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Farm Management System Based Irrigation System

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ABSTRACT: In this paper, a farm management system and automated irrigation system design and development are introduced to maximize the utilization of water and maximize yields. The system is equipped with sensors to get real-time measurements of soil temperature, humidity, and humidity and processes it to make decisions in terms of efficient irrigation schedules. Through remote control and automation, water loss is avoided, Labor effort is reduced, and irrigation is performed as and when actual soil conditions require. It has a user-friendly interface for data visualization and control and is thus easy to operate as well as implement on a day-to-day basis. This hybrid conception displays the potential for powered by technology agriculture in enhancing sustainability and operational efficiency in modern agriculture.

KEYWORDS: Farm management, Farm Management, IoT, Soil Moisture Sensor, Smart Farming, Agriculture Technology, Microcontroller, Smart Sensors, Agricultural IoT, Digital Agriculture Technology, Microcontroller, Smart Sensor.

I. INTRODUCTION

In this paperAgriculture is a base of nearly all economies globally, particularly in developing nations. Traditional crops, on each together, result in poor the use of assets, like in terms of water, which is a critical component of agriculture.

[1].[3].Agriculture is as the backbone of nearly all economies globally, more so in developing nations. This is a Farm Management System incorporating a smart irrigation system that has been developed to solve these issues by applying the latest technology.

[4].he system displays temperature, humidity, and soil moisture in real time in sensors. The system automatically manages the irrigation activities with regard to the above details in a way that crops are irrigated by the appropriate quantum of water at the appropriatetime.

[2].Agriculture faces increasing pressure to produce more with fewer resources. Traditional irrigation techniques lack precision, leading to water wastage and suboptimal crop yields. In this paper, we introduce a human-AI collaborative system for farm management, focusing on intelligent irrigation. AI algorithms learn from environmental data and human feedback to optimize water distribution. Farmers interact with the system through a user-friendly interface, enabling real-time decision-making and manual control when required.

[5].This paper aims to present the design,implementation, and benefits of a Farm Management System Based Irrigation System. It indicates out how such systems increase water usage, reduce expenses, and improve crop yields, all of this contribute to sustainable agriculture.

[2].The innovative Farm Management System Based Irrigation System includes historical agriculture practices with modern technology to enhance agricultural sustainability and productivity. Multiple problems have been facing the agriculture industry a while ago, including the need to produce more food to feed a growing population, climate change, and water limitations. In regions where water resources are scarce, effective water management is known as a top priority. Here's where a smart watering system who's included of a larger farm management platform applies in useful.

II. FARM IRRIGATION SYSTEM AND DRIP IRRIGATION

The diagram illustrates a modern Farm Irrigation System Design that integrates automation and smart technologies to improve irrigation efficiency. The process begins with a water source, from which water is drawn and passed through a filter system to remove impurities.This is a smart irrigation system that uses cloud control, sensors, and automated valves to deliver precise amounts of water and fertilizer to different sections of farmland.

The entire setup is managed from a control room and can also be remotely accessed via cloud control, using a smartphone or tablet. This allows farmers to monitor and control irrigation operations from anywhere. This smart system reduces water wastage, enhances crop yield, and supports sustainable farming practices by delivering preciseamounts of water and nutrients according to crop and environmental needs.

The image shows a farm field using a drip irrigation system, which is a highly efficient method for delivering water directly to the base of each plant. In this system, thin black drip lines run parallel to crop rows, with small emitters spaced along the pipes. These emitters slowly release water near the root zone, ensuring that plants receive the precise amount of moisture they need, minimizing evaporation and runoff.

Drip irrigation is especially beneficial in arid and semi-arid regions, where water conservation is crucial. It reduces water usage by up to 50% compared to traditional irrigation methods, such as flooding or sprinklers. Additionally, by keeping the soil consistently moist, it promotes healthy plant growth and helps prevent diseases caused by excessmoisture.

III. EXPERIMENTATION

The system was tested in a simulated garden environment. Moisture thresholds were configured at 30%. Below this, the solenoid valve turned ON, irrigating the area. Sensor readings and relay signals were monitored using serial outputs. Multiple cycles confirmed accurate detection and valve control.Data from soil moisture and temperature sensors was recorded and used to train the AI module. Human overrides were also logged. The AI model's irrigation decisions were compared with human inputs to evaluate adaptability and accuracy.pins.

Sensor Calibration:

- Soil moisture sensor was tested in dry, moist, and wet soil to define accurate threshold values.
- Threshold set: < 40% moisture → Start irrigation; > 70% → Stop irrigation.

System Testing:

- The system was installed in a test soil bed (with 1 plant).
- Dry soil conditions were created by leaving the soil unwatered for 24 hours.
- As moisture dropped below threshold, the pump automatically started.
- When the soil reached optimal moisture, pump turned off.

Data Monitoring:

- Real-time data was observed on the Blynk App.
- Logged sensor readings every 10 seconds to ThingSpeak for later analysis.

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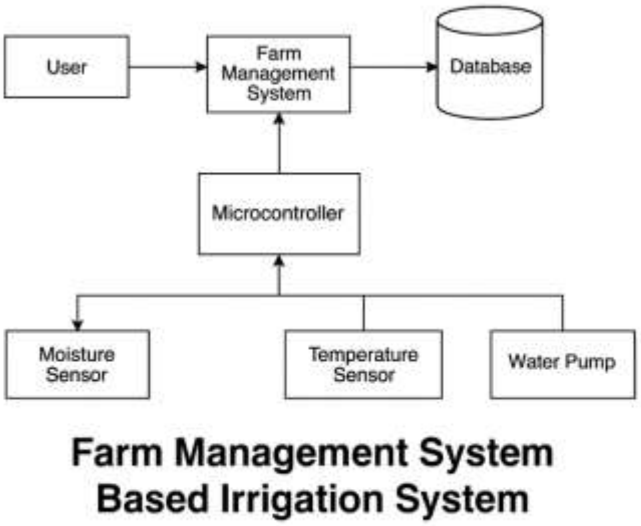

LINE DIAGRAM FOR FARM MANAGEMENT SYSTEM BASED IRRIGATION SYSTEM

A Farm Management System Based Irrigation System combines agricultural management practices with advanced irrigation technologies to optimize water usage, increase crop yield, and reduce waste. The system can be considered a smart solution that uses sensors, data analysis, and automation to manage farm irrigation based on real-time environmental conditions and crop requirements.

Microcontroller:

A microcontroller-based farm management system for irrigation automates water delivery to crops based on real-time data and pre-programmed parameters.

Moisture Sensor:

This system based irrigation, soil moisture sensors are crucial for optimizing water use by providing real-time data on soil moisture levels.

Water Pump:

This system based irrigation system, water pumps are essential for extracting and distributing water to crops, ensuring optimal irrigation and crop health.

Sensors:

These gather real-time data on soil moisture, temperature, humidity, and other factors relevant to crop water needs.

Controllers:

They analyse the sensor data and determine the optimal irrigation schedule, including when and how much water to apply.

Communication Devices:

These transmit data between sensors and controllers, allowing farmers to monitor and control the system remotely.

Automation:

The system automatically adjusts irrigation based on the collected data, minimizing manual intervention.

Remote Monitoring and Control:

Farmers can access and adjust irrigation parameters from a smartphone, tablet, or computer, says Intellia's.

SOURCECODEFORTHEMICROPROCESSOR:

```
intex_valve = 7;
int moisture_sensor = A0;
int solenoid_valve = 7;
int moisture level;
void setup() {
pinMode(solenoid_valve, OUTPUT);
 Serial.begin(9600);
}
void loop() {
moisture level = analogRead(moisture_sensor);
 Serial.println(moisture level);
if(moisture level< 400) {
digital Write(solenoid_valve, HIGH);  // Water ON
  } else {
digital Write(solenoid_valve, LOW);   // Water OFF
  }
delay(1000);
}
```

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IV. OBESERVATIONS FROM THE TESTS CONDUCTED SOLENOID FORCE

The actual force required in the application is need to move the engine valve along with spring that must be considered.

Where:

The force can be calculated by:
$F = (N*I)^2 \mu_0 A / (2 g^2)$,

S.No	Number of Turns (N)	Current (I)	Solenoid Force (F)	Valve Frequency (per second)
1	100	5A	0.512 N	14
2	120	5A	0.738 N	18
3	140	5A	1.001 N	22
4	160	5A	1.310 N	25
5	180	5A	1.661 N	28
6	200	5A	2.050 N	33

Valve Frequency

At average speed i.e the valve opening or closing time is 40msFor 1 sec 25 openings and closings isa force of 1.31N the inlet valve opens for 1500 times a possible For 1 min for one valve 25*60=1500 Withforce of 1.31N the inlet valve opens for 1500 timesand exhaust valve opens fo 1500 times.

SL. NO	TIME TAKEN FOR ONE OPENING OR CLOSING IN MILLI SECONDS	NO OF OPENINGS OR CLOSINGS IN ONE SECOND	NO OF OPENINGS OR CLOSINGS IN MINUTE
1	71.4	14	840
2	55.5	18	1080
3	45.45	22	1320
4	40	25	1500
5	35.7	28	1680
6	30.30	33	1980

- N is the number of turns
- F is the force in Newtons
- g is the length of the gap between the solenoid and a piece of metal.
- I is the current in Amps
- A is the area in length units squared

For different N values we get different solenoid force for valve operating
I=5amp, g=0.5, A=πdl. (d =2mm,l=5cm,)

V.CONCLUSION

The Farm Management System Based Irrigation System offers a smart and efficient solution to the challenges faced in traditional farming methods. It effectively monitors real-time environmental data such as soil moisture, temperature, and humidity, supporting more educated irrigation decisions. By using human control and oversight alongside AI-driven suggestions, the system becomes reliable, adaptable, and efficient. Part of the informalstrategy optimizes the use of water while also grow crops by fewer hands. Human input allows the AI model always learn and improve its decision-making, ensuring that the system adapts to shifting the field over time. The collaboration between farmer and machine lays the groundwork for scalable smart farming, making it a key phase toward agriculture's future.

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS

- Reduces water waste.
- Enhances crop productivity.
- Builds trust in automation.
- Adaptive learning through humanfeedback.
- User-friendly manual override.
- Increases crop productivity.
- Eco-friendly and sustainable

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