thus studying Bank Nifty volatility analysis will

show the direction Indian banking sector is heading.

Third paper by Dr. Sushma singh has tried to look into the impact of herd behaviour on financial risk tolerance after covid-19.Whenever individual investors make any investment; they want return on in it. Impact of human psychology through hearsay of other members in the herd can be seen on financial decision making. In this paper a research was conducted in five Different cities of Uttar Pradesh, India to look into the herd behaviour and financial risk tolerance by using GL-RTS scale.

Fourth paper by Dr. Nazia Sultan talked about business resilience during the covid-19. It is said that when faced with the extreme condition human tend to show the strength even unknown to him. During the covid-19, when lockdown was imposed businesses were shut. Businesses were needed to think outside the box, they come up with the financial, operational, organizational and financial resilience to keep-up their business running. This paper tried to look into the business resilience shown during covid-19 by the businesses. The practices and strategies adopted by the businesses were discussed in this paper.

Fifth paper by Divya MS talked about work life balance in new normal. After the covid-19 situation everybody was forced to change his ways of Living. Companies wanted their employees to work from home, teachers were teaching students through online mode. During the lockdown period everybody was looked into their own houses. Daily life of everyone was affected. This paper talked about the work life balance in this new normal scenario where partial or full restrictions are imposed by government or by self for safeguard of everybody.

Sixth paper by Dr. Periasamy P and Dr. Dinesh found about the data driven marketing strategic trends in 2020. A model called EPCMASQ of authors emphasized on how customer data helps in formulating marketing strategy to the sellers. Through this model authors discussed about

customer's ethical information, personalized marketing automation, better customer experience, multi-channel experience, artificial intelligence, Search Engine Optimisation and qualitative data. With this marketing concept any marketer can push his product to the customers easily and efficiently.

Seventh paper by Dr. M. Sharmila Devi and Mrs. J. Manjula Devi talked about the impact of covid-19 on FMCG sector. Fast moving consumer goods (FMCG) is one of the largest sectors contributing to be Indian GDP. Use of FMCG goods were also impacted due to many factors such as labour moving to their native places, Logistic issues. This paper shares about the impact of covid-19 pandemic on FMCG sector in India.

Eighth paper by Mr. Manoj Kumar Dewtwal tried to explore the e-Learning dimensions during pandemic situation. Teacher-student learning is impacted due to pandemic is looked upon in the paper. Every stakeholder in teaching-learning process is forced to learn through online mode and it impact is explored with this paper.

Ninth paper by Dr Ashima Garg, Mr. Amit Kumar & Dr. Veeralakshmi B. found out the organisational role stress among University teacher in Haryana state with respect to nature of job. The paper explored about the stress in university teaching staff in Haryana state. Over 500 respondents were used as sample size in this study to determine how much organisational stress is faced by University teachers in Haryana state.

Tenth paper by Dr. D S Parihar tried to look into the impact of covid-19 on tourism industry in Himalayan state Uttarakhand India. During any pandemic such as covid-19 tourism industry is bound to be impacted through this paper author looked into the impact, challenges and opportunities in tourism industry due to covid-19 pandemic in Himalayan state Uttarakhand, India. Uttarakhand is internationally known for beautiful glaciers, flower Valley, snow-capped

mountains, and diversity in animals, vegetation as well as society and great cultures. Due to covid-19 the tourism was badly impacted. This paper tried to explain the impact of lock down due to covid-19 on tourism industry in Uttarakhand.

Eleventh paper by Mr. Ravindra Verma and Mr. Mohan Kumar investigates into the work from home culture in pandemic era. This paper tried to explore the change of work culture in person's life due to pandemic situation. Employees were forced to work from home. How this have affected the behaviour of employees and how the work routine is changed has been tried to explored in this paper.

Twelth paper by Dr. Pulidindi Venugopal, Dr. S. Anjani Devi and S. Aswinipriya talked about the problem faced by GAP inc.GAP is clothing brand old and reputed company established in 1969 employing more than one lakh people in different countries under different brand names. This paper focused upon the problem faced by GAP INC. The solution and marketing strategies to overcome these problems bynGAP INC. are discussed in the paper.

Thirteenth paper by Mrs. Rajimol K P and Dr. Rajesh B, provides the overview of e- commerce industry in India and its evolution in India. Challenges faced by e-commerce and future prospects for e-commerce are also discussed in the paper.

Fourteenth paper by Dr. Sanjay Keshaorao Katait, talked about the impact of corona virus lockdown impact on health of women workers in construction industry in Maharashtra. In order to meet the growing infrastructure demand and developing economies women workers are bound to work in construction industry. When lockdown was imposed due to covid-19 these women workers were left stranded due to non-availability of work. Construction industry where health problems and unsatisfactory work conditions are common the women workers felt trapped. This paper talks about the situation of women workers in construction industry in Maharashtra during covid-19 lockdown.

Fifteenth paper by Mr. Ajay Yadav and Ms. Pooja Yadav looked into the digital marketing practices followed by the company. During the unprecedented times of covid-19 businesses needed to make sure that they reach to their customer. Authors in this paper tried to look into the digital marketing practices followed by the companies by discussing how online media is a way to connect to the world? People can discuss their thoughts opinions by eliminating the barriers of any boundaries. With the help of internet any marketer can promote his product and services through digital medium.

Sixteenth paper by Dr. Thimmaiah Bayavanda Chinnappa and Dr. Basheer Garba talks about the HR initiatives in banks. Banking system is backbone of any country's economic growth thus it needs to be robust and strong enough to serve its economic needs. With the changing scenario due to globalisation modern banking cannot have the same approach, what it used to have in 80's or 90's.Now a days due to competition banks are eager to serve customer at their doorstep thus their employees need to change their attitude. This paper talks about the HR initiatives in bank. The pragmatic approaches banks needs to follow in their HR policies is discussed in this paper.

Seventeenth paper by Mr. Ajay Yadav and Ms. Ramandeep Kaur talked about social media marketing. Social media has become integral part of one's life. Now-a-days social media is not only used for connecting with people online but also for sale and purchase of goods and services. Marketers are reaching to the customer through social media platforms. This paper explored the social media marketing on the basis of survey conducted on 400 respondents. Customer is influenced by social media in making purchase decision is discussed in the paper.

Eighteenth paper by Dr. R. Uma Devi and Dr. S. R. K.talks how covid-19 have disrupted business however human will to conquer those obstacles still pushes human to work harder. As discussed in paper entrepreneur also faced

difficulty in the time of covid-19. The adverse impact was observed in businesses. worldwide and most of the newly formed businesses and start-ups were compelled to dismiss theire mployees, leading to issues such as widespread unemployment, lack of productivity, and the downturn of economies however despite difficulties entrepreneurship is facing the obstacles and emerge victorious. As per paper even in the time Covid-19 many new start-ups were started and human will to remain strong was observed in the entrepreneurs. Entrepreneurs turned disaster into opportunity and earned reward by doing same.

Nineteenth paper by Nistha Adhikari is an article on Corporate Social Responsibility practices in Indian industry:COVID-19impact and way forward.The purpose of the study is toexplore various definition and descriptions of CorporateSocial Responsibility; elaborating upon the scope of corporatesocial responsibility (CSR) by studying deployment of CSRpractices over the last few years specifically the CSR initiativeof corporate during the pandemic situation in India.

Twentieth paper by Shruti Balhara talks about the work life balance among the women during the covid-19 situation. In Indian scenario where women are supposed to manage home along with their job, this paper explored the working women work life balance situations during pandemic lockdown. How working women were managing their work from home scenario and their families while working from home, since they are the key figure in their families is looked upon in this paper. Findings of this paper suggested that organisation must come with some new work life balance approaches, policies and practices with special reference to women employee to manage their job and home.

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Work Life Balance in the New Normal

Divya M S*

Abstract

Life after the pandemic Covid 19, will not be the same as we have seen or experienced. The epidemic has caused significant social and economic disruption, including the largest global recession since the 1930s Great Depression. It has resulted in massive supply shortages caused by the intensified panic purchasing, agricultural disruption, food shortages. Many educational institutions and public areas have been partially or completely closed. The industry and educational sectors experienced major and significant changes. The unanticipated shift to work from home during Covid-19 is taking a toll on employee's mental health with many unable to find breathing space, even in the comfort of their own homes. Most employees have experienced stress in their professional lives, personal finances, and family lives because of this predicament.

Keywords: *Covid-19, Pandemic, Depression, Mental Health*

Introduction

The pandemic Covid-19 has altered our entire way of life and work. Our life will not be the same as it was before the pandemic had struck on us. We have all become used to the new lifestyle, including small children and elderly parents. Changes prevailed in all fields and sectors, affecting every

**Assistant Professor, Basic Science and Humanities Department, SCMS School of Engineering and Technology, Ernakulam, Kerala*

corner of the globe. The epidemic has caused widespread social and economic disruption, including the worst global recession since the Great Depression of the 1930s. Increased panic buying, agricultural disruption, and food scarcity have resulted in massive supply shortages. Misinformation has been widely spread on social media alleviating political tensions all around the nation. Concerns about racial, geographic, and financial discrimination, unhealthiness, and the balance between public health imperatives and individual rights have increased because of the pandemic. Along the many draw backs caused by this, there are many take aways also. The world has imposed curfew/lockdown measures to limit human mobility as the symptoms of the corona virus got worsened day by day. The restriction of quarantine halted all commercial activity that has a significant impact on the various important environmental parameters that are directly or indirectly related to human health. As all forms of social, economic, industrial, and urban activities had an abrupt cease, nature reaps the benefits, demonstrating improvements in air quality, cleaner rivers, less noise pollution, and undisturbed and calm wildlife. As we have seen during these two years the pollutant emissions were comparatively very less that what it was before. Our environment had reaped the major benefits out of this threat. Nature is what we should rely on as our future is dependent on it.

The industry and educational sectors experienced major and significant changes. Many of the educational institutions have opted on a new term called as work from home, which was only familiar to IT companies till now. Schools and colleges have always followed on a conventional mode of teaching starting from the ancient Gurukul system onwards. Now both the students, teachers and also parents are struggling with the innovative mode of teaching and E-learning. The employees in industrial sector is also facing a major unbalanced shift in their career. Balance between work and life became crucial and many failed to cope up

with maintaining a healthy balance between personal and professional life. Because your office is now at your house, remote working or working from home has become a part of our everyday routine life, which is no longer limited to the office but also includes our families. Employees find it difficult to maintain a pleasant working environment at home as they are struggling between official duties and homely chores.

Employee well-being is critical, as good physical and mental health can only lead to happiness and job satisfaction. A healthy environment can only determine and motivate employees to be their best. It has become quite a normal phenomenon to think that working from home can make most of us feel like we are working all the time. It is not a good indication as extended working hours will impact the productivity of individuals, as employees will not be able to focus on tasks to be completed on a given deadline. If they are stressed up, then there will not be any consistent productive performance. Employees who are disorganised will be unable to fulfil their responsibilities, either professional or personal. Such behaviour does not go a long way and they will feel suffocated being surrounded by workload all the time. Working parents will always be stresses up as they need to focus on both the family and their work. When children and aged parents are at home, full time attention need to be given to them. This diversion of time and focus can badly affect anyone's health. Work life balance is an important aspect in maintain a rhythm between personal and professional life. If that rhythm goes wrong, then its will be extremely difficult to rectify it. Nearly every day, an increasing number of cases of frustration, stress, disinterest, hypertension, and depression are being reported. There is an urgent need to focus on such rising cases, and effective interventions must be identified to put a halt to this threating issues. Employees can focus on tasks and feel more accomplished at the end of the day if they have and follow a proper schedule. We need to recharge ourselves for the second half of the day by relaxing and using

simple but effective techniques. We cannot escape from our responsibilities but can handle it effectively. These simple techniques can reduce the intensity of stress and makes you feel better and refreshed for the next day.

Literature Review

Work-life balance is a concept that describes how employees perceive their professional and personal lives in a balanced and amicable way by not affecting each other. An investigation into the effects of both the work stress and parental expectations, on job satisfaction, marital satisfaction, and overall life satisfaction among accounting professionals proves always to be on an increased rate. Both the working parents were messed up by childcare arrangements and shift-based jobs, that was the prevalent concept before. Women becomes the prime victims even at workplace or with kids at home, as its their entire responsibility to run and balance with the two poles (Bedeian et al.,1988). Studies shows that stress will be immense on a single parent than others. Women especially had to endure more struggle than their male counterpart (Duxbury et al., 1994). A relevant study among U.K academics has observed there is more job satisfaction among high ranked female faculties than on IT sectors, their Job position and Job nature makes it more relax able to them (Oshagbemi, 2000). However, this study does not define a demarcation between job satisfaction and life satisfaction. Attention has been more focused on classifying types of HR strategy especially on existing models of corporate strategy. Miles and Snow (1984) cites a relevant example on earlier work on strategy and structure. They pronounce that each of their strategic types of human resource management will need to adopt a different set of human resource management policies and they are clearly precise with some variations. The notion is that those institutions, corporates or managements that have a definite demarcation and strategy between their business strategy, structure and human resource management policy and practice will always and definitely have superior performance. To sum up, those employers

RE-SPACING MENSTRUAL NARRATIVES

RAZEENA P R

Re-Spacing Menstrual Narratives

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Razeena P R

Foreword

Making visible the invisible, speaking about unspoken experiences, engaging with the most silenced in the most intense, passionate and politically committed manner is the spirit behind all movements of resistance and assertion. And the feminist movement has been no less in following this motto to the hilt. It is by unlocking centuries of silence around the female bodily and mental experiences that women have tried to express their dissent towards the dominant discourse around gendered realities all over the world. We realize today that even after almost two centuries of conscious activism and assertion on a global scale, women still have a lot to fight for. Our struggles to be seen, heard and understood in all our complexities and diversities are far from over. Each generation of spirited feminist women has pushed the boundaries of accepted questions and answers, and this generation is doing it to the menstrual discourse which has been actually existing through centuries. It is not a static discourse but a dynamic one, evolving in response to historical changes, negotiating the breakthroughs in science and technology and redefining gendered spaces symbolically and literally. Different cultures and societal formations have engaged with this biological process differently and constructed elaborate apparatuses of rituals and narratives to understand this mysterious process assigned to the female of the species. Chris Knight, one of the prominent researchers in the area of menstrual culture has pointed out that some of the primal human symbols are drawn from the semiotics of menstruation. And it becomes crucial to historicize every moment of this articulation in order to avoid falling into simplistic explanatory models and binary modes of thinking.

We are trying not only to produce narratives but also to listen to different narratives which might often conflict with each other. They may not fit into any theoretical framework and may demand an entirely different mode of understanding. The intention is to revise, revisit and reshape the dominant narratives built around menstruation – religious, scientific and commercial. Production of sanitary napkins is one of the

most lucrative industries today. As a product of capitalist modernity, it constructs the woman as a menstruator/consumer of certain kind of sanitary pads which wreak havoc on an already fragile ecosystem.

It is in this context that the articulations of this experience compiled and collected into a book become significant interventions in the emerging global discourse on menstruation. The book enables a plethora of narratives to interact with each other thus highlighting the diverse perspectives and positions which make possible more productive conversations – at the level of theory and practice. It goes to the credit of the editor Razeena P R that she took the initiative to venture into a field which people are still hesitant to talk about and is actually mired in a lot of misconceptions. I am sure any reader who picks up this book will find many layers of darkness falling away from them regarding their understanding about this vital process in the female body, which structures a woman's being in this world in so many crucial ways. I hope this book will generate more questions leading to more creative discussion and action beyond the spaces of the academia.

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Resilience Speaks the Beauty of Pain

Divya M S

Abstract

"Your understanding of your inner self holds the meaning of your life. As rightly penned by Leo Tolstoy, our life's journey starts with self-discovery. If we can't define ourselves, then how could we follow our heart to reach its destiny. A woman's journey starts with self-discovery defining herself in her own words. Self-awareness is the stepping stone of all people who have said to fulfil their dream, it is the only key to self-mastery. In our life's journey we have been caressed with the bundle of responsibilities tagged on us. Some gets unfolded on its way and others are befitted on us by the rich legacy of generations. I would like to venture through the written memoirs of women narratives especially in the works of Anne Frank The Diary of a young Girl and *Nadia Murad* The Last Girl: My Story of Captivity and My Fight Against the Islamic State. *We all are familiar with such experiences but ashamed to voice out or even pen down such thoughts. Somehow our gut feelings stop such thoughts, even now we are ashamed of saying aloud of our monthlies. We change into a staunch mode when we hear someone say about it. I would often associate it with the dialogue of Harry Potter movie, when they say about the evil 'Voldemort' as 'Do Not Say It Aloud'. It's the same we are doing when we restrict our thoughts and conversation about the "curse" that every woman is facing. This curse is the very reason behind what she is, she is complete only with all this so-called indifference.*

***Key Words**: Resilience, Self-awareness, Self-discovery, Monthlies*

Concept Note

"Resilience is knowing that you are the only one that has the power and the responsibility to pick yourself up." In the words of Mary Holloway, resilience is the powerful weapon that defines you and have the potential to uplift yourself from all atrocities. When we began to confine and reflect ourselves, shedding all the wounds heaped on us in our life's journey, our life takes on a new track. We began to live than being mere existence. There have been many narratives on women but a few to be short listed as depicting their self-portrayal. When we depict our self completely without any deletions or veil, we tend to be perfectly complete. When our emotions and expressions are being curtailed there will not be perfect depiction. We need to come out of the taboo long imposed on us. We believe nature to be pure and sacred,

when nature is mother, she in the real life should also be considered pure and sacred. Mother is the epitome of love, care, selflessness, comfort, from where our journey begins. Stories and personal narratives on and about women had always an everlasting authentic impact on us. Only a handful had dared to open up themselves to come beyond the restricted taboo. Our long-inherited customs and traditions taught us to be silent, calm, loving, caring like Sita. She becomes the epitome of sacrifice, love and care. History has also reminded us of our great leaders, and women with exceptional courage and devotion like Jhansi Rani, Mirabai, Rani Padmini, Anandi Gopal Joshi, Indira Gandhi, Justice Anna Chandy, Kalpana Chawla, Mother Teresa, Ahilyabai Holkar, Arati Saha, Aruna Asaf Ali, Durga Bhabhi, Mahaswetah Devi, Kamala Das, M S Subbulakshmi, Rudrama Devi, the names are endless. They have dared to think beyond their limitations imposed by the patriarchal society. Women have always exhibited exceptional courage, bravery, wisdom and knowledge to lead the world wisely than their counter parts. When we began to voice out our opinions, suggestions or findings we are type casted and stands out to face all the humiliations and sufferings from others. The worst atrocities are from the dearest ones. Menstruation had always been imposed on us as a taboo, like that of an untouchable. Apart from the generations ahead, we are moving on far more away from those uncivilized notions on womanhood. When there was a drastic shift from joint family to nuclear family and when we began to work and get involved in the financial decisions of a family, a change from house keeper to decision maker evolved. It wasn't that easy for us to enter into the dominated world of science and business. Now, we have learned to overcome the resilience imposed on us and to define ourselves. Is the menstrual cycle woman's curse, or is it an unexplored resource?".Judy Blume's *Are You There God? It's Me, Margaret* (1970) was a hall mark of the time, which made a reverberation of the preconceived notions and prejudiced mind. Menstruation was always believed and considered to be "Eve's curse", a long hereditary curse on us. The experience we had during the first period varies from person to person, but mood swings, emotional and hormonal imbalance that we experience are more over the same. We all forget to acknowledge the basic fact that it's the essence of our life. We need our monthlies, it's vital for mental and physical health, that's what makes us normal from all the abnormalities. The taboo imposed on us by our society is the basic reason for the inequalities happening to us. Women and girls are denied of their essential resources in many of the developing nations due to the fact that they are physically weak. I

would like to cite certain facts from google regarding the taboo conceived by many nations. - In Ghana, 90% of girls in rural areas say they feel ashamed during their period and 95% of girls sometimes miss school when they are menstruating. - 67% of girls from Nepal are not allowed to attend religious functions while menstruating. - 51% of girls in Iran do not take a bath eight days after the onset of their period. It's high time to unveil the inequalities in her, it's this taboo which makes her unequal. She is complete only with the taboo imposed on her becomes pure as her. Personal narratives and instructions of menarche, menstruation and menopause has been passed from mother to daughter or sister to sister or peer groups. Throughout history, we can find innumerable lives deprived of humanity and had undergone cruelties that's beyond their worst dreams. Time and again we have exhibited extraordinary courage to overcome those atrocities. The agonies and resilience faced by many have occupied pages in histories as memoirs and their wounds has caused many to rise and turn back. I would like to dwell into the real-life experience of Nadia Murad and Anne Frank, in their works *The Last Girl: My Story of Captivity, and My fight against the Islamic state* and *The Diary of a Young Girl*. The theme of resilience dominates the memoirs of holocaust faced by the Jews during Hitler's reign as marked in the writings of Anne Frank in her famous work *The Diary of a Young Girl*. Nadia Murad narrates her enduring pain, humiliation and sexual exploitation in *The Last Girl: My Story of Captivity, and My Fight against the Islamic State*". Both the memoirs narrate their life incidents with a sarcastic tone of pain and hope that they could live upon a life they envisioned, wordings capture their inner resilient beauty. This silent beauty made the works eternal in the minds of the readers, who could feel and imagine the pains endured. As rightly said by Malala Yousafzai, "We realize the importance of our voice only when we are silenced". Resilience is like a calisthenics training; experience makes you better for the world to live in. It takes into account the painful experiences you had come across, the setbacks you received and the immense courage and strength you acquired on the way. All this mounts up for you to become a better person, but it takes time and effort. It's easy to advice someone to endure all the atrocities and come back to life as a phoenix bird. To say only a few have come across such sufferings and once they have, eventually they will be at the top inspiring others with their life experience. When we withstand such miss happenings in life and is able to bounce back and survive, you succeed in life. When we experience any kind of hitches, stress,

emotional upheaval and suffering we are resilient, equating with mental toughness and emotional pain and suffering.

Beauty in her Openness – Anne Frank

"I want to bring out all kinds of things that lie buried deep in my heart". As rightly said by Anne Frank, this is exactly what her writings were. Holocaust, had taken the lives of many and had witnessed heights of pain and suffering which got captured in the frame of history. Anneliese Marie Frank, a young girl Jewish girl is forced into exile with her family in their "Secret Annexe". The autobiography tells about the anguish, anxiety and hope of a thirteen-year-old teenager. When Nazi came to power, life was not the same for Jews, they were forced to go on exile leaving behind whatever they possessed. It's been highlighted in her writings how desperately she missed her pet cat. May be this can be the reason why her diary got the name 'Kitty', she always addresses her diary as 'Dear Kitty'. The journal tells us about the daily accounts in her life on exile, her emotions, realisations, experience, family relation, friendship, her first monthlies, first love all that's being happening in a teenager's life. This autobiography makes us to think how a young teenager could be so open minded in her writings, which was rare during those times.

Our conditioned way of thinking doesn't allow us to accept such blunt writings. Nazis believed that the Jews were the root of all the prevailing evils and wanted all of the Jews to go on exile. They were tortured both physically and mentally by denying their basic rights. A brief account of these imposed restrictions is clearly mentioned in the initial pages of the diary: "The rest of our family, however, felt the full impact of Hitler's anti-Jewish laws, so life was filled with anxiety. After 1940 good times rapidly fled: first the war, then the capitulation, followed by the arrival of the Germans, which is when the sufferings of us Jews really began. Anti-Jewish decrees followed each other in quick succession. Jews must wear a yellow star, Jews must hand in their bicycles, Jews are banned from trams and are forbidden to drive, Jews are only allowed to do their shopping between three and five o'clock and then only in shops which bear the placard "Jewish shop". (pg. 20, 21) An account for her journals do tell us about how much Jews had suffered and deprived from the rest of the society. The restrictions imposed on them were even more harsh. They must always wear a yellow star and had to be indoors by eight o'clock and cannot even sit in their own gardens after that hour. They were forbidden to visit theatres, cinema halls and any other places of entertainment. Not

allowed to take part in public sports, swimming baths, tennis court hockey fields and other sports grounds. They cannot visit any Christian and were allowed only to go to Jewish schools, many more such restrictions. Life was horrific for Jews, and they began to flee from Germany to a much safer place with their families. Nazis burned down Jewish owned shops, synagogues, and their books. Jews were fleeing and tried to find shelter wherever they could. Nazis deported these people to forced labour camps, where they worked to produce supplies for the increasingly strained war economy. In most camps the prisoners were devoid of sufficient food, equipment, medicine and clothing. There was a complete disregard, and their health was deteriorating day by day. As a result of these conditions, death rates in labour camps were extremely high. Believing Holland was safe for Jews, Anne's family moved to Amsterdam in 1933. *The Diary of a Young Girl* also known as *The Diary of Anne Frank*, a book of diary writings kept by Anne frank while she was hiding for two years in the secret annex, with her family during the Nazi occupation of the Netherlands. The family was apprehended in 1944 and Anne frank died of typhus in the Bergen-Belsen concentration camp in 1945. The diary was retrieved by Anne's father Mr. Otto frank, the family's only known survivor after the war. The writings were from 14th June 1942 to 1 st August 1944. Her father gifted her a red checked diary on her 13th birthday, June 12 th 1942. It was not like a usual diary writing, she wrote as letters to her best friend that is, diary whom she addressed as kitty. In August 1944, they were caught from the secret annex and were deported to Nazi concentration camps. Anne died when she was just fifteen years old. These letters were not just the experiences of a thirteen-year-old young girl; it gives us an insight into the most terrific inhumane situation that mankind had ever undergone. The wordings which she breathed became eternal and true. In the autobiography by Anne Frank, she tells us about the daily accounts in her life on exile, her emotions, realisations, experience, family relation, friendship, her first monthlies, first love all that's being happening in a teenager's life. Her writings make us to think how a young teenager could be so open minded in her writings, which was rare during those times. Our conditioned way of thinking doesn't allow us to accept such blunt writings. The emotional frustrations and mental outbursts are all evident in Anne's writings. She had openly said about the teenager's frustrations, that we all have experienced while it's our first monthlies. Bodily changes, emotional imbalance, sensitives to certain thoughts and facts all are evident in her writings. She didn't feel to hide anything from her best friend Kitty. But that was found to be

one of the rarest of writings where a young teenage girl exposed her inner most intimate feelings and emotions to the world. She was indeed an inspiration for us, who made use of journaling to stress out her emotional outbursts. "I want to go on living even after my death" as rightly said, these words became eternal like her.

Pain in Resilience: Re-living the Pains of Nadia Murad

"The greatest glory in living lies not in never falling, but in rising every time we fall" – The eternal wordings of Nelson Mandela stand out when we read *The Last Girl: My Story of Captivity and My Fight Against the Islamic State,* a memoir by Nadia Murad. When death and suffering snatches the happiness and existence of our life, we fall in its tragic effect. Some couldn't withstand and they became a part of yesterday, those who bounced back creates history. Nadia Murad is the survivor and not a victim anymore. She is like Malala Yousafzai, Muniba Mazari and yet more. They are the victims who survived and inspired us to move on in life. We have heard a lot about the victims who struggled back to survive and fall apart. Remembering all those unheard heroines, we have to emit the ray hope to others who are still struggling to come out. Nadia speaks about the unspeakable brutality that she has endured in the hands of monstrous men. The memoir narrates to us about a world of extreme depravity of the basic human needs, and an intense struggle to overcome all the hurdles to get back their identity and relive. The writings do narrate a tale of depravity and a test of resilience who faced the worst adversities that any women could ever have faced. All this happens with a beautified synonym called "Call for Peace". Nadia Murad belongs to a large family of Yazidis in Kocho village, Sinjar, Iraq. Atrocities in all its kinds has been the worst nightmare for them. Faith is what kept them moving ahead to face and strive back all the cruelties imposed on them. It's true that Iraq has always been in a state of war, with the Americans in 2003, and with itself and then the Islamic state. Against their promise to protect them, the military forces betrayed them to the militants. Men and older women were slaughtered, and all the young women were made as sex slaves. Being in captivity and especially as a sex slave, life becomes as in a hell. These monsters had no humanity, not even considering there is life in them. Many instances had been narrated by Nadia, where she had to live on like an animal. Basic needs including clothing were denied to them, the punishments they had to face when attempting to escape were beyond imagination. Resilience was the power for her to strive back and come back in life. it's her ability to withstand adversity and bounce back made her what

she is today. She is the survivor and not a victim anymore. She is commonly known as Yazidi survivor, who battled against the terrible atrocities and now an author of the bestselling memoir and the recipient of Nobel Peace Prize. She is the person who had dared to rise up from the torment and went on to do her best to remedy it not only for herself for others who are still suffering. Nadia Murad Basee Taha, she belongs to one of the oldest religious minorities in the world. She and her sister were transported to Mosul like animals and tortured. As slaves, they were sold and traded by the militants and kept as sex slaves in their captor's house. She managed to escape from there and reached Germany in 2015. It's only through her open writings that the world was awakened to the horrors of sexual trafficking and brutalities at the hands of ISIS. In 2015, Amal Clooney appeared before the UN to represent Nadia Murad and said: "She was burned with cigarettes, she just endured the most brutal acts known to humanity". As a woman she had to face immmerable pains that cannot be even imagined by any human. While reading, we can feel the burden of pain and sufferings endured by her, we feel like empathizing with her to the situation. She fought against the cruelties that she had to face only for the fact that no other human being on earth should be in the same situation again. As woman, we feel to be resilient in many situations hoping to strike back on time. Resilience makes us more powerful than being reactive on every situation. We have often heard that there is much power in silence, as it gives us more power and energy to come back. Nadia is just one name than represents many among us who are still fighting in the dark to come out. Let she be a model for others to rise up and take action. Every woman is special in their own way and we come together to be the changing force. We should believe in ourselves and should begin to accept ourselves. Changes should begin from ourselves, we need to remove the taboos and restrictions imposed on us. I would to quote the wordings of Elizabeth Edwars to define the struggles Nadia had to encounter "She stood in the storm and when the wind did not blow her way, she adjusted her sails".

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Kochi Chapter

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Resilient response of mechanical-cement stabilized laterite gravel

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Abstract. Rapid economic growth is leading to ubiquitous expansion in highway projects around the world. Utilization of natural aggregate resources for the construction of flexible pavement has led to uncontrollable quarrying in the state of Kerala, India. The recent landslides in Kerala is the aftermath of extensive quarrying activities. Utilization of treated native soil in the subbase and base layers of flexible pavement can widely avert the danger associated with ecological imbalance due to quarrying. In this study, engineering properties of mechanical-cement stabilized laterite gravel were investigated for their effective utilization as a subbase course material in flexible pavements. The effects of cement content and the curing age on the resilient modulus and permanent strain of laterite gravel-stone chips-cement (LSC) mixes were investigated. A mix of 70% laterite gravel + 30% stone ships stabilized with 7% cement was obtained as the optimum mix. The optimum LSC mix with a 28-day curing period exhibited 55% higher resilient modulus and 78% lower permanent strain than the conventional granular subbase (GSB). On the basis of finite element analyses of flexible pavement, it was found that the pavement with optimum LSC mix in subbase exhibited a design life ratio of 1.29 and 1.13 with respect to that of pavement with conventional granular subbase corresponding to rutting and fatigue failure criteria.

Keywords: Laterite soil, cement, unconfined compressive strength, resilient modulus, California bearing ratio.

1 Introduction

The depletion of natural aggregate resources triggered new technologies for the implementation of marginal materials in road construction. Use of native soil in the base and subbase layers of flexible pavement is an innovative technology to minimize the exploitation of the natural aggregate resources, especially in an environmentally fragile state like Kerala. Several researchers have done various studies on both the mechanical and chemical stabilization of laterite soil.

Joel and Agbede found that partial replacement with 45% sand significantly improved the gradation of the laterite soil [1]. The 55% laterite and 45% sand mix when stabilized with 6% cement resulted to a stiff cemented mix of UCS value > 3 MPa. The compaction characteristics of laterite were significantly improved by the addition of cement [2]. In another study, 8% crushed steel slag were added to laterite for increasing the maximum dry density [3]. Laterite stabilized with 8% crushed steel slag gave a CBR

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Contents

$$V_{st} = V_w \phi + V_s \tag{12}$$

However, the void fraction cannot be measured directly and needs to be calculated using the following equation:

$$\phi = \frac{A}{p} + B.q_s + C.q_f^2 + D.e^{-\left(\frac{dp}{dt}\right)^2} + E \tag{13}$$

The unknown constants A, B, C, D, and E are assumed to be -1 each to determine the value of ϕ. Since, $\frac{dp}{dt}$ cannot be computed for $t = 1$, the initial guess for ϕ is taken as 0.5. The values of ϕ obtained from Eq. (13) are substituted in Eqs. (11) and (12). The values of V_{wt} and V_{st} obtained from Eqs. (11), (12) are substituted in Eq. (10). This was followed by minimizing the sum of squares of errors between the LHS and RHS of Eq. (10). This minimization was performed using the SLSQP optimizer from the SciPy library in Python.

Since the conditions inside a boiler vary rapidly, the predictive model needs to account for these variations. Such an adaptive model can be developed by performing regression on the newly fed data as well and changing the regression coefficients accordingly. To achieve this dynamism, the multivariate regression is performed on sets of 100 data samples. That is, the first set consists of samples from $t = 1$ to $t = 100$, the second set ranges from $t = 2$ to $t = 101$, and so on. The regression coefficients obtained after each iteration are used to obtain the void fraction at the last time step. Using this value, the apparent volume of water at the next time step is calculated and compared with the original value to determine the error. For example, after performing regression on the first set $\{t = 1 : 100\}$, the values of regression coefficients obtained are used to calculate V_w for the 101st time step. Using the V_{wt} and V_{st} values obtained from this process were substituted in the energy balance Eqn. [1] of boiler which is expressed as follows:

$$e_1 \times \frac{dV_{wt}}{dt} + e_2 \times \frac{dp}{dt} = q_f h_f - q_s h_s + Q \tag{14}$$

where

$$e_1 = \rho_w h_w - \rho_s h_s \tag{15}$$

$$e_2 = V_{st} \frac{\partial \rho_s h_s}{\partial p} - V_{wt} \frac{\partial \rho_w h_w}{\partial p} \tag{16}$$

Now, after determining the LHS, the only unknown in Eq. (14) is the heat of combustion, i.e., Q. Since Q cannot be measured, the amount of heat available at an instant is expressed as the sum of fractions of fuel consumptions over a certain period of time. Through trial and error this period was determined to be 25 min. Hence, the amount of heat available at an instant is expressed as:

Table 1 Ergonomic methods for evaluating risk factors for MSDs associated with driving [24, 25]

Types of methods	Name of techniques	Main features
1. Self-reports	1. VIDAR-Self-evaluation of the driver using videos of the driving process 2. Interview, category data, and visual analog scales 3. Evaluation of possible ergonomic risks employing a web-based tracking system	1. Driver load ratings and associated pain and discomfort estimations 2. Identification of variables that increase a driver's psychosocial risk for shoulder and neck pain 3. List of comfortable ergonomic positions that might help prevent discomfort, workplace stress, and functional restrictions
2. Observational methods	1. RULA 2. REBA 3. OWLS 4. QEC 5. LUBA 6. Checklist 7. NIOSH lifting equation	1. Concepts like body postures and force, together with action levels for evaluation 2. Elements of biomechanics include body postures and force, with activity levels for assessment 3. Force and body posture evaluation 4. Driver reactions to major body areas, as well as scores to suggest intervention 5. Angular displacement of the joint from neutral and discomfort evaluation 6. Displacement of neck, legs and trunk for repeated tasks 7. Driving posture is associated with biomechanical stress
2.a. Advanced observational methods	1. Video analysis 2. ROTA 3. TRAC 4. HARBO 5. SIMI motion	1. Hand/finger posture assessment, repetitiveness, force, velocity, and body postures are computed. Task evaluations, both static and dynamic 2. Static and dynamic task evaluation 3. Posture and activity analysis 4. Observation of different driving activities over a long period 5. Dynamic movements of the limbs and upper body are assessed

(continued)

1 Introduction

A space shuttle is a partially reusable rocket-launch vehicle meant to go into orbit about Earth, to transport people and cargo to and from orbiting spacecraft. Recent years have displayed increasing study and advancement in reusable and low-cost space travel with an uptick in the commercial space launch market. A considerable factor for the increase in the expense of space travel is the non-reusability of the space shuttle. During the re-entry of a space shuttle, a substantial amount of heat is generated as it reaches the atmosphere of the earth from space [1]. Temperatures exceeding 2000 K are produced due to the friction between vehicle and air. Since most metals and alloys cannot withstand these temperatures, a special class of materials known as ablators that act as heat shields are used. The ablator will be consumed in the heat, thus dissipating a large amount of heat. However, these conventional wing designs have numerous limitations. Due to the large number of forces acting on the wing during re-entry, the reusability is limited as the wing material gets consumed during re-entry [2]. Also, the wing can get damaged due to the same.

To overcome this, we have developed a new retractable wing mechanism that resembles the Japanese hand-fan, such that the wings of the space shuttle will be completely ducked inside the fuselage during re-entry, thus minimizing the influence of forces (here, the forces of gravity, drag, lift, etc., are considered) acting on the wings, which can result in a safer and economic space journey. The aerodynamic force coefficients of drag and lift forces are estimated numerically using CFD tools for five different deploying phases to study the effectiveness of the novel design. Based on the above analysis, this paper studies the aerodynamic performance of a space shuttle equipped with deployable wings, with an expectation of proving theoretical foundation and technical base for conceptual space shuttle design.

2 Materials and Methods

2.1 Geometry Acquisition

The conceptual modeling was performed in SOLIDWORKS 2016. The material selected for the model is a composite material using a heterogeneous composite material bonded by adhesives for making the wing structure lighter [3, 4]. The dimensions of the model were inherited from the famous Russian space shuttle BURAN, and the wing cross-section was modeled based on NACA 4412 aerofoil profile. It has a maximum thickness of 12% at 30% chord and maximum camber of 4% at 40% chord length, and a side view of the wing profile is presented in Fig. 1. The wingspan is 23.9 m which is equivalent to the BURAN space shuttle wingspan.

10 Effect of Exfoliation on Structural and Electrochemical Properties

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10.1 INTRODUCTION

The term exfoliation represents a process during which the layered bulk materials are expanded through a chemical or physical method to overcome the weak inter-layer forces that hold the layers together. Generally, the stacked layered materials seized together by van der Waals forces can be easily intercalated or exfoliated by solution methods or simple physical means such as shear or ultrasonic vibrations to form 2D nanosheets. The exfoliated 2D nanosheets are often composed of single or few layers of atoms, and most importantly several of their properties are largely deviated from the bulk. Such materials find applications in electronics, photonics, catalysis, supercapacitors, fuel cells, batteries, etc. [1]. The success of graphene triggered the development of other 2D structured nanomaterials, especially by the exfoliation of layered bulk inorganic materials. Unlike bulk materials, 2D nanosheet counterparts exhibit unique electron and phonon transport characteristics, which leads to several fascinating properties such as thermal conductivity, ion transport, and charge carrier concentration, besides the structural and mechanical properties.

Many of the 2D nanosheets are non-toxic and can be handled easily, and they can be cast to any substrate as a thin film for device fabrication [2]. Over the years, exfoliated 2D nanolayers have become an essential part of electrochemistry, mainly in sensing, energy, and environmental applications. 2D carbon allotropes such as graphene and 2D porous carbon are not electrochemically active by themselves; therefore, they are often doped/modified by heteroatoms such as B, P, and N or transition metals. The high charge conductivity of the 2D carbon materials is highly favorable for several electrochemical applications such as batteries, supercapacitors, sensors, and catalysis. The stability of several inorganic 2D nanosheets in acidic and basic media makes them attractive for the aforesaid applications and they are considered as the immediate replacement for expensive noble metal electrocatalysts [3].

MXenes are 2D nanolayers of metal carbides, carbo-nitrides, and nitrides, an important class of electroactive 2D nanomaterials that are developed lately. $Ti_3C_2T_x$ is the first MXene discovered in 2011. So far about 50 different types of MXenes with wide chemical and structural variations are synthesized by exfoliating MAX phases by selective etching and mechanical shearing. MAX phases represent a family of ternary carbides and nitrides. MXenes are unstable in oxygen-containing environments. The hydrophilic nature and high surface charge of MXene nanosheets make them stable in polar solutions for device printing. The ability of MXenes to intercalate various cations including multivalent ions and polar organic molecules between its 2D layers makes them apt for non-lithium-ion batteries and supercapacitors [4]. Alike graphene, MXene exhibits excellent electronic conductivity and can be functionalized, hybridized, and doped for tuning the properties to meet the requirements of a specific application.

Many non-noble metal electrocatalysts are inactive and unstable in acidic mediums. The reaction in an acidic medium is highly efficient at a high current density. Transition metal dichalcogenides (TMDs) are highly active electrocatalysts for sensing, batteries,

supercapacitor, water splitting, etc., especially in acidic and harsh environments. TMDs have the general formula MX_2, where M is the transition metal and X is the chalcogen (X = S, Se, and Te), having a similar layered structure to those of graphene. Alike any other 2D layered nanosheets, TMDs can be doped, functionalized, and hybridized for improving various operating parameters such as selectivity, sensitivity, and affordability in sensing and efficiency, stability, and life span in catalysis. Additionally, TMDs have good electronic and mechanical properties favorable for electrode materials [5].

2D nanosheet of layered hydroxides (LDHs) and oxides are also an important class of electrochemical materials, starting from sensing to fuel cells. The presence of oxyl and hydroxyl groups allows the efficient transport of ions when they are used as electrodes in energy storage. The possibility of intercalation of ions other than Li^+ makes them a promising candidate for non-lithium-ion batteries. The electronic conductivity of LDHs and oxides are poor, therefore these materials are often hybridized with carbon-containing conductive materials as an effective strategy to increase the intrinsic catalytic activity. In this chapter, the electrochemical applications of the exfoliated 2D nanosheets in batteries, supercapacitors, biological sensing, and water splitting are discussed concisely. The underlying mechanism of electrochemical activity of different classes of 2D layered nanosheets is different. Such unique characteristics of different classes of 2D nanosheets favorable for the respective applications are also explored in this chapter.

10.2 ELECTROCHEMICAL SENSORS

A large number of sensors are used in our daily life to monitor and modify ourselves and our surroundings in a positive way. Electrochemical sensors have the largest share among all the chemical sensors, which use an electrochemical reaction (parameters such as a change in current and impedance) of the analyte to quantify the concentrations. Analytes electrochemically interact with the active material to produce signals and the sites on which such interactions happen are known as electrochemically active sites. Usually, the concentration of electrochemically active surface area increases with the surface area of the active material. Interestingly, exfoliation of 2D materials increases the surface area and exposes active sites, which may not be active otherwise. Often, exfoliated materials take part in the electrochemical reaction or act as a host to molecules such as enzymes that catalyze the reaction. Exfoliation, being a top-down approach results in defects that can also have a positive influence on the electrochemical reactions because of their very high activity. Apart from this, the extend of exfoliation, lateral size, etc. is also critical in deciding exfoliated material's electrochemical activity [6].

Graphene, which is a carbon allotrope, is the first known material to be exfoliated into atomically thin layers from its bulk counterpart graphite. Graphite can be easily exfoliated by mechanical cleaving. This can be used as an advantage in sensing where the fouling of the electrode material is a serious concern. The detection of material like bisphenol-A involves the polymerization of the analyte molecules and results in the deposition of the material on the surface of the electrode, which results in the electrode fouling. Exfoliated graphite helps in tackling this issue wherein a mild polishing results in the removal of the polymerized products from the surface as described by Ndlovu et al. [7]. Figure 10.1 schematically represents how exfoliation acts as a tool to challenge the fouling issues in electrochemical sensing.

Graphite oxide samples are usually exfoliated using thermal shock to achieve high quality and are electrochemically active for the detection of hydrogen peroxide and this is extensively reported by many researchers. Moolayadukkam et al. in 2020, in detail, explained the effect of solar exfoliation on the H_2O_2 sensing performance. Exfoliated graphene sheet has more defect concentration, which acts as the electrocatalytically active sites by adsorbing the analyte molecules. These adsorbed analyte molecules are electrocatalytically oxidized and corresponding signals can be recorded with a technique such as chronoamperometry. Figure 10.2 schematically shows graphene layers with defects/pores and their activity in adsorbing H_2O_2 molecules (analyte) [8].

Non-carbonaceous materials are electrocatalytically more active and their exfoliation has revolutionized electrochemical sensing research and developments. Layered 2D TMDs offer a wide variety of materials that can be exfoliated and having electrical properties varying from metallic to semiconducting nature. The peculiar arrangement of each atomic layer in TMDs offers a variety of active sites for the analyte adsorption in each layer after the exfoliation process. This property is widely used in the efficient detection of biomolecules. MoS_2 is one of the most widely used TMDs for sensing and other applications. Ashwathi et al. studied the relation between the analyte affinity and the active material by taking MoS_2 and Hg (II) ions as an example. In this particular example, Hg (II) ions have a high affinity toward S-containing groups. Exfoliation leaves S on both the surfaces of nanosheets exposed while the Mo layer at the center acting as the backbone. This arrangement of atoms improves the sensitivity by many folds clearly showing exfoliation of 2D TMDs could be used as an effective method for fine-tuning sensing capabilities [9].

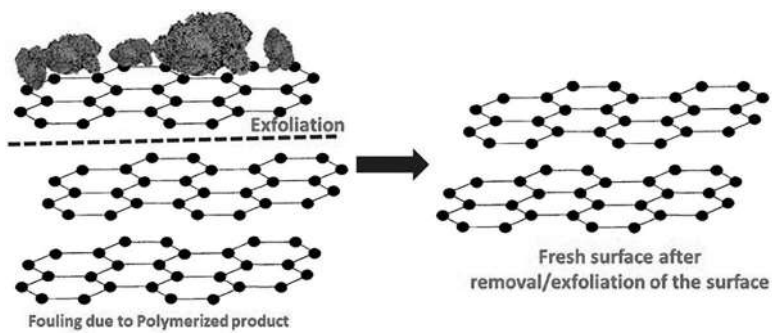

FIGURE 10.1 Shows how exfoliation of the material helps tackle the fouling issues in sensing.

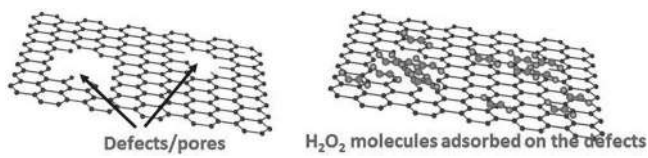

FIGURE 10.2 Schematic representation showing the importance of defects in adsorbing the analyte molecules on the graphene surface.

LDHs are another class of materials that can be exfoliated to form molecular layers with metal as the center layer. Compared to TMDs, LDHs have the advantage that there may be more than one metal in the metallic center layer, and varying the ratios of metals at the center and the metals themselves can tweak the sensing properties [10]. Sahoo et al. studied the sensing properties of ultrasonically exfoliated Ni_2Co-LDH with dopamine, an important biomolecule. The electron transfer rates are reported to be improved on moving from bulk to the monolayers of the LDH. Going from bulk to monolayers could help decrease the electron scattering at the active material, which can have a positive impact on the sensing properties [11]. Strong dependence of the exfoliation on the sensing properties is also reported by Chia et al., Authors explained the effect of exfoliation using enzymatic glucose sensing as a tool. Exfoliated 2D sheets show better sensing properties because of the high surface area and thin nature. Thinner sheets result in a decreased distance between adsorbed enzyme and the electrode, which facilitates efficient electron transfer. Polymeric 2D material, graphitic carbon nitride also shows similar sensing properties upon exfoliation. Kesavan et al. exfoliated graphitic carbon nitride using ultrasonication technique and demonstrated the flutamide (FLT) sensing properties. With the help of impedance spectroscopic studies, they have shown that active sites and conductivity are increased as a result of exfoliation. Along with this, the affinity of FLT and nitrogen on the graphitic carbon nitride played an important role in improving the sensing properties [12].

Irrespective of the layered material, exfoliation is observed to have a significant influence on the sensing properties. Exfoliation results in exposing active sites and the reduction in thickness resulting in better absorption of the analyte molecules and better electron transfer characteristics. Apart from this, the method of exfoliation induces different types of defects on the 2D crystal, the electron density on these defects such as edges and pores have an impact on the electrocatalysis of the analyte molecule. Carefully altering the method of exfoliation, sensing capabilities of the materials could be extended.

10.3 WATER SPLITTING AND FUEL CELLS

Water is an abundant source of energy and splitting water in a most economic route is a serious research concern in recent years for the production of hydrogen and oxygen. Hydrogen is considered the most advantageous renewable source of energy and the availability of oxygen is critical for the treatment of patients affected with COVID 19. Oxygen is also important for the complete combustion of any fuel, including hydrogen. The commercial electrocatalysts containing noble metals are currently used in fuel cells as hydrogen evolution reaction (HER), oxygen evolution reaction (OER), and oxygen reduction reaction (ORR) catalysts. The involvement of noble metals in crucial energy-related applications such as a fuel cell increase the installation and operation cost tremendously. Recently, several non-noble metal electrocatalysts are introduced as a replacement for noble metals and their derivatives. Several 2D layered nanosheets prepared by intercalation/exfoliation are subjected to HER and OER/ORR. Many are identified as potential replacements for noble metals in their respective applications. A list of widely studied exfoliated 2D materials as electrocatalysts are discussed in this session.

10.3.1 Hydrogen Evolution Reaction (HER)

The evolution of hydrogen by electrochemical water splitting can be a feasible way of storing hydrogen for energy-related applications, especially for fuel cells. Over the years, noble metals are broadly used as an efficient catalyst for HERs. However, the high cost of noble metals limits their extensive use as a catalyst at a large scale. To overcome the high cost of noble metal catalysts, electroactive materials that are available in abundance are proposed as catalysts. However, the major challenges of most non-noble materials used in HER are (1) the low efficiency, well below the thermodynamic limits of the water-splitting reaction and (2) the short lifetime [13]. Materials containing transitions metals are very active for HER. Though HER can be performed either in an acid $\left(2H^+ + 2e^- \leftrightarrow H_2\right)$ or basic $\left(2H_2O + 2e^- \leftrightarrow H_2 + 2OH^-\right)$ medium, a basic medium is commonly preferred due to the short-term stability of many materials in the acid medium. Similarly, due to stability issues, pure metals are avoided for HER reactions. To improve the performance of electroactive materials par to the noble metals several strategies are adopted. The suitability of a nanostructured material as an electrocatalyst depends on the surface area, presence of defects such as oxygen vacancies, availability of active sites on the surface, and dopants. The surface area plays an important role in HER since HER is a surface-active reaction.

Materials with the layered structure are identified as a suitable candidate for the HER since the layered materials are often characterized by the presence of multivalent transition metals in their crystal structure and the synergic interaction of these elements can augment the catalysis by offering many active sites for catalyzing the reaction. Interestingly, the conductive flexible 2D nanosheets enable the easy access of the electron from the catalyst substrate to the surface through intimate contact. As a result, the interfacial electron transfer resistance can be reduced and electrons can circulate through the external circuit efficiently [14]. The most active sites of exfoliated 2D materials for HER are located along the edges of the layers, but its performance is currently limited by the density and reactivity of active sites. The unprecedented HER activity of the layered materials is observed when they are exfoliated by intercalating a charged ion such as Li and Na, and thereby surface area is increased enormously in addition to the increased electrical conductivity. The overall HER activity is determined by how well hydrogen atoms can be adsorbed on the catalyst surface [14].

Among the layered materials, the introduction of exfoliated TMDs is a breakthrough in the history of non-noble metal catalysts for HER. Chemically exfoliated layers of dichalcogenides such as MoS_2, WS_2, CoS_2, VS_2, and NiS_2 are extensively studied as a promising electroactive HER catalyst. The above materials exhibit a low overpotential in the range of 100–250 mV vs reversible hydrogen electrode in an acidic medium. Overpotential is the measure of the efficiency of a material for a water-splitting reaction and it represents the loss of the applied voltage. The overpotential of platinum/carbon commercial electrodes are ~30–50 mV. The layered materials without exfoliation or intercalation are often inactive as in the case of MoS_2. The ultra-thinning and 2D nanosheet formation create an abundance of HER active sites at the edges [15]. Moreover, the planar mobility of electrons along the 2D layer guarantees rapid electron transfer from the substrate to active sites. The exfoliated transition metal selenides and tellurides are also reported as electroactive materials for HERs.

For instance, exfoliated WSe_2, $MoSe_2$, $MoS_{2(1-x)}Se_{2x}$, $MoTe_2$, WTe_2, $MoSe_2/WSe_2$, VSe_2, etc. 2D nanosheets exhibited a superior performance than the bulk counterparts. Doping noble metals such as Pt and Ru to the 2D chalcogenides can increase the catalytic activity tremendously. $MoSe_2$ is an n-type semiconductor, converting $MoSe_2$ to a p-type semiconductor by Nb or Ta doping reduces its activity toward HER [16].

MXene (layered metal nitrides and carbides) is a new family of exfoliated materials and potential electrocatalyst for HER, MXene adopts a general formula of $M_{n+1}X_nT_x$ ($n = 1–3$), where M is a transition metal such as Mo, V, or Ti, X is C and/or N, and Tx represents surface functional groups such as H or OH. Despite the high surface area, MXenes are characterized by excellent hydrophilicity and conductivity. Interestingly, the active HER sites for MXene are located on the O^* basal plane, which makes them ideal for HER [17]. The HER activity of MXene is enhanced by modifying the transition metal, during which the Gibbs free energy for hydrogen adsorption is improved, subsequently, one can obtain a decreased barrier energy for hydrogen production [18]. MXene combined with nanostructured platinum is widely used as the electrocatalyst. $Mo_2TiC_2T_x$, $Ti_3C_2T_x$, $V_4C_3T_x$, $Mo_2TiC_2T_x$, etc. are some representative MXene electrocatalysts for HER.

Layered carbon allotropes such as graphene and its oxide exhibit poor adsorption toward hydrogen; therefore, they are not efficient catalysts for HER. However, these materials are extensively used as supporting materials for electroactive elements and nanostructures. The graphene decorated with electroactive nanostructures of Pt, Ni-Mo-N, Ni, CoP, MoS_2, $ReSe_2$, WS_2, etc. is identified as excellent catalysts for HER in a basic medium. In addition to the large surface area, the high conductivity of the graphene/graphene oxide significantly reduces the interfacial electron transfer resistance between the catalyst support and the active sites, which ultimately improves the efficiency toward HER.

10.3.2 Oxygen Evolution Reaction (OER) and Oxygen Reduction Reaction (ORR)

The electrochemical generation of oxygen through water splitting is critical in metal-air batteries and fuel cells. The electrochemical OER ($2H_2O \rightarrow O_2 + 4H^+ + 4e^-$) and ORR ($O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$) are four-electron transfer reactions. Due to the complicated multi-electron transfer steps, the ORR/OER suffers from sluggish kinetics. Similar to HER, noble metals and their derivatives exhibit low overpotential for both ORR (e.g., Pt) and OER (e.g., IrO_2 and RuO_2) applications. 2D nanolayers are unique due to a large number of surface atoms as compared to the internal atoms, which makes them highly electroactive for a variety of applications. Exfoliated 2D materials like graphene and graphene oxide, inorganic monolayer materials such as metal oxides, TMDs, LDHs, MXenes, diatomic hexagonal boron nitride, and black phosphorous (BP or phosphorene) are studied as potential candidates for OER and ORR applications. In addition to the planar strength, exfoliated 2D materials are flexible with an atomic or few-layer thickness. Interestingly, the most single or few layers of graphene, carbon nanosheets (CNS), TMDs, LDHs, and MXenes are exfoliated from their bulk, and these are the most extensively studied 2D materials for OER application.

To overcome the scarcity of OER electrocatalysts for acid medium the transition metal dichalcogenides (TMD) are proposed. The exfoliated 2D nanosheets of MoS_2, TaS_2, WS_2, $MoSe_2$, etc. either in 1T and 2H polymorphic forms are the common electroactive catalysts for OER. The performance of the above materials for OER is par to stable IrO_2. Liquid phase and ion intercalation are the most common routes for the exfoliation of TMDs nanosheets from the bulk by overcoming the weak van der Waals interaction among layers. The step-by-step exfoliation of bulk TMDs using Isopropyl alcohol and the preparation of electrodes using exfoliated nanolayers are shown in Figure 10.3. Alike HER, the dominant active sites of TMDs for OER are on the edges rather than the surface [19]. The dichalcogenides of noble metals such as Rhenium-, Ruthenium-, and Iridium- exhibit exceptional activity toward OER and ORR.

Unlike in the HER, MXenes themselves are not directly active for ORR or OER electrocatalysis; however, they serve as excellent supports for various electroactive materials. MXenes are better catalyst support for Pt nanoparticles or Pt/Pd atoms than carbon as in the commercial Pt/C electrode for OER due to the strong interaction between Pt and the respective MXene layers. Likewise, other electroactive materials such as metal-organic frameworks, carbon nitride, LDHs, oxides, borate, sulfides, and metals bound to the surface of MXenes also exhibited superior OER activity par to the commercial noble metal catalysts. Hybrid TMD–MXene-like materials are recently introduced as OER catalysts. The heterostructure of the above hybrids allows the synergistic interactions between TMDs and MXenes and one can achieve a significant improvement in the OER activity.

Carbon allotropes themselves are not active for OER or ORR, though when doped with heteroatoms (B, S, N, P, F, and O) or transition metals (Ni, Co, Fe, etc.), they become excellent ORR and OER catalysts. The conductivity of graphene, 2D porous

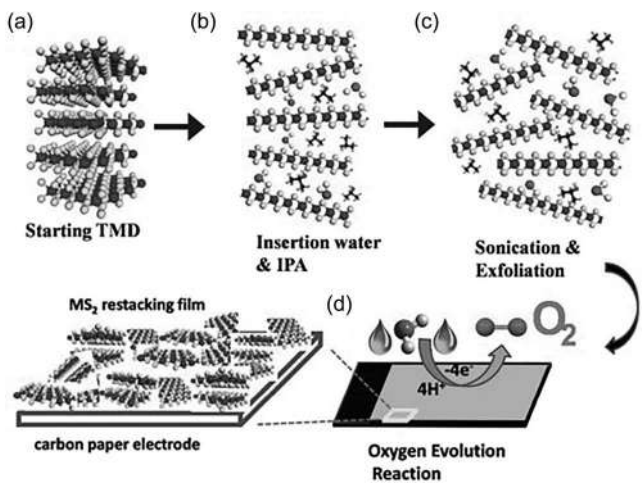

FIGURE 10.3 Schematic representation of step-by-step electrode fabrication process using exfoliated TMDs. (a) Starting TMD, (b) Insertion water and IPA, (c) Sonication and exfoliations, and (d) application for OER (Wu et al. 2016). Reprinted with permission from © 2016 John Wiley and Sons.

carbon, and graphitic carbon nitride (g-C_3N_4) layers can significantly reduce the interfacial resistance between the electroactive materials or the active sites and the current-carrying substrate. Additionally, as discussed in the case MXenes, the exfoliated 2D carbon layers are commonly used as a support for nanosized or atomic catalytic materials. MoS_2, Fe_3O_4, FeP, Ni_2P, CoP_2, CoO_x, NiO, etc. are some representative nanoparticles grown on 2D carbon materials for OER. Nevertheless, the long-term stability of carbon-based electrocatalysts is inferior to MXenes. Both MXenes and 2D carbon allotropes are mostly sought for OER and ORR in a basic medium.

Among the OER catalysts, layered double hydroxides (LDHs) are extensively studied as a potential replacement for noble metal catalysts due to their compositional and structural flexibility in addition to the simple preparation routes. Often LDHs adopt a formula either $M_x^{2+}M_{1-x}^{3+}(OH)_2\left(A^{n-}\right)_{\frac{x}{n}}.\ yH_2O$ or $M_x^{1+}M_{1-x}^{4+}(OH)_2\left(A^{n-}\right)_{\frac{x}{n}}.\ yH_2O$; where M is a metal and A is the intercalating anion. In LDHs, every single layer is composed of edge-sharing octahedral MO_6 moieties (M stands for metal) as shown in Figure 10.4. The color code used in the figure are: purple for metals, red for oxygen, and grey for inter-layer anions and water molecules. If d_1 is the inter-layer distance before intercalation, the inter-layer distance increases after intercalation to d_2 and $d_2 > d_1$. One can observe the change in interlayer spacing under an electron microscope and the subsequent change in the crystal structure from X-ray diffraction. The transition metal oxides (TMOs) with *d*-orbitals can effectively bind oxygen species on its surface, which is an essential requirement for OER/ORR catalyst. The substitution of elements in M^{2+} and M^{3+} sites can fine-tune the electronic as well as the catalytic properties of LDHs. Exfoliated LDHs formed by a combination of the transition metals, Ni-Co, Ni-Fe, Co-Fe, Co-Co, Ni-Mn, Co-Mn, etc. are some representative low overpotential electrocatalysts for OER in a basic medium among the non-noble metal catalysts.

Exfoliated layered perovskite with the general formula ABO_3 (A and B can be occupied by a large number of elements in the periodic table) and delafossite with the general formula AMO_2 is also studied as potential OER catalysts [20]. The above oxides with transition metals such as Co, Ni, and Fe at one of the sites are excellent OER catalysts. Such oxides are stable than the carbon-containing catalysts under oxidative environments and offer a competitive catalytic property comparable to noble metals.

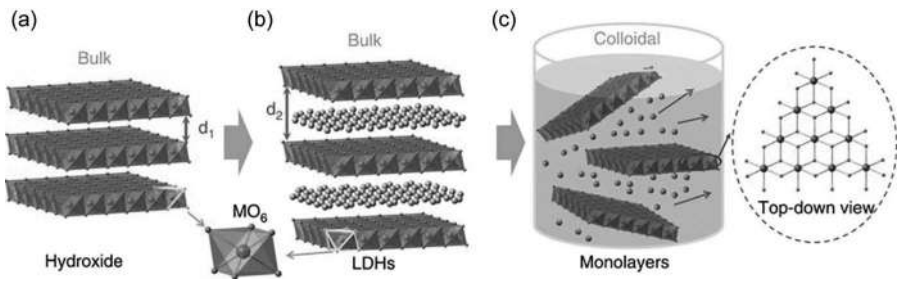

FIGURE 10.4 (a) Structure of layered hydroxides, (b) LDHs intercalated with a layer of anions and water molecules, and (c) exfoliated LDH monolayers in a colloidal solution (Song and Hu 2014). Reprinted with permission from © 2014 Springer Nature.

10.4 SUPERCAPACITORS

Supercapacitors bridge the gap between rechargeable batteries and conventional capacitors. But one of the major restrictions of supercapacitors is their lower energy density than the rechargeable batteries. There are several reported attempts to improve and enhance the energy density of supercapacitors. Supercapacitors mainly consist of electrodes, electrolytes, current collectors, sealants, and separators. The selection and design of the electrode materials have a major role in the overall performance of a supercapacitor as it determines the ionic conductivity, surface area, and chemical and thermal stability [21].

Supercapacitors are categorized mainly into two, based on their charge storage mechanism, one is electric double-layer (EDLC) or faradaic capacitor where energy is stored via non-Faradaic electrostatic interaction and the other one is pseudocapacitor where the energy storage is accomplished through Faradaic redox charge transfer reactions [22]. When 2D layered nanomaterials are used as electrodes in both Faradaic and non-Faradaic storage systems, the charge is mainly stored at the basal plane of the layered nanosheet, i.e., with the larger planar area. Additionally, the presence of active edge sites and the weak van der Waals gap between the nanosheet layers of 2D nanomaterials offer enhanced and suitable electrochemical performance in supercapacitors. Here in this section, the most commonly used exfoliated 2D nanosheets of both carbon-based and non-carbon-based are discussed in detail.

Graphene is one of the most common 2D layered carbon sheets with a hexagonal lattice structure, widely investigated for supercapacitor applications. The kinetics of an electrode material mainly depends on the transportation and diffusion of electrolyte ions. Due to the lack of enough edge planes and surface charges, monolayer graphene is considered one of the most chemically and electrochemically inert materials [23]. During the charge storage process, graphene acts as a superior active material as the electrolyte ions like Na^+, K^+, etc., can be stored electrostatically on the electrode. But the agglomeration of graphene nanosheets due to the strong van der Waals interaction limits the full utilization of graphene surface for ion adsorption. The agglomerated structure extremely limits the direct access to the charge-storage surfaces, which finally leads to the increase in ionic resistance at the electrode [24]. Higher agglomeration, hydrophobicity, and the random orientation of graphene nanosheets restrict the availability of ions on the active surface. Thus, the morphology of the electrode materials plays a vital role in the charge storage mechanism of supercapacitors.

Stoller et al. developed chemically modified graphene (CMG) electrodes with good electrical conductivity and a specific surface area of 705 $m^2 g^{-1}$, by chemical functionalization of monolayer graphene. The CMG electrode materials exhibited a specific capacitance of 135 F g^{-1} in aqueous electrolyte (5.5 M KOH) and 99 F g^{-1} in the organic electrolyte [25]. Most reported graphene-derived electrode materials exhibited lower specific surface area than their theoretical value (2,630 $m^2 g^{-1}$). But the Ruoff group reported KOH-activated thermally exfoliated graphene oxide and microwave exfoliated graphene oxide (MEGO) electrode material, which exhibited an ultrahigh specific surface area value of 3,100 $m^2 g^{-1}$, a high electrical conductivity (~500 $S.m^{-1}$), high content of sp^2-bonded carbon, and low hydrogen content. The KOH-activated MEGO electrode exhibited a notable high energy density (~70 Wh kg^{-1})

and power density (~250 kW kg^{-1}) at a current density of 5.7 A g^{-1} [26]. El-Kady et al. fabricated a graphene-based supercapacitor via laser irradiation of a graphene oxide film coated on a flexible substrate mounted in a LightScribe DVD optical drive. The graphene oxide sheets stacked in the film were reduced and exfoliated simultaneously upon laser irradiation and this structure restricts the agglomeration of graphene sheets and also the open pores in them facilitate the easy accessibility of electrolyte on the electrode surface. The resultant laser-scribed graphene sheets exhibited a high specific surface area of 1,520 $m^2 g^{-1}$, good mechanical flexibility, and high electrical conductivity (1,738 $S.m^{-1}$) [27]. Miller and his group fabricated supercapacitor electrodes using radio frequency plasma-enhanced chemical vapor deposition in which vertically oriented graphene nanosheets were deposited on a heated Ni-substrate. They showed a specific surface area of ~ 1,100 $m^2 g^{-1}$ and effective filtering of 120 Hz current with a resistance-capacitance time constant value less than 0.2 ms. With the exposed edge planes the vertically aligned graphene nanosheets showed enhanced charge storage as compared to the flat graphene nanosheets [28]. The exceptional properties and promising application of graphene in energy storage devices have triggered a remarkable interest in exploring other non-carbon 2D layered nanostructures with versatile properties.

Non-carbon-based 2D layered nanomaterials have been considered as a potential candidate for supercapacitor electrodes owing to their unique physical and chemical properties such as high electronic conductivity, tunable surface chemistry, more surface-active sites, dual non-faradaic and faradaic electrochemical performances, and larger mechanical strength. 2D non-CNSs include TMDs (MoS_2, WS_2, TiS_2, ZrS_2, $MoSe_2$, WSe_2, etc.), layered metal-oxides, hexagonal boron nitride (h-BN), LDHs, graphitic carbon nitride (g-C_3N_4), and MXenes (Ti_3C_2, V_2C, Ti_2AlC, TiAlC, Ti_3CN) [29]. Among TMDs, 2D MoS_2 nanosheets are a potential supercapacitor electrode material that exhibits large electrical double layer capacitance (EDLC) owing to their stacked sheet-like structure, and large pseudocapacitance due to the different Mo oxidation states (+2 to +6). Tour and his co-workers developed vertically aligned/edge-oriented MoS_2 nanosheets that offer a high capacitive property with more van der Waals gaps and rendered reactive dangling bonds sites for the electrolyte ions. Areal Capacitance of 12.5 mF cm^{-2} was obtained for sponge-like vertically aligned MoS_2 electrodes [30]. Layered 2D TMOs exhibit exceptionally high surface area and high conductivity as they are capable of holding charged ions on their surface without intermixing. Supercapacitors based on layered TMOs feature superior cyclic stability, high energy density, and high discharge currents. Commonly used 2D layered TMOs include MnO_2, NiO, Co_3O_4, and RuO_2. MnO_2 possesses low conductivity and thus they require a conductive matrix of graphene or metal foam. Peng et al. fabricated a supercapacitor electrode integrating 2D graphene and 2D MnO_2 into a planar capacitor design that was highly flexible [31].

2D LDH sheets are a class of multi-metal clay materials that consist of metal cations brucite layers octahedrally surrounded by hydroxyls forming $M^{2+}(OH)_6/M^{3+}/M^{4+}(OH)_6$ octahedra. Their high redox activities can be attributed to their unique properties like cations, easy tenability in their host layers and they are capable of exchanging anions without disturbing the structure. In NiAl-LDH, its electrochemical

property is due to a mixed mechanism comprising of 'electron hopping' along with the layers of LDH and the migration of protons from the host layer to the solution [32]. MXenes have become a widely accepted supercapacitor electrode material with their impressive electrochemical properties due to their unique 2D structure and well-defined geometry. MXenes are one of the fast-growing materials among 2D materials, which include metal carbides, nitrides, and carbonitrides. One of the promising features of MXene is the exceptionally large interlayer spacing, which helps in the de/intercalation of ions like Na^+, Li^+, etc. Mainly hydrogen bonding and van der Waals bonding interactions act between the MXene layers. To produce MXene single flake suspensions, water, cations, tetrabutylammonium hydroxide (TBAOH), dimethylsulfoxide (DMSO), etc. are intercalated into the MXene interlayer spacing followed by the sonication process. In the H_2SO_4 electrolyte, $Ti_3C_2T_x$ shows a high volumetric capacitance of ~1,500 F cm^{-3} (380 F g^{-1}), and the conductive, transparent $Ti_3C_2T_x$ films are used to fabricate solid-state transparent supercapacitors [33].

10.5 LITHIUM-ION BATTERY

Lithium-ion batteries (LIBs) are the answer to many of the energy storage-related challenges. LIBs become an essential part of everyday life. LIBs work by the rocking chair mechanism wherein the lithium ions are moved between the anodes and cathodes. The electrodes play an important role in storing the lithium ions by the intercalation and deintercalation reactions. Historically, layered materials have played an important role in the development of LIBs by allowing the layered structures of the electrodes like graphite to intercalate lithium ions. Currently, LIBs use a wide variety of electrodes having mechanisms such as insertion, alloying, and conversion reactions [34]. Electrodes with higher rate capability, higher charge capacity, and (for cathodes) sufficiently high voltage can improve the energy and power densities of Li batteries and make them smaller and cheaper. The fast-paced life around the globe is forcing researchers to focus on materials that can be charged faster and hold more energy per volume and weight. Layered materials are often helpful in achieving faster lithium-ion diffusion and have a higher capacitive contribution. Owing to compelling electrochemical and mechanical properties, exfoliated 2D nanomaterials have been propelled to the forefront in investigations of electrode materials in recent years.

Exfoliated 2D nanomaterials are exceedingly desirable as anodes and cathodes. As anodes, the famous candidates are graphene and graphene-based composite materials, including carbon nanotubes/graphene, nonmetal/graphene, TMOs/graphene, sulfide/graphene, and salts/graphene. As cathodes, exfoliated 2D nanomaterials have remarkable electron transport velocity, high theoretical capacity, and excellent structural stability. The exfoliation of bulk material and Li^+ insertion was represented in Figure 10.5, which shows easier paths for lithium-ion storage.

Graphite is the most traditionally used anode in LIBs, which is a layered material. Expansion and exfoliation of the graphite are well reported by various researchers. Graphite as such shows a theoretical capacity of 372 mAh g^{-1}. Due to good electrical conductivity, high surface area, and greater mechanical flexibility, graphite exfoliation has attracted the most attention for fabricating high-performance electrode material for LIB. Lithium may bond both graphene sheet sides as well as edges and

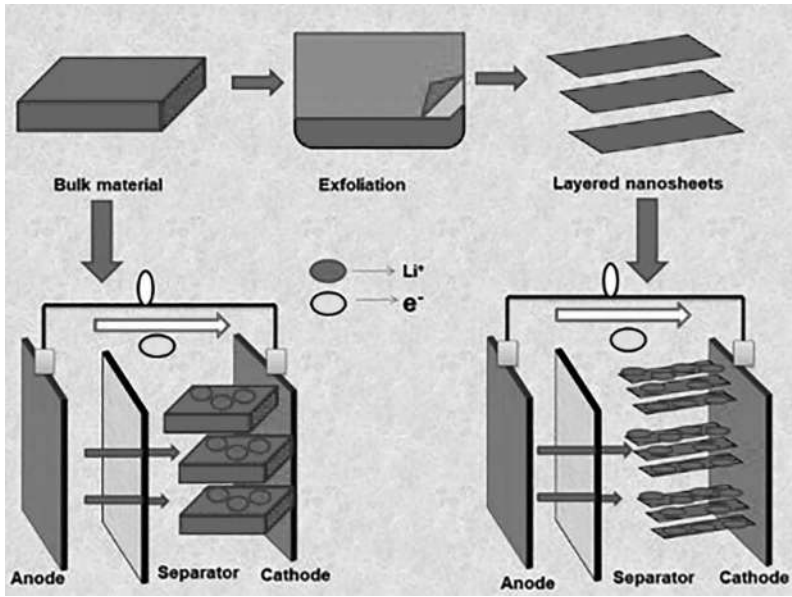

FIGURE 10.5 Sketch of the exfoliated layered material as a cathode for Li^+ insertion in LIBs.

covalent sites. Recent studies demonstrated that the small lateral sizes of narrow graphene nano-ribbons can accommodate Li^+ ions at the edges sites more efficiently than basal sites, thus leading to maximum Li-storage in the form of Li_4C_6. The probable defects formed during the exfoliation process become an advantage in such cases. Apart from this, graphene nanosheets are widely used to make composites with other electrode materials. In materials like silicon, graphene sheets are also used to give cushioning effect to accommodate the high volume change during the lithium uptake.

Exfoliated carbons are trustable electrodes for lithium battery electrodes but lack high capacity, which restricts the overall capacity of the batteries. Exfoliated 2D group V nano-crystals have a greater theoretical capacity than graphite. Exfoliation of these metallic electrodes is challenging because of the stability issues. Among them, layered 2D antimony has the potential as electrode material for LIBs, owing to their large interlayer distance in their layered structure, high capacity, long mean free path, and environmental friendliness. The theoretical capacity of antimony is moderate therefore other 2D materials are also explored as LIB electrodes. The layered transition metal oxides (LTMOs) require a special mention in LIBs. The exceptional feature of these materials is the presence of an interlayer region that serves as the host for ion intercalation. The extensive interlayer spacing and weak interlayer bonding of LTMOs permit the intercalation of an enormous variety of guest species, like cations, polymers, and anions. LTMO has excellent electronic and ionic conductivity, the attainability of interlayer sites for the intercalation of cations from the electrolyte, and the ability to undergo redox reaction property for high energy density LIB. Several mechanisms are possible when LTMO is in contact with an electrolyte like intercalation, conversion, double layer capacitance, conversion, and pseudocapacitance [35].

2D TMDs consist of greater specific capacity and larger interlayer spacing, which permit a quick Li^+ insertion/extraction process without persuading noteworthy volume changes [36]. Exfoliated layers of chalcogenides such as MoS_2, $NbSe_2$, WS_2, $MoSe_2$, $TaSe_2$, and $MoTe_2$ nanosheets are widely used for the LIB. Among them, MoS_2 is an exciting electrode material for LIBs due to its high theoretical capacity. MoS_2 nanolayers allow intercalation of Li^+ ions into the structure without noteworthy volume change and charging and discharging prevent the disintegration of active material. Based on the reaction $MoS_2 + 4Li^+ + 4e^- \leftrightarrow 2Li_2S + Mo$, the electrochemical reaction of Li with MoS_2 involves 4 moles of Li per mole of MoS_2. The main concern of MoS_2 layered nanomaterial is low electronic conductivity and poor cyclic stability [37].

Another class of materials that is gaining recent attention is MXenes, which possess 2D layered structure. The main advantage of MXene as electrode material for the energy storage device is the separation between MXene layers that can be controlled systematically. MXenes usage as anode for LIBs was first reported by Naguib et al. [38]. The MXenes prepared by Naguib showed improved surface area by ~10-fold as compared with graphene since MXenes exhibit improved specific capacity. Layered morphology of the electrodes always had a positive impact on LIBs by facilitating the rocking chair mechanism. Fast charging and higher capacities are repeatedly reported as a result of exfoliation. Structural changes during the exfoliation are usually acting in favor of the intercalation of more lithium ions to the electrodes. Therefore, exfoliated 2D materials are going to have a large impact on the future development of LIBs.

10.6 CONCLUSIONS

Exfoliated 2D nanosheets have gained considerable attention from the research community in recent years. The development of various 2D nanosheets of different origins allows the researchers to resolve numerous bottlenecks associated with many electrochemical devices, especially in sensors, fuels cells, supercapacitors, and batteries. Though exfoliation is a top-down approach, it can produce reasonably good quality nanosheets in large quantities, which is essential for device fabrication at a large scale. Interestingly the defects generated during exfoliation favor electrochemical activity than the ones prepared by chemical vapor deposition with fewer defects. The exfoliated 2D materials are expected to play an important role in the further advancements in electrochemical devices in the coming years.

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Personality Prediction using Machine Learning

Hima Vijay ; Neenu Sebastian All Authors

Abstract: This paper uses the k-means clustering machine learning technique to classify people's personalities. Several prior studies have attempted to estimate a person's personal... **View more**

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Abstract:
This paper uses the k-means clustering machine learning technique to classify people's personalities. Several prior studies have attempted to estimate a person's personality type automatically. One of the most important applications of machine learning algorithms is to distinguish individuals based on their personality types. There are many benefits to classifying people according to their categories. Identifying one's personality can contribute a lot in today's world with great opportunities. Each individual can choose their career or other interests based on these predictions. In present world many organizations rely on these personality predictions while shortlisting candidates as this increase the efficiency of the work because the person is working in what he is good at than what he is forced to do. The project classifies personalities using K-means clustering algorithms and big five model.

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Contents

I. Introduction

Personality refers to an individual's distinctive patterns of thoughts, feelings, and behaviours. Personality tests can cover a wide range of topics, such as reading figure out what your talents, limitations, temperament, and leadership style are.

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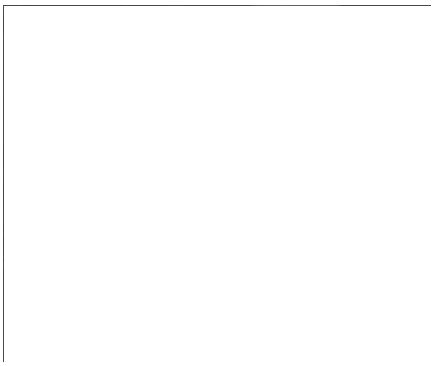

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Attendance Management System Using Facial Recognition

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In a classroom, keeping track of attendance is a difficult and time-consuming task. Here comes the importance of automated techniques for attendance marking. Facial recognition is necessary for automated attendance tracking methods. This suggested study uses face detection algorithms to provide an attendance marking system. The primary goals of this endeavor are to accurately record attendance and speed up the procedure. This lessens peoples' workloads as well. This Proposed system is implemented using 4 Steps such as Finding all faces, Posing and working faces, Encoding faces, Finding the person's name from the encoding

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Contents

Today, recording someone's presence through their attendance is crucial for every organization. Being present in an organization is evidence that a person is honoring their commitment to that agency or organization. Attendance is typically taken by hand. It may be signed or referred to individually. To be able to accelerate and give time efficiency in this digital age, a change from this lack is necessary. Face recognition allows us to keep track of attendance for every person present in a company.

Sentence Similarity - A State of Art Approaches

T Nora Raju ; P A Rahana ; Raichel Moncy ; Sreedarsana Ajay ; Sindhya K Nambiar **All Authors**

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This paper draws up a summary of the different approaches to sentence similarity methods. Sentence similarity has a important place in different applications of natural language processing. Plagiarism check, question answering, information retrieval, text summarization, text classification are some of the natural language processes where sentence similarity finds its applications. The existing works on text similarity have been discussed by approaching through 3 methods: String-based, Knowledge-based, and Corpus-based similarity. Relatedness between short texts is measured by each approach based on a specific perspective. Moreover, the introduction of datasets that are mostly used as benchmarks for the evaluation of techniques in this field provides an absolute view on this issue. Better results are obtained when approaches that combine more than one perspective are used.

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Contents

I. Introduction

Amidst the evolution of the digital world, the internet has become the ultimate information hub. New data keeps getting added on a regular basis into the internet. The addition of all human languages and the digitalization of all data calls for the need for sentence similarity.

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Speech Emotion Recognition Using Bagged Support Vector Machines

Bini Omman ; Shallet Mary T Eldho **All Authors** •••

Abstract: Speech emotion popularity is one of the quite promising and thrilling issues in the area of human computer interaction. It has been studied and analysed over several deca... **View more**

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Speech emotion popularity is one of the quite promising and thrilling issues in the area of human computer interaction. It has been studied and analysed over several decades. It's miles the technique of classifying or identifying emotions embedded inside the speech signal.Current challenges related to the speech emotion recognition when a single estimator is used is difficult to build and train using HMM and neural networks,Low detection accuracy,High computational power and time.In this work we executed emotion category on corpora — the berlin emodb, and the ryerson audio-visible database of emotional speech and track (Ravdess). A mixture of spectral capabilities was extracted from them which changed into further processed and reduced to the specified function set. When compared to single estimators, ensemble learning has been shown to provide superior overall performance. We endorse a bagged ensemble model which consist of support vector machines with a gaussian kernel as a possible set of rules for the hassle handy. Inside the paper, ensemble studying algorithms constitute a dominant and state-of-the-art approach for acquiring maximum overall performance.

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Contents

Speech is a very natural way for humans to express themselves. As a result, it's only logical for you to extend this communication to computer programs. Speech recognition systems (SER) are a set of processes that operate together to classify and detect embedded emotions in audio files. The SER has been attracting attention for more than two decades. These unique studies make use of improvements in all areas of computer and technology, necessitating the need to update the current methodologies and procedures that enable the SER.

A comparitative study of machine learning models for the detection of Phishing Websites

Publisher: IEEE

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Josna Philomina ; K A Fahim Fathima ; S Gayathri ; Glory Elizabeth Elias ; Abhinaya A Menon All Authors

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Abstract:
Global cybersecurity threats have grown as a result of the evolving digital transformation. Cybercriminals have more opportunities as a result of digitization. Initially, cyberthreats take the form of phishing in order to gain confidential user credentials.As cyber-attacks get more sophisticated and sophisticated, the cybersecurity industry is faced with the problem of utilising cutting-edge technology and techniques to combat the ever-present hostile threats. Hackers use phishing to persuade customers to grant them access to a company's digital assets and networks. As technology progressed, phishing attempts became more sophisticated, necessitating the development of tools to detect phishing.Machine learning is unsupervised one of the most powerful weapons in the fight against terrorist threats. The features used for phishing detection, as well as the approaches employed with machine learning, are discussed in this study.In this light, the study's major goal is to propose a unique, robust ensemble machine learning model architecture that gives the highest prediction accuracy with the lowest error rate, while also recommending a few alternative robust machine learning models.Finally, the Random forest algorithm attained a maximum accuracy of 96.454 percent. But by implementing a hybrid model including the 3 classifiers- Decision Trees,Random forest, Gradient boosting classifiers, the accuracy increases to 98.4 percent.

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Contents

Since approximately a decade, internet usage has exploded, and consumers have utilised it to find and fulfil a variety of needs such as communication, shopping, money transactions, and more by using the web instead of time-consuming traditional methods [1]. The internet facilitates a variety of activities and makes life easier. Despite this, it has flaws and flaws of its own. Cybercriminals take use of the internet's flaws and exploit them to scam unsuspecting users [2]. In a recent work [3] an adaptive time-based approach was proposed for predicting the possibility of harmful assaults with great accuracy by hackers to obtain sensitive information such as account credentials, bank account information, and even social networking information by fooling and misleading the user into paying into the hacker's account, among other things. Every year, Internet users lose billions of dollars due to phishing.Phishing is one of the most known threats on gullible people, in which their private details is revealed through bogus websites. These URLs are used to pilfer the sensitive information of the users like banking and credit card details, and passwords.Those websites that look akin to those of actual websites are the ones used by the phishers. Phishing is one of the most important online security concerns. The Internet has evolved into a critical infrastructure that provides enormous benefits to human society. However, there are many issues with Internet security, such as phishing, malicious software, and data leakage, which have already affected users' finances severely.To get beyond anti-phishing software and approaches, phishers use new and hybrid techniques.Phishing is a criminal activity that uses social engineering and technical deception to obtain a consumer's personal information and bank account credentials.It is defined by the Anti-Phishing Working Group (APWG) as the criminal activity obtaining consumers' financial and personal information through deception such as fraud.[1]. Cyberattacks such as phishing are common strategies used to hack into networks, steal information, and damage property. According to Kaspersky Lab statistics, over the course of the year, 29.4 percent of user computers were exposed to at least one Malware-class web assault, and web antivirus components identified 199 455 606 distinct URLs as malicious [2]. In addition, the percentage of financial phishing detections grew from 47.5 percent to nearly 54 percent in 2017 [2]. Phishing has evolved into one of the most serious Internet security risks. The most unsafe criminal exercise in cyberspace is Phishing. Phishing comes under social engineering, which uses email or malicious websites to trick people for stealing their personal information.The phishers attack the vulnerable users by sending the fake email, which appears to come from a legitimate organization, asking to enter personal credentials like online banking details, login details and other sensitive personal data.These malicious website imitates their legitimate websites reassuring the users. Phishing messages mostly propagate over instant messengers, email, VoIP, social networking sites,short message service and so forth[2]. When users respond to these messages, they get easily trapped by the perpetrator.To prevent phishing attacks, many researches are done by different communities around the world. Some prevention methods include detecting the fake websites by implementing machine learning algorithms such as Logistic Regression, Linear Regression, SVM(support vector machine), KNN, Naive Bayes, Random Forest, K-Means and providing awareness workshops to pinpoint legitimate websites[3].

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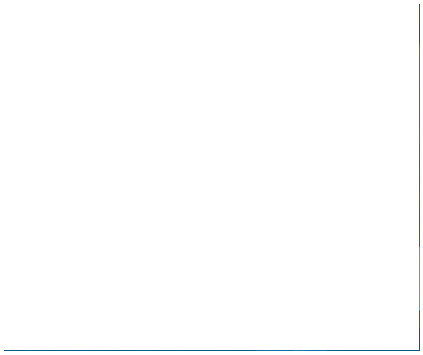

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Performance of Hybrid Satellite-UAV NOMA Systems

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Abstract: This paper investigates the performance of non-orthogonal multiple access (NOMA) based hybrid satellite-unmanned aerial vehicle (UAV) systems, where a low Earth orbit (LE... **View more**

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Abstract:
This paper investigates the performance of non-orthogonal multiple access (NOMA) based hybrid satellite-unmanned aerial vehicle (UAV) systems, where a low Earth orbit (LEO) satellite communicates with the ground users via a decode and forward (DF) UAV relay. We investigate a two NOMA users system, where a far user (FU) and a near user (NU) are served by the UAV which is located at a certain height above the origin of the coverage circle. The channel between satellite and UAV is assumed to follow a Shadowed-Rician fading and the channels between UAV and users are assumed to follow a Nakagami-m fading. New closed-form expressions of the outage probabilities for the two users and the system are derived. Different from other work in literature, we take into consideration different parameters affecting the total link budget. Additionally, we propose an algorithm for minimizing the system outage probability. The mathematical analysis is verified by extensive representative Monte-Carlo (MC) simulations. Finally, simulations are provided to demonstrate the impact of important parameters on the considered system as well as the superiority of the NOMA scheme the over reference scheme.

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Contents

Recently, satellite communication (SatCom) has withdrawn an increasing research interest due to the several advantages offering over conventional terrestrial communication such as wide coverage area, covering harsh and isolated geographical regions where conventional wired or wireless communication can't reach including maritime, deserts, and jungles. Moreover, SatCom serves well in disaster areas where the terrestrial networks are compromised. Additionally, SatCom can provide a wide range of flexible applications in the field of navigation, TV and Radio broadcasting services, Weather prediction and climate monitoring, Internet access, and satellite telephony [1]. On the other hand, SatCom networks face several challenges including operation cost [2], propagation delay [3], and signal degradation due to rain and atmospheric disturbances. Additionally, antenna-pointing errors angle caused by satellite perturbation or user's mobility may lead to communication outage [4]. Furthermore, the line-of-sight (LOS) link may be blocked by heavy shadowing or obstacles that retard communication between the satellite and terrestrial users [5]. To combat such issues, hybrid satellite-terrestrial networks (HSTNs) based on relaying have been proposed in many literature [2], [5]– [7] to increase efficiency, and enhance the performance of the user whose direct link is unavailable or deteriorated. Satellites can be stationed in a variety of orbits including Low Earth orbit (LEO), medium Earth orbit (MEO), highly elliptical orbit (HEO), and geosynchronous orbit (GEO) [8]. Recently, LEO satellites constellation networks have withdrawn a great interest due to their small propagation delay, high data rate, and lower transmit power [9]. Consequently, we consider a LEO satellite setup in this work.

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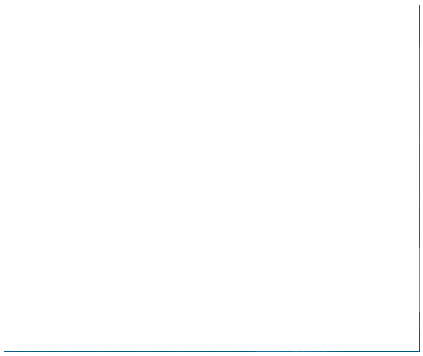

RESEARCH-ARTICLE

Multi-Domain Network Traffic Analysis using Machine Learning and Deep Learning Techniques

Authors: Dincy Arikkat, Rafidha Rehiman K A, Vinod, Suleiman Y. Yerima, Manoja, Pooja, Shilpa Sekhar, Sohan James, Josna Philomina Authors Info & Claims

IC3-2022: Proceedings of the 2022 Fourteenth International Conference on Contemporary Computing • August 2022 • Pages 305–312 • https://doi.org/10.1145/3549206.3549262

Published: 24 October 2022 Publication History Check for updates

ABSTRACT

Recent heterogeneous computing facilities and data explosion introduce challenges in network traffic analysis and demand intelligence-based approaches to ensure cyber security and the protection of online digital services. Researchers have been proposing various machine and deep learning approaches for network traffic analysis in different problem domains. However, it is also crucial to understand how these algorithms perform across the different domains. Hence in this research work we extend an analysis of diverse machine learning and deep learning techniques across three different problem domains: DDoS attack detection, Malicious URL detection and Tor traffic classification. We

andom Forest achieved superior performance compared to other machine learning models with

measure of 89% and 100% for multi-class and binary problems respectively.

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Index Terms

Multi-Domain Network Traffic Analysis using Machine Learning and Deep Learning Techniques

Computer systems organization

Dependable and fault-tolerant systems and networks

Redundancy

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Recommendations

In this paper, Big Data and Deep Learning Techniques are integrated to improve the performance of intrusion detection systems. Three classifiers are used to classify network traffic datasets, and these are Deep Feed-...

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An autonomic traffic analysis proposal using Machine Learning techniques

MEDES '17: Proceedings of the 9th International Conference on Management of Digital EcoSystems

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RESEARCH-ARTICLE

Towards energy-efficient UAV-assisted 5G internet of underwater things

Authors: Sandeep Verma, Shahbaz Akhtar, Aneek Adhya, Varun G Menon Authors Info & Claims

DroneCom '22: Proceedings of the 5th International ACM Mobicom Workshop on Drone Assisted Wireless Communications for 5G and Beyond
• October 2022 • Pages 1–6 • https://doi.org/10.1145/3555661.3560855

Published: 24 October 2022 Publication History Check for updates

ABSTRACT

Adhering to the requirements of Fifth Generation (5G) communication for seamless data gathering, especially from underwater resources, Unmanned Aerial Vehicles (UAVs)-assisted 5G Internet of Underwater Things (IoUT) have been leaving an everlasting impression. However, the resource-constrained underwater sensor nodes limit the potential of IoUT for reliable data dissemination due to their shorter operational period. To extenuate this concern, in this paper we present an Energy-Efficient Unmanned Aerial Vehicle (UAV)-assisted Routing Architecture (EEURA) for 5G IoUT. The Cluster Head (CH) is selected using Improved-Tunicate Swarm Algorithm (I-TSA). We use Energy-Harvesting (EH)-

sively better than the state-of-the-art routing methods in IoUT.

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Towards energy-efficient UAV-assisted 5G internet of underwater things

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Control path algorithms

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Context-aware gender and age recognition from smartphone sensors

Publisher: IEEE

Sajana T S ; Susmi Jacob ; Vinod P ; Varun G Menon ; Shilpa P C **All Authors**

Abstract: Smartphones include multiple sensors to track a device's movement. This research investigated the capability of smartphone motion sensors to determine the user's gender a... **View more**

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Abstract:
Smartphones include multiple sensors to track a device's movement. This research investigated the capability of smartphone motion sensors to determine the user's gender and age in different contexts. A subject's context is an action they engage in, such as sitting or standing. This paper is based on the differences in behavior between male and female smartphone users, precisely, how they hold and manage their devices. To build our approach, we use the MotionSense Dataset. This dataset contains data from accelerometer and gyroscope sensors over time (attitude, gravity, acceleration, and rotationRate). In this study, we consider multiple contexts such as walking, sitting, standing, and jogging. Our method proposes to use smartphone sensors to detect an individual's age and gender with an accuracy of 99.89% if they are seated.

Published in: 2022 International Conference on Computing, Communication, Security and Intelligent Systems (IC3SIS)

Date of Conference: 23-25 June 2022 **DOI:** 10.1109/IC3SIS54991.2022.9885610

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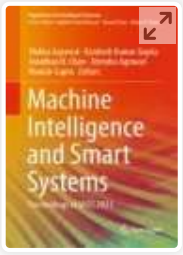

Machine Intelligence and Smart Systems pp 75–87

Underwater Image Enhancement Using Fusion Stretch Method

Litty Koshy & Shwetha Mary Jacob

Conference paper | First Online: 24 May 2022

Part of the Algorithms for Intelligent Systems book series (AIS)

Abstract

Underwater image enhancement is an effective method for improving the captured underwater images that have been damaged owing to medium dispersion and absorption. Based on the principles of fusion, this method derives the inputs and the weight maps from the image's degraded version. Two inputs representing color-corrected and contrast-enhanced versions of the original underwater image and three weight maps that seek to increase the visibility of degraded objects due to

the medium dispersion and absorption are specified here to overcome the limitations of the underwater medium. This method is a single image approach that does not need specialized hardware or underwater conditions or scene expertise. In order to facilitate the transfer of edges and color contrast to the output image, the two fusion images, as well as their associated weight maps, are identified. The detailed qualitative and quantitative assessment show that the enhanced images are distinguished by improved illumination of the dark areas, enhanced global contrast, and sharpness of the edges.

Keywords

Image enhancement **Image fusion**

White balancing **Contrast stretching**

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Deep Learning applications to detect pneumonia on chest X-ray: A systematic study

Publisher: IEEE

Neenu Sebastian ; B. Ankayarkanni **All Authors**

Abstract: Pneumonia is serious infection that affects the air sacs in our lungs of our body. Air sacs plays a vital role in the procedure of our breathing process. When the lungs a... **View more**

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Abstract:
Pneumonia is serious infection that affects the air sacs in our lungs of our body. Air sacs plays a vital role in the procedure of our breathing process. When the lungs are infected by bacterial or viral infection these air sacs will get filled with pus or fluid. As a result, this infection causes fever, cough and leads to a serious medical condition called pneumonia. The severity of this infection can range from mild to severe. It goes to a life-threatening situation in case of infants, young children and old aged people. The doctors use chest X-rays for the confirmation infection. Analyzing the chest x-rays for the detection of pneumonia infection by the doctors visually by naked eyes is time consuming process. Computer aided diagnosis helps the doctors for the faster and accurate detection of Pneumonia infection on chest X-rays. Computer aided diagnosis uses the CNN models for the confirmation of pneumonia which have achieved better performance than humanbeings

Published in: 2022 International Conference on Advanced Computing Technologies and Applications (ICACTA)

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Conference Location: Coimbatore, India

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In Dynamic Environments, How To Extend The Life Of A Wireless Sensor Network-A Review

Neethu Krishana ; G.Naveen Sundar All Authors

Abstract: In unmanned areas, wireless sensor networks are used to monitor events and environments for extended periods of time. Improving lifetime and coverage are the fundamental ... **View more**

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Abstract:
In unmanned areas, wireless sensor networks are used to monitor events and environments for extended periods of time. Improving lifetime and coverage are the fundamental challenges of wireless sensor networks. The heterogeneous environments make situations more critical. The use of a genetic algorithm to optimize sensor node scheduling can extend the life of wireless sensor networks while also reducing sensor node energy consumption. As the sensor nodes are sending huge amount of data continuously, it is very difficult to extract fruitful information from it. With the help of machine learning technique, support vector machine we can extract useful information from the sensed data. The effectiveness of machine learning algorithm can be measured through accuracy, overhead and throughput.

Published in: 2022 International Conference on Computing, Communication, Security and Intelligent Systems (IC3SIS)

Date of Conference: 23-25 June 2022 **INSPEC Accession Number:** 22050401

Date Added to IEEE *Xplore*: 15 September 2022 **DOI:** 10.1109/IC3SIS54991.2022.9885727

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Publisher: IEEE

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Wireless sensor networks consist of a group of sensors deployed in unmanned area. Each sensor consists of non-removable battery, transceiver, processor etc. In WSN the nodes communicate with each other. Each sensor in the network is called a node. When the node collects data and sends the data it loses some of its energy [9]. In this paper, an optimized scheduling technique based on Machine Learning is proposed to improve the energy efficiency of wireless sensor networks in dynamic environments. Wireless sensor network transfer collected data to the base station on a regular basis [2]. The received data consists of multiple entries of same data collected by different sensors. It is very difficult to identify which information are useful and which information are unwanted, so, using a machine algorithm SVM aids in the extraction of relevant information from data. Overall performance can be measured through parameters like throughput, packet delivery ration and routing overhead.

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Chapter

Li-Fi: A Novel Stand-In for Connectivity and Data Transmission in Toll System

January 2023
DOI:10.1007/978-981-19-1844-5_20
In book: Intelligent Communication Technologies and Virtual Mobile Networks (pp.239-255)

Authors:

Rosebell Paul
SCMS Group of Educational Institutions

M. Neeraj

P. S. Yadukrishnan

References (30)

Abstract

This paper describes an application framework which uses Li-Fi (Light Fidelity) technology to reduce the time delay and congestion caused at the toll system. The Li-Fi is a disruptive technology driven by the visible light spectrum that makes the data transmission process much faster and enhances the system efficiency. In Li-Fi, there is no interference as in radio waves and it provides higher bandwidth. It is a bidirectional wireless data carrier medium that uses only visible light and photodiodes. Everything happens very fast in this world, including transportation. In the present scenario, spending a long time in traffic is irritating. Even after the introduction of FASTag, there is not much change in toll booth queues. It is at this point where we start to think about a different plan to avoid unwanted blocks at toll booths. Hence, we introduce the concept of Li-Fi where vehicles can move through the toll booths without any pause. All that we are using here is DRL (Daytime Running Lights). This will have a corresponding receiver section which will accept the signals from the DRL. This method also has certain extra perks which will provide an interdisciplinary help to many major fields.KeywordsLi-FiLight-emitting diode (LED)TollIoT

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Pyp Singh · U P Bijnor

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O D Alao · J V Joshua · A S Franklyn · O Komolafe

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Enhanced planar wireless power transfer using strongly coupled magnetic resonance

January 2015 · Electronics Letters

Farid Jolani · Zhizhang Chen · Yiqiang Yu

A novel planar wireless power transfer (WPT) system using strongly coupled magnetic resonance is proposed. Additional layers of printed spiral coils (PSCs) are applied to the transmitter/receiver resonator of the 4-coil planar WPT system to improve the quality factor and transmission efficiency. In addition, by connecting multilayer transmitter/receiver resonators together using conductive ... [Show full abstract]

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Optically reversible switching between binary states using multistable loops

November 1993 · Applied Physics Letters

Yasunori Tokuda · Yuji Abe · Noriaki Tsukada · Shigetosi Nara

We present a novel method of optically reversible switching between binary transmission states by taking advantage of the optical multistability which can be obtained from two bistable devices optically connected in series. The basic set and reset functions were experimentally demonstrated by use of an n-i-p-i-n device in which two quantum well self-electro-optic effect devices are vertically ... [Show full abstract]

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January 2019 · Advances in Intelligent Systems and Computing

Abdul Quaiyum Ansari · Mashhood Hasan · Noorul Islam

The interline power flow controller (IPFC) has two converter/inverters connected back to back with DC link. One of the converter is knows as series inverter which improve voltage quality of the load bus and second inverter known as shunt converter is used to compensate the reactive power of load and minimize the losses of the transmission line. In this work, the impact of the IPFC is seen in ... [Show full abstract]

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Triangle-arranged method for coverage with connectivity in sensor networks

March 2007

C.-F. Xu · Shijian Li · D.-Z. Rao · Y.-H. Pan

This paper considers the problem of coverage with connectivity in large-scale unreliable sensor networks. Based on an abstract sensor network model, a novel triangle-arranged circle division method is proposed to model a sufficient condition for the network to maintain coverage with connectivity. Then using probability method, we derive the formula between the probability of coverage with ... [Show full abstract]

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155 Mb/s three-plane reconfigurable wavelength-division-multiplexed optical interconnection

December 1995 · Proceedings of SPIE - The International Society for Optical Engineering

J.E. Leight · Sven Homan · Alan E. Willner · [...] · C.J. Chang-Hasnain

The ability to efficiently connect many high-speed parts is of critical importance for large- capacity data communications. High bandwidth, 2D optical planes can be employed to achieve such an interconnection and avoid electronic bottlenecks. A novel solution which dramatically increases the functionality of optical-plane interconnections uses wavelength multiplexing to facilitate one 2D optical ... [Show full abstract]

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Trial model of the M-ary multilevel FSK power-line transmission modem

January 2003

Akihiko Oshinomi · G. Marubayashi

In this paper a design of power-line transmission system us-ing M-ary Multilevel FSK modulation is described. The sys-tem is capable of transmitting 128 kbps data over 10~450kHz band. To achieve such a high transmission rate by a spread spectrum system, a novel multi-tone modulation technique is introduced in addition to M-ary modulation. The system is conveniently called as M 3 FSK (i.e., ... [Show full abstract]

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Abstract:
Methodologies used for the detection of malicious applications can be broadly classified into static and dynamic analysis based approaches. With traditional signature-based methods, new variants of malware families cannot be detected. A combination of deep learning techniques along with image-based features is used in this work to classify malware. The data set used here is the 'Malimg' dataset, which contains a pictorial representation of well-known malware families. This paper proposes a methodology for identifying malware images and classifying them into various families. The classification is based on image features. The features are extracted using the pre-trained model namely VGG16. The samples of malware are depicted as byteplot grayscale images. Features are extracted employing the convolutional layer of a VGG16 deep learning network, which uses ImageNet dataset for the pre-training step. The features are used to train different classifiers which employ SVM, XGBoost, DNN and Random Forest for the classification task into different malware families. Using 9339 samples from 25 different malware families, we performed experimental evaluations and demonstrate that our approach is effective in identifying malware families with high accuracy.

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