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FOREWORD BY IR DR. ILHAM BIN RUSTAM KPP FKE UITMCTKD

All praise be to Allah for the successful culmination of this collaborative endeavor between Politeknik Sultan Mizan Zainal Abidin and Universiti Teknologi MARA (UiTM) Terengganu, which has led to the publication of this compilation of Extended Abstracts. The field of Electrical Engineering continues to evolve at a remarkable pace, driven by rapid technological advancements and the increasing demand for smarter, more sustainable, and efficient systems. This publication presents a curated collection of extended abstracts derived from final year projects undertaken by students of the Electrical Engineering programs at both institutions. These projects not only reflect the students' technical capabilities but also their creativity, critical thinking, and commitment to addressing real-world engineering challenges. I would like to express my heartfelt appreciation to all contributors, particularly the editorial teams, for their dedication and hard work in bringing this publication to life. May the knowledge, methodologies, and outcomes shared within these pages serve as a source of inspiration and a foundation for future advancements in the field of Electrical Engineering. More importantly, may it continue to embody the spirit of discovery and lifelong learning that lies at the core of engineering education. Thank you.

FOREWORD BY HAJI MOHD DASRI BIN CHE MOK @ ADNAN

All praise be to Allah for the successful publication of this collection of Extended Abstracts for Final Year Projects, a collaborative effort between the Electrical Engineering Department of UiTM Terengganu and the Department of Electrical Engineering (JKE), Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu. I extend my heartfelt congratulations to the editorial teams from both UiTM Terengganu and JKE PSMZA, as well as everyone involved in making this publication possible. This compilation showcases the work of diploma students in electrical engineering and is intended to serve as a valuable reference for students, especially those currently undertaking their final year projects. Thank you.

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ORGANIZED BY FAKULTI KEJURUTERAAN ELEKTRIK UITM CAWANGAN TERENGGANU KAMPUS DUNGUN (UITMCTKD)
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Extended Abstracts of Final Year Projects

Volume 1

AUTOMATIC IRRIGATION SYSTEM WITH SOLAR ENERGY

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Abstract: Efficient and sustainable water management is essential for modern agriculture. This project presents an Automatic Irrigation System powered by solar energy, designed to optimize water usage and reduce reliance on conventional energy sources. The system integrates a soil moisture sensor and an ultrasonic distance sensor to automate irrigation processes and monitor the water level in the storage tank. The soil moisture sensor continuously measures soil hydration levels. When moisture falls below a defined threshold, the system activates a water pump to irrigate the soil, ensuring optimal plant growth. Once the moisture level exceeds the required range, irrigation halts, conserving water and preventing over-irrigation. An ultrasonic distance sensor is used to monitor the water level in the tank. If the water level drops below a critical point, an alert system comprising LEDs and a buzzer is activated, ensuring timely refilling of the tank to maintain operational readiness. The entire system is powered by solar energy, making it environmentally friendly and ideal for deployment in off-grid or resource-constrained areas. The integration of renewable energy reduces operating costs and supports sustainable agricultural practices.

Keywords: Irrigation system, Moisture Sensor, Arduino, Solar Powered

INTRODUCTION

Water is a vital resource for agriculture, yet inefficient irrigation practices often lead to wastage and reduced productivity. With increasing water scarcity and the growing demand for sustainable farming methods, there is a pressing need for innovative solutions that optimize water usage while minimizing environmental impact. The Automatic Irrigation System powered by solar energy offers a practical approach to address these challenges by combining smart sensors and renewable energy technology. This project integrates a soil moisture sensor and an ultrasonic distance sensor to automate the irrigation process and monitor water resources effectively. The soil moisture sensor ensures precise irrigation by measuring soil hydration levels and activating a water pump only when the soil is dry. This prevents both over-irrigation and under-irrigation, promoting healthier crop growth and efficient water usage. The ultrasonic distance sensor monitors the water level in the storage tank, triggering alerts when the water level falls below a critical threshold, ensuring timely refilling and uninterrupted irrigation. Powered by solar energy, the system operates independently of conventional power sources, making it suitable for remote or off-grid farming areas. This renewable energy integration reduces operational costs and supports eco-friendly practices, contributing to the global push toward sustainable agriculture.

METHODOLOGY

The system design and development involve assembling key hardware components, including a soil moisture sensor, ultrasonic distance sensor, water pump, LEDs, buzzer, and a relay module. The entire system as shown in the Figure 1.0 is controlled by a microcontroller, which processes sensor inputs and executes actions such as activating the water pump, LEDs, and buzzer. A well-structured circuit layout is developed to integrate these components effectively, ensuring seamless communication and functionality. Additionally, the system incorporates a water level monitoring mechanism using an ultrasonic distance sensor to track water levels in the storage tank. When the water level drops below a predefined threshold, the system activates both visual (LED) and audible (buzzer) alerts, notifying users of the low water condition. For efficient irrigation control, the soil moisture sensor measures the soil's hydration levels and regulates the water pump accordingly. The pump is activated when the moisture level falls below the required threshold and deactivates once sufficient hydration is achieved, ensuring optimal water usage. To enhance sustainability, the system integrates solar energy through a solar panel and charge controller, allowing it to operate on renewable energy. A backup battery storage mechanism is also included to ensure uninterrupted functionality during periods of low sunlight.

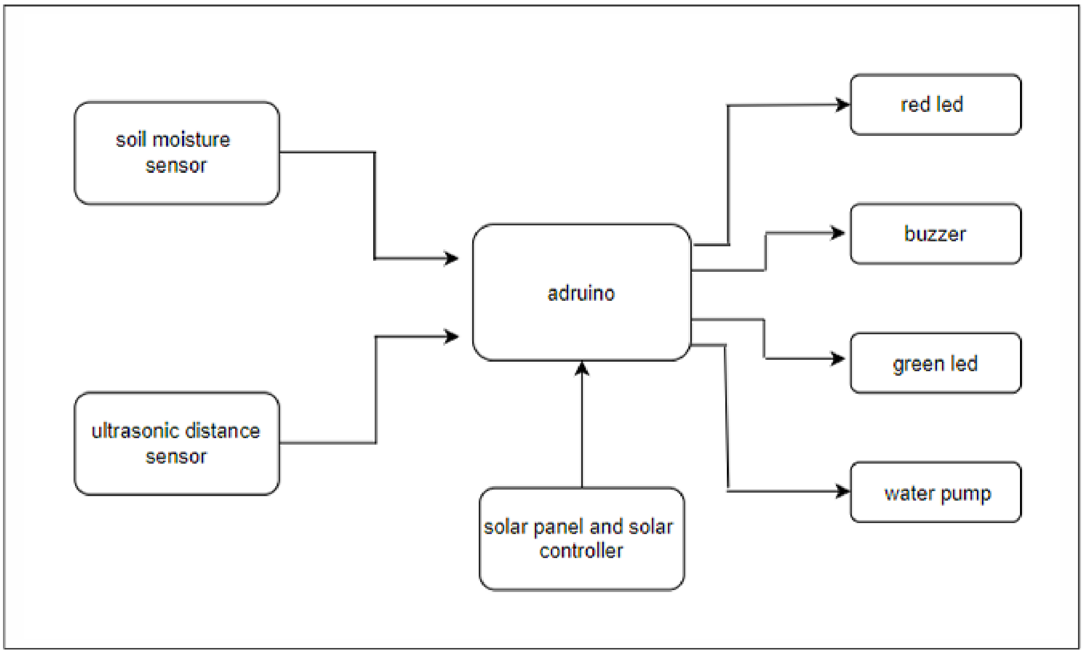

Figure 1.0 Block diagram of the project

RESULT AND DICUSSION

The flowchart shown in Figure 2.0 outlines the system incorporates an ultrasonic distance sensor to monitor the water level in the storage tank. The sensor emits ultrasonic waves and measures the time taken for the waves to reflect back, calculating the water level. If the water level is low (≤10 cm), a red LED and buzzer are activated to alert the user to refill the tank. When the water level is sufficient (>10 cm), a green LED is activated, ensuring a reliable water supply for irrigation.

The system is powered by solar energy, which is a renewable and sustainable source of electricity. Photovoltaic (PV) panels convert sunlight into electrical energy, which is stored in batteries for continuous operation. This eliminates dependency on conventional electricity, making the system ideal for rural or off-grid areas. Solar powered systems are environmentally friendly, cost-effective, and promote sustainable agricultural practices.

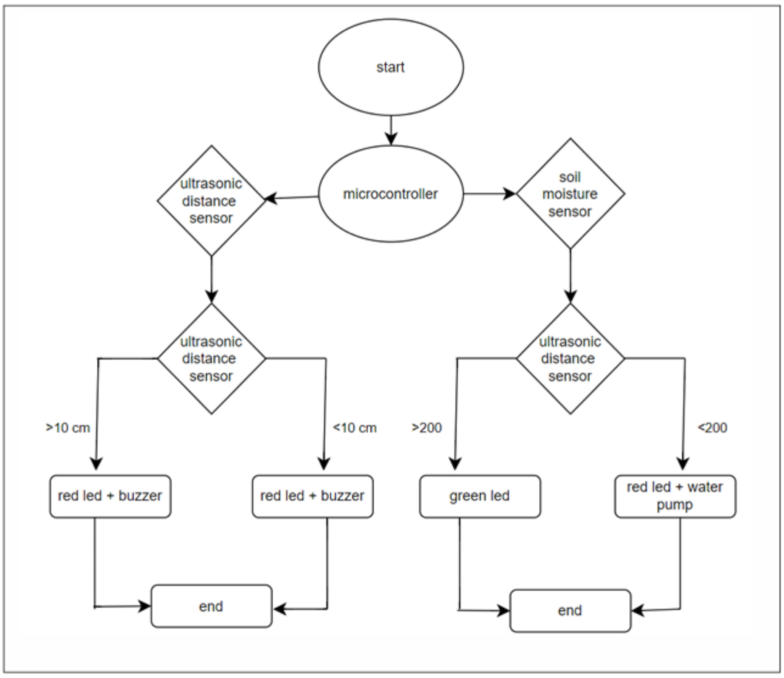

Figure 2.0 Flow chart diagram of the project

CONCLUSIONS

The Automatic Irrigation System powered by solar energy is a practical, efficient, and sustainable solution for modern agricultural needs. By integrating a soil moisture sensor and an ultrasonic distance sensor, the system effectively monitors soil hydration levels and water tank capacity, automating the irrigation process to reduce water wastage and labor dependency. The use of solar energy as the primary power source ensures the system's reliability in off-grid or resource-constrained areas, contributing to eco-friendly and cost-effective agricultural practices. The system provides real-time alerts through LEDs and a buzzer, ensuring timely actions for refilling water tanks and managing irrigation schedules.

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CAR PARKING SYSTEM

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Abstract: This project presents an automated car parking system designed to manage vehicle entry and exit efficiently, addressing traffic congestion in busy parking areas. Utilizing two IR proximity sensors, the system detects incoming cars and controls a servo motor-operated barrier accordingly. An LCD display provides real-time information on parking availability. When spaces are available, the barrier opens automatically; otherwise, it remains closed to prevent overcrowding. This system improves parking management by reducing the need for staff intervention and minimizing the time drivers spend searching for parking spaces, benefiting both users and developers through enhanced convenience and traffic flow.

Keywords: Automated car parking system, IR proximity sensors, LCD display.

INRODUCTION

The introduction of automobiles revolutionized transportation by providing greater freedom of travel and boosting economic growth across various sectors. However, this advancement has also led to significant challenges such as environmental degradation, pollution, noise, traffic accidents, and economic losses due to congestion [1]. Among these issues, parking has become a critical problem in crowded urban areas. The difficulty of finding parking spaces wastes time, consumes excess fuel, and contributes to climate change, making parking a prominent topic in political and environmental discussions. In response, technological innovations like smart car parking systems have emerged to optimize the use of limited resources such as time, space, and fuel [2]. These systems bring order and efficiency to parking lots by detecting available spaces and guiding drivers accordingly. Typically installed in places like shopping complexes, the system displays the number of vacant spots on an LCD screen and operates automatically when a vehicle is detected, reducing unnecessary circulation and easing traffic congestion [3]. Car parking systems benefit various urban stakeholders by improving traffic flow and reducing accidents caused by distracted drivers searching for parking [4]. By integrating mechanical and technological solutions, these systems offer a practical approach to managing parking spaces more effectively, enhancing safety, convenience, and environmental sustainability.

The objectives of this car parking system are to develop an easily implementable solution for visitors, reduce parking costs and overhead, and minimize pollution caused by vehicles circulating unnecessarily, thereby conserving fuel and lowering harmful emissions in parking areas.

METHODOLOGY

Figure 1 shows the block diagram of the car parking system. The car parking system uses two IR proximity sensors, one to detect cars entering and another for cars exiting the parking slot. An Arduino UNO R3 processes these sensor inputs and controls the outputs. The LCD display shows the number of available parking spaces, while a servo motor operates the gate to open or close accordingly, ensuring efficient and automated parking management. Figure 2 shows the schematic diagram of the car parking system. In Proteus software, switches simulate IR proximity sensors to avoid errors. The first sensor connects to Arduino pin 4, the second to pin 2, and the servo motor to pin 3. The LCD display interfaces with analog pins A0 to A5 on the Arduino UNO R3 for effective system operation.

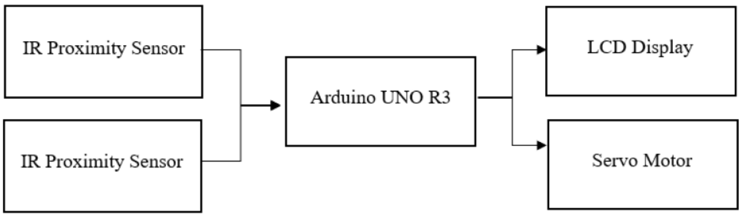

Figure 1: Block diagram of car parking system.

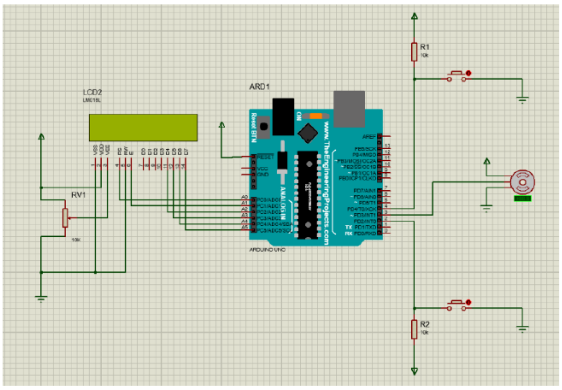

Figure 2: Schematic diagram of car parking system.

RESULT AND DISCUSSION

Table 1 and table 2 shows the simulation results of the traffic following of entrance and exit of the car into parking lot. For the entrance after 5th car the LCD shows "not available" to indicate no more parking space left. As for the exit flow, the space increases whilst the car exits from the parking lot. The simulation is successful.

Table 1: The flow of cars enters the parking lot

No of Car	LCD Display (Parking Left)	Servo Motor (ON/OFF)
1	4	ON
2	3	ON
3	2	ON
4	1	ON
5	0	ON
6	Sorry! Not Available	OFF

Table 2: the flow of car exits the parking lot

No of Car	LCD Display (Parking Left)	Servo Motor (ON/OFF)
1	1	ON
2	2	ON
3	3	ON
4	4	ON
5	5	ON

CONCLUSIONS

The car parking system project successfully demonstrates an efficient and automated solution to manage parking spaces using IR sensors, Arduino UNO, an LCD display, and a servo motor. By accurately detecting vehicle entry and exit, the system optimizes parking availability, reduces traffic congestion, and minimizes fuel wastage and pollution caused by vehicles searching for parking. This technology not only enhances convenience for visitors but also supports better traffic management and environmental sustainability. Overall, the project highlights the potential of integrating simple electronic components to address urban parking challenges effectively, benefiting both users and city infrastructure.

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ENHANCING HOME SAFETY WITH IOT-BASED SMART FIRE DETECTION AND NOTIFICATION SYSTEM

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Abstract: This project aims to develop a fire detection system leveraging modern sensor technology and IoT capabilities. The system incorporates a flame sensor, smoke sensor, LED indicators with a buzzer for immediate on-site alerts. Additionally, it utilizes a NodeMCU ESP8266 microcontroller to connect to the Telegram platform, enabling remote monitoring and control via the internet. The primary objectives are to enhance fire detection accuracy, provide real-time alerts, and facilitate remote monitoring to ensure timely responses to fire incidents. The system is designed to be user-friendly, requiring minimal technical expertise for operation and maintenance. By automating the fire detection process and integrating IoT features, the proposed solution aims to improve safety and efficiency in fire management.

Keywords: NodeMCU ESP8266, Telegram Notification, fire alarm system, IOT

INTRODUCTION

Fire hazards pose a significant threat to both residential and commercial properties, leading to substantial loss of life and property annually. Traditional fire detection systems often rely on standalone smoke detectors that provide only localized alerts, limiting their effectiveness, especially when occupants are not present to respond immediately. The advent of Internet of Things (IoT) technology offers a transformative approach to fire detection and prevention by enabling real-time monitoring, remote alerts, and automated responses [1]. Recent advancements in IoT-based fire detection systems have demonstrated the potential to enhance safety measures significantly. For instance, integrating various sensors such as smoke, heat, and gas detectors with IoT platforms allows for comprehensive monitoring and timely detection of fire incidents [2]. These systems can transmit real-time data to users and emergency responders, facilitating prompt action to mitigate fire-related damages. Moreover, the incorporation of microcontrollers like the NodeMCU ESP8266 enables seamless connection between sensors and communication platforms, such as Telegram, for instant notifications. This integration not only enhances the accuracy of fire detection but also provides users with remote monitoring capabilities, ensuring that alerts are received promptly regardless of the user's location. Such systems have been shown to improve response times and reduce the impact of fire incidents [3]. Furthermore, the use of IoT in fire detection aligns with the growing trend of smart home technologies, where automation and remote control are pivotal features. By leveraging IoT capabilities, fire detection systems can be integrated into broader home automation frameworks, providing users with a centralized platform to monitor and manage various safety and security devices. This holistic approach not only enhances user convenience but also contributes to a more robust and responsive fire safety infrastructure [4].
In this context, the present study aims to develop a comprehensive fire detection system that utilizes modern sensor technology and IoT capabilities to provide real-time alerts and remote monitoring. By integrating flame and smoke sensors, LED indicators, buzzers, and the NodeMCU ESP8266 microcontroller with the Telegram platform, the proposed system seeks to enhance fire detection accuracy, ensure timely notifications, and facilitate swift responses to fire incidents. This initiative underscores the importance of adopting advanced technologies to improve fire safety measures and protect lives and property effectively.

METHODOLOGY

Figure 1 illustrates the block diagram of the fire alarm system. The system utilizes flame and smoke sensors as input components, which transmit data to the Wi-Fi module. The ESP8266 microcontroller processes this information and activates multiple output devices, including an LED, a buzzer, and the Telegram application. As a versatile development board, the ESP8266 features built-in General-Purpose Input/Output (GPIO) pins, enabling seamless integration with external hardware components.

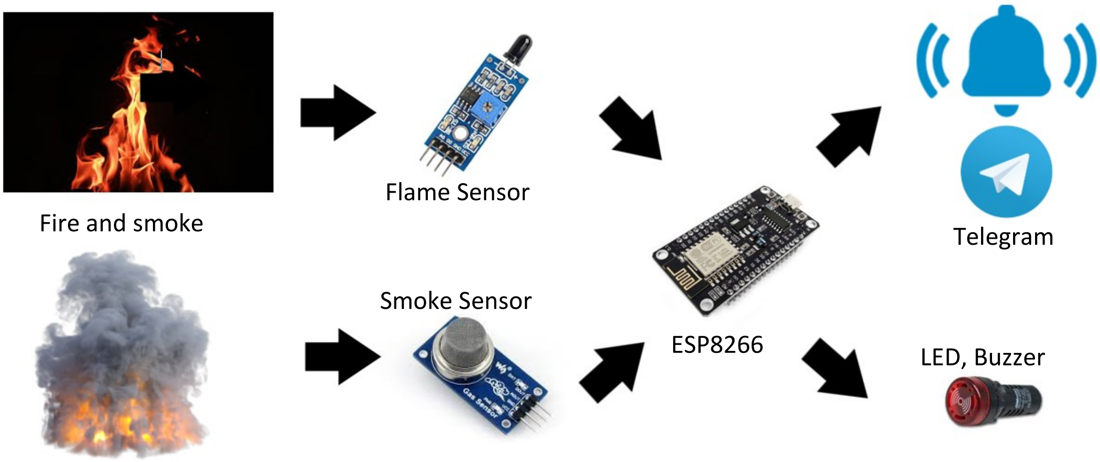
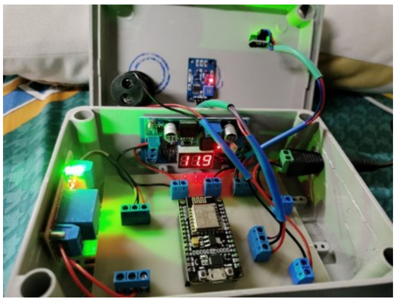
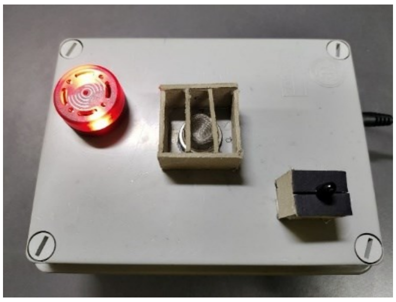


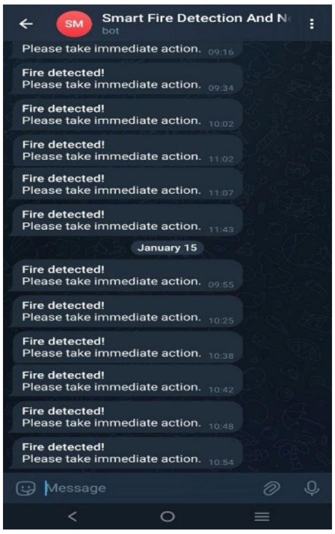
Figure 1. Block diagram of the smart fire alarm system



(a)The circuit



(b)The completed project



(c)The Telegram notifications

Figure 2. The complete hardware and the Telegram application of the smart fire alarm and alert system

RESULT AND DICUSSION

Based on the results obtained, the system responds to fire or smoke detection by activating both the LED and buzzer, signaling a potential danger. At the same time, an alert is sent to the Telegram application, notifying the smartphone owner of the detected hazard. This real-time notification plays a vital role in enhancing safety, allowing the owner to take swift action. Figure 2 presents the system's complete circuit layout, while Table 1 summarizes its overall functionality.

Table 1. An overview of the overall process of smart fire detection and alert system

Fire or smoke detected?	LED + Buzzer	Telegram Apps
TRUE	ON	Send notification
FALSE	OFF	No notification

CONCLUSIONS

In conclusion, the NodeMCU ESP32 and Blynk platform, together with advanced flame and smoke sensors, LED indicators, a buzzer, and Internet of Things integration, all work together to improve fire safety through the quick and accurate alerts that the Quick Notified Fire Alarm system provides. The ubiquity of smartphones can be utilized by this system to ensure faster evacuations and responses by providing real-time remote alerts and on-site notifications. The Quick Notified Fire Alarm makes fire evacuation more responsive and effective by addressing potential problems with traditional alarm systems. To improve fire management and safety in a variety of settings, this creative solution shows the fact that prevention is better than cure. It does this by attempting to save lives and lower the likelihood of fire-related accidents through fast and accurate alerts.

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IOT BASED SOLAR POWERED IRRIGATION SYSTEM WITH REAL TIME MONITORING

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Abstract: This project presents the development of a smart irrigation system tailored for Anthurium plants, leveraging Internet of Things (IoT) technology to optimize water usage and support healthy plant growth. Given the Anthurium's specific moisture requirements, precise irrigation is crucial to avoid overwatering or underwatering. The objective of this project is to design an automated system that monitors soil moisture levels in real time and activates irrigation only when necessary. The system incorporates a soil moisture sensor, an ESP32 microcontroller, an automated water pump, indicator LEDs, an LCD display, and the Blynk IoT platform. The soil moisture sensor continuously collects data, which is processed by the ESP32 to determine whether the soil is dry, moist, or wet. Based on this analysis, the system uses LEDs and the LCD to display soil status. When the soil is detected as dry, the water pump is activated for 30 seconds, and a notification is sent to the user via the Blynk app. The results confirm the system's effectiveness in maintaining optimal soil moisture levels for Anthurium plants while minimizing water wastage. This project demonstrates the potential of IoT-based solutions in addressing irrigation challenges, enhancing plant care, and promoting sustainable gardening practices. The approach is adaptable and can be extended to a wide range of indoor and outdoor plant management systems.

Keywords: ESP32, IoT, irrigation system, soil moisture, anthurium plant

INTRODUCTION

Agriculture continues to play a vital role in supporting economies and feeding growing populations. However, in the face of climate change, dwindling water resources, and rising operational costs, the agricultural sector is under immense pressure to evolve. One of the most pressing challenges is water scarcity, which directly affects crop yields and overall food security. According to [1], unsustainable irrigation practices are among the leading causes of water depletion in agriculture, leading to poor water use efficiency and environmental degradation.

Traditional irrigation methods, such as flood or manual watering, are inherently inefficient. These systems often supply uniform amounts of water regardless of soil moisture variability, which can result in both overwatering and underwatering. Inefficiencies not only wastewater but also reduce plant health, increase disease susceptibility, and ultimately lower crop productivity [2]. Furthermore, manual irrigation methods are labor-intensive, and with the rising costs and scarcity of labor in many agricultural regions, there is a growing need for smarter, automated solutions. To overcome these limitations, the integration of Internet of Things (IoT) technology in agriculture specifically for irrigation has gained significant attention. IoT-enabled systems offer real-time monitoring and data-driven decision-making, allowing for precise irrigation based on actual soil moisture levels. This project proposes the development of a solar-powered smart irrigation system that utilizes soil moisture sensors, an ESP32 microcontroller, a water pump, and wireless connectivity to automate irrigation tasks.

IoT-based smart irrigation systems can significantly improve water use efficiency by monitoring environmental conditions and responding automatically [3]. In this project, soil moisture sensors are embedded in the soil to collect data on moisture content at specific intervals. This data is transmitted to a control unit, which analyzes the readings and activates irrigation only when the soil moisture level falls below a predefined threshold. The system also includes visual indicators (LEDs, LCD display) and is connected to a mobile app via the Blynk IoT platform, providing real-time updates and manual override capabilities. One of the most notable features of this system is its use of solar energy as a power source, allowing the irrigation mechanism to function autonomously and sustainably, even in remote rural areas without grid electricity. In [4] highlight that solar-powered irrigation systems not only reduce dependence on fossil fuels but also offer long-term cost savings and environmental benefits, making them ideal for sustainable farming.

Moreover, remote access to irrigation controls via mobile apps enhances the farmer's ability to manage resources efficiently. Mobile-integrated irrigation systems increase responsiveness, reduce human error, and facilitate timely interventions further increasing water savings and yield outcomes [5]. By combining IoT, solar energy, and automation, this project aims to present a scalable, cost-effective solution to modern irrigation challenges. The outcomes of this research contribute to the field of precision agriculture, promoting sustainable practices and helping farmers maximize resource utilization while preserving environmental integrity.

METHODOLOGY

This section explains the operation of the IoT based solar powered irrigation system with real time monitoring project. The project's block diagram is shown in **Figure 1**.

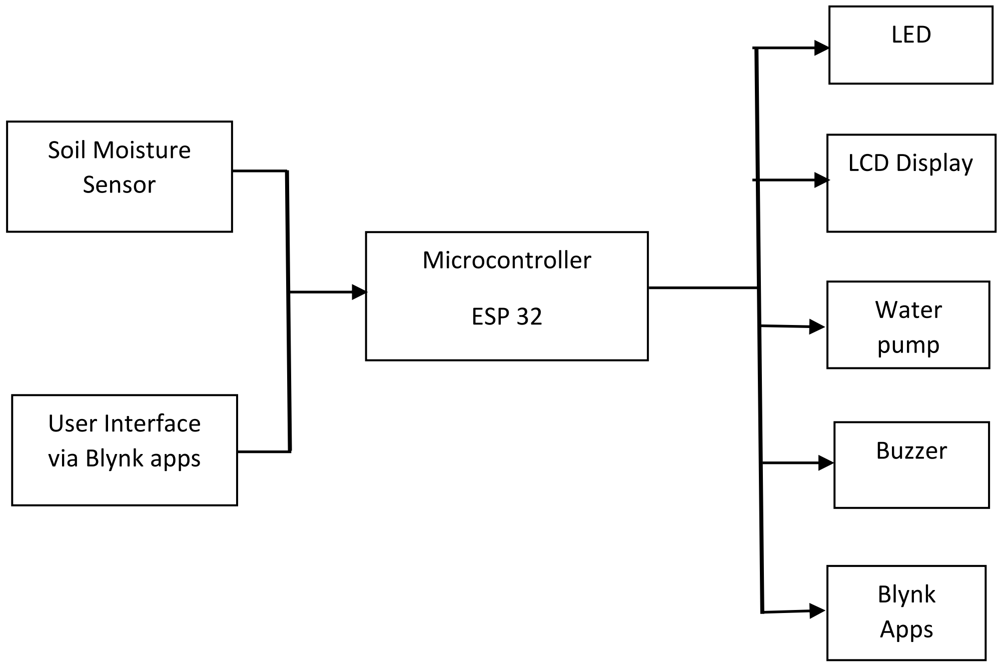

Figure 1. Block diagram of the solar powered irrigation system with real time monitoring

The block diagram represents the functional architecture of an irrigation system controlled by an ESP32 microcontroller. At the heart of the system, the ESP32 acts as the central processing unit that coordinates communication between various input and output components to ensure optimal irrigation. The system begins by collecting real-time data from a soil moisture sensor, which is embedded in the soil near the plant. This sensor continuously monitors the moisture level and transmits the readings to the ESP32. Based on these readings, the microcontroller determines whether irrigation is necessary. When the soil is detected to be too dry, the ESP32 activates a water pump to irrigate the plant for a predetermined duration typically around 30 seconds to restore the appropriate moisture level. In addition to activating the pump, the ESP32 also controls an LED and an LCD display. The LED serves as a simple visual indicator of the soil's moisture status, signaling whether the condition is dry, adequate, or overly wet. The LCD display provides more detailed information such as the exact soil moisture reading and the status of the irrigation system. Furthermore, the system includes a buzzer that emits an alert sound under specific conditions which are when the soil is too dry. To enable user interaction and remote monitoring, the ESP32 is connected to the Blynk IoT platform. Through the Blynk mobile application, users can access real-time soil moisture data, receive irrigation notifications, and manually control the water pump if needed. This wireless connectivity empowers users to manage their irrigation system from anywhere, enhancing both convenience and efficiency. Overall, the system's integration of sensors, actuators, and IoT communication demonstrates a comprehensive approach to automated irrigation, promoting water conservation and supporting healthier plant growth.

RESULT AND DISCUSSION

The prototype is tested in various scenarios as shown in the results below:

Table 1. Soil moisture monitoring system response

Soil Moisture Range	System Response	LED Status	Buzzer	Pump Action	Status Display
Above 3800	Indicates critical dryness. Triggers alerts and starts irrigation	Red	ON	ON (30 seconds)	Updated on LCD & Blynk
3300 - 3800	Indicates moderate dryness. Alerts user, but no irrigation is activated	Yellow	OFF	OFF	Updated on LCD & Blynk
Below 3300	Indicates sufficient soil moisture. No action is required beyond status update	Green	OFF	OFF	Updated on LCD & Blynk

The results in **Table 1** illustrate how the soil moisture monitoring system intelligently responds to different levels of soil moisture to ensure optimal irrigation and plant health. When the soil moisture reading is above 3800, it indicates that the soil is critically dry. In this case, the system activates the red LED as a visual alert and sounds the buzzer to notify the user of the urgent condition. Simultaneously, the water pump is turned on for 30 seconds to irrigate the soil and restore moisture to an acceptable level. This status is also updated on the LCD display and Blynk mobile application, allowing the user to monitor the situation remotely. For readings between 3300 and 3800, the system identifies the soil as moderately dry. It then activates the yellow LED to indicate a warning, but the pump and buzzer remain inactive as the situation is not yet critical. The system still updates the soil condition on the display and the mobile app, providing users with the necessary data to anticipate when watering might soon be required. When the soil moisture level is below 3300, it signifies that the soil has sufficient moisture. In this condition, the green LED is activated to reassure the user that no immediate action is needed. The water pump and buzzer are not activated, thereby conserving energy and water. Despite no active measures being taken, the system continues to update the status on the LCD and Blynk app, maintaining transparency and enabling continuous monitoring.

Overall, this automated system demonstrates an efficient way to manage irrigation using IoT technology. It minimizes water usage by only activating the pump when necessary and provides real-time feedback to the user through visual indicators and mobile alerts, promoting sustainable and informed gardening or farming practices.

CONCLUSIONS

The IoT-based, solar-powered smart irrigation system presents an innovative and sustainable approach to modern agriculture. By combining soil moisture sensors, an ESP32 microcontroller, and IoT connectivity, the system automates the irrigation process to ensure that plants receive the optimal amount of water based on real-time soil conditions. Powered by solar energy, the system operates efficiently and independently of the electrical grid, making it particularly suitable for use in remote or off-grid locations. This solution not only conserves water by preventing over-irrigation but also reduces the need for manual monitoring and intervention. Overall, it enhances crop health and productivity, illustrating the potential of integrating automation and renewable energy into smart farming practices.

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IoT-BASED IRRIGATION SYSTEM USING BLYNK

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Abstract: This project aims to develop an irrigation system monitoring for chilli plants using the Blynk platform to monitor soil moisture levels and control irrigation. The NodeMCU ESP8266 system utilizes sensors to measure soil moisture and wirelessly transmits the data to the Blynk application. Users can remotely view real-time moisture readings and control the water pump. The Blynk interface enables growers to activate or deactivate the irrigation system based on the readings, offering flexibility and convenience. By optimizing water usage and providing monitored watering, the system promotes plant health and reduces manual intervention. The integration of Blynk provides an intuitive and user-friendly interface for irrigation management. This project showcases the potential of Internet of Things (IoT) technology in agriculture, empowering growers with real-time insights and data-driven decision-making for sustainable chilli plant cultivation.

Keywords: NodeMCU ESP8266, chilli plants, soil moisture, Blynk, IoT

INTRODUCTION

Traditional irrigation methods often lack real-time monitoring capabilities and efficient water usage, leading to suboptimal plant growth and water wastage. In recent years, there have been several advancements in the field of plant irrigation systems. Many existing systems have utilized various sensors and technologies to improve water efficiency and automate the irrigation process.

Related studies have proposed several methods, including [1] using Raspberry Pi and IoT to control soil humidity and watering management with user notifications via email. In [2] is presented an IoT enabled smart drip irrigation system that uses an ESP32 microcontroller with multiple sensors and remotely manages irrigation schedules through a web interface.

This project is designed to develop an improved watering system that utilizes a moisture sensor for real-time monitoring of soil moisture levels. By incorporating the Blynk platform with the ESP8266 board, users will have the convenience of online control and monitoring through their smartphones. This system will optimize water usage, improve watering timings, and provide accurate data to enhance plant health and productivity.

METHODOLOGY

In this section, the operation of the IoT-Based Irrigation System using Blynk are explained in a block diagram as shown in Figure 1.

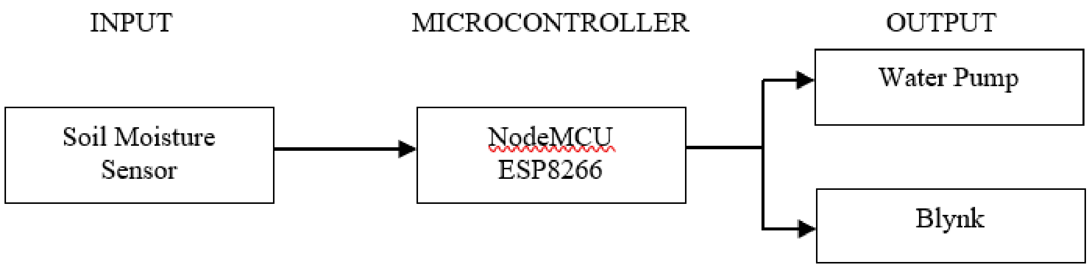


Figure 1. Block diagram of IoT-Based Irrigation System using Blynk

The system monitors soil moisture levels in real-time using the Blynk application. If the soil moisture level drops below 45%, the user can turn on the water pump, and if it rises above 45%, the user can turn it off. The water pump is controlled through the ON/OFF button in the Blynk application.

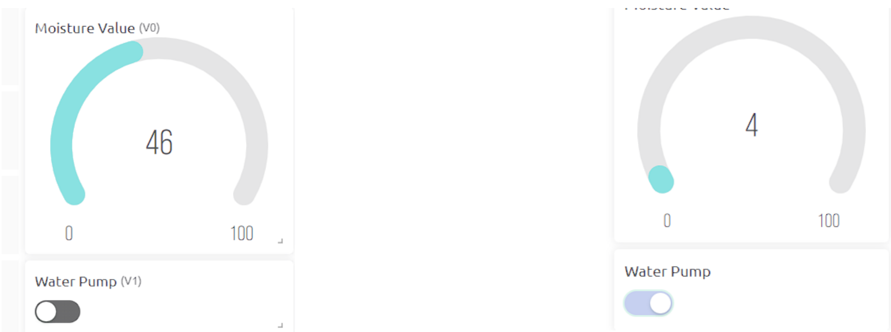
RESULT AND DISCUSSION

Table 1 shows the actions users need to take based on the soil moisture level using the ON/FF button in the Blynk application. The arguments and findings are described in detail in this section.

Table 1. Water pump control based on soil moisture percentage

Motion sensor (in percentage)	Water Pump
Moisture Level < 45	On
Moisture Level > 45	Off

Figure 2 shows the Blynk application interface displaying the soil moisture value along with the ON/OFF control button.



(i) OFF **(ii) ON**

Figure 2. Blynk application interface

CONCLUSIONS

The soil moisture sensing and watering system has been successfully developed, providing an efficient and user-friendly solution for plant irrigation. By integrating a moisture sensor with the Blynk platform and ESP8266 board, the system can monitor soil moisture levels and enables remote control through the Blynk application. To enhance the system's capabilities, future recommendations include adding features such as automated pump activation based on threshold values, solar-powered operation, and integration with additional environmental sensors such as temperature and humidity sensors for more comprehensive crop care.

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GREEN HOUSE SMART MONITORING SYSTEM WITH SOLAR POWER INTEGRATION

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Abstract: This project presents the design and implementation of a smart greenhouse monitoring system utilizing modern sensors to maintain optimal plant growth conditions. Traditional greenhouse systems often rely on manual processes, leading to inconsistent environmental control, reduced efficiency, and lower crop yields. Additionally, the absence of real-time monitoring and remote access further complicates operations, particularly for large-scale or resource-constrained setups. To address these challenges, the proposed system integrates a temperature sensor, humidity sensor, soil moisture sensor, and Light Dependent Resistor (LDR) to measure environmental data. An ESP32 microcontroller processes this data and adjusts the greenhouse conditions in real time. A user-friendly mobile interface enables remote monitoring and control, providing users with easy access to real-time environmental data. This innovative system enhances greenhouse efficiency and productivity by improving crop quality and reducing operational complexity.

Keywords: Green house, temperature, soil moisture, LDR, microcontroller.

INTRODUCTION

Greenhouses play a vital role in modern agriculture by providing controlled environments that optimize plant growth and crop yields. However, maintaining these optimal conditions can be challenging due to the constantly changing nature of environmental factors such as temperature, humidity, soil moisture, and light intensity. Traditional methods of monitoring and controlling these parameters often rely on manual intervention, which tends to be labour-intensive [1], and inefficient [2]. Moreover, despite offering regulated conditions, many greenhouses still depend on non-renewable energy sources and manual operations, resulting in various inefficiencies and contributing to environmental issues. Integrating renewable energy sources such as solar power can significantly improve the sustainability of greenhouse operations while also supporting global efforts to reduce environmental impact [3].

The goal of this project is to develop an energy-efficient and cost-effective greenhouse system aimed at assisting small and medium scale farmers by increasing crop yields and promoting environmentally sustainable agricultural practices. The project involves the design and construction of a smart monitoring system using the ESP32 microcontroller, along with humidity sensor, Light Dependent Resistor (LDR) sensors, and soil moisture sensors to monitor environmental parameters. The system integrates IoT technology to enable real-time monitoring of greenhouse conditions. By leveraging solar energy, the Greenhouse Smart Monitoring System not only reduces reliance on external power sources but also minimizes the environmental impact of greenhouse operations.

METHODOLOGY

Figure 1 illustrates the block diagram of the greenhouse smart monitoring system that integrates multiple sensors and is controlled by an ESP32 microcontroller. The DHT22 sensor monitors temperature and humidity levels, activating a fan to maintain optimal environmental conditions. The LDR sensor measures light intensity and controls a lamp to support effective photosynthesis. Meanwhile, the soil moisture sensor detects moisture levels in the soil to control a water pump, helping to prevent both under and over watering. The system allows for remote control and real-time monitoring using IoT technology, providing users with flexibility in managing greenhouse conditions.

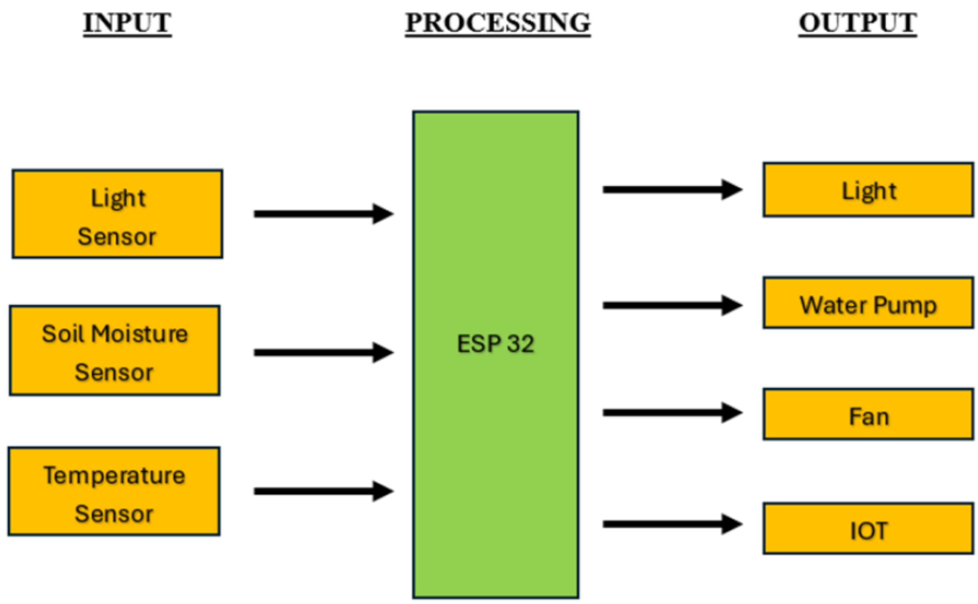

Figure 1 Block diagram of the greenhouse smart monitoring system

RESULT AND DISCUSSION

Figure 2 illustrates the available solar power generated by the solar panel, while Figure 3 displays the output of the system during real-time monitoring. Table 1 provides a summary of the sensor conditions during the operation of the system.

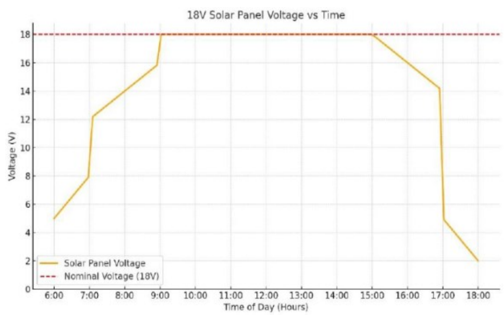

Figure 2. Solar output power measurement

Figure 3. IoT monitoring value

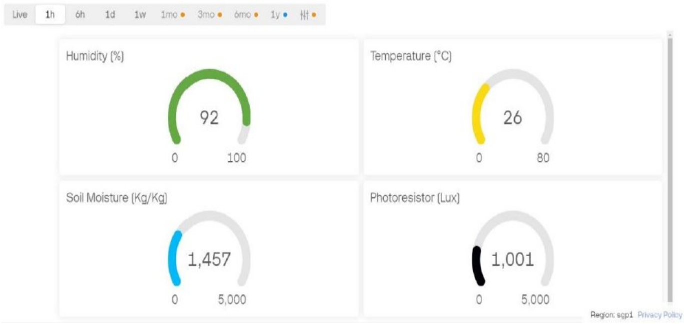

Table 1. Output condition

Condition	Output
Light Intensity less than 50%	Light will turn ON
Temperature more than 25° C	Fan will turn ON
Soil Moisture less than 40%	Water Pump will turn ON

CONCLUSIONS

The proposed solar-powered greenhouse smart monitoring system integrates environmental sensors, Internet of Things (IoT) technologies, and renewable energy sources to enhance operational efficiency and overall greenhouse performance. Future research may focus on optimizing the solar energy subsystem through the implementation of maximum power point tracking techniques and expanding battery storage capacity to improve system scalability and energy reliability.

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