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Smart Farm Monitoring and Automatic Irrigation System Using Esp32-Cam and Arduino

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Abstract: *This paper presents a Smart Farm Monitoring and Automatic Irrigation System using ESP32-CAM and Arduino. The system is designed to monitor soil moisture levels and automatically control irrigation based on soil conditions. A soil moisture sensor is used to detect the water content in soil, and the Arduino processes this data to control a relay-based water pump. The ESP32-CAM module provides live video streaming of the farm through a web server, enabling remote monitoring. This system helps in reducing water wastage, minimizing human effort, and improving agricultural productivity. It is cost-effective and suitable for smart farming applications.*

Keywords: Smart Irrigation, ESP32-CAM, Arduino, Soil Moisture Sensor, IoT.

I. INTRODUCTION

Agriculture is an important sector that requires efficient management of water resources. Traditional irrigation methods depend on manual operation, which often leads to over-irrigation or under-irrigation. This results in water wastage and reduced crop productivity.

To overcome these problems, an automated irrigation system is developed using sensors and microcontrollers. In this system, a soil moisture sensor measures the moisture level of the soil and sends the data to the Arduino. Based on this data, the Arduino controls the water pump automatically.

The ESP32-CAM module is used to provide live video streaming of the field through a web server. This allows farmers to monitor their farms remotely. The system is simple, efficient, and economical.

TABLE I: COMPONENTS USED IN SMART FARM SYSTEM

Component	Description
Arduino UNO	Used for processing sensor data and controlling system
ESP32-CAM	Provides live video streaming and web monitoring
Soil Moisture Sensor	Detects moisture level in soil
Relay Module	Controls ON/OFF operation of water pump
Power Supply	Provides required voltage to system
Water Pump	Supplies water for irrigation

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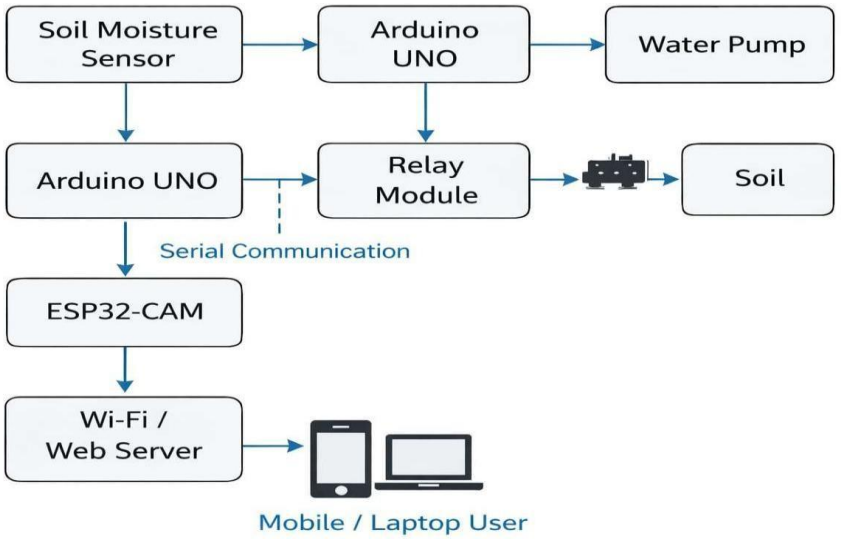

Fig. 1 Block Diagram of Smart Farm Monitoring System

Description:

The block diagram consists of soil moisture sensor, Arduino UNO, relay module, water pump, and ESP32-CAM. The sensor sends data to Arduino, which controls the pump through relay. ESP32-CAM is connected to the Arduino through serial communication.

The Arduino reads the moisture value and compares it with a predefined threshold. If the soil is dry, the relay module is activated, which turns ON the water pump to irrigate the soil. If the soil is wet, the pump is turned OFF.

The ESP32-CAM module receives data from Arduino and provides live video streaming through a Wi-Fi/web server. The system status and live feed can be monitored on a mobile or laptop by the user. Thus, the system ensures automatic irrigation along with remote monitoring.

System Working Flow:

1. Start system
2. Read soil moisture value
3. Compare with threshold
4. If dry → Pump ON
5. If wet → Pump OFF
6. Send data to ESP32-CAM
7. Display live video on web page
8. Repeat process

Hardware Setup

The hardware setup consists of Arduino UNO, ESP32-CAM, soil moisture sensor, relay module, and water pump connected properly. The soil moisture sensor is inserted into the soil to measure moisture level. The sensor output is given to the Arduino, which processes the data and controls the relay module. The relay acts as a switch to turn the water pump ON or OFF.

The ESP32-CAM module is interfaced with the Arduino using serial communication. It provides live video streaming of the field and displays system status on a web page. The entire system is powered using a suitable power supply and operates automatically based on soil condition.

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II. SOFTWARE SETUP

The software setup of the Smart Farm Monitoring and Automatic Irrigation System is done using Arduino IDE and required libraries for Arduino UNO and ESP32-CAM.

Steps:

1. Install Arduino IDE on the computer.
2. Install ESP32 board package in Arduino IDE using Board Manager.
3. Select Arduino UNO board for programming sensor and relay control.
4. Select ESP32-CAM board for video streaming setup.
5. Write Embedded C program for:

o Reading soil moisture sensor

o Controlling relay (pump ON/OFF)

6. Write program for ESP32-CAM to enable Wi-Fi and web server.
7. Upload code to Arduino UNO and ESP32-CAM using USB/FTDI programmer.
8. Connect ESP32-CAM to Wi-Fi network.
9. Open IP address in browser to view live video and system status.

III. CONCLUSION

The Smart Farm Monitoring and Automatic Irrigation System provides an efficient solution for modern agriculture. The system automatically controls irrigation based on soil moisture levels, reducing water wastage and human effort. The integration of ESP32-CAM enables real-time monitoring through live video streaming. This project is cost-effective, reliable, and suitable for improving agricultural productivity. It can be further enhanced with advanced technologies for better performance.

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REFERENCES

[1] Arduino UNO Datasheet, Arduino Official Website.
[2] ESP32-CAM Technical Reference Manual, Espressif Systems.
[3] Soil Moisture Sensor Module Datasheet.
[4] K. Ashton, “That ‘Internet of Things’ Thing,” RFID Journal, 2009.
[5] https://www.arduino.cc/
[6] https://www.espressif.com/

BIOGRAPHY

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