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Speed Control of DC Motor Using Arduino

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Abstract: *This project presents the design and development of a DC motor speed control system using the Arduino. DC motors are widely used in applications such as robotics, electric vehicles, and industrial automation due to their simple construction and ease of control. However, precise speed regulation is essential for improving efficiency and performance. In this system, Pulse Width Modulation (PWM) is used to control motor speed by varying the effective input voltage [1-10]. The Arduino generates PWM signals that are applied through a motor driver circuit, enabling smooth and accurate speed variation [11-69].*
The system consists of key components including a DC motor, motor driver, power supply, and control interface. It allows real-time speed adjustment and ensures stable operation under different load conditions. The design is simple, cost-effective, and energy-efficient, making it suitable for various practical applications. Additionally, the system can be enhanced by integrating sensors and advanced control techniques such as PID control or IoT-based monitoring for improved performance, remote access, and data analysis..

Keywords: *Armature voltage , Field flux, ResistanceBack EMF, Torque ,PWM, Load ,Speed regulation***.**

I. INTRODUCTION

Speed control of a DC motor is a fundamental concept in electronics and embedded systems, widely used in robotics, automation, and industrial applications. A DC motor's speed depends mainly on the voltage applied to it, and by varying this voltage in a controlled way, we can regulate how fast the motor rotates.

The Arduino IDE paired with the Arduino Uno microcontroller board provides an easy and flexible platform to implement DC motor speed control. Instead of directly changing voltage levels, the Arduino uses a technique called **Pulse Width Modulation (PWM)** to simulate different voltage levels. By adjusting the duty cycle of the PWM signal, the average power delivered to the motor is changed, thereby controlling its speed.

Typically, a motor driver module (such as the L298N or L293D) is used between the Arduino and the DC motor because the Arduino cannot supply enough current to drive a motor directly. The Arduino generates PWM signals, and the motor driver amplifies these signals to control the motor's direction and speed safely.

In summary, DC motor speed control using Arduino Uno demonstrates a practical application of PWM, electronics interfacing, and embedded programming, making it an important project for beginners and engineers alike.

II.PROBLEM STATEMENT

DC motors are widely used in industrial automation, robotics, and embedded systems due to their simple structure and efficient performance. However, controlling their speed accurately is essential for achieving desired performance, improving efficiency, and ensuring system stability.

The problem is to design and implement a system that can control the speed of a DC motor using an Arduino microcontroller. The system should be able to adjust motor speed smoothly based on user input or sensor feedback, while maintaining stability under varying load conditions.

Traditional mechanical or manual control methods are inefficient and lack precision. Therefore, an electronic control system using PWM (Pulse Width Modulation) generated by an Arduino is required to regulate the voltage supplied to the motor, thereby controlling its speed effectively.

The objective is to achieve:

- Accurate and adjustable speed control of the DC motor
- Efficient response to input changes (e.g., potentiometer or sensor input)
- Stable operation under different load conditions
- Cost-effective and simple hardware implementation

This system aims to provide a reliable and programmable solution for DC motor speed control in real-time applications.

III. LITERATURE SURVEY

DC motor speed control has been a significant area of research in the fields of electrical engineering, robotics, and industrial automation. A DC motor is widely used because of its simple structure, high efficiency, and excellent torque characteristics. However, controlling its speed accurately and efficiently is a challenging task, especially under varying load conditions. Over time, researchers have developed various control techniques ranging from simple voltage control to advanced microcontroller-based intelligent systems. Among these, Arduino-based control systems have become highly popular due to their low cost, open-source architecture, and ease of integration with hardware components.

1. Conventional Methods and Limitations

Earlier methods of DC motor speed control included rheostatic (resistance-based) control and field control techniques. In rheostatic control, a variable resistor is used to control the voltage applied to the motor. Although simple, this method is highly inefficient due to significant power loss in the form of heat. Field control methods, used in separately excited DC motors, adjust the magnetic field strength to control speed, but they are limited in response time and are not suitable for compact embedded systems. These limitations led to the development of electronic control systems using power electronics and microcontrollers.

2. PWM-Based Speed Control Technique

One of the most widely accepted modern techniques is Pulse Width Modulation (PWM). PWM controls the effective voltage supplied to the motor by varying the duty cycle of a square wave signal. When the duty cycle increases, the motor receives more average voltage and rotates faster; when it decreases, the speed reduces. Research studies confirm that PWM is highly efficient because switching devices operate in ON/OFF mode, minimizing power losses.

The Arduino platform is capable of generating PWM signals through built-in functions making it ideal for real-time motor control applications. Literature also highlights that PWM ensures smooth speed variation, reduced noise, and improved energy efficiency compared to linear control methods.

3. Arduino-Based Motor Control Systems

With the rise of embedded systems, Arduino-based motor control has gained widespread attention. Arduino acts as the central processing unit that reads input signals (such as potentiometers, IR sensors, or encoder feedback) and produces corresponding PWM outputs. Motor driver modules such as L298N or L293D are used to interface the low-power Arduino signals with high-power DC motors.

Studies show that Arduino-based systems are widely used in educational and prototype-level applications due to their simplicity and flexibility. Researchers also note that Arduino allows easy integration with additional modules like Bluetooth, Wi-Fi, and IoT platforms for remote control applications.

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4. Closed-Loop Feedback Systems

To overcome limitations of open-loop systems, researchers have developed closed-loop control systems. In closed-loop systems, the actual motor speed is continuously measured using sensors such as optical encoders or Hall-effect sensors. This feedback is compared with the reference speed, and the error is corrected automatically.

Literature indicates that closed-loop systems significantly improve performance by reducing speed fluctuations, improving disturbance rejection, and maintaining constant speed under varying load conditions. Such systems are widely used in robotics and industrial automation where precision is critical.

5. PID Control Implementation

Proportional-Integral-Derivative (PID) controllers are commonly used in Arduino-based DC motor control systems to achieve precise regulation. PID control works by continuously adjusting the control signal based on three components:

- Proportional control reduces present error
- Integral control eliminates accumulated past error
- Derivative control predicts future error trends

Research findings show that PID-controlled systems provide better dynamic response, reduced overshoot, and improved steady-state accuracy compared to simple PWM control. However, proper tuning of PID parameters (Kp, Ki, Kd) is essential for optimal performance, and different tuning methods such as Ziegler-Nichols method are commonly referenced in literature.

6. Advanced and Modern Approaches

Recent studies have explored advanced control strategies such as fuzzy logic control, neural network-based control, and adaptive control systems. These methods aim to improve performance in highly nonlinear and uncertain environments. However, due to complexity and cost, Arduino-based implementations remain more practical for educational and small-scale industrial applications.

Additionally, integration with IoT technologies has enabled remote monitoring and control of DC motors. Applications include smart automation systems, industrial conveyors, robotic arms, electric vehicles, and smart home devices. Simulation tools like MATLAB/Simulink are also widely used before hardware implementation to validate system performance and reduce design errors.

7. Summary of Literature Review

From the reviewed literature, the following key points can be summarized:

- PWM is the most efficient and widely used technique for DC motor speed control.
- Arduino provides a cost-effective, flexible, and user-friendly platform for implementation.
- Motor driver circuits are essential for interfacing control signals with power motors.
- Closed-loop systems improve accuracy and stability under varying load conditions.
- PID control enhances performance by minimizing error and improving response time.

Advanced systems are emerging, but Arduino-based solutions remain dominant in academic projects and prototypes.

IV. PROJECT DESCRIPTION

The speed control of a DC motor using an Arduino Uno is a simple and efficient project that demonstrates how motor speed can be regulated using modern microcontroller techniques. In this system, a potentiometer is used as an input device to vary the speed, and the Arduino reads this analog input and converts it into a Pulse Width Modulation (PWM) signal. This PWM signal is then sent to a motor driver such as the L298N Motor Driver Module, which controls the voltage supplied to the DC motor. By adjusting the duty cycle of the PWM signal, the effective voltage across the motor changes, thereby increasing or decreasing its speed. This method is energy-efficient and widely used in

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applications like robotics, fans, and automated machines. The project highlights the practical use of Arduino in real-world control systems and provides a strong foundation for understanding motor control techniques.

V. OBJECTIVES OF SYSTEM

The main objective of this system is to design and implement a simple and efficient method to control the speed of a DC motor using an Arduino microcontroller.

The system aims to achieve the following:

- To control the speed of a DC motor smoothly using PWM (Pulse Width Modulation) generated by Arduino.
- To use a potentiometer as an input device for adjusting motor speed manually.
- To interface the Arduino with an L298N motor driver for proper motor driving and direction control.
- To provide a push button control for starting, stopping, or changing the motor operation mode.
- To ensure efficient and safe operation of the DC motor by regulating voltage and current through the motor driver.
- To demonstrate a low-cost, microcontroller-based speed control system suitable for industrial and educational applications.

VI. ADVANTAGES & APPLICATION

1. Advantages

1. Low Cost System

one of the major advantages of this system is its low cost. Arduino boards and L298N motor drivers are inexpensive and easily available. This makes the system suitable for students, hobbyists, and small-scale industrial applications

2. Simple and Easy Implementation

The system is simple to design and implement. Arduino programming is easy to understand, and the interfacing of components like potentiometer and motor driver requires minimal hardware complexity.

3. Precise Speed Control

Using PWM signals generated by Arduino, the speed of the DC motor can be controlled with high precision. The potentiometer allows smooth variation of speed from minimum to maximum.

4 .Energy Efficient

PWM-based speed control reduces power loss compared to traditional voltage control methods. This improves the efficiency of the motor operation and reduces heat dissipation.

5 .Flexibility in Control

The system allows both manual and programmed control. The potentiometer provides manual adjustment, while Arduino code can be modified for automatic or condition-based control.

6. Easy Integration with Other Systems

Arduino can easily interface with sensors, IoT modules, and other electronic devices. This makes it possible to upgrade the system into an advanced automated control system.

7. Bidirectional Control

Using L298N motor driver, the system can control the direction of the motor along with speed control, making it more versatile.

8.Educational Value

This system is highly useful for students to understand concepts like microcontrollers, PWM, motor drivers, and embedded systems.

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2. Application:

1. Industrial Automation

DC motor speed control is widely used in industries for conveyor belts, assembly lines, and robotic arms where controlled motion is required.

2. Robotics

In robotics, precise motor speed control is essential for movement, navigation, and task execution. Arduino-based systems are commonly used in educational and research robots.

3. Electric Vehicles and E-Bikes

Speed control systems are used in small electric vehicles, e-rickshaws, and e-bikes to regulate motor speed efficiently.

4.Home Appliances

Many home appliances such as washing machines, mixers, and fans use DC motor speed control techniques to adjust performance based on user needs.

5.Conveyor Systems

Factories use conveyor belts that require different speed levels depending on the production process. Arduino-based control systems can manage this effectively.

6. Automated Doors and Gates

DC motors are used in automatic gates and doors where controlled opening and closing speed is required for safety and efficiency.

7.Research and Educational Projects

This system is widely used in engineering colleges for learning embedded systems, control systems, and electronics.

8.Solar Tracking Systems

DC motors controlled by Arduino are used in solar panel systems to adjust the position of panels for maximum sunlight exposure.

VII. RESULTS AND DISCUSSION

The results of the DC motor speed control system using Arduino showed that the motor speed could be effectively varied using a potentiometer, where low input values resulted in slow or near-zero rotation and higher values gradually increased the motor speed up to its maximum level. The Arduino successfully generated PWM (Pulse Width Modulation) signals based on the analog input from the potentiometer, and these signals were properly processed by the L298N motor driver to control the DC motor. The push button also worked as expected, allowing smooth start and stop control of the motor without any noticeable delay or malfunction. During testing, the motor response was found to be stable and fairly linear with respect to changes in input, demonstrating that PWM-based control provides efficient and smooth speed variation. The L298N driver was able to handle the required current and provided reliable operation, although a slight voltage drop was observed due to internal losses. At very low speed settings, the motor occasionally showed stalling behavior, which is common in DC motors when insufficient torque is available. Overall, the system performed well with quick response to input changes, minimal fluctuation, and good controllability. The discussion of results indicates that Arduino-based PWM speed control is an efficient, low-cost, and practical solution for DC motor control, though improvements such as better motor drivers, noise filtering, or closed-loop feedback systems could further enhance performance and accuracy.

VIII. WORKING OVERVIEW

The working of a DC motor speed control system using an Arduino Uno is based on generating and varying Pulse Width Modulation (PWM) signals to regulate the voltage supplied to the motor. In operation, a user input device such as a potentiometer provides an analog voltage signal to one of the Arduino’s analog input pins. The Arduino continuously reads this analog value (ranging from 0 to 1023) and processes it within its microcontroller. It then converts or maps this value into a corresponding PWM signal (0–255 range) that is output through one of its digital

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PWM pins. This PWM signal is sent to a motor driver module like the L298N Motor Driver Module, which acts as an intermediary because the motor requires higher current than the Arduino can safely supply. The motor driver switches the motor's power supply on and off rapidly according to the PWM signal. When the duty cycle of the PWM signal is low, the motor receives less average voltage and rotates slowly; when the duty cycle is high, the average voltage increases, causing the motor to spin faster. If direction control is included, the Arduino also sets specific logic levels on the driver's input pins to determine the rotation direction of the motor. Throughout this process, the system operates in real time, continuously adjusting the PWM output based on input changes, ensuring smooth and efficient speed variation without excessive energy loss.

IX. CONCLUSION

The DC motor speed control system using Arduino was successfully designed and implemented using a potentiometer as the input device, an L298N motor driver for interfacing, and a push button for basic control operations. The main objective of achieving smooth and efficient speed variation of the DC motor was accomplished through PWM (Pulse Width Modulation) signals generated by the Arduino based on the analog input from the potentiometer. The system demonstrated stable and reliable performance, where the motor speed increased or decreased proportionally with the change in input, showing good linear control characteristics. The L298N motor driver effectively handled the power requirements of the motor and ensured proper interfacing between the low-power Arduino signals and the high-power motor. The push button added additional functionality by allowing simple ON/OFF control of the motor. Although the system worked efficiently, minor limitations such as slight voltage drops due to the driver circuit and occasional stalling at very low speeds were observed, which are common in such configurations. Despite these limitations, the project successfully proved that Arduino-based DC motor speed control is a cost-effective, easy-to-implement, and flexible solution suitable for educational purposes, prototypes, and basic automation systems, and it can be further improved by using advanced motor drivers and closed-loop feedback systems for higher accuracy and performance.

X. FUTURE SCOPE

The future scope of DC motor speed control using an Arduino Uno is quite broad, especially as automation and smart systems continue to evolve. This basic project can be extended into more advanced applications by integrating feedback mechanisms such as encoders or sensors to achieve precise closed-loop control, enabling accurate speed regulation even under varying loads. It can also be enhanced with wireless technologies like Bluetooth, Wi-Fi, or IoT platforms, allowing users to monitor and control motor speed remotely through mobile apps or cloud-based systems. In industrial settings, such systems can be scaled up and integrated with PLCs and smart manufacturing processes to improve efficiency and reduce energy consumption. Additionally, combining the system with machine learning algorithms could enable predictive maintenance by analyzing motor performance data and detecting faults early. Renewable energy applications, such as solar-powered motor systems, and electric vehicle prototypes also present strong opportunities for development. Overall, this project serves as a foundation for building intelligent, energy-efficient, and automated motor control systems that align with the growing demand for smart technology solutions.

REFERENCES

[1]. Peerzada, P., Larik, W.H., & Mahar, A.A. (2021). DC Motor Speed Control Through Arduino UNO and L298N Motor Driver Using PID Controller. International Journal of Electrical Engineering & Emerging Technology, 4(2), 21–24.

[2]. Bhuyan, M.H. (2012). Microcontroller Based DC Motor Speed Control Using PWM Technique. International Conference on Electrical Engineering.

[3]. Adejumo, O.O., & Azeez, W.A. (2019). Development of a Microcontroller Based DC Motor Speed Control System. World Journal of Engineering and Technology, 7(4).

[4]. Rukmana, M. (2023). DC Motor Speed Control with Potentiometer Based on Arduino Uno. JREEC Journal.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 14, April 2026 Impact Factor: 8.2

[5]. Waleed Abdulsattar, A. (2026). Motor Voltage Control System Using Arduino Uno and L298N Driver. Journal of Engineering Research.
[6]. Tesfaye, H.K., & Liu, J. (2025). Speed and Direction Control of DC Motor Using Arduino Uno Microcontroller. Open Access Library Journal.
[7]. Divya, S. et al. (2024). DC Motor Speed and Direction Control System Using Arduino and ESP8266. IJIREEICE Journal.
[8].Larika, P.P.W.H. (2021). DC Motor Speed Control Using Arduino and L298N Motor Driver. IJEEET Journal.
[9]. Gamazo-Real, J.C. et al. (2024). Position and Speed Control of Motors Using Sensorless Techniques. arXiv Review Paper.
[10]. ESP32 Datasheet, Espressif Systems, Available online: https://www.espressif.com
[11]. T. Joshi and A. Chavan, "Smart Motor Control Using Embedded Systems," International Journal of Engineering Research & Technology, vol. 9, no. 6, pp. 140–145, 2022.
[12]. V. J. Patil, S. B. Khadake, D. A. Tamboli, H. M. Mallad, S. M. Takpere and V. A. Sawant, "Review of AI in Power Electronics and Drive Systems," 2024 3rd International conference on Power Electronics and IoT Applications in Renewable
Energy and its Control (PARC), Mathura, India, 2024, pp. 94-99, doi: 10.1109/PARC59193.2024.10486488
[13]. A BalkrishnaDudgikar, A Ahmad Akbar Ingalgi, A GensidhaJamadar et al., "Intelligent battery swapping system for electric vehicles with charging stations locator on IoT and cloud platform", International Journal of Advanced Research in Science Communication and Technology, vol. 3, no. 1, pp. 204-208, January 2023. DOI: 10.48175/IJARSCT-7867. Available at: https://ijarsct.co.in/Paper7867.pdf
[14]. S. B. Khadake and V. J. Patil, "Prototype Design & Development of Solar Based Electric Vehicle," 2023 3rd International Conference on Smart Generation Computing, Communication and Networking (SMART GENCON), Bangalore, India, 2023, pp. 1-7, doi: 10.1109/SMARTGENCON60755.2023.10442455.
[15]. V. J. Patil, S. B. Khadake, D. A. Tamboli, H. M. Mallad, S. M. Takpere and V. A. Sawant, "A Comprehensive Analysis of Artificial Intelligence Integration in Electrical Engineering," 2024 5th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI), Lalitpur, Nepal, 2024, pp. 484-491, doi: 10.1109/ICMCSI61536.2024.00076.
[16]. Suhas B. Khadake, Sudarshan P. Dolli, K.S. Rathod, O.P. Waghmare and A.V. Deshpande, "AN OVERVIEW OF INTELLIGENT TRAFFIC CONTROL SYSTEM USING PLC AND USE OF CURRENT DATA OF VEHICLE TRAVELS", JournalNX, pp. 1-4, Jan. 2021.
[17]. Shraddha S Magar, Archana S Sugandhi, Shweta H Pawar, Suhas B Khadake, H. M. Mallad,"Harnessing Wind Vibration, a Novel Approach towards Electric Energy Generation- Review", IJARSCT, Volume 4, Issue 2, October 2024, pp. 73-82. DOI: 10.48175/IJARSCT-19811.
[18]. Khadake, S. B., Padavale, P. V., Dhere, P. M., & Lingade, B. M., "Automatic hand dispenser and temperature scanner for Covid-19 prevention", International Journal of Advanced Research in Science, Communication and Technology, 3(2), 362367. DOI: 10.48175/IJARSCT-11364. https://ijarsct.co.in/A11364.pdf
[19]. Seema S Landage, Sonali R Chavan, Pooja A Kokate, Sonal P Lohar, M. K. Pawar, Suhas B Khadake.,"Solar Outdoor Air Purifier With Air Quality Monitoring System", Synergies Of Innovation: Proceedings Of Ncstem 2023, Pp. 260-266, September, 2024. Available At: https://www.researchgate.net/publication/383631190_Solar_Outdoor_Air_Purifier_with_Air_Quality_Monitoring_System
[20]. Suhas B. Khadake. (2021). Detecting Salient Objects Of Natural Scene In A Video's Using Spatio-Temporal Saliency &Amp; Colour Map. Journalnx - A Multidisciplinary Peer Reviewed Journal, 2(08), 30–35. Retrieved From Https://Repo.Journalnx.Com/Index.Php/Nx/Article/View/1070
[21]. Khadake Suhas .B. (2021). Detecting Salient Objects In A Video's By Using spatio-Temporal Saliency & Colour Map. International Journal Of Innovations In Engineering Research And Technology, 3(8),1-9, Https://Repo.Ijiert.Org/Index.Php/Ijiert/Article/View/910.

[22]. Prachi S Bhosale, Pallavi D Kokare, Dipali S Potdar, Shrutika D Waghmode, V A Sawant, Suhas B Khadake.,“DTMF Based Irrigation Water Pump Control System”, Synergies Of Innovation: Proceedings Of NCSTEM 2023, Pp. 267-273, September, 2024. Available At: https://www.researchgate.net/publication/383629320_DTMF_Based_Irrigation_Water_Pump_Control_System

[23]. Pramod Korake, Harshwardhan Murade, Rushikesh Doke, Vikas Narale, Suhas B. Khadake, Aniket S Chavan., “Automatic Load Sharing of Distribution Transformer using PLC”, Synergies Of Innovation: Proceedings Of NCSTEM 2023, Pp. 253- 259, September, 2024. Available At: https://www.researchgate.net/publication/383628063_Automatic_Load_Sharing_of_Distribution_Transformer_using_PLC

[24]. Suhas B khadake, Pranita J Kashid, Asmita M Kawade, Santoshi V Khedekar, H. M. Mallad .,“Electric Vehicle Technology Battery Management –Review”, International Journal of Advanced Research in Science, Communication and Technology, Volume 3, Issue 2, Septeber 2023,pp. 319-325. DOI: 10.48175/IJARSCT-13048. Available at: https://www.researchgate.net/publication/374263508_Electric_Vehicle_Technology_Battery_Management_-_Review

[25]. Suhas B. khadake, Amol Chounde, Buddhapriy B. Gopnarayan, Karan Babaso Patil, Shashikant S Kamble. (2024). Human Health Care System: A New Approach towards Life, 15th International Conference on Advances in computing, Control, and Telecommunication Technologies, ACT 2024, 2024, 2, pp. 5487-5494.

[26]. Khadake SB, Patil VJ, Mallad HM, Gopnarayan BB, Patil KB. Maximize farming productivity through agriculture 4.0 based intelligence, with use of agri tech sense advanced crop monitoring system. Grenze Int J Eng Technol. 2024;10(2):5127–5134. Available At: https://www.researchgate.net/publication/382625572_Maximize_Farming_Productivity_through_Agriculture_40_based_Intelligence_with_use_of_Agri_Tech_Sense_Advanced_Crop_Monitoring_System

[27]. Suhas B Khadake, Santoshi V Khedekar, Asmita M Kawade, Shradhha Shivaji Vyavahare, Pranita J Kashid, Chounde Amol B, H. M. Mallad., “Solar Based Electric Vehicle Charging System-Review”, IJARSCT, vol. 4, Issue 2, December 2024, pp. 42-57, DOI: 10.48175/IJARSCT-22705.

[28]. Akshay B Randive , Sneha Kiran Gaikwad , Suhas B Khadake , Mallad H. M., “Biodiesel: A Renewable Source of Fuel”, IJARSCT, vol. 4, Issue 3, December 2024, pp. 225-240, DOI: 10.48175/IJARSCT-22836 Available at: https://www.researchgate.net/publication/387352609_Biodiesel_A_Renewable_Source_of_Fuel

[29]. K. K. Sayyad Liyakat, S. B. Khadake, A. B. Chounde, A. A. Suryagan, M. H. M. and M. R. Khadatare, "AIDriven- IoT(AIIoT) Based Decision Making System for High-Blood Pressure Patient Healthcare Monitoring," 2024 International Conference on Sustainable Communication Networks and Application (ICSCNA), Theni, India, 2024, pp. 96-102, doi: 10.1109/ICSCNA63714.2024.10863954.

[30]. K. K. Sayyad Liyakat, S. B. Khadake, D. A. Tamboli, V. A. Sawant, M. H. M. and S. Sathe, "AI-Driven-IoT(AIIoT) Based Decision-Making- KSK Approach in Drones for Climate Change Study," 2024 4th International Conference on Ubiquitous Computing and Intelligent Information Systems (ICUIS), Gobichettipalayam, India, 2024, pp. 1735-1744, doi: 10.1109/ICUIS64676.2024.10866450.

[31]. Suhas B khadake, Shraddha S Magar, Archana S Sugandhi, Shweta H Pawar, “ A Research Paper on Harnessing Wind Vibration Novel Approach towards Electric Energy Generation”, IJARSCT, Volume 5, Issue 4, May 2025, pp. 533-552. DOI: 10.48175/IJARSCT-26466. Available At https://www.researchgate.net/publication/391857597_A_Research_Paper_on_Harnessing_Wind_Vibration_Novel_Approach _towards_Electric_Energy_Generation

[32]. Avinash. A. Suryagan, Arti L Nemte, Kirti D Thorat, Suhas B Khadake,“ IoT Based Flood Monitoring System by using Thing Speak Cloud”, IJARSCT, Volume 5, Issue 4, May 2025, pp. 666-687. DOI: 10.48175/IJARSCT-26480

[33]. Sagar M Chavare, Prasad P Nanaware, Shriprasad S Wagh, Ashish T Jadhav, Yeole Yogesh, Suhas B Khadake,“ Smart Plant Monitoring and Automated Irrigation System Using IOT”, IJARSCT, Volume 5, Issue 4, May 2025, pp. 688-706. DOI: 10.48175/IJARSCT-26481

[34]. Swapnil S Sudake, Suhas B Khadake, Santoshi V Khedekar, Asmita M Kawade, Shraddha S Vyavahare,“ Solar Based Wireless Electric Vehicle Charging System”, IJARSCT, Volume 5, Issue 5, May 2025, pp. 325-348. DOI: 10.48175/IJARSCT-26647

[35]. Manjeet Kumar, Shubhangi S Sul, Jyoti S Lakhara, Pranita J Kashid, Shravani R Bhinge, Amaraja S Waghmode, Suhas B Khadake,“ Small Wind Electric System Energy Saver”, IJARSCT, Volume 5, Issue 5, May 2025, pp. 447-466. DOI: 10.48175/IJARSCT-26663

[36]. Namrata Ganesh Jadhav , Pranjali R Nagane , Akanksha M Khapare , Arvind Pande , Suhas B Khadake,“Identify and Measuring Parameter of PV Module Test Bench with the Ammeter and Voltmeter”, IJARSCT, Volume 5, Issue 6, May 2025, pp. 5-24. DOI: 10.48175/IJARSCT-26702

[37]. Sujit N. Bhandare, Prashant R. Mule, Yogesh A. Yeole, Krushna D More, Suhas B. Khadake,“ Vehicle Tracking And Accident Alert System”, IJARSCT, Volume 5, Issue 6, May 2025, pp. 234-252. DOI: 10.48175/IJARSCT-26728

[38]. Manjeet Kumar, Suhas B Khadake, Madhuri S Doke, Shivani D Pujari, Pratiksha B Rupnar,“ Sun Track: A Compact IoT System for PV Parameter Monitoring with NodeMCU”, IJARSCT, Volume 5, Issue 9, May 2025, pp. 261-280. DOI: 10.48175/IJARSCT-27037

[39]. Nikita R Bhosale , Sakshi D Shete , Laxmi A Koganure ,Aditi A Gaikwad ,Vedhangi S Sukre , Suhas B Khadake,“ Development of a Real-Time Hydrogen Level Detection System for Storage Cylinders”, IJARSCT, Volume 5, Issue 4, June 2025, pp. 690-708. DOI: 10.48175/IJARSCT-27666

[40]. Bhinge Shravani Rajendra, Salunkhe Majushree Jayant, Tarse Mayuri Kundlik, Suhas B Khadake, B. B. Gopnarayan, Manisha P Bidve,“ Smart Water Waste Collection System Using Bluetooth Control”, IJARSCT, Volume 5, Issue 7, June 2025, pp. 561-578. DOI: 10.48175/IJARSCT-28072

[41]. K. K. Sayyad Liyakat, S. B. Khadake, P. S. More, R. J. Shinde, K. P. Kondubhairi and S. S. Kamble, "AI-Driven IoT based Decision Making for Hepatitis Diseases Patient’s Healthcare Monitoring: KSK Approach for Hepatitis Patient Monitoring," 2025 7th International Conference on Intelligent Sustainable Systems (ICISS), India, 2025, pp. 256-263, doi: 10.1109/ICISS63372.2025.11076213.

[42]. K. K. Sayyad Liyakat, S. B. Khadake, K. Galani, K. B. Patil, A. Dhavale and S. D. Sarik, "AI-Powered-IoT (AIIoT) based Bridge Health Monitoring using Sensor Data for Smart City Management- A KSK Approach," 2025 7th International Conference on Intelligent Sustainable Systems (ICISS), India, 2025, pp. 296-305, doi: 10.1109/ICISS63372.2025.11076329.

[43]. Rani N Bhosale , Tejashri M Salunkhe , Sayali S Ghodake , Shruti S Deshpande ,Chandani N Kendale , Suhas B Khadake,“ Smart Lawn Cutter using Solar and Bluetooth”, IJARSCT, Volume 5, Issue 1, august 2025, pp. 158-171. DOI: 10.48175/IJARSCT-28618.

[44]. Ganesh Navnath Surwase, Ashish Tukaram Jadhav, Krushna Dinesh More, Ingudam Chitrasen Meitei, Suhas B Khadake, “Accident Detection and Alerting Using Embedded System”,IJARSCT,Volume 5, Issue 2, October 2025,pp. 550-562. DOI: 10.48175/IJARSCT-29269.

[45]. Rohini Walke, Samarth Mole, Rohan More, Sonali Salunkhe, Rahul Jadhav, Suhas B Khadake, ” Automated Canopy System”, IJARSCT, Volume 6, Issue 3, January 2026, pp. 438-447. DOI: 10.48175/IJARSCT-30956.

[46]. Samarth S Mole, Rohini J Walke, Rohan D More, Sonali A Salunkhe, Rahul N Jadhav, Sagar S Kawade , Suhas B Khadake, “Automated Fertilizer Dispensing System”, IJARSCT, Volume 6, Issue 4, January 2026, pp. 256-268. DOI:0.48175/IJARSCT-31034.

[47]. Khapare Akanksha Mahadev , Jadhav Namrata Ganesh , Kshirsagar Manasi Pravin , Waghamode Amarja Santosh, Dr. Mrinal K. Rajak , Suhas B Khadake,” Paper on Aqua Lift OWS (Oil Water Separator)”, IJARSCT, Volume 6, Issue 8, March 2026,pp.468-477. DOI: 10.48175/IJARSCT-32164.

[48]. Sujit N. Bhandare, Prashant R. Mule, Yogesh A. Yeole, Suhas B. Khadake, ” Vehicle to Vehicle Charging System”, IJARSCT, Volume 6, Issue 2, April 2026,pp.433-442. DOI: 10.48175/IJARSCT-32459.

[49]. Sujit N. Bhandare, Prashant R. Mule, Yogesh A. Yeole, Suhas B. Khadake, “Vehicle to Vehicle Charging System”,IJARSCT, Volume 6,Issue 2, April 2026,pp.433-442. DOI: 10.48175/IJARSCT-32459.

[50]. Suyog P Maindarkar, Soham R Salunke, Shriprasad S Wagh, Prathmesh A Dhekane, Sagar S Chaugule, Suhas B Khadake, "Solar-Powered Automated Electrocoagulation System for Sustainable Sugar Mill Wastewater Treatment", IJARSCT, Volume 6, Issue 3, April 2026,pp-523-536. DOI: 10.48175/IJARSCT-32576.

[51]. Nikita R Bhosale, Sakshi D Shete, Aditi A Gaikwad, Nikita S Patil, Suhas B Khadake,Vijay A Savant, "Design and Development of a BLDC Motor Test Bench for Performance Evaluation", IJARSCT, Volume 6, Issue 4, April 2026,pp.654663. DOI: 10.48175/IJARSCT-32676.

[52]. Ganesh V Metkari, Rohan K Survase , Ashish T Jadhav, Sagar S Kawade, Suhas B. Khadake, "Design and Implementation of A Real-time Monitoring Platform to check the performance of E2V", IJARSCT, Volume 6, Issue 5, April 2026,pp-549563. DOI: 10.48175/IJARSCT-32873

[53]. Shravani R Bhinge, Manjushree J Salunkhe, Mayuri K Tarse, Tanjim P Bhaldar,Sagar S Chaugule, Suhas B Khadaake, Sagar S. Kawade, "Design and Implementation of an Automated Product Handling Robot for Industrial Applications", IJARSCT, Volume 6, Issue 9, April 2026,pp-181-195. DOI: 10.48175/IJARSCT-33226

[54]. Rani N Bhosale, Tejashri M Salunkhe, Sayali S Ghodake,Shruti S Deshpande, Suhas B Khadake, Vijay.A.Savant, "An Evaluation of Battery Using Peltier Module", IJARSCT, Volume 6, Issue 9, April 2026,pp-583-594. DOI:10.48175/IJARSCT-33282

[55]. Madhuri S Doke, Pratiksha B Rupnar, Pranjali R Nagane, Shivani D Pujari, Manjeet Kumar , Suhas B Khadake, Sagar S Kawade, "Solar Powered Pesticides Sprayer with Multipurpose Application", IJARSCT, Volume 6, Issue 10, April 2026,pp186-199. DOI: 10.48175/IJARSCT-33425

[56]. Mayuri G Rupnar, Shruti G Parit, Priyanka S Suryawanshi, Sagar S Kawade, Suhas B Khadake, "Design and Implementation of A Real-time Monitoring Platform to check the performance of E2V", IJARSCT, Volume 6, Issue 10, April 2026,pp-200-218. DOI: 10.48175/IJARSCT-33426

[57]. Mr. Pratik D. Nagtilak, Mr. Karanraj B. Pujari, Mr. Rushiprasad A. Nara, Mr. Kiran T. Wadekar, Dr. Mrinal K. Rajak, Suhas B Khadake, "Smart GSM-Based Power Meter with Continuous Load Monitoring", IJARSCT, Volume 6, Issue 10, April 2026,pp-228-237. DOI: 10.48175/IJARSCT-33429

[58]. Ravikiran R khandagale, Prathamesh S Jamdade, Vishwajit V Babar , Suhas B Khadake, "GSM Based Substation Monitoring and Control System", IJARSCT, Volume 6, Issue 10, April 2026,pp-238-248. DOI: 10.48175/IJARSCT-33430

[59]. Ranjit Kadam, Onkar Shinde, Mohit Londhe, Mayur Ingawale, Vijay Karande, Swapnil Bhosale, Suhas B Khadake, "Surveillance Car using ESP32 CAM Module", IJARSCT, Volume 6, Issue 10, April 2026,pp-522-530. DOI: 10.48175/IJARSCT-33464

[60]. Shambhavi R Kurde, Vijayalaxmi A Vhate, Shravani H Pujari , Tejswini T Bhui, Jay S Raut, Misbah J Tamboli, Suhas B Khadake, "Solar Powered Multi-Utility Umbrella", IJARSCT, Volume 6, Issue 11, April 2026,pp-211-223. DOI:10.48175/IJARSCT-33631

[61]. Yash D Palkar, Nikhil K Waghachavare, Akash P Mane, Vikram S Rane, Paras P Jadhav, Pratik N Patil, Vijay A Sawant, Suhas B Khadake, "Real Time IoT-Enabled Smart Plant Irrigation and Weather Monitoring System using the ESP32 microcontroller & MATLAB", IJARSCT, Volume 6, Issue 11, April 2026,pp-420-428. DOI:10.48175/IJARSCT-33660

[62]. Komal V Anantkawalas, Sakshi K Bhosale, Chandani N Kendale, Khushi S Shaikh, Sujata A Galgunde, Monali S Landage,Suhas B Khadake, "IoT Based Health Monitoring System", IJARSCT, Volume 6, Issue 11, April 2026,pp-453-462. DOI:10.48175/IJARSCT-33665

[63]. Prathmesh R Dulange, Prajwal U Bajantri, Sujal P Bajantri, Vivek D Patkulkar, Suhas B Khadake,Sagar S Chaugule, "Footstep Power Generation Using Piezoelectric Sensors", IJARSCT, Volume 6, Issue 11, April 2026,pp-434-442. DOI:10.48175/IJARSCT-33662

[64]. Dhanashri D. Karande, Diksha S. Shinde, Sonali M. Gandule Smital S. Kumbhar, Dhanraj D. Daphale Suhas B Khadake, "Three Phase Motor Drive System Powered By Parallel Single Phase Rectifier", IJARSCT, Volume 6, Issue 11, April 2026,pp-497-505. DOI:10.48175/IJARSCT-33671

[65]. Jay S Raut, Aniket B Shinde, Sanskar S Ambare, Ravikiran S Chavan, Shambhavi R Kurde , S S Chougule, Suhas B Khadake, "Battery Monitoring and Detection System for EVs", IJARSCT, Volume 6, Issue 12, April 2026,pp-89-98. DOI:10.48175/IJARSCT-33713

[66]. Giriraj S Choudhari, Rahul B Kadam, Aditya C Dudhbhade, Prasad P Nanaware, Swapnil S Sudake, Suhas B Khadake, "Solar-Assisted Hybrid Electric Bicycle with Gear Optimization for Efficient Range Extension.", IJARSCT, Volume 6, Issue 12, April 2026,pp-221-233. DOI:10.48175/IJARSCT-33732

[67]. Ramdas Kadam, Swapnil Garad, Ankit Kumar, Ganesh Dhangekar, Saurabh Patole, Vishal Nalawade, Suhas B Khadake, "Robotic Arm", IJARSCT, Volume 6, Issue 12, April 2026,pp-261-270. DOI: 10.48175/IJARSCT-33735

[68]. Atul B Jadhav, Saurav S Kamble, Rushikesh D Mohite, Manjeet Kumar, Suhas B Khadake, "IoT-Enabled Gas Leakage Detection System Using ESP32", IJARSCT, Volume 6, Issue 12, April 2026,pp-250-260. DOI: 10.48175/IJARSCT-33734

[69]. Jayprakash Chavan, Amarjit Dhale, Shriyash Latake, Suraj Shinde, Dhanraj D Daphale, Suhas B Khadake, "Speed Control of DC Motor Using ESP32 and Speed Measurement in RPM", IJARSCT, Volume 6, Issue 12, April 2026,pp-514-522. DOI: 10.48175/IJARSCT-33769