

Electric vehicle and battery looping concept

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Abstract - Electric vehicles (EVs) are a modern transportation option that eliminates the need for fossil fuels by relying on electricity as their primary power source. They offer an environmentally friendly and efficient alternative for travel. Unlike traditional vehicles that use internal combustion engines, EVs operate using electric motors. The increasing development of high-capacity batteries and their implementation methods are expected to significantly boost the number of EVs in the future. However, this growth presents new challenges to ensure the safe and stable operation of power grids due to unpredictable charging demands. Additionally, the rechargeable batteries in EVs have a limited lifespan and require replacement after a certain period. Consequently, a major challenge lies in developing batteries that require less charging time. Limited vehicle range remains a significant hurdle hindering the widespread adoption of electric vehicles in India. Nevertheless, India is witnessing a revolution in electric mobility, with two-wheelers and three-wheelers leading the way. This paper focuses on an approach aimed at increasing the range of electric vehicles using existing battery technology.

Keywords: Brushless DC motor (BLDC motor), Battery looping (BL), Electric vehicle (EV), Hybrid Electric vehicle (HEV), Green House Gas Emission (GHG), Remote Execution Service (RES), Vehicle to grid (V2G)

I. INTRODUCTION

Numerous governments have raised concerns about climate change and global warming since the beginning of the twenty-first century. Extensive research and meteorological organizations have highlighted the detrimental effects of human-induced weather changes on seasons and climates. As our global civilization continues to expand and industrialize rapidly, the excessive usage of fossil fuels in transportation leads to the daily emission of significant amounts of harmful gases such as CO₂, CO, and NO_x. [1][2]

Fossil fuels being a non-renewable resource means that they will run out one day. To overcome the issues of emission from fossil fuels with the shrinking supply of it, this era has seen a shift to electric vehicles which gives zero-emission and has more renewable options for energy. But the obstacles faced by the electric vehicle are the

scarcity of charging stations as the electric vehicles require a DC power supply to charge the battery which is required to drive the vehicle. And also, the issue of charging capacity and range provided by the battery is not as efficient as it could be, so this problem can be resolved by the battery looping concept.[3][4]

Basically, the looping concept means there is a switching between two batteries when the first battery is driving the vehicle at that time another battery is getting charged once the main battery gets drained completely or until a certain level at that time the percentage of another battery is checked and if it is charged till the required level then there is switching between both batteries and the second battery drives the vehicle and at the same time the first battery gets charged and in this way, the cycle keeps on going. [5][6]

The popularity of electric vehicles (EVs) is on the rise as individuals become more conscious of the necessity to decrease greenhouse gas emissions and reduce reliance on fossil fuels. However, a primary obstacle for EVs lies in the present battery technology, which imposes limitations on the achievable range. This is where the concept of battery looping comes in. Battery looping refers to the process of reusing and repurposing used EV batteries. Rather than disposing of the batteries, they can be used in second-life applications such as energy storage systems for homes or businesses. This not only reduces waste but also increases the overall sustainability of the EV ecosystem. [7][8]

In addition, battery looping can also help to reduce the cost of EVs by lowering the cost of the batteries. This is because the batteries can be sold at a reduced price once they have reached the end of their useful life in an EV. This can make EVs more affordable and accessible to a wider range of consumers. Overall, battery looping has the potential to revolutionize the EV industry by making EVs more sustainable and affordable. As we continue to move towards a more sustainable future, battery looping will play an important role in helping us achieve our goals.

II. RELATED WORK

In this article by Chan, C. C. [1], an examination is presented on the current and future directions of electric vehicle technology. The emphasis is placed on the progress made in electric motors, power electronics,



microelectronics, and novel materials. Additionally, a comparison is drawn between different electric drive and battery systems. The article delves into the projected expansion of the electric vehicle market and explores the potential consequences of widespread electric vehicle adoption. Ding, Ning, Krishnamachar Prasad et al [2] Electric vehicles have received a lot of attention as a promising way to reduce greenhouse gas emissions. Because of advancements in power electronics, energy storage, and support, the plug-in hybrid electric vehicle (PHEV) has a competitive driving range and fuel economy when compared to traditional internal combustion engine vehicles. The efficiency of PHEVs can be greatly improved by using optimised control strategies or an energy management system (EMS). This paper explains how different types of EVs work and discusses battery and supercapacitor technology as potential ways to increase the energy capacity of PHEVs.

Garcia-Valle, Rodrigo et al. [4] This chapter explores the main drivers and obstacles surrounding the widespread adoption of electric vehicles (EVs). It also examines critical aspects of EV technology, such as charging infrastructure power levels, plug types, prevalent powertrain architectures, and available energy storage solutions. The chapter briefly discusses the controllability of EV charging and highlights its benefits for distribution grid operation and the expansion of renewable energy sources.

Ren, Qinglian, D. A. Crolla, and Adrian Morris [5] The current level of interest in electric vehicles (EVs) is of significant importance, as manufacturers and governments worldwide are showing an increasing and notable interest. This renewed interest, seen in the early twenty-first century, has been driven by both political and technological advancements, particularly the need to address global emissions and the emergence of new battery designs with enhanced specific energy, energy density, and rechargeability properties. The torque characteristic of electric motors is identified as one of the major advantages, providing maximum torque from zero to low speeds and then governed by the maximum available motor power as speed increases.

Borge-Diez, David, Daniel Icaza, Emin Açıkkalp et al. [6] Buildings represent a significant energy consumer in advanced economies. The widespread adoption of electric vehicles (EVs) can contribute to decarbonizing the economy by utilizing renewable energy for electricity generation. One strategy involves utilizing a combination of Vehicle to Grid (V2G), Vehicle to Home (V2H), and Vehicle to Building (V2B) technologies to increase the number of electric vehicles, establish better alignment between energy generation and consumption, reduce peak demand, and improve global energy efficiency. This study presents an innovative approach to combining V2H and V2B that can be applied in various scenarios, such as when building workers own EVs, when companies have shared car fleets, or in leasing arrangements. The energy recharged from

workers' homes during the night is then supplied to the building.

Kirsch, David A. [7] The popularity of electric vehicles (EVs) is increasing due to several factors, such as price reductions and growing awareness of climate and environmental issues. This paper investigates the progress of EVs in terms of battery technology trends, charging methods, and identifies new research challenges and opportunities. It includes a comprehensive analysis of the global market status and future prospects for EVs. Emphasizing the significance of the battery in EVs, the paper provides a thorough examination of battery technologies, ranging from lead-acid to lithium-ion. Additionally, it explores different standards for EV charging and presents proposals for power control and battery energy management. The paper concludes by presenting our vision for the future.

Sanguesa, Julio A., Vicente Torres-Sanz et al. [8] EVs are gaining popularity due to factors like lower prices and increased climate and environmental awareness. This study investigates the advancements in EVs, focusing on battery technology trends, charging methods, and exploring new research challenges and opportunities. It includes an analysis of the global market situation and the future prospects of EVs. Recognizing the critical role of batteries in EVs, the study provides an extensive review of battery technologies, ranging from lead-acid to lithium-ion. Additionally, it examines various EV charging standards and presents proposals for power control and battery energy management. The study concludes by outlining our vision for the future.

Tran, Martino, David Banister et al. [10] Full-battery electric vehicles (BEVs) have emerged as a significant policy option for addressing climate change, but uncertainties remain regarding the scale and timing of their market diffusion. While substantial research has focused on demonstrating the potential energy and climate benefits of BEVs, demand-side factors, particularly consumer behavior, have received less attention in discussions. We emphasize the importance of evaluating the diffusion of BEVs from an integrated perspective, considering the key interactions between technology and behavior across various scales, including power-system demand, charging infrastructure, vehicle performance, driving patterns, and individual adoption behavior.

Crabtree, George [11] Electric vehicles are poised to revolutionize almost every aspect of transportation, including fuel, carbon emissions, expenses, repairs, and driving habits.

Dhameja, Sandeep [12] Engineers and technicians involved in designing and constructing efficient power sources for electric vehicles (EVs) can benefit from understanding the operational theory and design recommendations provided by electric car battery systems. To effectively develop and maintain intricate EV battery systems, not only vehicle designers but also those involved

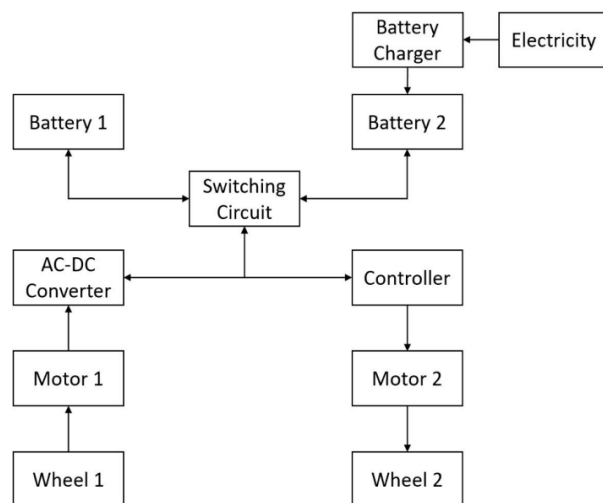


in providing recharging and maintenance services, as well as utility infrastructure providers, require the necessary technology. This includes applications for hybrid and fuel cell vehicles. The book "Electric Vehicle Battery Systems," prioritizing cost-effectiveness, offers vital information on failure mode analysis of VRLA and NiMH battery systems, fast-charging techniques for Pb-acid, NiMH, and Li-ion-based electric vehicle battery systems.

Jensen, Anders Fjendbo, Elisabetta Cherchi et al. [14] In this study, we approach the EV charging scheduling problem by formulating it as an optimal control problem. Our aim is to achieve a generalized concept of valley-filling and analyze the properties of optimal charging profiles. To solve the optimal control problem, we employ a decentralized algorithm, where EVs adjust their charging profiles based on the control signal transmitted by the utility company in each iteration. Meanwhile, the utility company modifies the control signal to guide the EVs' updates. Irrespective of the specific requirements, such as maximum charging capacity, the algorithm consistently converges to optimal charging profiles that prioritize a "flat" charging pattern.

III. METHODOLOGY

When the vehicle travels, Motor 1 will rotate using the power supplied by Battery 1, and while this process is running, Motor 2 will regenerate E.M.F, which will be stored as voltage in Battery 2. When Battery 1 exhausts, it will automatically switch to Battery 2, and Battery 2 will now be the primary source of power for all vehicle parameters such as Motor 1, Headlights, Display, Sensors, and so on, while Battery 1 will be charged by Motor 2 using the same back E.M.F concept. As a result, the vehicle's range and battery efficiency will improve.



EV Block Diagram

Figure 1: Proposed Methodology

For this design of an electric scooter, there will be a main charging socket through which the main battery will get charged and the AC power supply from the mains will get converted into a DC power supply. The 60v battery will drive the rear wheel motor. The power will be supplied through a switching circuit to the main controller. Before the main controller, the power will pass through the power distribution unit (PDU) where the power will be split into two parts where the first part will step down the power to 12v which will be used to drive other low power parameters of the vehicle like headlight, taillight, indicators, display, horn, etc.

The other part will supply the 60V to the central controller which will pass power to the motor and control it to drive the rear wheel. When the vehicle runs on the road, the front wheel will produce the back emf (electromotive force) after a set RPM (Rotations per minute) that will be in AC form. With the help of a step-up chopper, the AC power will be stepped up and converted into a pulsating DC supply. Then this DC power will pass through the switching circuit which will be stored in a second battery. The charge percentage of both batteries will be displayed on the main display of the electric vehicle for easy decision-making. Basically, the looping concept means there is a switching between two batteries when the first battery is driving the vehicle at that time another battery is getting charged once the primary battery gets drained completely or until a certain level at that time the percentage of another battery is checked and if it is charged till the required level then there is switching between both batteries and the second battery drives the vehicle and at the same time the first battery gets charged and in this way, the cycle keeps on going. There are three modes in which the vehicle will operate

Mode 1: The vehicle is standing with no wheels being driven, in this mode the rear wheel will be connected to the main battery but the drain won't be that significant. Only auxiliary components like the lights and display will be working.

Mode 2: The vehicle has begun operation. Here the main battery will provide a supply to the rear wheel during which the front wheel will charge the second battery through electromotive force.

Mode 3: Once the main battery has drained to a certain percentage, the switching circuit will switch the supply to the second battery and the main battery will begin charging from the front wheel. Once the second battery drains as well and the main battery has charged enough then it will switch back to the main battery, otherwise, the vehicle will stop.



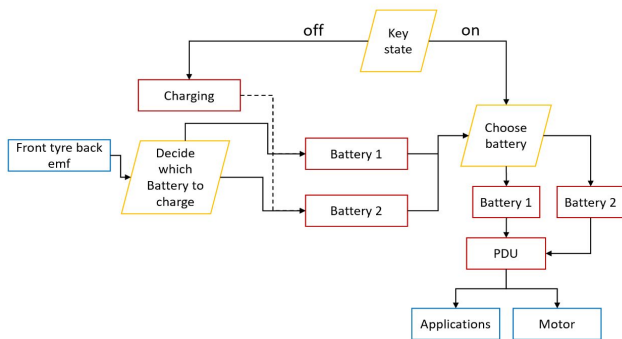


Figure 2: Flowchart of proposed system

The flowchart begins with the Key operation which has two outcomes ON / OFF. Depending on the status of the Key, the system conditions itself as Charging or ON state. In the Charging state, the charger primarily charges Battery 1 as it is the central power supply unit. In the ON state, the switching circuit chooses which battery to use i.e which battery is fully charged to produce power for motor. The Charging also consists of two modes i.e a) Charging directly from socket where the output voltage is 60V DC converted from mains (230 AC 50 Hz) via a rectifier circuit and this method only charges Battery 1, b) Charging using Back E.M.F produced from motor 2 from the front wheel which is used to charge Battery 2. Both Battery 1 and Battery 2 gives output to PDU but the switching operation is decided by the percentage of charge in both batteries. Further, PDU controls the Motor 1 and other appliances like Headlights, Lamps, Indicators, Sensors, etc

IV. HARDWARE COMPONENTS AND SPECIFICATIONS

EV SPECS		
Parameters		
Motor Specs	750 W	60V
Mass of Vehicle	150 + 60 = 210 kg	
Battery Specs	60V	36AH or 25AH
F(total)	120 N	
F(rolling)	5.886 N	
F(grad)	89.86 N	
F(aero drag)	25.143 N	
Power (req)	1166.66 W	
Battery Watt.hr	900 w.hr	
Current Rating	15 AH	
Current Rating of Charger	8A	

Table no: 1 EV Specification

A. Switching Circuit:

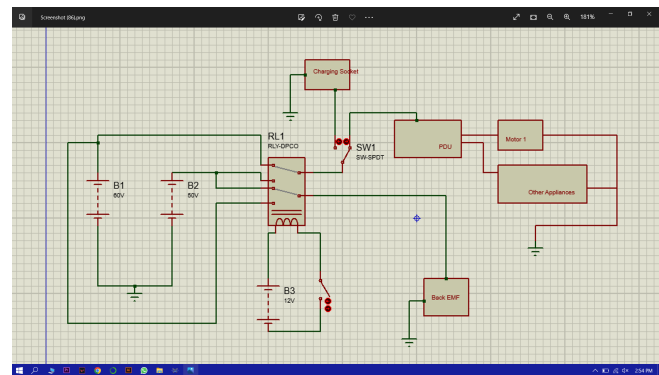


Figure 3: switching circuit

The use of DPDT (Dual Pole Dual Throw) is done to switch between Battery 1 and Battery 2 based on the Relay input. A mechanical switch will be provided to turn the Relay ON/OFF, determining the switching. The percentage level of Battery 1 and Battery 2 will be displayed on the display, and the user will operate the relay to switch the Batteries.

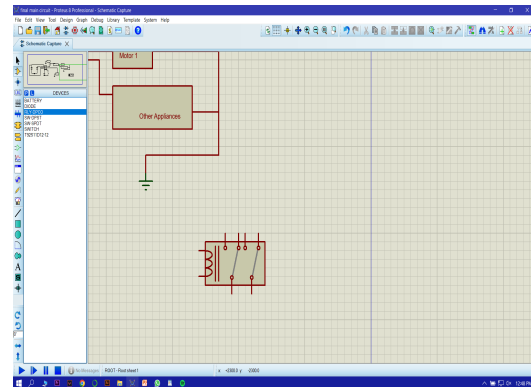


Figure 4 : Relay

A DPDT (Double Pole Double Throw) switch consists of six terminals, where two terminals function as separate inputs. Each pole of the switch has two separate circuits associated with it. This means that each input terminal is connected to two different output terminals, and all four output terminals operate independently.

B. Motor (PMDC)

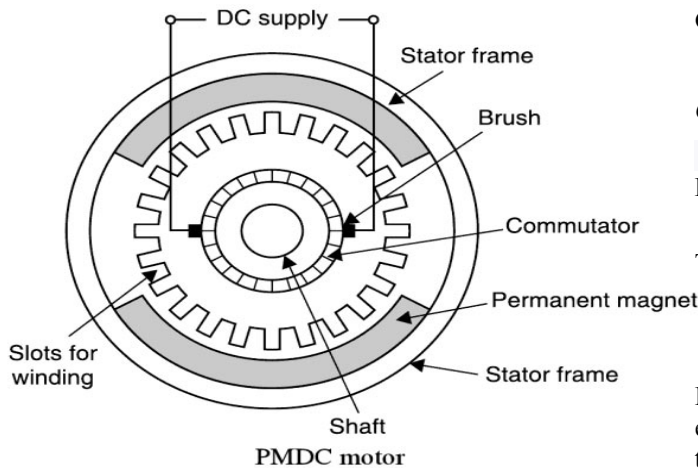


Figure 5 : PMDC Motor

The PMDC motor is generally commutated with brushes and commutators. The PMDC motor works on the DC power supply and drives the vehicle and produces the AC power supply in the form of back E.M.F.

C. Chassis



Figure 6 : Chassis

It is the body of the vehicle that holds all the electro-mechanical components including Batteries, motors, controllers, and other components such as Brakes, Suspension, Casing, Lamps, Tyres, etc.

I. PERFORMANCE METRICS

A. Speed:

$$\text{Circumference} = \text{Diameter of tyre} \times \pi$$

$$\text{Speed} = \frac{\text{RPM of Tyre} \times \text{Circumference of Tyre}}{39370.076}$$

[Note: 39370.076 are the inches in kilometer]

B. Power:

$$\text{Power} = \text{Voltage} \times \text{Current}$$

C. Charging Time:

$$\text{Charging Time (T)} = \frac{\text{Battery Capacity}}{\text{Charger Output}}$$

D. Torque of Motor:

$$\text{Torque} = \frac{60 \times \text{power(kW)}}{2\pi \times \text{Speed (RPM)}}$$

V. CONCLUSION

Electric vehicles (EVs) have wide-ranging impacts on the environment, power system, and economy, in addition to the transportation sector. They hold promise for reducing greenhouse gas (GHG) emissions and providing efficient and cost-effective transportation solutions. However, they can also present challenges to the power system, including issues like voltage instability, harmonics, and voltage sag. These challenges can be addressed through the adoption of smart grid technologies. Research opportunities exist in various areas related to EV penetration, such as vehicle-to-grid (V2G) technology, smart metering, integration of renewable energy sources (RES), and ensuring system stability. Currently, EVs primarily rely on batteries as their main source of energy. Battery technology has undergone significant advancements, rendering lead-acid and NiMH technologies obsolete.

Although Li-ion batteries are currently utilized, they often fail to alleviate 'range anxiety' in most situations due to their limited energy capacity. Therefore, the main research emphasis should be on enhancing battery capacity and durability by either developing higher-capacity batteries or implementing battery loop concepts. Essentially, the looping concept means that when the first battery is driving the vehicle, another battery is charging. When the main battery is completely drained or until a certain level, the percentage of the other battery is checked, and if it is charged to the required level, there is a switching between both batteries, and the second battery drives the vehicle while the first battery charges. In this way, we create a new concept of regenerative batteries by using prerequisite knowledge of switching and batteries. In future various machine and deep learning techniques can be utilized for analysis of battery and electrical vehicle energy management system [16-26].

VI. REFERENCES

1. CHAN, C. C. "AN OVERVIEW OF ELECTRIC VEHICLE TECHNOLOGY." *PROCEEDINGS OF THE IEEE* 81, NO. 9 (2007): 1202-1213.
2. DING, NING, KRISHNAMACHAR PRASAD, AND TEK TJING LIE. "THE ELECTRIC VEHICLE: A REVIEW." *INTERNATIONAL JOURNAL OF ELECTRIC AND HYBRID VEHICLES* 9, NO. 1 (2017): 49-66.

3. CHAN, C. C., AND K. T. CHAU. *MODERN ELECTRIC VEHICLE TECHNOLOGY*. VOL. 47. OXFORD UNIVERSITY PRESS ON DEMAND, 2001.
4. GARCIA-VALLE, RODRIGO, AND JOÃO A. PEÇAS LOPES, EDS. *ELECTRIC VEHICLE INTEGRATION INTO MODERN POWER NETWORKS*. SPRINGER SCIENCE & BUSINESS MEDIA, 2012.
5. REN, QINGLIAN, D. A. CROLLA, AND ADRIAN MORRIS. "EFFECT OF TRANSMISSION DESIGN ON ELECTRIC VEHICLE (EV) PERFORMANCE." IN *2009 IEEE VEHICLE POWER AND PROPULSION CONFERENCE*, PP. 1260-1265. IEEE, 2009.
6. BORGE-DIEZ, DAVID, DANIEL ICAZA, EMIN AÇIKKALP, AND HORTENSIA AMARIS. "COMBINED VEHICLE TO BUILDING (V2B) AND VEHICLE TO HOME (V2H) STRATEGY TO INCREASE ELECTRIC VEHICLE MARKET SHARE." *ENERGY* 237 (2021): 121608.
7. KIRSCH, DAVID A. THE ELECTRIC VEHICLE AND THE BURDEN OF HISTORY. 2000.
8. SANGUESA, JULIO A., VICENTE TORRES-SANZ, PIEDAD GARRIDO, FRANCISCO J. MARTINEZ, AND JOHANN M. MARQUEZ-BARJA. "A REVIEW ON ELECTRIC VEHICLES: TECHNOLOGIES AND CHALLENGES." *SMART CITIES* 4, NO. 1 (2021): 372-404.
9. SUH, NAM PYO, DONG-HO CHO, AND CHUN T. RIM. "DESIGN OF ON-LINE ELECTRIC VEHICLE (OLEV)." IN *GLOBAL PRODUCT DEVELOPMENT: PROCEEDINGS OF THE 20TH CIRP DESIGN CONFERENCE*, ECOLE CENTRALE DE NANTES, NANTES, FRANCE, 19TH-21ST APRIL 2010, PP. 3-8. SPRINGER BERLIN HEIDELBERG, 2011.
10. TRAN, MARTINO, DAVID BANISTER, JUSTIN DK BISHOP, AND MALCOLM D. MCCULLOCH. "REALIZING THE ELECTRIC-VEHICLE REVOLUTION." *NATURE CLIMATE CHANGE* 2, NO. 5 (2012): 328-333.
11. CRABTREE, GEORGE. "THE COMING ELECTRIC VEHICLE TRANSFORMATION." *SCIENCE* 366, NO. 6464 (2019): 422-424.
12. DHAMEJA, SANDEEP. *ELECTRIC VEHICLE BATTERY SYSTEMS*. ELSEVIER, 2001.
13. YOUNG, KWO, CAISHENG WANG, LE YI WANG, AND KAI STRUNZ. "ELECTRIC VEHICLE BATTERY TECHNOLOGIES." IN *ELECTRIC VEHICLE INTEGRATION INTO MODERN POWER NETWORKS*, PP. 15-56. NEW YORK, NY: SPRINGER NEW YORK, 2012.
14. JENSEN, ANDERS FJENDBO, ELISABETTA CHERCHI, AND STEFAN LINDHARD MABIT. "ON THE STABILITY OF PREFERENCES AND ATTITUDES BEFORE AND AFTER EXPERIENCING AN ELECTRIC VEHICLE." *TRANSPORTATION RESEARCH PART D: TRANSPORT AND ENVIRONMENT* 25 (2013): 24-32.
15. GAN, LINGWEN, UFUK TOPCU, AND STEVEN H. LOW. "OPTIMAL DECENTRALIZED PROTOCOL FOR ELECTRIC VEHICLE CHARGING." *IEEE TRANSACTIONS ON POWER SYSTEMS* 28, NO. 2 (2012): 940-951.
16. A. SONAWANE, M. U. INAMDAR AND K. B. BHANGALE, "SOUND BASED HUMAN EMOTION RECOGNITION USING MFCC & MULTIPLE SVM," *2017 INTERNATIONAL CONFERENCE ON INFORMATION, COMMUNICATION, INSTRUMENTATION AND CONTROL (ICICIC)*, 2017, PP. 1-4, DOI: 10.1109/ICOMICON.2017.8279046
17. BHANGALE, KISHOR, AND K. MOHANAPRASAD. "SPEECH EMOTION RECOGNITION USING MEL FREQUENCY LOG SPECTROGRAM AND DEEP CONVOLUTIONAL NEURAL NETWORK." IN *FUTURISTIC COMMUNICATION AND NETWORK TECHNOLOGIES*, PP. 241-250. SPRINGER, SINGAPORE, 2022.
18. BHANGALE, KISHOR BARASU, AND K. MOHANAPRASAD. "A REVIEW ON SPEECH PROCESSING USING MACHINE LEARNING PARADIGM." *INTERNATIONAL JOURNAL OF SPEECH TECHNOLOGY* 24, NO. 2 (2021): 367-388.
19. BHANGALE, KISHOR & KOTHANDARAMAN, MOHANAPRASAD "SURVEY OF DEEP LEARNING PARADIGMS FOR SPEECH PROCESSING" *WIRELESS PERSONAL COMMUNICATIONS*. 1-37. 10.1007/S11277-022-09640-Y, 2022.
20. BHANGALE, KISHOR B., PRANOTI DESAI, SALONI BANNE, AND UTKARSH RAJPUT. "NEURAL STYLE TRANSFER: RELIVING ART THROUGH ARTIFICIAL INTELLIGENCE." IN *2022 3RD INTERNATIONAL CONFERENCE FOR EMERGING TECHNOLOGY (INCET)*, PP. 1-6. IEEE, 2022.
21. BIRADAR, PRIYA, PRIYANKA KOLSURE, SUJATA KHODASKAR, AND KISHOR B. BHANGALE. "IOT BASED SMART BRACELET FOR WOMEN SECURITY." *INT. J. RES. APPL. SCI. ENG. TECHNOL.(IJRASET)* 8, NO. 11 (2020): 688-691.
22. SARRAF, RAJAN, SHALINI OJHA, DAMINI BIRARIS, AND KISHOR B. BHANGALE. "IOT BASED SMART QUALITY WATER MANAGEMENT SYSTEM." *INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS* 5, NO. 3 (2020).
23. MAPARI, RAHUL, KISHOR BHANGALE, LAUKIK DESHMUKH, PRASHANT GODE, AND ANKIT GAIKWAD. "AGRICULTURE PROTECTION FROM ANIMALS USING SMART SCARECROW SYSTEM." IN *SOFT COMPUTING FOR SECURITY APPLICATIONS*, PP. 539-551. SPRINGER, SINGAPORE, 2022.
24. ANAND, TEJVEER, SOURABH UPARE, SIDDHANT JAIN, MAITHILI ANDHARE, AND KISHOR BHANGALE. "DEPLOYMENT OF REAL-TIME ENERGY MONITORING SYSTEM USING IOT." IN *2022 3RD INTERNATIONAL CONFERENCE FOR EMERGING TECHNOLOGY (INCET)*, PP. 1-4. IEEE, 2022.
25. MAPARI, RAHUL G., KISHOR B. BHANGALE, PRANJAL PATIL, HARISH TIWARI, SHIVANI KHOT, AND SANJANA RANE. "AN IOT BASED AUTOMATED HYDROPONICS FARMING AND REAL TIME CROP MONITORING." IN *2022 2ND INTERNATIONAL CONFERENCE ON INTELLIGENT TECHNOLOGIES (CONIT)*, PP. 1-5. IEEE, 2022.
26. MAPARI, RAHUL G., HARISH TIWARI, KISHOR B. BHANGALE, NIKHIL JAGTAP, KUNAL GUJAR, YASH SARODE, AND AKASH MAHAJAN. "IOT BASED VERTICAL FARMING USING HYDROPONICS FOR SPECTRUM MANAGEMENT & CROP QUALITY CONTROL." IN *2022 2ND INTERNATIONAL CONFERENCE ON INTELLIGENT TECHNOLOGIES (CONIT)*, PP. 1-5. IEEE, 2022.

