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# IOT Power Dynamics for Smart DC Motor Control

**[1]A.M.Shelke, [2]A.P.Tambe, [3]S.B.Shinagde, [4]T.R.Divate, [5]S.B.Kumbhar**

[1,2,3,4,5]Electrical Engineering, DKTE's Yashwantrao Chavan Polytechnic, Ichalkaranji, Maharashtra, India
E-mails: [1]tejasdivate1430@gmail.com, [2]akshayshelke244@gmail.com, [3]ashwinitambe0718@gmail.com, [4]shreyashingade95@gmail.com, [5]satwashilkumbhar@gmail.com

***Abstract* - Motor control involves initiating, guiding, and regulating purposeful voluntary movements. This entails the body's or system's capability to initiate, direct, and adapt movements to carry out specific actions efficiently. For example, when someone reaches out to pick up an object, the brain sends signals to the muscles to initiate and control that movement. According to Shumway-Cook, a well-known researcher in motor control, it involves the ability to adapt mechanisms essential for movement.**

**This means motor control is not just about producing movements but also adjusting and fine-tuning those movements based on external and internal factors. For instance, while walking on uneven terrain, the body continuously adapts muscle responses to maintain balance and stability. This bidirectional motor driving system utilizes the widely recognized dual H-Bridge motor driver Integrated Circuit (IC). The term "bidirectional" indicates that the system allows motors to move in both forward and reverse directions. The IC is widely used because it is reliable, efficient, and a foundational component for controlling motor movement.**

**The H-Bridge design is a key feature that enables motors to operate in multiple directions by controlling current flow. The circuit allows you to easily control motors independently, handling currents of up to 2A in each direction.**

**In technical terms, the circuit design ensures that two motors can be controlled simultaneously and independently, meaning each motor can move at its speed and direction without interfering with the other.**

***Keywords:*** Internet of Things (IoT), Smart DC Motor Control, Power Dynamics, Intelligent Power Management, Energy Optimization Techniques, Embedded Systems Design, Microcontroller-Based Automation, Real-Time Monitoring and Control, Wireless Communication (Wi-Fi/MQTT), Cloud-Based Data Logging, PWM Speed Regulation, PID Control Algorithm, Current and Voltage Sensing, IoT Dashboard Visualization, Predictive Maintenance, and Fault Detection System.

## I. INTRODUCTION

Engine skills demand deliberate control of joint movements and body segments to accomplish a defined objective. In simpler terms, motor skills involve coordinating muscles, joints, and body parts to perform purposeful actions. These tasks can range from simple daily movements, like walking or standing up, to complex activities, like riding a bike, surfing, or performing athletic feats like weightlifting and jumping

For example, bike riding demands balance, precise leg movement, and coordination between hands and feet, whereas weightlifting requires strength, stability, and control of joint movements. The process of planning and executing these skills is commonly referred to by movement scientists as motor learning, motor control, or skill acquisition. Here, "planning" involves the brain's ability to design a sequence of movements to accomplish a goal, while "execution" refers to efficiently carrying out those planned movements. Movement scientists study how humans acquire, refine, and improve these skills over time. The field of motor learning focuses on understanding how practice and experience enable individuals to master tasks, while motor control deals with the mechanisms and processes that regulate movements. Skill acquisition describes the gradual process of developing proficiency, transitioning from basic or uncoordinated attempts to skilled performance.

Experts note that motor learning and control are essential for both the performance and rehabilitation of these skills, particularly in cases like stroke recovery or total knee arthroplasty rehabilitation. For example, individuals recovering from a stroke often face challenges with basic movements like walking or grasping objects due to brain damage affecting motor control pathways. Rehabilitation programs use motor learning principles to help patients regain these movements by encouraging repetition and adaptive strategies. Similarly, after total knee arthroplasty (knee replacement surgery), patients need to relearn motor skills like standing, walking, and climbing stairs. Effective rehabilitation relies on structured practice, guided exercises, and feedback to restore movement patterns and joint function.

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New engine patterns are formed through exploration, engagement with diverse sensory environments, and experiences that challenge individuals to solve encountered problems. In other words, learning new motor skills involves experimenting with movements, receiving sensory feedback (like visual, auditory, or tactile cues), and overcoming obstacles that require creative problem-solving. For instance, a child learning to walk must adjust to different surfaces, like carpets or tiles, and adapt their balance based on the feedback from their environment. Athletes and performers similarly improve their skills by practicing under various conditions and environments, which enhances their ability to adapt and perform effectively.

Motor control and learning abilities shape our understanding of how individuals advance from beginners to skilled performers across different stages of life. This progression highlights how motor skills develop from early childhood, where movements are unrefined and essential, to adulthood, where they are highly coordinated and skilled. For example, a toddler initially struggles with fine motor skills, like holding a pencil, but later learns to write legibly through practice and feedback. Similarly, older adults may experience a decline in motor skills due to aging, but targeted motor control training can help maintain functional independence and slow this decline.

## II. LITERATURE REVIEW

The existing literature establishes that the integration of the Internet of Things (IoT) into smart DC motor control systems fundamentally reshapes power dynamics by shifting control from localized, reactive mechanisms to decentralized, data-driven, and predictive architectures. This transformation is best understood by analyzing the new dynamics of information flow, control authority, and system efficiency.

### 1. The Shift in Control Authority

The primary power dynamic is the change in control locus. Traditional DC motor control relied on local hardware and analog circuits. IoT introduces a hierarchical system where remote platforms and cloud intelligence wield the ultimate control.

- **Remote Command and Control:** Studies frequently highlight the use of microcontrollers (like the ESP8266 NodeMCU) and communication protocols to link the motor drive to a cloud platform (e.g., Blynk). This allows users to remotely adjust the motor's state (ON/OFF) and its speed, typically via Pulse Width Modulation (PWM), from a smartphone or web dashboard. This establishes a decoupling of physical presence and control authority.
- **Data as the Control Enabler:** The power to control is driven by the power of information. Sensors continuously monitor key electrical and environmental parameters (current, voltage, temperature). This real-time data flow empowers the remote system to make instantaneous control decisions, such as adjusting the motor speed to maintain an optimal operating point or triggering a protective shutdown.

### 2. The Power Dynamic of Efficiency and Protection

The most significant benefit of the IoT power dynamic is the enhancement of motor lifespan and energy efficiency through proactive management.

- **Predictive Power Protection:** The continuous data flow enables a shift from reactive motor failure protection (stopping the motor after an overcurrent or over-temperature event) to predictive maintenance. IoT systems can analyze real-time trends to forecast impending failures related to power anomalies (overload, overheating). This allows the system to proactively implement a power-saving response, such as reducing the PWM duty cycle, thereby conserving the motor's Power integrity. For instance, some projects show that monitoring current and temperature allows the system to adjust motor operation to reduce overload occurrence significantly.
- **Energy Management Optimization:** IoT provides the necessary visibility for smart energy management. By logging and analyzing historical power consumption patterns, algorithms can optimize the motor's operational scheduling and load handling. This ensures the motor uses only the energy required for the task, minimizing energy wastage and contributing to a more sustainable and cost- effective power dynamic within industrial settings.

### 3. Integration of Artificial Intelligence (AI)

In advanced smart motor systems, AI algorithms represent the highest level of control power.

- **Intelligent Control:** AI techniques, particularly Fuzzy Logic Control (FLC) and Artificial Neural Networks (ANNs), are being integrated to manage the power electronics that drive the DC motor. These intelligent controllers supersede traditional Proportional-Integral-Derivative (PID) controllers by offering superior adaptability to non-linear changes in load or system parameters. This results in more stable power delivery and higher operational precision.
- **Self-Correction and Optimization:** Reinforcement learning approaches, though computationally intensive,

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are emerging to grant the system the power of self-optimization. The motor controller can learn the most energy-efficient speed and torque profile for a given task, autonomously optimizing its power consumption over time.

### 4. The Internal Power Consumption Challenge

A critical counter-dynamic is the power constraint of the IoT node itself.

- The components granting the remote control—the Wi-Fi module, microcontroller, and sensors—require their own power. This necessitates focusing on low-power design techniques, such as employing deep-sleep modes for the microcontrollers and selecting energy-efficient connectivity protocols.
- The literature also explores the use of energy harvesting (e.g., solar, vibration) to power the sensing and communication aspects, ensuring the monitoring system does not become a net power drain, thereby maintaining a sustainable power dynamic for the entire control ecosystem.

## III. OBJECTIVE AND SCOPE

### Objectives:

1. Design and Develop an IoT-based Smart DC Motor Control System: Create a system that leverages IoT technologies to optimize power dynamics, improve efficiency, and enhance reliability in DC motor control.
2. Optimize Power Dynamics for Improved Efficiency: Develop advanced control strategies that minimize energy consumption, reduce power losses, and improve overall system efficiency.
3. Enhance Scalability, Flexibility, and Adaptability: Design a system that can easily adapt to changing application requirements, motor types, and operating conditions.

### Scope:

- The module is a two-line with sixteen men or women interfaced to the daughter board.
- The interface only requires two data connections and a direct current voltage to operate.

### Industrial Automation

- **Remote Monitoring:** Monitor motor performance, speed, and temperature remotely using IoT sensors and platforms.
- **Predictive Maintenance:** Machine learning algorithms and IoT sensor data predict motor failures and schedule maintenance.
- **Automated Control:** Control motors remotely using IoT-enabled devices, reducing the need for manual intervention.

### Robotics and Autonomous Systems

- **Robot Arms Control:** IoT-enabled DC motor control precisely controls robot arm movements.
- **Autonomous Vehicle Control:** Control DC motors in autonomous vehicles, such as drones or self-driving cars.
- **Swarm Robotics:** Coordinate multiple robots using IoT-enabled DC motor control.

### Energy Efficiency and Sustainability

- **Energy Monitoring:** Monitor energy consumption of DC motors in real-time using IoT sensors.
- **Optimized Control:** Optimize motor control algorithms using IoT data to reduce energy consumption.
- **Renewable Energy Systems:** Control DC motors in renewable energy systems like wind or solar.

### Smart Home and Building Automation

- **Smart Lighting:** Control DC motors in smart lighting systems to adjust brightness and color.
- **HVAC Systems:** Control DC motors in heating, ventilation, and air conditioning (HVAC) systems.
- **Security Systems:** Control DC motors in security systems, such as gates or doors.

### Healthcare and Medical Devices

- **Medical Pump Control:** Control DC motors in medical pumps to deliver precise amounts of medication.
- **Prosthetic Limb Control:** Control DC motors in prosthetic limbs to enable precise movement.
- **Medical Imaging:** Control DC motors in medical imaging equipment, such as MRI or CT scanners.

## IV. RELEVANCE

The integration of IoT (Internet of Things) and power dynamics into DC motor control is highly relevant in modern automation and energy-efficient systems. Traditional DC motor control methods often lack real-time monitoring, adaptive power management, and remote accessibility. By embedding IoT technologies, the system gains the ability to collect, analyze, and respond to operational data in real time. This ensures smarter power utilization, improved motor performance, and predictive maintenance capabilities.

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This approach is especially relevant for modern industrial automation, electric vehicles, robotics, and smart manufacturing, where efficient power management and intelligent control are essential. Hence, incorporating IoT power dynamics in DC motor control not only enhances operational efficiency and reliability but also aligns with the global trend toward smart, connected, and sustainable systems.

The relevance of IoT power dynamics for smart DC motor control lies in its ability to integrate intelligent monitoring, control, and power optimization within a connected system. By using IoT-enabled sensors and controllers, the DC motor's parameters such as voltage, current, speed, and temperature can be continuously monitored and adjusted in real time to ensure efficient power usage and stable performance.

This integration allows for remote operation, predictive maintenance, and adaptive control based on varying load conditions, reducing energy wastage and improving reliability. Such an approach is highly relevant in modern applications like industrial automation, robotics, and electric vehicles, where smart, efficient, and connected systems are essential for achieving energy efficiency, sustainability, and enhanced performance.

### 4.1 Relevance of new system

The proposed system, *IoT Power Dynamics for Smart DC Motor Control*, is highly relevant in today's era of automation and smart technology. Traditional DC motor control systems often rely on manual or pre-set operations that do not adapt to varying load conditions or energy demands. This result in inefficient power usage, increased operational costs, and limited monitoring capabilities. By integrating IoT technology, the system overcomes these limitations through real-time data acquisition, analysis, and communication, making motor control more intelligent and adaptive.

With IoT-enabled sensors and controllers, the new system continuously monitors key parameters such as current, voltage, temperature, and speed. This data is transmitted to a cloud platform or central server for real-time analysis and decision-making. The system can dynamically adjust motor power levels according to load variations, ensuring optimal performance while reducing energy wastage. This smart regulation of power enhances the overall efficiency, reliability, and lifespan of the DC motor, making it suitable for energy-conscious and performance-critical applications.

Another major relevance of this new system is its ability to provide remote monitoring and predictive maintenance. Through IoT connectivity, users can access motor performance data from anywhere, detect irregularities, and receive alerts before faults occur. This predictive approach reduces downtime and maintenance costs compared to traditional reactive maintenance methods. Moreover, the system supports automation and intelligent control, enabling seamless integration into industrial IoT networks, smart manufacturing systems, and automated processes.

Lastly, this system aligns with modern trends such as Industry 4.0, renewable energy integration, and sustainable engineering. It provides a scalable platform that can be adapted for electric vehicles, robotics, smart agriculture, and home automation. By combining IoT communication with dynamic power control, the system not only improves motor performance but also contributes to energy conservation and environmental sustainability. Hence, the IoT Power Dynamics for Smart DC Motor Control system represents a significant advancement in efficient, intelligent, and eco-friendly motor control technologies.

## V. PROPOSED WORK

The proposed system aims to develop an IoT-based smart DC motor control mechanism that integrates real-time monitoring, dynamic power management, and remote accessibility. The main objective is to create an intelligent control framework capable of adjusting motor performance based on load variations and energy demands. Unlike traditional control systems, which operate on fixed parameters, this system will utilize IoT sensors and microcontrollers to collect and process data continuously, allowing for adaptive and energy- efficient control of the DC motor.

The hardware design will involve key components such as a DC motor, microcontroller (e.g., Arduino or ESP32), IoT communication module (Wi-Fi or MQTT protocol), and sensors to measure voltage, current, temperature, and motor speed. The collected data will be transmitted to a cloud platform for real-time monitoring and control through a web or mobile interface. Using IoT technology, users can remotely start, stop, or vary the speed of the motor, as well as receive alerts in case of abnormal conditions or faults.

The system will also implement dynamic power control algorithms to optimize motor operation. By analyzing real-time sensor data, the controller will automatically adjust the power supplied to the motor depending on its workload. This ensures efficient energy consumption, prevents overheating, and reduces mechanical stress, thereby extending motor lifespan. Additionally, predictive maintenance features will be developed by using data trends and thresholds to detect potential faults before they occur.

Finally, the proposed work includes the development of a cloud-based dashboard for visualization and analytics. The

 

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dashboard will display live performance metrics such as power usage, efficiency, and motor health status. Users will have access to historical data and performance reports to support decision-making and optimization. Through this IoT-enabled smart control system, the project aims to achieve a more efficient, reliable, and intelligent DC motor control solution suitable for modern automation, industrial, and energy management applications.

### 5.1 Problem statement

Traditional DC motor control systems face significant challenges in optimizing power dynamics, leading to reduced efficiency, reliability, and overall system performance. The increasing demand for smart, connected, and adaptive motor control systems necessitates the development of innovative solutions that can effectively manage power dynamics in real-time.

**Specific Challenges:**

1. **Inefficient Power Consumption:** Traditional DC motor control systems often result in inefficient power consumption, leading to increased energy costs and reduced motor Lifespan.
2. **Limited Scalability:** Existing motor control systems can be inflexible and difficult to scale, making it challenging to adapt to changing application requirements.
3. **Poor Fault Tolerance:** Traditional motor control systems often lack robust fault tolerance mechanisms, leading to reduced system reliability and increased downtime.
4. **Lack of Real-Time Monitoring:** Inadequate real-time monitoring and feedback mechanisms limit the ability to optimize power dynamics and respond to changing system conditions.

## VI. METHODOLOGY

The DC motor control system consists of three primary components: a DC motor, a motor driver, and a control unit. Each element ensures efficient motor operation and task performance.

The DC motor, an electromechanical device, converts direct current (DC) electrical energy into mechanical motion. Based on the principle of electromagnetic induction, it generates rotational motion through the interaction of a magnetic field and an electric current, which produces a driving force on the motor shaft. This motion is utilized for various applications, such as propelling wheels in robotic vehicles, operating fans, or powering industrial mechanical systems.

**Hardware Components:**

- **DC Motor:** A 12V, 5A DC motor is used for the experimental setup.
- **Motor Driver:** A PWM-capable motor driver IC is used to drive the DC motor.
- **Control Unit:** A microcontroller (MCU) is used as the control unit to generate the control signals.
- **Sensors:** A rotary encoder measures the motor's rotational speed.

**Software Components:**

- **Control Algorithm:** A PID control algorithm is implemented in the MCU to regulate The motor’s speed.
- **Programming Language:** C programming language is used to develop the control algorithm.
- **IDE:** An appropriate Integrated Development Environment (IDE) is utilized to write, compile, and upload the code to the Microcontroller Unit (MCU).

**Data Acquisition and Analysis:**

- Data acquisition is performed using a data acquisition card and analyzed using suitable software tools.

**Efficiency Measures:**

The performance of the DC motor control system is assessed using the following metrics:

- **Steady-State Error:** The difference between the desired and actual motor speeds.
- **Settling Time:** The motor speed takes to pay within a specified range.
- **Overshoot:** The maximum deviation of the motor speed from the desired value.

### 6.1 Block Diagram:

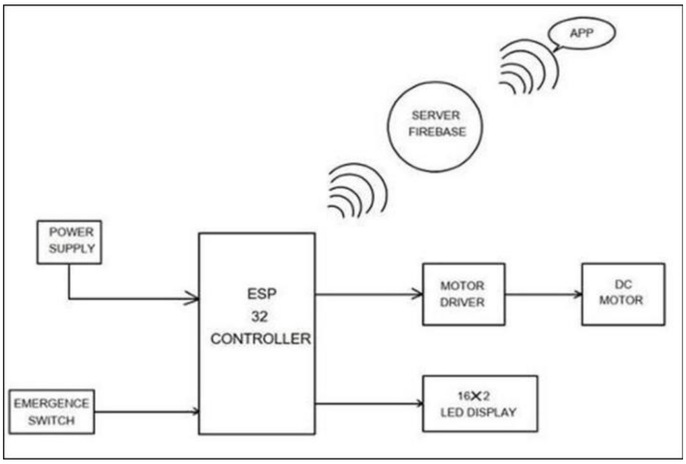


**Figure 1**

 

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## VII. FACILITIES REQUIRED FOR PROPOSED WORK

### 1. Hardware Facilities

- **DC Motor (12v or 24v):** The DC motor serves as the primary actuator in this project. It is used to demonstrate variable speed and load control using IoT-based dynamic power management. The motor's parameters such as speed, torque, and current draw will be monitored to evaluate system performance and energy efficiency.
- **Microcontroller or IoT Board (Arduino/ESP32/Raspberry Pi):** The microcontroller acts as the brain of the system, processing input data from sensors and executing control algorithms. An IoT-enabled board like the ESP32 or Raspberry Pi provides built- in Wi-Fi connectivity, enabling communication with cloud platforms for remote monitoring and control.
- **Motor Driver Ciruit (L298N/BTS7960):** Since the DC motor requires higher current than a microcontroller can supply, a driver circuit is used to control the power delivered to the motor. The motor driver facilitates direction and speed control based on PWM (Pulse Width Modulation) signals generated by the microcontroller.
- **Sensors (Current, Voltage, Temperature, and Speed):**
  1. Current Sensor (ACS712): Measures current drawn by the motor to analyze energy consumption.
  2. Voltage Sensor: Tracks supply voltage to monitor power fluctuations.
  3. Temperature Sensor (LM35/DS18B20): Detects overheating to prevent motor damage.
  4. Speed Sensor (Hall Effect or IR): Measures motor RPM for feedback-based control.These sensors provide real-time data for smart decision-making and power regulation.
- **Power Supply Unit:** A regulated DC power source is essential to supply stable voltage and current to both the motor and the control circuitry. It ensures reliable operation and protects sensitive components from voltage fluctuations.
- **Wi-Fi or Communication Module:** ESP8266/ESP32 or MQTT protocol module enables wireless data transmission to IoT platforms. This allows real-time updates of motor parameters and remote control from any connected device.
- **Laptop or PC:** Used for programming the microcontroller, uploading firmware, monitoring data, and visualizing results through cloud dashboards.

### 2. Software Facilities

- **Arduino IDE / ESP-IDF / Python Environment:** These development environments are used to write and upload code to the microcontroller. The code will include sensor interfacing, data acquisition, PWM-based motor control, and IoT communication protocols.
- **Database and Data Logging Software:** A local or cloud-based database will be used to record sensor readings and system events. This historical data helps analyze performance trends and supports predictive maintenance.
- **Data Analysis Tools (MATLAB, Python, and Excel):** These tools will process and visualize collected data to evaluate efficiency, power savings, and system stability under various operating conditions.

### 3. Testing and Measurement Facilities

- **Digital Multimeter (DMM):** Used to measure voltage, current, and resistance during circuit assembly and testing. It helps verify the accuracy of sensor readings and circuit integrity.
- **Stable Internet Connectivity:** Required for continuous communication between the hardware and cloud server. A reliable Wi-Fi connection ensures real-time data transfer and control without delay.
- **Safety Equipment:** Includes fuses, circuit breakers, insulated gloves, and protective gear to prevent electrical hazards during testing and operation.

### 4. Supporting Facilities

- **Electronics Laboratory or Workshop:** Provides workspace equipped with basic tools, soldering stations, and testing instruments necessary for assembling and debugging the circuit.
- **Power Backup (UPS or Inverter):** Ensures uninterrupted operation during programming or testing, protecting hardware and data from sudden power loss.
- **Technical Support and Internet Access:** Access to IoT platform accounts, open-source libraries, and online resources for troubleshooting and system integration.
- **Documentation and Analysis Tools:** Word processors and presentation software will be used to document findings, generate reports, and present results clearly.

## VIII. FEASIBILITY STUDY AND FUTURE SCOPE

**Feasibility study:**

The IoT Power Dynamics for Smart DC Motor Control project is technically, economically, and operationally feasible due to advancements in IoT technology, affordable microcontrollers, and accessible cloud services. From a technical feasibility standpoint, the system can be implemented using readily available components such as the ESP32 microcontroller, IoT platforms like Thing Speak or Blynk, and low-cost sensors. These devices are easy to

 

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integrate and program, making it possible to achieve real-time monitoring, data communication, and smart motor control with high accuracy and reliability.

In terms of economic feasibility, the project requires only moderately priced hardware and software resources. Most components, including the DC motor, sensors, and driver circuits, are inexpensive and easily available in the local market. IoT platforms often offer free or lowcost access for academic and prototype use. As a result, the project provides a cost-effective solution for developing an intelligent motor control system that can reduce power wastage and improve operational efficiency, leading to long-term economic benefits in industrial and domestic applications.

The environmental and social feasibility of the project also adds value. By enabling power optimization and efficient motor control, the system supports sustainable energy management and reduces unnecessary energy consumption. Moreover, its IoT-based monitoring capability promotes safety, reliability, and energy awareness, aligning with global trends toward smart and green technologies. Therefore, the proposed system is highly feasible in all key aspects—technical, economic, operational, and environmental.

**Future Scope:**

**Industrial Automation**

- **Remote Monitoring:** Monitor motor performance, speed, and temperature remotely using IoT sensors and platforms.
- **Automated Control:** Control motors remotely using IoT-enabled devices, reducing the need for manual intervention (Fig. 6). Robotics and Autonomous Systems.

**Energy Efficiency and Sustainability**

- **Optimized Control:** Optimize motor control algorithms using IoT data to reduce energy consumption.
- **Renewable Energy Systems:** Control DC motors in renewable energy systems like wind or solar.

**Smart Home and Building Automation**

- **Smart Lighting:** Control DC motors in smart lighting systems to adjust brightness and color.
- **HVAC Systems:** Control DC motors in heating, ventilation, and air conditioning (HVAC) systems.

**Healthcare and Medical Devices**

- **Medical Pump Control:** Control DC motors in medical pumps to deliver precise amounts of medication.
- **Medical Imaging:** Control DC motors in medical imaging equipment, such as MRI or CT scanners.

## IX. TABLE 1: APPROXIMATE VALUE/ESTIMATION

The proposed system is a low-cost, farmer-friendly solution that offers automation and precision with estimated optimal performance values.

| Sr. No | Parameter | Approximate Value / Estimation |
|---|---|---|
| 1 | ESP32 (Web Server + Controller) | 312 |
| 2 | Motor Driver ( LS298A) | 145 |
| 3 | Motor (1000 RPM,DC) | 325 |
| 4 | Display (Display) | 175 |
| 5 | Ultrasonic sensor (Ultrasonic sensor) | 115 |
| 6 | Buzzer (Buzzer) | 100 |
| 7 | Switch (Switch) | 50 |
| 8 | Battery | 450 |
| 9 | Wheels (10*2cm) | 150 |
| 10 | Coding And App | 10,000 |
| 11 | Total cost | 12,000 |

**Table 2: Time schedule (proposed Timeline - 6 months)**

| Month | Work Schedule |
|---|---|
| 25/08/2025-10/09/2025 | Finding problem in searching place (hospital, agriculture, petrol pump, MSEB etc.). |
| 11/09/2025-25/09/2025 | Discussion on effective problems and identification of most real problem. |
| 26/09/2025-10/10/2025 | Final selection of problem. |
| 11/10/2025-25/10/2025 | Collect references (books, journals, research papers, online sources). |
| 26/10/2025-10/11/2025 | Fixing suitable project title. |
| 11/11/2025-10/12/2025 | Literature review (study of past work, existing solutions, gap). |
| 11/12/2025-31/12/2025 | Discussion on costing of project and estimation of budget (~25k). |
| 01/01/2026-20/01/2026 | Preparation of block Diagram (input–process–output). |
| 21/01/2026-20/02/2026 | Methodology and flowchart preparation. |
| 21/02/2026-15/03/2026 | Draft report preparation (Intro, Problem statement, Literature, Costing, Block diagram, Methodology) |
| 16/03/2026-10/04/2026 | Correction, editing, and final report writing |

 

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| | |
|---|---|
| 11/04/2026-26/04/2026 | Final submission, viva and presentation. |

## X. CONCLUSION

In conclusion, motor control is a complex process that involves initiating, directing, and grading purposeful voluntary movement. The Motor Driver Integrated Circuit provides a reliable and efficient solution for controlling DC motors in various applications, including robotics and automation.

With its ability to independently control two motors in both directions, this motor driver is an ideal choice for applications requiring precise motor control. Its compatibility with microcontrollers, manual switches, and other devices makes it a versatile and convenient solution for many motor control needs. Motor control and learning are essential aspects of human movement, enabling individuals to acquire and refine motor skills throughout their lifespan. Studying motor control and learning has significant implications for rehabilitation and performance enhancement. Similarly, advanced DC motor control techniques in engineering are crucial for achieving high performance and energy-efficient systems.

This paper has comprehensively reviewed these techniques, effectiveness and demonstrating their efficiency through theoretical analysis, simulation results, and experimental validation. This research's findings significantly impact sophisticated DC motor control systems advancement across industrial, automotive, and robotics applications.

The DC motor control system outlined in this study offers a thorough and efficient method for motor speed regulation. The system's hardware components, including the direct current motor, motor driver, and control unit, work with the software components, such as the control algorithm and C programming language, to achieve precise motor control. The performance metrics, such as steady-state error, settling time, and overshoot, highlight the system's effectiveness in precisely regulating motor speed. This study makes a significant contribution to the field of DC motor control and holds promising applications in the industrial, automotive, and robotics sectors.

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