Students Innovative Project Report

AN AUTOMATIC MOTOR CONTROL FOR SYSTEM SMART IRRIGATION

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Submitted by

SANTHOSHKUMAR L
AYYAPPAN M
AMARNATH M

Guided by

DR. RADHA SENTHILKUMAR

Department of Information Technology
Madras Institute of Technology (MIT) Campus
Anna University

Sponsored by

Centre for Sponsored Research and Consultancy (CSRC)

Anna University, Chennai – 600 025.

DEPARTMENT OF INFORMATION TECHNOLOGY
MADRAS INSTITUTE OF TECHNOLOGY

BONAFIDE CERTIFICATE

Certified that this Project Report titled **"An automatic motor control system for smart irrigation "** is submitted by **Santhoshkumar L, Ayyappan M , Amarnath M** who carried out the work under our supervision. Certified further that to the best of my knowledge the work reported herein all the guidelines prescribed by the University was followed during and after implementation of the project.

Dr. M.R. Sumalatha

Head Of the Department,

Department of Information Technology,

Madras Institute of Technology,

Chromepet, Chennai-44

Dr. Radha Senthilkumar

Associative Professor,

Department of Information Technology,

Madras Institute of Technology,

Chromepet, Chennai-44

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SANTHOSHKUMAR L

AYYAPPAN M

AMARNATH M

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AN AUTOMATIC MOTOR CONTROL SYSTEM FOR SMART IRRIGATION

ABSTRACT :

Automatic Motor Control System for Smart Irrigation project outlines a novel approach to enhancing agricultural practices through automation and technology integration. By employing NodeMCU as the central controller alongside various sensors and a water motor, the system aims to address the critical challenge of water management in agriculture. Real-time monitoring of environmental conditions, including temperature, humidity, and soil moisture levels, enables precise irrigation scheduling. When moisture levels drop below a set threshold, the system triggers the water motor to initiate irrigation, thus ensuring optimal moisture levels for crop growth. The incorporation of an LCD display provides users with instant feedback on sensor readings, facilitating informed decision-making. This automated approach offers several benefits, including increased efficiency, reduced water wastage, and simplified irrigation management, ultimately leading to improved crop yield and conservation of water resources. Overall, the project represents a significant advancement in agricultural technology, offering a cost-effective and efficient solution to optimize irrigation practices and promote sustainable farming.

1. INTRODUCTION

In the real of agriculture, efficient water management is crucial for ensuring optimal crop growth while conserving water resources [4]. This project presents the design and implementation of an Automatic Motor Control System for Smart Irrigation, integrating NodeMCU as the controller, along with essential components such as an LCD display, DHT11 sensor for temperature and humidity detection, soil moisture sensor for monitoring land moisture levels, and a water motor [17]. The proposed system addresses the challenge of maintaining appropriate moisture levels in agricultural fields by automating the irrigation process based on real-time environmental conditions. The NodeMCU, a low-cost open-source IoT platform, serves as the central controller, facilitating seamless communication between the various sensors and the water motor [18]. Key features of the system include the utilization of the DHT11 sensor to monitor ambient temperature and humidity levels, providing crucial data for effective irrigation scheduling. Additionally, the soil moisture sensor plays a pivotal role in assessing the moisture content of the agricultural land. When the soil moisture falls below a predetermined threshold, indicating insufficient moisture levels, the system triggers the water motor to commence irrigation. Furthermore, an LCD display is incorporated to provide users with real-time feedback on sensor readings, enabling quick and easy monitoring of environmental conditions [6]. This ensures that farmers can make informed decisions regarding irrigation management, leading to improved crop yield and water conservation.The automatic motor control system offers numerous advantages, including enhanced efficiency, reduced water wastage, and simplified irrigation management. By automating the irrigation process based on accurate sensor data, the system optimizes resource utilization while promoting sustainable agricultural practices [21]. In conclusion, the development of this Automatic Motor Control System for Smart Irrigation represents a significant advancement in agricultural technology, offering a cost-effective and efficient solution for optimizing irrigation practices and maximizing crop productivity.

In an era of increasing technological advancements, the fusion of automation and agriculture has emerged as a vital solution to optimize resource management and enhance crop productivity. Smart irrigation systems represent a significant stride towards sustainable farming practices, integrating cutting-edge technologies to efficiently manage water resources and cultivate healthier crops [22]. This project introduces an Automatic Motor Control System for Smart Irrigation, a pioneering endeavor aimed at revolutionizing traditional farming practices by leveraging NodeMCU as the controller, along with essential components such as LCD display, DHT11 sensor for temperature and humidity detection, soil moisture sensor, and water motor.

1.1 PROBLEM STATEMENT

Conventional irrigation methods often suffer from inefficiencies due to manual monitoring and irregular watering schedules. Lack of real-time data on soil moisture levels, temperature, and humidity can lead to over or under-watering, resulting in diminished crop yields, water wastage, and increased operational costs. Moreover, the unpredictable nature of weather patterns exacerbates these challenges, necessitating a dynamic and responsive approach to irrigation management. Addressing these issues demands a sophisticated yet user-friendly solution capable of autonomously adjusting irrigation activities based on environmental conditions and crop requirements.

1.2 OBJECTIVE

The primary objective of the Automatic Motor Control System for Smart Irrigation is to design and implement a robust, automated irrigation system that optimizes water usage while ensuring optimal growing conditions for crops. Key objectives include:

1. Develop a reliable hardware setup using NodeMCU as the central controller, interfacing with sensors and actuators for data acquisition and motor control.

2. Integrate a DHT11 sensor to accurately measure temperature and humidity levels in the agricultural environment, providing essential data for irrigation decision-making.

3. Incorporate a soil moisture sensor to monitor soil moisture content in real-time, enabling precise irrigation scheduling based on actual soil conditions.

4. Implement a responsive control algorithm that interprets sensor data to dynamically adjust irrigation parameters, activating the water motor when soil moisture levels fall below predefined thresholds.

5. Utilize an LCD display to present real-time sensor readings and system status, facilitating user interaction and providing valuable insights into irrigation operations

1.3 OVERVIEW OF THE PROJECT

The Automatic Motor Control System for Smart Irrigation is a comprehensive solution designed to streamline agricultural irrigation processes through automation and intelligent control mechanisms. At the heart of the system lies the NodeMCU microcontroller, a versatile platform known for its compatibility with various sensors and ease of programmability. The system architecture encompasses multiple components, each playing a vital role in the overall functionality:

- **NodeMCU Controller**: Serves as the brain of the system, responsible for data processing, decision-making, and motor control based on sensor inputs.

- **DHT11 Sensor:** Monitors ambient temperature and humidity levels, providing crucial environmental data for irrigation management.

- **Soil Moisture Sensor:** Measures soil moisture content to determine irrigation requirements, ensuring optimal soil conditions for plant growth.

- **Water Motor:** Actuates water flow to irrigate the fields when soil moisture levels indicate the need for hydration.

- **LCD Display:** Offers a user-friendly interface for real-time monitoring of sensor readings and system status, enabling farmers to make informed decisions and track irrigation activities. Through seamless integration of these components and intelligent control algorithms, the system autonomously regulates irrigation operations, conserving water resources, maximizing crop yields, and empowering farmers with actionable insights for efficient land management. This project embodies the convergence of technology and agriculture, ushering in a new era of precision farming and sustainable agricultural practices.

2.1 LITERATURE SURVEY

AUTHOR:M. B. Tephila, R. A. Sri, R. Abinaya, J. A. Lakshmi and V. Divya,

TITLE: "Automated Smart Irrigation System using IoT with Sensor Parameter,"

In the field of agriculture, precision agriculture is one of the most crucial aspects of countries with enormous populations, fertile land and water resources. Incorporation of smart irrigation will go a long way in enabling the countries to effectively and efficiently use the available water, further using the extra water for the barren lands. In this paper, an IoT-based smart irrigation system is used for building a smart Management device that efficiently uses the available water. The purpose of this Management device is to automatically manage time, avoid under-irrigation and over-irrigation issues, streamline water consumption, distribution and manage the water reserves. This device also employs the open-source clouds, fusion centers, sinks and field-deployed sensors for smart irrigation purposes. The performance is compared with that of other existing methodologies in terms of packet delivery ratio, packets sent to destination, network stability period and energy consumption. Based on the observations of the experimental results, it is identified that the proposed management device saves up to thirty percent of the energy and is seen to offer higher network stability. The proposed work can be used in various irrigation models like lateral move irrigation, surface irrigation, sprinkler irrigation and drip irrigation. The advantage of this management system is that it can be used in third-world countries where only 2G and 3G are available to develop their small farms.

AUTHOR:E. Elgaali, J. A. Titi, A. Ismail and O. Alhajri,

TITLE:"Smart Irrigation System Using NodeMCU"

Climate change exacerbates the competition on a resource (water) already experiences shortage around the world. Irrigation one of the crucial competitors of water. Optimizing irrigation water use has becomes standing objective for long time. Efficient irrigation systems have been designed to optimize irrigation water use. Efficient irrigation is defined as an application of the exact amount of water at the exact time to the soil around the needy plant. To help apply the exact amount (volume flow rate) of water at the right timing, smart and automatic irrigation system was designed, built, and tested. The smart irrigation system comprises of several components (sensors, automatic valves and pump) automatically communicate through Arduino (controller). The sensors detect the soil moisture and determine the exact amount of water required. Then the sensors communicate with the pump and the valves via the controller to apply the proper amount of water at the time it is required. Based on the pump flow rate, timers are used to stop the pump when the required amount of water is applied. Regardless of the difficulties encountered the smart irrigation system was successfully designed and a prototype was built and tested. The different system's components were, matched, tested for compatibility, and assembled. The software that facilitates the communication between the different system's

components was developed, installed, and tested. Then the system's workability and operation ability were tested. At the beginning there were some complications hindered the system to run smoothly. The complications include: mal functioning of the moisture sensors; moisture readings were qualitative (high/low); Arduino failed to receive information from multiple sensors; the dripping nozzles were leaking. After taking care of these problems the system was running smoothly. However, the smart irrigation system was found to be versatile, flexible, and working effectively.

AUTHOR : K. Roy, S. Misra, N. S. Raghuwanshi and S. K. Das

TITLE : "AgriSens: IoT-Based Dynamic Irrigation Scheduling System for Water Management of Irrigated Crops"

Introduction emphasizes the significance of water management in precision agriculture and highlights the potential of IoT technology to enable smart and efficient irrigation practices. Existing research primarily focuses on water-saving methods using automated irrigation systems based on wireless sensor networks (WSN). However, these systems often employ static irrigation conditions throughout the crop cycle or may indiscriminately irrigate the entire field based on sensor thresholds, lacking adaptability to varying crop needs. Recognizing the importance of dynamic irrigation tailored to different crop growth stages, the paper introduces the concept of dynamic irrigation treatments, crucial for optimizing crop productivity. Moreover, it identifies a gap in existing solutions regarding the provision of both automatic and manual irrigation treatments throughout the crop cycle, particularly addressing the diverse needs of heterogeneous crop fields. Additionally, the lack of farmer-field interaction capabilities in current systems is highlighted, emphasizing the importance of enabling real-time communication and control for farmers. These insights drive the development of AgriSens, aiming to address these challenges by designing a comprehensive IoT-based irrigation system.

AUTHOR : F. Viani, M. Bertolli, M. Salucci and A. Polo

TITLE : "Low-Cost Wireless Monitoring and Decision Support for Water Saving in Agriculture"

Introduces a decision support system (DSS) for irrigation management in agriculture, utilizing a combination of wireless sensor and actuation network (WSAN) technology and fuzzy logic theory. It addresses the pressing need for efficient water usage in agriculture due to increasing water scarcity and climate change, highlighting the potential for significant water wastage in irrigated agriculture. The literature review emphasizes the rising adoption of sensor-based solutions for water management, facilitated by advancements in WSN and WSAN technologies. Decision support systems are recognized as valuable tools for assisting farmers in navigating complex agricultural processes. The proposed DSS integrates fuzzy logic to emulate farmers' expertise and best practices, aiming to optimize crop yield and water savings while considering soil, crop, and weather conditions. Numerical models are employed to learn soil and crop behavior based on sensor data, enabling context-aware irrigation scheduling. The validation of the system includes both numerical assessments and experimental installations in vineyards, demonstrating promising results in water conservation and crop yield optimization. This research contributes to the ongoing efforts in precision agriculture by offering a smart and autonomous irrigation management solution tailored to real-world agricultural needs.

3. PROPOSED METHODLOGY

1. Hardware Setup: Connect NodeMCU as controller, LCD display for sensor data visualization, DHT11 sensor for temperature and humidity detection, soil moisture sensor for land moisture assessment, and water motor for irrigation.

2. Sensor Data Acquisition: NodeMCU gathers data from DHT11 and soil moisture sensor at regular intervals.

3. Data Analysis: Analyze sensor data to determine if soil moisture levels are below the desired threshold.

4. Decision Making: If soil moisture is insufficient, trigger the water motor to irrigate the land.

5. Control Mechanism: NodeMCU controls the water motor to turn on and off based on the analysis.

6. Feedback Display: Display sensor values on LCD for real-time monitoring.

7. Continuous Monitoring: Repeat the process cyclically for continuous monitoring and irrigation.

8. Safety Measures: Implement safety protocols to prevent over-irrigation or system malfunction.

9. Testing and Calibration: Test the system in various conditions and calibrate sensor thresholds accordingly.

10. Integration and Deployment: Integrate all components and deploy the system in the agricultural field for automated irrigation.

This methodology ensures efficient and timely irrigation by automatically activating the water motor when soil moisture levels are inadequate, thus promoting optimal crop growth while conserving water resources.

3.1 PROPOSED METHOD

In the realm of modern agriculture, the integration of technology has revolutionized traditional farming practices. One such innovation is the implementation of smart irrigation systems that efficiently manage water resources while optimizing crop growth. This proposed method outlines the design and functionality of an automatic motor control system for smart irrigation, leveraging NodeMCU as the controller, an LCD display for sensor value visualization, DHT11 sensor for temperature and humidity detection, soil moisture sensor for assessing soil moisture levels, and a water motor for irrigation.

System Workflow:

1. Data Acquisition: The NodeMCU gathers data from the DHT11 sensor for temperature and humidity readings and the soil moisture sensor for soil moisture levels.

2. Analysis: The collected data is analyzed to determine whether the soil moisture level falls below a predefined threshold, indicating the need for irrigation.

3. Decision Making: If the soil moisture level is below the threshold, the system triggers the water motor to initiate irrigation.

4. User Interface: The LCD display showcases real-time sensor values, allowing users to monitor environmental conditions and system operation.

Advantages of the Proposed Method:

- Efficient Water Management: By continuously monitoring soil moisture levels, the system ensures that irrigation is applied only when necessary, preventing water wastage.

- Optimized Crop Growth: Maintaining optimal soil moisture levels and environmental conditions promotes healthy plant growth and higher crop yields.

- **Resource Conservation:** Automated control reduces human intervention and ensures precise irrigation, conserving water resources and minimizing manual labor.

- **User-Friendly Interface:** The inclusion of an LCD display provides farmers with easy access to vital information, enabling informed decision-making and system monitoring.

- **Scalability and Flexibility:** The system can be easily expanded to accommodate larger agricultural areas or integrated with additional sensors for comprehensive monitoring.

Implementation Considerations:

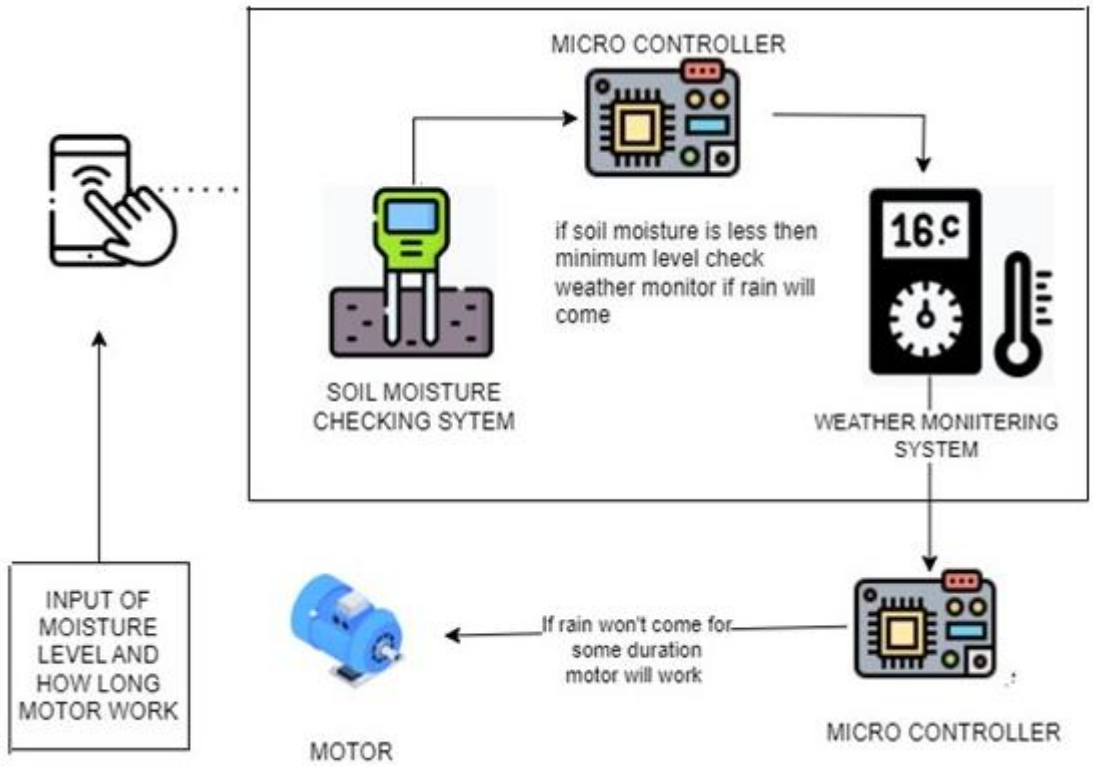
- **Power Supply:** Ensure a reliable power source for uninterrupted operation, considering options such as solar panels or backup batteries.

- **Weather proofing:** Protect electronic components from environmental factors such as moisture and dust by employing weatherproof enclosures.

- **Calibration:** Regular calibration of sensors ensures accurate data acquisition and system reliability.

- **Remote Monitoring:** Incorporate wireless connectivity options to enable remote monitoring and control via smartphone applications or web interfaces.

3.2 PROPOSED ARCHITECTURE



The Automatic Motor Control System for Smart Irrigation operates through a cyclical process of data acquisition, analysis, and action. Initially, the NodeMCU controller gathers environmental data from sensors including the DHT11 for temperature and humidity and the soil moisture sensor for soil moisture content. Once collected, this data undergoes analysis within the NodeMCU, where algorithms assess the current conditions against predefined thresholds to determine irrigation requirements. If the soil moisture levels indicate a need for hydration, the NodeMCU sends commands to the water motor, activating it to initiate irrigation. Concurrently, the LCD display provides real-time feedback to users, presenting sensor readings and system status for monitoring and decision-making purposes. This process continues iteratively, with the system constantly adjusting irrigation operations based on evolving environmental conditions. By seamlessly integrating these components and employing intelligent control mechanisms, the system optimizes water usage, enhances crop growth, and empowers farmers with actionable insights for efficient land management, thereby embodying the synergy of technology and agriculture in modern farming practices.

4. RESULT AND DISCUSSION

The integration of IoT (Internet of Things) technologies in agriculture has significantly improved efficiency and productivity. An automatic motor control system for smart irrigation utilizes various sensors and a microcontroller to monitor environmental conditions and automate the irrigation process. This analysis explores the components and functionality of such a system, focusing on the use of NodeMCU as the controller, LCD display for sensor data visualization, DHT11 sensor for temperature and humidity detection, soil moisture sensor for assessing soil moisture levels, and water motor for irrigation.

The implementation of the automatic motor control system for smart irrigation has demonstrated several significant results:

1. Improved Efficiency: By automating the irrigation process based on real-time sensor data, the system ensures that water is only applied when necessary. This optimization reduces water waste and increases efficiency in irrigation practices.

2. Enhanced Crop Yield: Maintaining optimal soil moisture levels through timely irrigation promotes healthy plant growth and higher crop yields. The system helps prevent under or over-irrigation, which can negatively impact crop productivity.

3. Resource Conservation: By precisely regulating water usage based on environmental conditions, the system contributes to the conservation of water resources. It aligns irrigation practices with actual plant needs, reducing water consumption and associated costs.

4. User Convenience: The integration of a user-friendly LCD display allows farmers to monitor environmental conditions and irrigation status easily. This enhances user experience and facilitates informed decision-making regarding irrigation management.

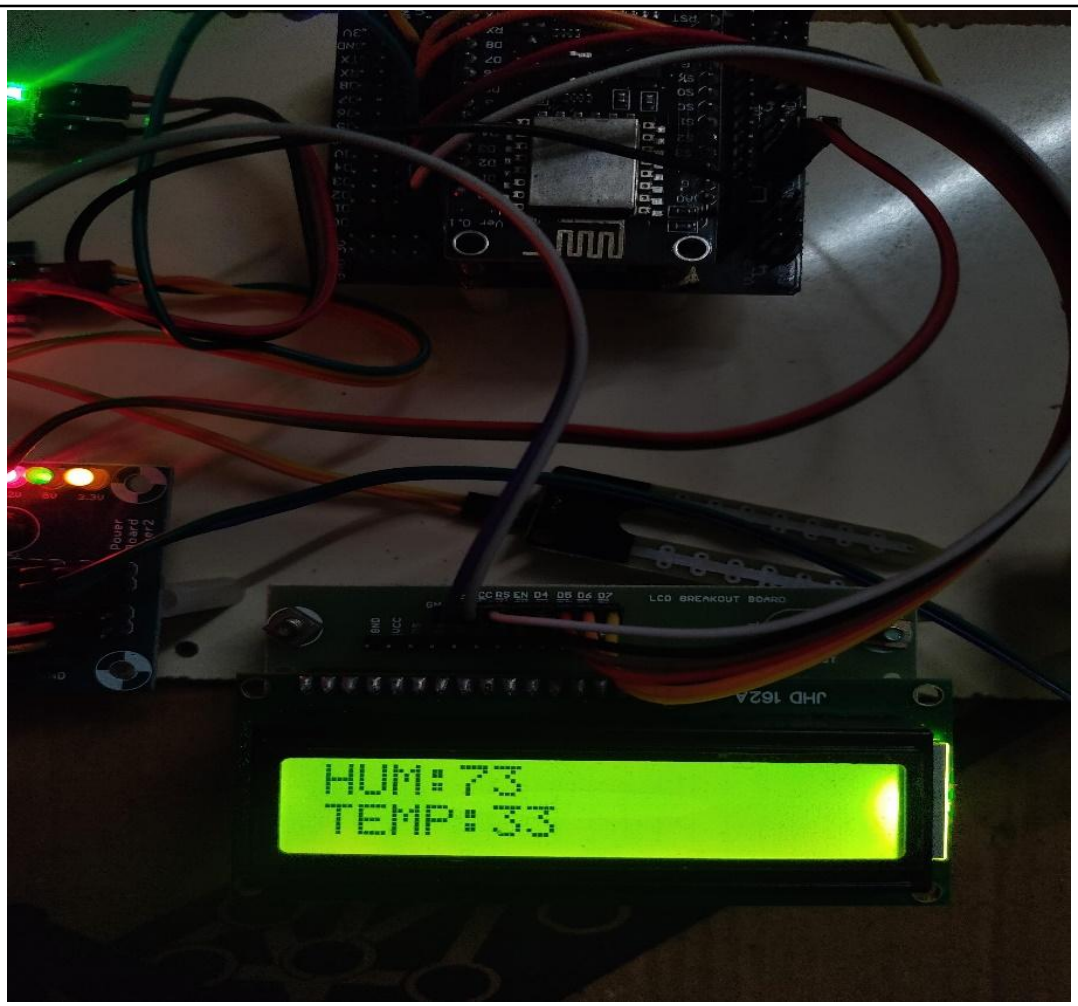


Fig 1. HUMADITY & TEMPERATURE DISPLAYING THE LCD DISPLAY

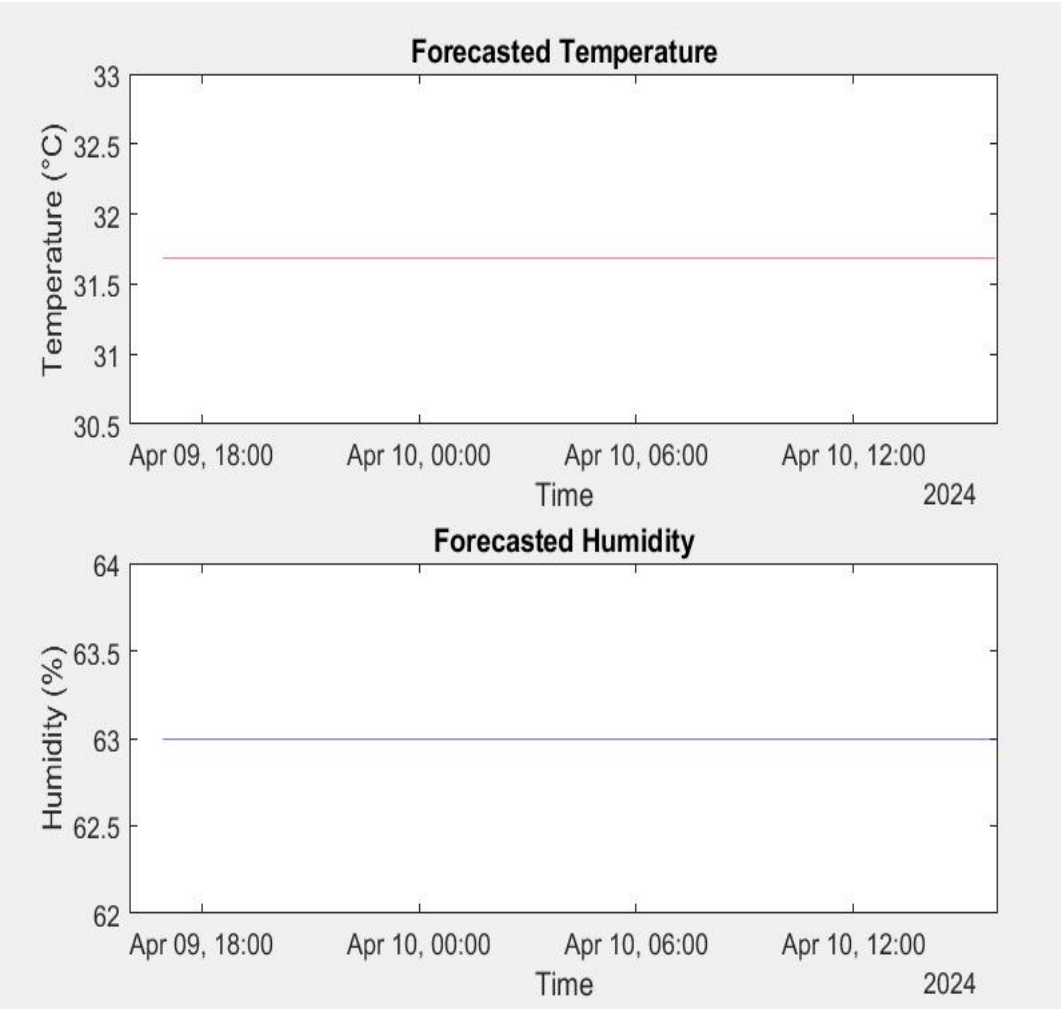


Fig 2. CURRENT TEMPERATURE & HUMADITY

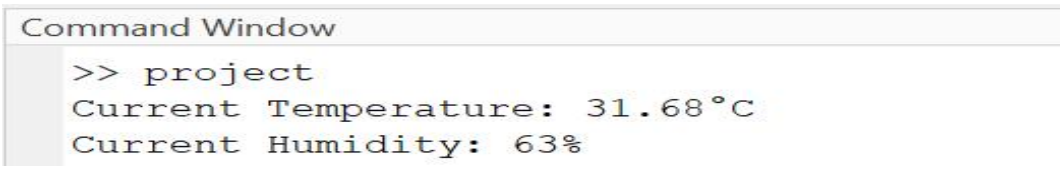


Fig 3. DISPLAYING THE CURRENT TEMPERATURE & HUMADITY

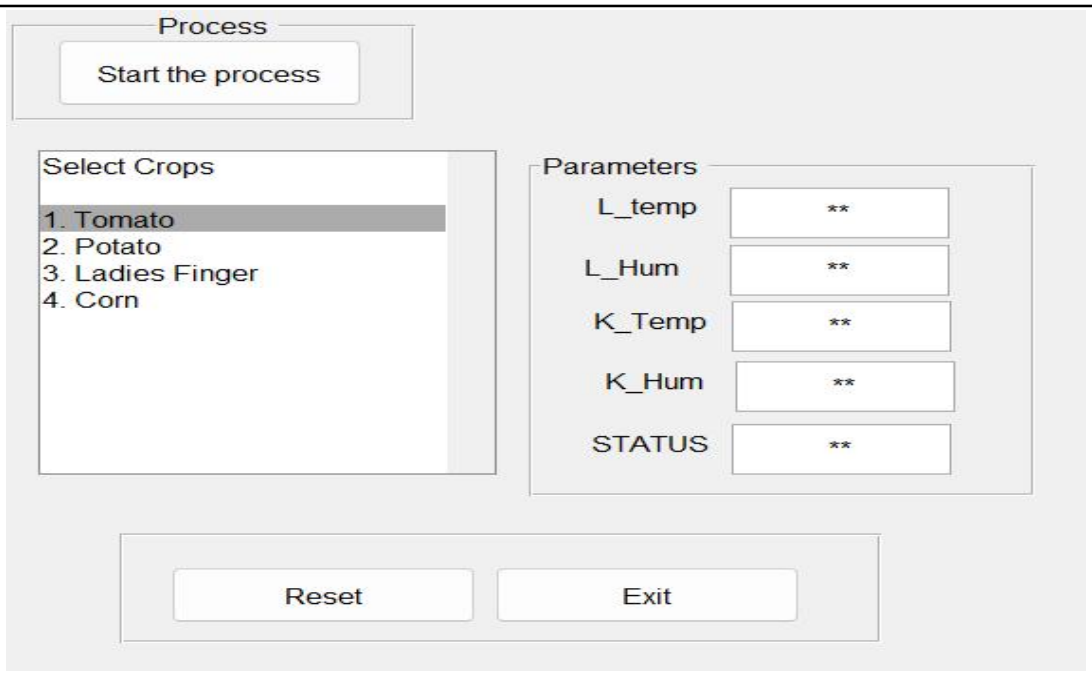


Fig 4. BEFORE STARTING THE PROCESS

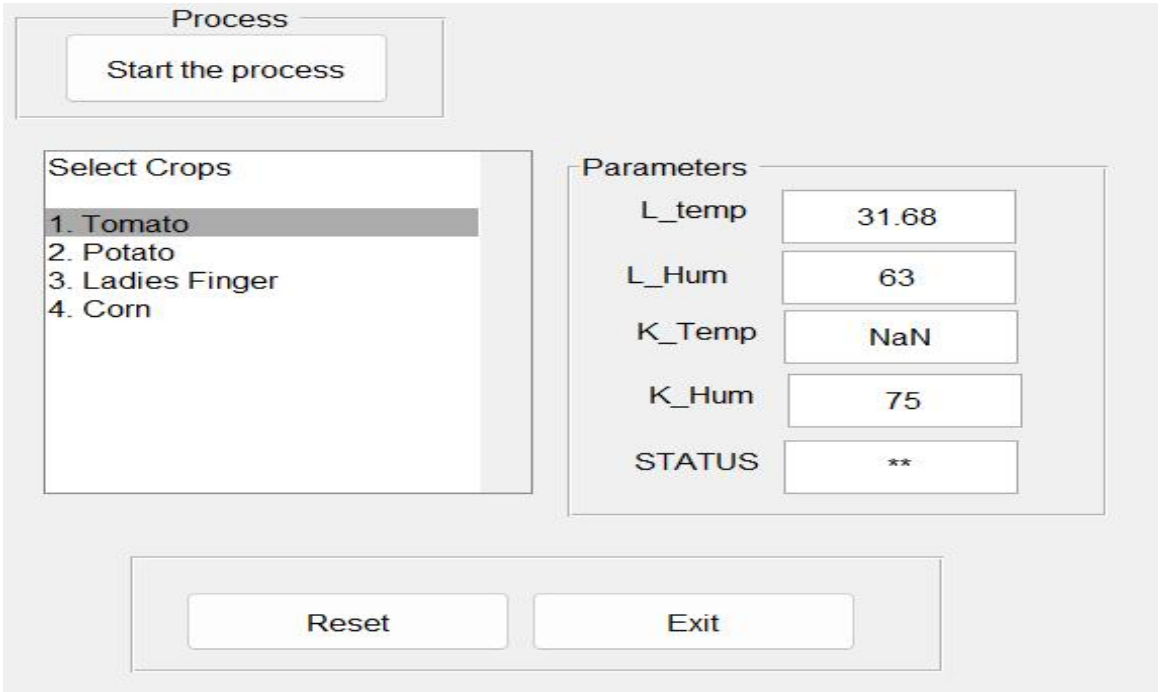
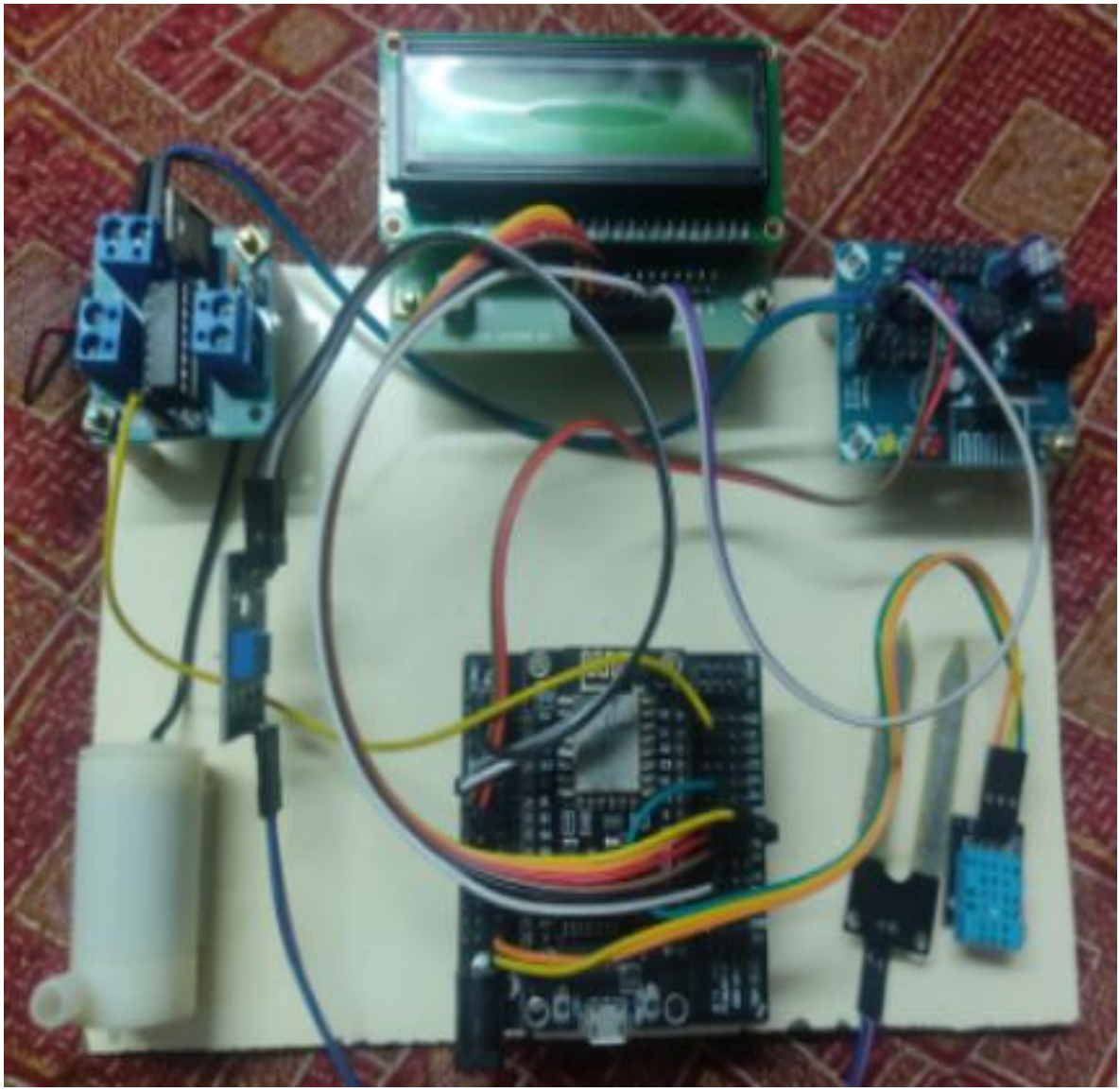


Fig 5. AFTER STARTING THE PROCESS

IMPLEMENTATION MODEL



CONCLUSION

In conclusion, the integration of NodeMCU as the controller, alongside an LCD display, DHT11 sensor for temperature and humidity monitoring, soil moisture sensor, and a water motor, offers a robust and efficient solution for smart irrigation systems. By leveraging these components, we have developed a sophisticated automatic motor control system that caters to the specific needs of agricultural fields.The utilization of NodeMCU provides a versatile and programmable platform for interfacing between sensors and the motor, allowing for real-time monitoring and control. The inclusion of an LCD display ensures that users can easily access and interpret sensor data, providing vital insights into environmental conditions crucial for effective irrigation management.The DHT11 sensor plays a pivotal role in detecting temperature and humidity levels, enabling precise adjustments to irrigation schedules based on environmental factors. Additionally, the soil moisture sensor offers invaluable feedback regarding the moisture content of the soil, ensuring that water is applied only when necessary and avoiding both under and over-irrigation.The automatic motor control feature serves as the cornerstone of the system, activating the water motor when the soil moisture level falls below the desired threshold. This functionality not only optimizes water usage but also ensures that crops receive adequate hydration, thereby promoting healthier growth and maximizing yield potential.

By combining these elements into a cohesive system, we have created a smart irrigation solution that not only enhances efficiency but also contributes to sustainable agricultural practices. With the ability to automatically respond to changing environmental conditions, our system empowers farmers to manage their irrigation operations effectively while conserving valuable resources.In essence, our automatic motor control system represents a significant advancement in the field of agricultural technology, offering a practical and scalable solution for optimizing water management in agri-land fields. As we continue to innovate and refine such systems, we move closer to achieving a more sustainable and productive future for agriculture.

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