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GSM Based Water Pump and Irrigation Control Using Arduino

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ABSTRACT:

The increase in population has led to food and water shortages in modern times, highlighting the importance of promoting agriculture to mitigate these challenges. However, agriculture itself often faces issues such as water loss, particularly through inefficient irrigation practices. To address this, there is a need for automated solutions that can effectively manage water usage in agricultural fields.

This article introduces a fully automated irrigation system designed to monitor soil moisture levels and determine the need for irrigation. The system utilizes an Arduino UNO microcontroller, programmed to continuously monitor soil moisture levels. When the moisture content falls below a predefined threshold, the system activates a water pump to supply the required amount of water to the fields. Once the soil moisture reaches the desired level, the pump automatically switches off, thus optimizing water usage and reducing the need for manual intervention.

By employing such technology, farmers can ensure efficient water management in their fields, leading to improved crop yields and conservation of water resources. This system not only saves time and labor but also contributes to sustainable agricultural practices in the face of increasing population pressures.

Keywords: GSM technology, Arduino microcontroller, Water pump control, Irrigation system, Remote monitoring, Soil moisture sensing.

I. INTRODUCTION

In contemporary times, one of the most pressing challenges facing the agriculture industry is the significant setbacks it encounters. Agricultural losses, whether in terms of materials or finances, predominantly stem from issues related to crop health and quality. Detecting crop problems at an early stage is crucial to avoid losses. However, for farmers managing large fields, maintaining constant vigilance and care is a daunting task.

The aim of this research project is to utilize sensors for detecting soil dryness and efficiently delivering water to plants based on their needs. By employing sensor technology, this project simplifies plant care by continuously monitoring soil moisture levels and determining the requirement for irrigation.

The system that presents a wise irrigation system appropriate to be used in places wherever water inadequacy could be a challenge. These kinds of typical irrigation system had many issues like increase in work of farm labor and infrequently it result in downside like excess-irrigation and activity of soil. good irrigation system is thereby believed to be a serious answer. therefore here creating GSM primarily based automatic Irrigation System victimization Arduino, that mechanically provides water to crop field and keep farmer updated by causation message to telephone[1].

The system that relies on an automatic system that is employed for watering plants. The system provides water to the plant automatically once it's needed. The soil moisture will sense the moisture content of the soil. Water conducts electricity, therefore less resistance implies that there's water present within the soil. Whenever there's additional resistance, it means that there's less water within the soil [2].

The system of automatic water irrigation system, wherever he has used 2 moisture sensors which is able to browse the moisture value of the soil by taking its resistance value. He has used the sensors in analogue mode therefore it'll reads the values from 0-1024. Then He has taken mean of the values reads by each the sensors, which is able to be then compared to threshold value. Threshold values area unit determined by testing the sensors many times. If the value reads by the sensors satisfies the condition for moisture, the relay can activate pump. If the value reads by the device satisfies the condition for moisture, the relay can shut down the pump[4].

The system, where the sensors will start working when the Arduino is supplied with power. Temperature and Humidity of the roots of the plants will be sensed by DHT11 Sensor and on the other side wet sensor will detect the moisture level of the sensor. Micro-controller is programmed in such a way that it will run the system according to the weather conditions and work as per the requirement. When the value read by sensor is less than threshold value then the values will be displayed in the LCD Display through Micro-controller. When the value read by the sensor is not less than the threshold value then the user will get a alert message to his mobile phone through the micro-controller even if he is far away from the area[7].

II. SYSTEM DESCIPTION

This system describes an automated irrigation system capable of supplying water to crops on demand and adjusting the water quantity based on soil moisture levels. Moisture sensors determine moisture content by passing an electric current through the soil and assessing the resulting resistance. Since water conducts electricity, the resistance level indicates the soil's water content. An increase in resistance indicates a decrease in soil moisture.

The primary control system of the system is an Arduino Uno microcontroller. It is connected to a 4-channel, 5V relay module, which regulates the operation of two solenoid valves and a pump. The Arduino also interfaces with the soil moisture sensor. Water is delivered to the solenoids through a pump drawing water from a reservoir.

The Arduino receives power from a 5V DC power bank. The relay and the soil moisture sensor both use the Arduino board's 5V DC pass through.

The system operates on the sensing and actuation principle. A soil moisture sensor, integrated with a microcontroller, measures soil moisture levels. Upon detection, the sensor provides the moisture content of the soil in that segment. If the moisture percentage drops below 20%, the Arduino sends a signal to activate the relay, triggering the pump. The pump, in turn, is connected to a solenoid valve, directing water to the designated area.

The Procedure for Implementing a Framework

The board in concern is an Arduino UNO. The application can be built from a PC or laptop prior to use. The software is ready to use once it has been compiled.

1) Step 1: Install the Arduino UNO board, relay module, power supply, and moisture sensor on the board.
2) Step 2: Next, connect all of the relay's and Arduino UNO board's pins.
3) Step 3: To monitor the plant's water content, a moisture sensor is also added to the UNO board.
4) Step 4: In this phase, the motor is connected to the relay.

III.PROPOSED TECHNIQUE

The objective of the "**Gsm Based Water Pump And Irrigation Control Using Arduino** " project is to develop an automated irrigation mechanism capable of detecting the moisture content of the soil and controlling the pumping motor accordingly. In agricultural practices, the adoption of suitable irrigation technologies is essential for efficient crop cultivation. The advantage of utilizing such systems lies in their ability to minimize human intervention while ensuring adequate irrigation.

The proposed model consists of three steps:

i. **Moisture Content Detection**: The first step involves measuring the moisture content of the soil. This is typically achieved using sensors that are capable of accurately detecting the moisture levels in the ground.

ii. **Moisture Level Assessment**: The second stage is to analyze the moisture data obtained from the sensors to determine whether the soil is dry or moist. Based on this assessment, the system decides whether irrigation is required.

iii. **Motor Control**: The final stage involves controlling the pumping motor based on the moisture level readings. If the soil is determined to be dry, the pumping motor is turned on to deliver water to the plants. Conversely, if the soil is sufficiently moist, the motor is turned off to prevent over-irrigation.

By implementing this automated irrigation system, the need for manual intervention is significantly reduced, while ensuring that the plants receive the appropriate amount of water for optimal growth and productivity.

The GSM module is connected to the Arduino. When the farmer shoots a message to turn ON the motor, it will be received by the GSM module. Then GSM module forwards this message as a signal to the Arduino board. This, Arduino will make the relay input HIGH, resulting inturning ON the motor pump and this way our smart irrigation system will start supplying the water to crops. The procedure remains same while turning OFF the motor. This time the farmer will send a message to turn OFF the motor, and the relay output will be made LOW which is then followed by the shutdown of the water pump.

The working principle of a GSM-based water pump and irrigation control system using Arduino involves the integration of various components to create an intelligent and automated irrigation system. Here is a general overview of the working principle:

- **Soil Moisture Sensing:**
    - Soil moisture sensors are embedded in the soil at different locations in the field or garden. These sensors measure the moisture content in the soil.
- **Arduino Microcontroller:**

- The Arduino serves as the brain of the system. It reads data from the soil moisture sensors and makes decisions based on predefined thresholds or user-configured settings.

- **Decision Making:**
  - The Arduino compares the measured soil moisture levels with a predefined threshold. If the soil moisture falls below the threshold, indicating that the soil is too dry, the system decides to initiate irrigation.
- **GSM Module Communication:**
  - Upon deciding to irrigate, the Arduino communicates with the GSM module. The GSM module enables wireless communication using the Global System for Mobile Communications (GSM) network.
- **User Interface:**
  - The system may have a user interface, often accessible through a mobile app or web platform. Users can monitor the system, receive notifications, and control the irrigation process remotely.
- **Sending SMS Command:**
  - The Arduino, with the help of the GSM module, sends SMS (Short Message Service) commands to a predefined number or server. These commands may include instructions to start or stop the water pump.
- **Water Pump Control:**
  - The water pump is connected to the Arduino, and the Arduino controls its operation based on the received commands. When instructed to do so, the water pump starts, delivering water to the plants.
- **Weather adaptability:**
  - The system may incorporate weather sensors to gather data on environmental conditions such as temperature, humidity and rainfall. This data can be used to adjust the irrigation schedule dynamically.
- **Alerts and Notifications:**
  - The system can send SMS alerts or notifications to the user, providing real-time updates on the irrigation process, soil moisture levels, or any system-related issues.
- **Logging and Data Storage:**
  - The system may log relevant data, such as soil moisture levels, pump operation times, and weather conditions. This data can be valuable for analysis and optimization.

This working principle creates an intelligent irrigation system that conserves water by irrigating only, when necessary, allows for remote monitoring and control through GSM communication, and adapts to changing environmental conditions. The specific implementation details may vary depending on the design and features of the system you are working with.

IV. MATERIALS AND METHODS

1. Arduino UNO : The Arduino Uno is equipped with an ATmega328P CPU and offers 14 digital I/O pins, six of which support PWM outputs, along with six analog inputs

2. Soil Moisture Sensor : Soil moisture is a concept that can be challenging to define due to variations in terminology across different fields. Farmers, water resource managers, and meteorologists may each have their own understanding of soil moisture.
3. Relay Module: A relay serves as an electromechanical switch, which can be controlled by a small current. It facilitates the management of the switching operation of larger electrical devices with the use of minimal electrical current. Arduino, for instance, cannot directly control high voltages and currents.
4. DC Motor: A direct current (DC) motor is an electrical device that converts electrical energy into mechanical rotation. This conversion is achieved by utilizing the magnetic fields generated by electrical currents to drive the movement of a rotor positioned within the motor's output shaft. Due to the inherent design of the motor, both the output torque and speed are determined by the electrical input.
5. Water Pump: To facilitate water pumping, this project will utilize a 12-volt submersible pump equipped with an 18-watt motor capable of lifting water up to 1.7 meters. It is essential to ensure that the pump remains fully submerged in water for optimal performance. However, it is crucial to maintain water within the bucket at all times, as operating the pump without water can cause damage to the equipment.
6. Resistor: A resistor is a passive electrical component utilized to impede the flow of electricity within electrical networks and electronic circuits.
7. Breadboard: A breadboard is a surface-mounted device used for prototyping circuits and testing circuit designs on a temporary basis.
8. Jumper Wires: Jumper wires are simple cables with connector pins on both ends, enabling the connection of two points without the need for soldering.
9. Power Supply: A power supply is a device responsible for delivering electrical power to a load. Its primary function is to convert electric current from a source into the appropriate voltage, current, and frequency required to power the load power.

V. RESULT AND ADVANTAGE

A semi-automated version of this system was constructed using a single pump which supplied water to the plant when soil moisture went below the required moisture level. A LCD display was used for displaying the output. A buzzer was also used for alerting the user. A GSM module was also connected. As the system needs to be fully automated and cost-effective, the LCD display and the buzzer have been replaced by a GSM Module and a pair of pumps. For each and every action, the user will receive SMS Alerts. The second pump has been installed to refill the storage tank, from a reservoir, when the water level in the tank comes to lowest level. Therefore the user will no longer need to check the water level in the tank at regular intervals and switch on the pump manually.

A. A.SENSOR TESTING

a. Soil Moisture Sensor

Figure 4.1 SOIL MOISTURE SENSOR TESTING

In the above fig's we can see that the moisture sensor is changing the threshold values according to the moisture content in the soil. So we can know that the soil moisture sensor is working.

b. Rain Sensor

Figure 4.2 RAIN SENSOR TESTING

In the above fig's we can see that the rain sensor is changing it's threshold values when ever the water drop let's fell on the rain sensor. So we can know that the rain sensor is working.

c. Water flow sensor

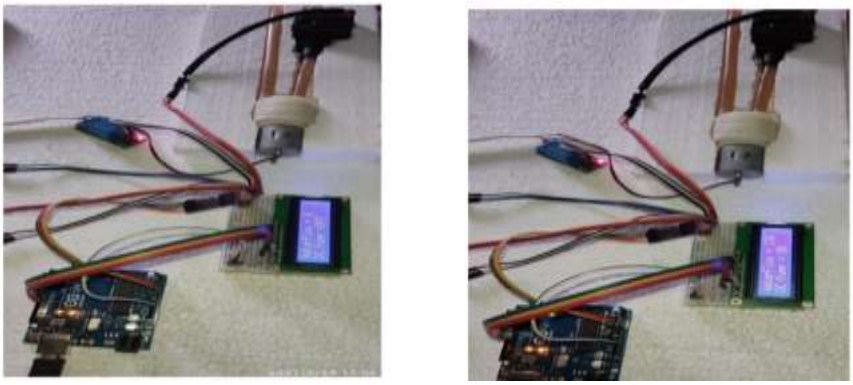

Figure 4.3 WATRE FLOW SENSOR TESTING

In the above fig's we check the water flow sensor when ever the pump is on the water flow sensor send the data to Arduino in the form of pulses. So we can know that the water flow sensor is working.

B. RELAY TESTING

Figure 4.5 RELAY TESTING

In the above fig's we are checking the relay whenever we give input LOW to the relay then the relay is ON and whenever we give input High to the relay then the relay is OFFwith the help of these conditions we can check the relay is on/off.

C. ALERT MASSAGES

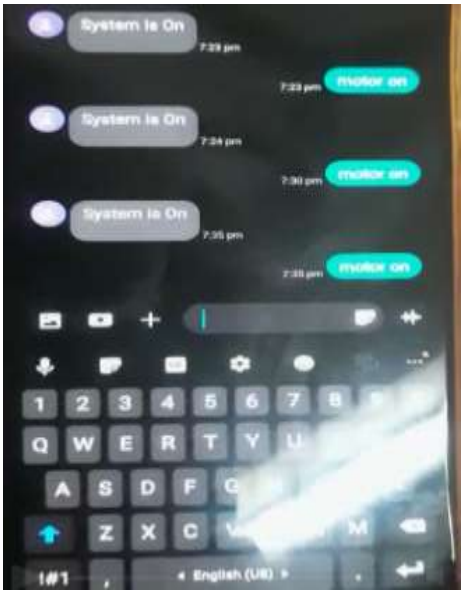

Figure 4.5 MASSAGING

D. LIMITATIONS

In spite of trying the best to rectify the errors,there are a few limitations under which the model has to be operated. ¬ We are using power supply instead of battery it should be continuously turned on whenever there is power. If power is not their then we cannot read the sensor data. ¬ If we don't have internet connection, we can't monitor the sensor values throughthing-speak server but the system will run. ¬ If the sensor gets damaged, we get an alert message, where we have to manuallycheck and replace with good one. ¬ This system is not fully automated in certain cases it requires human efforts.

E. ADVANTAGES

a. **Water Efficiency**: Drip irrigation delivers water directly to the root zone of plants, minimizing wastage due to evaporation or runoff. This targeted approach ensures that plants receive the water they need without excess.

b. **Weed Control**: By delivering water only to the root zone of plants, drip irrigation can help suppress weed growth since nearby weed seeds are less likely to germinate without consistent surface moisture.

c. **Disease Prevention**: Watering at the roots helps prevent the spread of leaf diseases that can occur when water droplets remain on the foliage for extended periods. By avoiding wetting the leaves and flowers, drip irrigation reduces the risk of fungal diseases like blight.

d. **Conservation of Resources**: Drip irrigation systems can be designed to deliver water precisely where it's needed, reducing overall water usage compared to traditional methods.

e. **Labor Savings**: With less need for manual weeding and disease management, drip irrigation systems can save time and effort in garden maintenance. Overall, drip irrigation is a smart choice for efficient and effective watering in gardens, landscapes, and agricultural settings.

f. **Prevents Disease and Weeds:** Drip irrigation systems, as opposed to showering the entire garden like a conventional deluge, send water to each plant's root ball. As a result, nearby weed seeds will not germinate, requiring less weeding. Standing droplets on the leaves produce leaf diseases, which are prevented by water at the roots. Blight diseases have no chance of spreading because the water does not come into. contact with the leaves or flowers.

g. **Saves Water and Time:** Mostly in beginning, watering by hand with a hose or a watering can takes a long time. Evening watering procedures take time. away from family and work. Drip and sprinkler are both effective. Irrigation systems contain timers that may be set to water on a daily or weekly basis, allowing you to save time and money. There's no need to keep an eye on the watering because the timer cuts. it off when it's done. Has been completed. If your irrigation system is working properly, your water cost should be reduced.

h. **Maintains soil structure and nutrients:** Irrigation with a fully open garden hose may cause the soil to absorb an excessive amount of water. As a result, nutrients leach off. with the water runoff, making less nutrients available to the plants. When you irrigate with a hose, the earth may become. compacted as well. With stifling, compacted soil, plants may exhibit indications of wilting or root disease. Smaller droplets are produced by drip or sprinkler watering, which helps to maintain nutrients and reduce soil compaction.

i. **Gardening Flexibility.** You'll like to be able to work in the garden while the plants are being watered if you have a busy schedule. You can plant and trim. in one garden patch while another is being watered.

j. **Low Cost and Maintenance.** The System implementation is very low, and it is cheap for maintenance, so this system is well-suited for farmers.

V. CONCLUSION

- Automatic water pump control system employs the use of different technologies in its design, development, and implementation.
- The system used microcontroller to automate the process of water pumping in an over- head tank storage system and has the ability to detect the level of water in a tank, switch on/off the pump, accordingly, give message to owner by using GSM and display the status on an LCD screen.
- It can also be operated manually with the user sending and receiving the messages according to the status.
- This project has successfully provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level.
- The advantages of this system include reduction in wastage of power, reduction in wastage of water and increase in the pump set life due to efficient use of the equipment's involved.
- The future scope of this project is that by using solar panels we can provide supply to the sensor circuit and then we can monitor the water level during power cut events also.

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