A MINI PROJECT

REPORT ON

IOT BASED IRRIGATION SYSTEM

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2022-2023

CERTIFICATE

This is to certify that the mini project report entitled

"IOT BASED IRRIGATION SYSTEM"

is a bonafide work and it is submitted to Government College of Engineering, Yavatmal

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GOVERNMENT COLLEGE OF ENGINEERING, YAVATMAL
2022-2023

DEPARTMENT OF COMPUTER ENGINEERING
GOVERNMENT COLLEGE OF ENGINEERING YAVATMAL

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"IOT BASED IRRIGATION SYSTEM"

SUBMITTED BY:

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in the partial fulfillment for the award of B. Tech in COMPUTER ENGINEERING. This mini project report is reward of the work carried out by them under our Guidance and supervision during the year2022-2023

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ABSTRACT

The main objective of this project is to propose a **Smart IOT based Agriculture** assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to do smart farming and increase their overall yield and quality of products. The Agriculture being proposed via this project is integrated with **NODEMCU** Technology, Breadboard mixed with various sensors and live data feed can be obtained online from **JSON**

In order to achieve this, an **IoT (Internet of Thing)** Module is interfaced to the **Arduino Node MCU** board at the receiver end while on the transmitter end, the mobile phones sends ON/OFF commands to the receiver where loads are connected by sensors data

By touching the specified location on the **IOT interface**, the loads can be turned ON/OFF remotely through this technology. The loads are operated by IoT board through relay module. Along with this we use soil sensor, which detects whether soil is dry or wet. When the soil condition is dry soil sensor give command to IoT module to start the pump and when soil becomes wet it gives command to stop the pump. It works in accordance with the soil condition. This project is complete smart project for advance irrigation.

ACKNOWLEDGEMENT

I would like to express our deepest appreciation to all those who provided us the possibility to complete this project report. A special gratitude I give to our final year project mentor, **Prof. S. A. Bachwani,** whose contribution in stimulating suggestions and encouragement helped us to coordinate our project. He gave us support from the start to the end of this project and kept us on the correct path.

I would like to express my special thanks to **Prof. S. A. Bachwani**, Project In-Charge of Computer Engineering and **Prof. C. V. Andhare, Head of the Department, Computer Engineering, Government College of Engineering, Yavatmal** who have invested her full effort in guiding the team in achieving the goal for all the timely support and valuable suggestions during the period of project.

I would like to express our sincere thanks to **Dr. P. M. Khodke, Principal of Government College of Engineering Yavatmal**, for providing the Working facilities in college.

We are equally thankful to all the staff members of Computer Engineering Department, Government College of Engineering, Yavatmal for their valuable suggestions. Also, I would like to thank all of my friends for the continual encouragement and the positive support.

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INTRODUCTION

1.1 Introduction

Agriculture is the unquestionably the largest livelihood provider in India with rising population, there is a need for increasing agricultural production. In order to support greater production in farms the requirements of the amount of fresh water used in irrigation also rises. Currently agriculture accounts 83% of the total water consumption in India Unplanned use of water inadvertently results in wastage of water. This suggests that there is an urgent need to develop systems that prevent water wastage without imposing pressure on farmers.

Over the past 15 years, farmers started using computers and software systems to organize their financial data and keep track of their transactions with third parties and also monitor their crops more effectively. In the Internet era, where information plays a key role in people's lives, agriculture is rapidly becoming a very data intensive industry where farmers need to collect and evaluate a huge amount of information from a diverse number of devices (eg., sensors, faming machinery etc.) in order to Become more efficient in production and communicating appropriate information.

With the advent of open source Arduino boards along with cheap moisture sensors, it is viable to create devices that can monitor the soil moisture content and accordingly irrigating the fields or the landscape as an when needed. The proposed system makes use of microcontroller ATMEGA328P on arduino uno platform and IOT which enable farmers to remotely monitor the status of sprinklers installed on the farm by knowing the sensor values thereby, making the farmers' work much easier as they can concentrate on other farm activities.

1.2 LITERATURE REVIEW

In A Remote Measurement and Control System for Greenhouse Based on GSM-SMS the proposed system introduced a GSM-SMS remote measurement and control system for greenhouse based on PC-based database system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the central station receives and sends messages through GSM module. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity.

We mainly focuses on reviews in the field of remote monitoring and control, the technology used and their potential advantages. The paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending on the temperature and humidity reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designed system via SMS on GSM network. A Bluetooth module is also interfaced with the main microcontroller chip which eliminates the SMS charges when the user is within the limited range of few meters to the designated system. The system informs users about many conditions like status of electricity, dry running motor, increased temperature, water content in soil and smoke via SMS on GSM network or by Bluetooth.

1.3 IMPORTANCE OF SENSORS

Smart agriculture, also known as precision agriculture, allows farmers to maximize yields using minimal resources such as water, fertilizer, and seeds. By deploying sensors and mapping fields, farmers can begin to understand their crops at a micro scale, conserve resources, and reduce impacts on the environment. Smart agriculture has roots going back to the 1980s when Global Positioning System (GPS) capability became accessible for civilian use. Once farmers were able to accurately map their crop fields, they could monitor and apply fertilizer and weed treatments only to areas that required it. During the 1990s, early precision agriculture users adopted crop yield monitoring to generate fertilizer and pH correction recommendations. As more variables could be measured and entered a crop model, more accurate recommendations for fertilizer application, watering, and even peak yield harvesting, could be made.

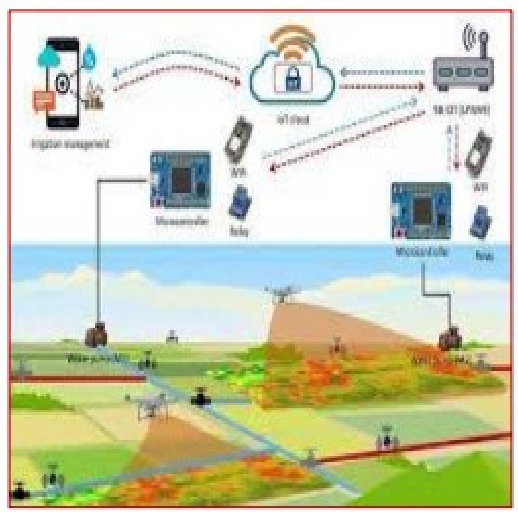
1.4 SOIL MOISTURE SENSORS

70 percent of the world's freshwater withdrawals go towards irrigation uses. Close to 90 percent of freshwater is used for irrigation in India. It is recorded that only 5 percent of water gets used for domestic purpose in India. Despite that, farmers often obtain sub-optimal yields from their crop due to improper irrigation management practices. What if farmers could monitor soil moisture in their fields? It would help them take has informed decisions on irrigation and be cost-effective too. By monitoring soil moisture, farmers can now optimize their water usage, increase produce yield, produce high quality crops, reduce water resource degradation and save a lot of money. Monitoring soil moisture will help farmers understand the actual soil water condition and how much their crops need to use. Soil moisture sensors enable in taking informed irrigation decisions on when to irrigate and how much water must 8 be supplied to avoid low quality production. With the help of soil moisture sensors, some of these questions that are commonly asked by farmers are easily addressed

COMPONENTS AND SENSORS USED IN SMART IRRIGATION SYSTEM

2.1 INTERNET OF THINGS

Internet of Things (IOT) describes an emerging trend where many embedded devices (things) are connected to the Internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend. The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, or people that are provided with identifiers and the ability to transfer data over a network without requiring humanto-human (or) human-to-computer interaction.



2.2 NodeMCU and ESP8266 MODULE

The irrigation system plays a vital role in agriculture by supplying water to crops at regular intervals, ensuring their healthy growth. In recent years, the integration of Internet of Things (IoT) technologies has revolutionized traditional irrigation systems. One such technology is NodeMCU, a popular open-source IoT platform based on the ESP8266 microcontroller.

NodeMCU and ESP8266:

NodeMCU is an open-source firmware and development board based on the ESP8266 Wi-Fi module. The ESP8266 is a low-cost, low-power, and highly integrated Wi-Fi microchip with built-in TCP/IP protocol stack. NodeMCU provides a development environment that allows programmers to easily program and interface with the ESP8266 module.

Features and Benefits of NodeMCU:-

Wi-Fi Connectivity: NodeMCU enables wireless connectivity to the internet, allowing remote monitoring and control of the irrigation system.

- GPIO Pins: NodeMCU provides multiple General-Purpose Input/Output (GPIO) pins, which can be used to interface with sensors, actuators, and other peripheral devices.
- Programming Language: NodeMCU supports the Lua scripting language, making it easy to develop applications and control the irrigation system.
- Cloud Integration: NodeMCU can connect to cloud platforms like IoT platforms, allowing data logging, analytics, and control from anywhere.
- Cost-Effective: NodeMCU is an affordable solution compared to other IoT platforms, making it suitable for small-scale irrigation systems.

Components of an IoT-enabled Irrigation System:

- NodeMCU Board: The main controller that connects the irrigation system to the internet and performs data processing and control.
- Sensors: Various sensors can be used, such as soil moisture sensors, temperature sensors, humidity sensors, and rain sensors. These sensors provide data for making informed irrigation decisions.
- Actuators: Devices like solenoid valves, pumps, and motors can be controlled

through NodeMCU to regulate water flow and irrigation activities.

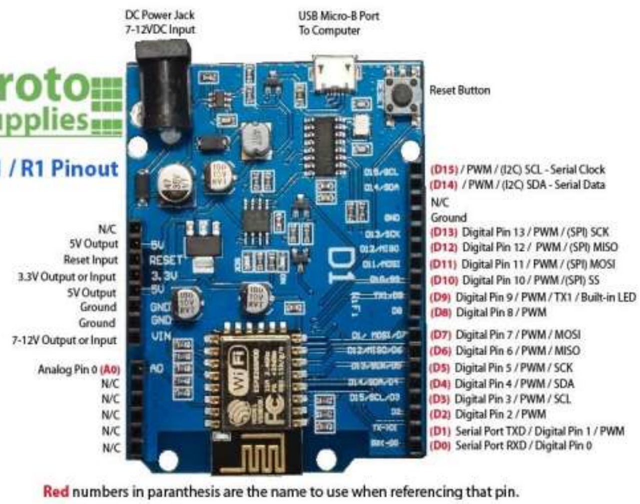
- Power Supply: NodeMCU and other components require a stable power source, which can be a battery, solar panel, or AC power supply.
- Internet Connectivity: NodeMCU connects to the internet via Wi-Fi, allowing access to cloud platforms and remote control.

Functionality and Operation:

- Data Acquisition: NodeMCU reads sensor data such as soil moisture levels, temperature, and humidity through the GPIO pins.
- Data Processing: The acquired sensor data is processed by NodeMCU to determine the irrigation requirements and schedule.
- Decision-Making: Using the processed data, the NodeMCU executes decision-making algorithms to control the irrigation system based on predefined thresholds and rules.
- Control and Actuation: NodeMCU sends signals to actuators, such as opening or closing solenoid valves, to control the water flow and irrigation process.
- Remote Monitoring and Control: With internet connectivity, the irrigation system can be monitored and controlled remotely using a web or mobile application.

Advantages of Using NodeMCU in Irrigation Systems :

- Automation: NodeMCU enables automated control of irrigation processes, reducing manual intervention and optimizing water usage.
- Real-time Monitoring: With NodeMCU, farmers can monitor irrigation system parameters in real-time, allowing them to respond promptly to changing conditions.
- Water Conservation: By using sensor data and intelligent control algorithms, NodeMCU helps optimize water usage, reducing wastage and conserving water resources.
- Scalability: NodeMCU can be easily scaled up to accommodate larger areas or expanded to control multiple irrigation zones simultaneously.
- Cost



2.3 SENSORS USED IN THIS PROJECT

Soil Moisture Sensor

The soil moisture sensor and the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of the plants.

- The sensor is set up by two pieces: the electronic board (at the right), and the probe with two pads, that detects the water content (at the left).
- The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED.

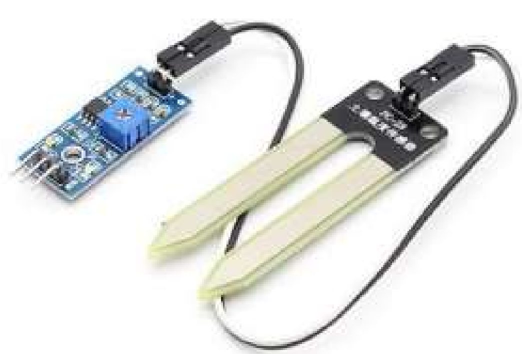


Figure 2 : Soil Moisture Sensing Unit

2.3 5V RELAY MODULE AND MOTOR

Relays are most commonly used switching device in electronics. Let us learn how to use one in our circuits based on the requirement of our project. Before we proceed with the circuit to drive the relay we have to consider two important parameter of the relay. Once is the Trigger Voltage, this is the voltage required to turn on the relay that is to change the contact from Common- >NC to Common->NO. Our relay here has 5V trigger voltage, but you can also find relays of values 3V, 6V and even 12V so select one based on the available voltage in your project. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range

IMPLEMENTATION

3.1 Implementation of Irrigation System

The agricultural sector is set to face enormous challenges in order to feed the 9.6 billion people that the Food and Agriculture Organization (FAO) predicts are going to inhabit the planet by 2050.So what's the solution? Welcome to smart farming. Smart Farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. The farming and agricultural industry relies on innovative ideas and technological advancements to help increase yields and better allocate resources. The late 19th century and the 20th century brought several mechanical innovations, like tractors and harvesters. Today, a driving force behind increased agricultural production at a lower cost is the Internet of Things (IOT). Internet of Things applications in agriculture include farm vehicle tracking, livestock monitoring, storage monitoring, and much more. The next several years will see increasing use of these smart farming technologies. In fact, IOT device installations in the agriculture world are projected to experience a compound annual growth rate of 20 percent. According to a January 2016 MACHINA Research report, the number of connected agricultural devices is expected to grow from 13 million at the end of 2014 to 225 million by 2024.

Implementation of an IoT-based irrigation system involves several key steps. Here is a general overview of the implementation process:

1. **System Design:**
- Define the objectives and requirements of the irrigation system, considering factors like crop type, climate, soil conditions, and water availability.
- Identify the suitable IoT devices and sensors required for monitoring and controlling irrigation parameters.

2. **Sensor Deployment:**
- Install soil moisture sensors, weather sensors, and other relevant sensors at appropriate locations in the field.
- Ensure proper calibration and maintenance of the sensors.

3. **Connectivity Setup:**
- Establish a reliable network infrastructure for connecting the sensors to a central system.
- Choose the appropriate connectivity options such as Wi-Fi, cellular, or LPWAN (Low-Power Wide-Area Network) based on the field's coverage and data transmission requirements.

4. **Data Collection and Processing:**
- Collect data from the deployed sensors, including soil moisture levels, temperature, humidity, and weather conditions.
- Process the collected data to extract meaningful insights and identify irrigation requirements.

5**. Centralized Control and Automation:**
- Develop or implement a centralized control system to monitor and manage the irrigation process.
- Integrate the IoT system with irrigation equipment such as pumps, valves, and sprinklers for automated control based on the sensor data.

6. **Decision Support System:**
- Utilize advanced analytics and algorithms to analyze the collected data and provide decision support for irrigation scheduling.
- Incorporate weather forecasts and historical data to optimize irrigation schedules and water usage.

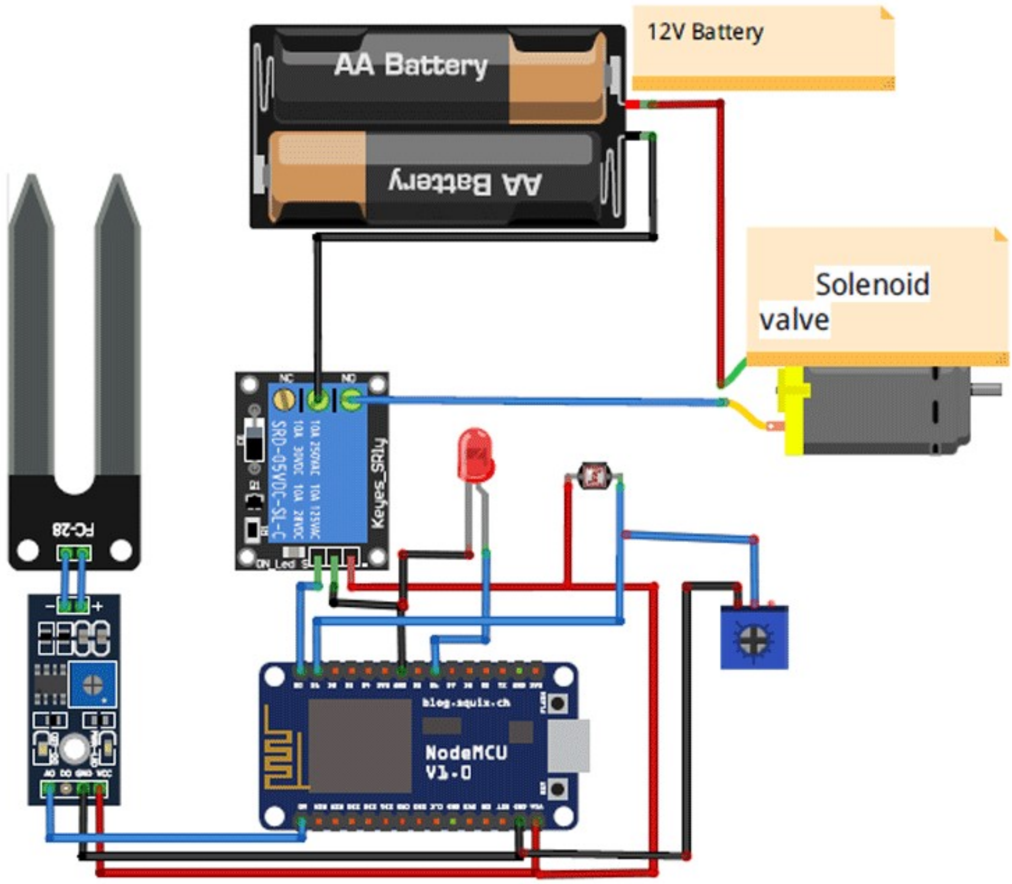
7. **Mobile/Web Interface:**
- Develop a user-friendly interface that allows farmers or users to monitor and control the irrigation system remotely.
- Provide real-time access to sensor data, alerts, and irrigation schedules through a mobile app or web portal.

8. **Maintenance and Calibration**:
- Regularly maintain and calibrate the sensors to ensure accurate data collection.
- Monitor the system's performance, identify any issues or anomalies, and perform necessary maintenance and repairs.

9. **Training and Support:**
- Provide training and support to farmers or users on how to operate and manage the IoT-based irrigation system effectively.
- Offer ongoing technical assistance and troubleshooting services.

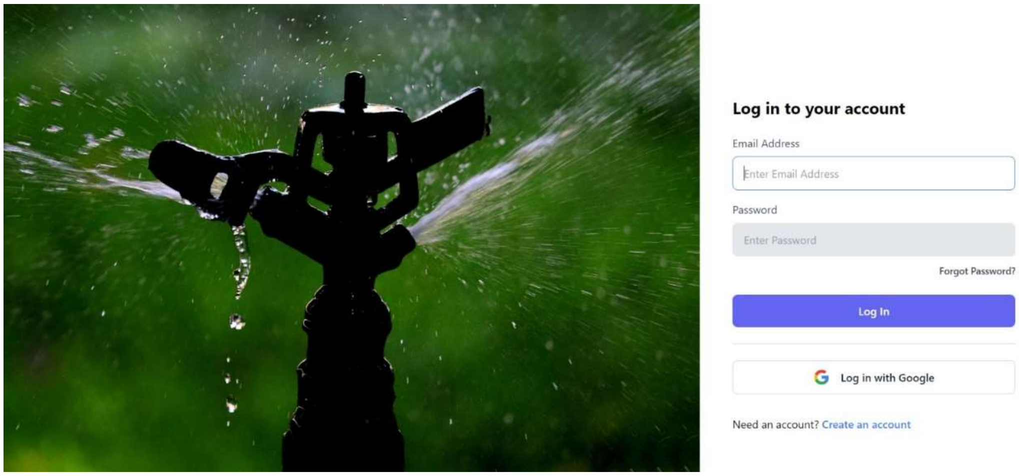
10. Continuous Improvement:
- Regularly evaluate the system's performance and identify areas for improvement.
- Stay updated with emerging IoT technologies and advancements in irrigation practices to enhance system efficiency.

It is important to note that the implementation process may vary depending on specific system requirements, technology choices, and the scale of the irrigation system. Collaboration with experts and IoT solution providers can significantly facilitate the successful implementation of an IoT-based irrigation system.



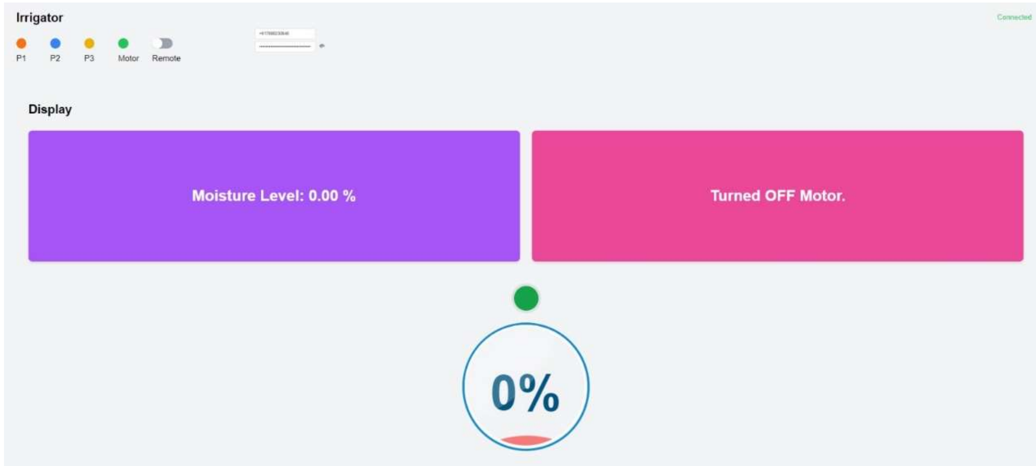
Real time working of module

USER INTERFACE

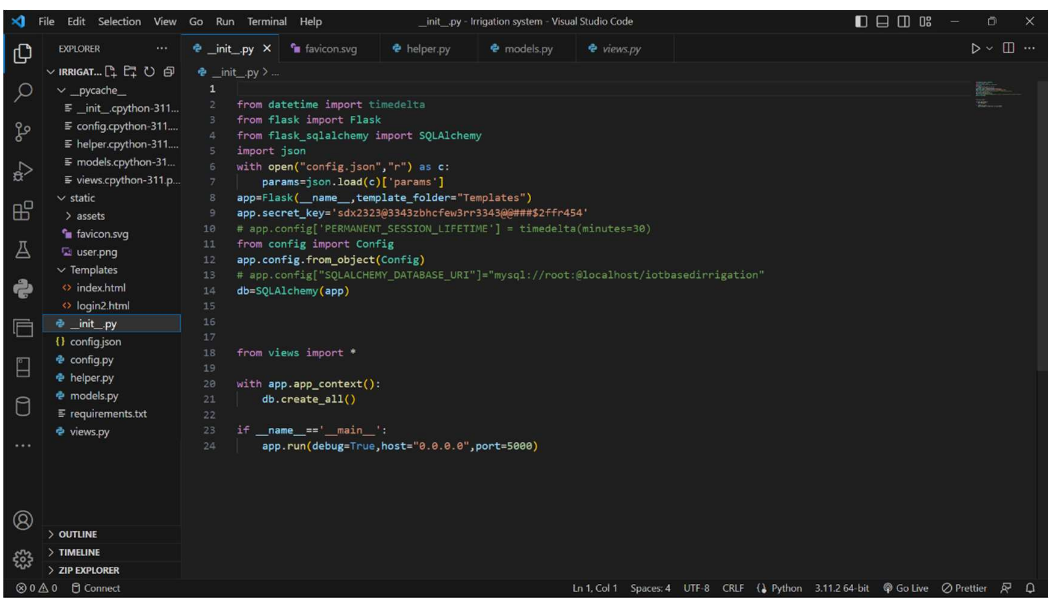


A login page is a web page or interface that allows users to access a secure system or application by entering their credentials, typically a username and password. The purpose of a login page is to verify the identity of the user and grant them appropriate access privileges to the system.

1. Username/Email: A field where the user enters their unique identifier, such as their username or registered email address.
2. Password: A secure field where the user enters their password, typically masked to prevent unauthorized individuals from viewing it.
3. "Remember Me" Option: A checkbox that allows users to save their login information for future sessions, enabling them to bypass the login process on subsequent visits.
4. "Forgot Password" Link: A link that users can click on if they have forgotten their password. This usually triggers a password reset process, where users can regain access to their account through a recovery email or security questions.
5. "Sign Up" or "Register" Link: A link provided for new users who don't have an account yet. Clicking on this link typically redirects users to a registration page where they can create a new account.
6. "Login" or "Sign In" Button: The primary action button that users click to submit their login credentials and attempt to access the system.



This system integrates various technologies, such as sensors, connectivity, and data analytics, to optimize water usage, enhance crop yield, and promote sustainable farming practices.



ADVANTAGES AND DISADVANTAGES

ADVANTAGES :

- **Precision Irrigation:**

IoT-based irrigation systems enable precise and targeted irrigation by incorporating real-time data from sensors such as soil moisture, weather conditions, and plant health. This allows for optimized water usage and prevents over- or under-watering, leading to healthier crops and increased yield.

- **Remote Monitoring and Control:**

IoT connectivity enables farmers and irrigation system operators to monitor and control the system remotely from anywhere. They can access real-time data, receive alerts or notifications, and adjust irrigation schedules or parameters as needed, enhancing convenience and efficiency.

- **Data-Driven Decision Making:**

IoT-based irrigation systems generate a wealth of data regarding soil conditions, weather patterns, and crop requirements. This data can be analyzed to gain insights, make informed decisions, and implement precision irrigation strategies for improved productivity and resource management.

- **Water Conservation:**

By utilizing IoT technology, irrigation systems can be fine-tuned to deliver the precise amount of water required by the crops. This prevents water wastage and promotes sustainable water usage, leading to significant water conservation and reduced environmental impact.

- **Energy Efficiency:**

IoT-based irrigation systems can optimize energy consumption by automating pump operations based on demand and resource availability. This helps reduce energy costs and enhances overall system efficiency.

- **Scalability and Flexibility:**

IoT technology allows for easy scalability and flexibility in irrigation systems. Additional sensors, actuators, and control devices can be integrated into the system as per the specific requirements of different crops, soil types, or field layouts.

- **Predictive Maintenance:**

IoT-enabled sensors can monitor the health and performance of irrigation system components, detecting anomalies or malfunctions in real-time. This proactive monitoring enables predictive maintenance, preventing system failures and minimizing downtime.

- **Integration with Other Systems:.**

IoT-based irrigation systems can be seamlessly integrated with other agricultural management systems, such as farm management software, weather forecasting systems, or pest monitoring systems. This integration enables a holistic approach to farm management and promotes data-driven decision making.

- **Cost Savings:**

IoT-based irrigation systems optimize resource usage, reduce water and energy wastage, and improve crop yield. These factors contribute to cost savings for farmers by minimizing input costs and maximizing productivity.

- **Environmental Sustainability:**

By enabling precise irrigation and efficient resource management, IoT-based systems contribute to environmental sustainability in agriculture. They help conserve water, reduce energy consumption, minimize chemical runoff, and promote sustainable farming practices.

It's worth noting that while IoT-based irrigation systems offer numerous advantages, proper installation, configuration, and maintenance are essential to ensure optimal performance and long-term benefits.

DISADVANTAGES :

1. Cost: Implementing an IoT-based irrigation system can involve upfront costs, including the purchase of IoT devices, sensors, actuators, and the required infrastructure for connectivity. The initial investment may be a barrier for small-scale farmers or those with limited financial resources.

2. Technical Complexity: IoT-based irrigation systems require technical expertise for installation, configuration, and maintenance. Farmers or system operators may need to acquire new skills or rely on external experts to handle the technical aspects of the system, which could increase operational complexity and costs.

3. Connectivity and Reliability: IoT systems rely on stable and reliable internet connectivity for data transmission, monitoring, and control. In areas with poor or unreliable internet connectivity, system performance may be compromised, leading to delays or disruptions in monitoring and control operations.

4. Power Dependency: IoT devices and sensors in irrigation systems require a stable power source for operation. In regions with unreliable or limited access to electricity, alternative power solutions such as solar panels or batteries may be necessary, adding to the overall system cost.

5. Data Security and Privacy: IoT systems generate and transmit a significant amount of data, including sensitive information related to crop health, weather conditions, and irrigation schedules. Ensuring data security and protecting privacy becomes crucial, requiring robust security measures to safeguard against unauthorized access or data breaches.

6. Compatibility and Interoperability: Integrating different IoT devices, sensors, and components from different manufacturers can be challenging due to compatibility issues. Ensuring seamless interoperability and communication between various system elements may require additional efforts or customization.

7. **Maintenance and Support:** IoT-based systems require regular maintenance and periodic updates to ensure their optimal performance. Additionally, technical support and troubleshooting may be needed in case of system failures, requiring dedicated resources and expertise.

8. **Data Overload and Interpretation:** IoT-based irrigation systems generate a vast amount of data from sensors and devices. Analyzing and interpreting this data to make informed decisions can be overwhelming, especially for farmers who may not have the necessary data analytics skills or tools.

9. **Dependency on Technology :** IoT-based systems rely heavily on technology infrastructure, including hardware, software, and connectivity. System failures, technical glitches, or issues with the supporting infrastructure can disrupt operations and lead to downtime, impacting irrigation schedules and crop health.

10. **Adoption and Adaptation Challenges**: Transitioning from traditional irrigation methods to IoT-based systems may require a change in mindset, farming practices, and operational workflows. The adoption process could face resistance or difficulties in adjusting to new technologies, especially in areas where traditional methods have been deeply ingrained.

While these disadvantages exist, they can be mitigated through proper planning, training, and selecting appropriate IoT solutions that align with the specific needs and constraints of the agricultural context.

CONCLUSION AND FUTURE SCOPE

Conclusion

Smart irrigation is an important technology in saving water for the plant which requires more attention especially in Iraq. Using WSN as an Internet of things gives more flexibility in system monitoring and management. Results show that the proposed network can be used along the season with minimum maintenance. The proposed Smart Irrigation System for agriculture is that the farmer can operate the motor by remotely in his smart phone anywhere in the world either in manual mode or in Auto mode and he can verify the soil status and also the temperature of the motor by the graph in the mobile phone itself. The proposed irrigation system for agricultural purpose can measure the Soil moisture, temperature of the field and transmits the real time data to the user through the Wi-Fi and IoT server, if there is any deviation from the span of reference value, then the user can send the command through the IoT server to maintain the set point value of field parameter for a proper irrigation and proposed IoT based irrigation system is better than the recently proposed other irrigation systems.

Future Scope

1. Artificial Intelligence (AI) Integration:

The integration of AI algorithms and machine learning techniques with IoT-based irrigation systems holds great potential. AI can analyze vast amounts of data collected from sensors, historical patterns, and crop models to make accurate predictions and optimize irrigation schedules dynamically.

2. Predictive Analytics:

Building upon the data collected by IoT sensors, predictive analytics can be utilized to forecast water requirements, detect anomalies, and anticipate irrigation needs. This can enable proactive decision-making and optimize resource allocation for improved efficiency and crop productivity.

3. Edge Computing:

Traditional IoT systems transmit all sensor data to the cloud for processing and analysis. However, the use of edge computing, where data processing and analytics occur locally on the IoT devices or gateways, can minimize latency, reduce data transmission costs, and enhance real-time decision-making capabilities.

4. Wireless Sensor Networks (WSNs):

WSNs are networks of interconnected IoT sensors that communicate wirelessly to collect and transmit data. Future developments may involve advancements in WSNs, such as improved battery life, enhanced communication protocols, and increased sensor capabilities, leading to more efficient and robust data collection in irrigation systems.

5. Robotics and Automation:

Integrating IoT with robotics can lead to autonomous irrigation systems. Robotic devices equipped with sensors and actuators can navigate fields, monitor soil conditions, and perform irrigation tasks with precision. This can reduce labor requirements, increase operational efficiency, and enable large-scale automated irrigation.

6. Blockchain Technology:

Blockchain technology offers potential applications in irrigation systems by providing secure and transparent data recording and sharing. It can ensure the integrity of irrigation data, enable traceability of water usage, and facilitate smart contracts for transparent water transactions and resource management.

7. Weather Forecasting and Integration:

Improving the integration of real-time weather data into IoT-based irrigation systems can enhance their predictive capabilities. Accurate weather forecasts can help optimize irrigation schedules, adapt to changing weather conditions, and minimize water waste.

8. Integration with Smart Grids:

Integrating IoT-based irrigation systems with smart grid infrastructure can enable demand-side management and energy optimization. By leveraging grid information, real-time energy prices, and renewable energy sources, irrigation systems can adjust their operations to optimize energy consumption and contribute to a more sustainable energy ecosystem.

9. Multi-Sensor Fusion:

Future IoT-based irrigation systems may utilize multi-sensor fusion techniques to combine data from various sensors, such as soil moisture, temperature, humidity, and crop health sensors. This integrated data can provide a comprehensive understanding of the field conditions and enable more accurate and precise irrigation decisions.

10. Data Sharing and Collaboration:

IoT-based irrigation systems can facilitate data sharing and collaboration among farmers, agronomists, and researchers. Platforms or networks can be developed to exchange data, best practices, and irrigation strategies, fostering collective learning and improving overall irrigation management.

These future scopes and advancements hold the potential to further enhance the efficiency, sustainability, and productivity of IoT-based irrigation systems, making them integral components of modern agricultural practices.

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