IOT Based Smart Plant Monitoring System

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***Abstract*- The IoT-based smart plant monitoring system is an efficient way to monitor and control plants remotely. Without a remote monitoring system, it is difficult to control scattered plants. A canopy remote monitoring system based on Ethernet has been developed in recent years. In this project, various modules such as IoT, Arduino as controller, temperature sensor, moisture sensor, and humidity sensor are used to monitor plants. A humidity sensor is used to determine the atmospheric humidity, and a moisture sensor senses if the soil is dry or wet. If the soil is dry, a water pump is automatically turned on. The temperature sensor senses the temperature, and if it exceeds the set threshold value, a fan is turned on automatically. Wireless devices are used to monitor parameters in industries during certain hazards because it can be difficult to monitor parameters through wires and analog devices such as transducers. Wireless devices such as Wi-Fi, Bluetooth, and Wi-Max are now commonly used for data transfer due to rapid technological development. This project is designed as a plant monitoring system based on IoT, and the condition of soil and temperature are displayed on an LCD. The same values are updated on the internet through the IoT module connected to the controller**.

***Keywords*: IOT, Moisture, Temperature, Humidity**

I.INTRODUCTION

As the world becomes increasingly automated, agriculture has been slower to adopt automation due to factors like cost. Despite this, plant monitoring is critical to achieving optimum crop yield by controlling climate conditions. Automating plant monitoring and climatic parameter control can replace human operators with automated systems, reducing the need for manual labor and minimizing errors. This paper presents a plant monitoring system technology that provides feedback to users through their smartphones. This system can be automated to reduce the need for manual labor, making it easier for farmers to monitor the system's efficiency, especially in large-scale areas. With this technology, farmers can easily monitor the system's performance using their smartphones.

II. LITERATURE SURVEY

The agricultural sector in India faces a significant challenge due to the dependency on monsoon for water supply, which only covers about 35% of the land under irrigation. This issue results in food insecurity, low productivity, and limited job opportunities in rural areas. In irrigated areas, farmers still face problems determining the appropriate amount and timing of water supply for their crops. Overwatering can cause crop damage and water wastage. To address this issue, this paper suggests using humidity, moisture, and temperature sensors placed in the root zone of plants. These sensors collect data transmitted to an Android application using a gateway unit, ESP8266. The information is used to control the amount of water supplied to the plants by programming it into a microcontroller.

Various researchers have conducted studies in the field of agriculture, exploring the use of technology to enhance productivity while minimizing manual labor. These researchers have investigated different controllers such as PIC microcontroller, 8051 controller, ARM 7, and communication technologies such as Zigbee, Wireless Sensor Network (WSN), and GSM to improve agricultural production and monitor crops.

One example is Marwa Mekki et al.'s greenhouse monitoring and control system, which uses wireless sensor nodes with temperature, humidity, moisture, light, and CO2 sensors throughout a greenhouse. The system uses a microcontroller programmed to control environmental factors based on preset values or manual control through a user interface panel.

Another example is K. Lokesh Krishna et al.'s ZigBee-based energy-efficient environmental monitoring, alerting, and controlling system for agriculture. The system uses an ARM7 processor, various sensors, and ZigBee communication modules. Physical data gathered by sensors in real-time is transmitted to the processor and end-user via ZigBee communication, and necessary actions are initiated based on the data to reduce or eliminate the need for human labor.

III. MATERIAL & METHOD

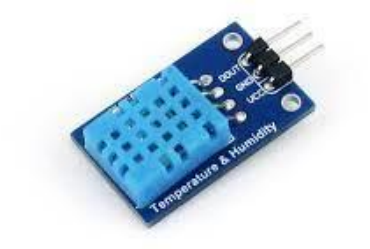
A. *Arduino UNO*

The Arduino Uno is a powerful and flexible microcontroller board that is based on the ATmega328P. It is equipped with essential components, including a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. With 14 digital input/output pins, including 6 PWM outputs, and 6 analog inputs, the board offers a wide range of connectivity options for various projects. The board is easy to set up, as it can be connected to a computer via a USB cable or powered by an AC-to-DC adapter or battery. This board has all the necessary components for microcontroller programming, making it an excellent choice for both beginners and advanced users.

Arduino UNO

B. ***Temperature and Humidity Sensor***

This device measure humidity and temperature sensor that is designed to provide accurate and reliable readings. The calibration and digital output features likely ensure that the readings are precise and easy to interpret, while the long-term stability ensures that the device will continue to function effectively over time. The ability to transmit signals over long distances may make this device useful for remote monitoring applications, and the low power consumption may help to extend its battery life. Overall, this device seems well-suited for applications that require accurate and reliable humidity and temperature measurements, such as environmental monitoring or HVAC systems.



Temperature and Humidity Sensor

C. ***MCU ESP8266***

The NodeMCU development board also provides a convenient platform for rapid prototyping, with built-in support for Wi-Fi connectivity, HTTP, MQTT, and other communication protocols. It features a USB port for programming and power, as well as headers for connecting to external sensors and modules. The board can be programmed using Lua scripts, making it easy to develop and test IoT applications without the need for complex programming languages or toolchains. With its low cost and wide range of features, the NodeMCU development board is an ideal choice for hobbyists, students, and professionals alike.

MCU ESP8266

D. *exhaust cooling fan*

This is a small cooling fan for exhaust systems. Its size is comparable to that of your hand. It operates on 12 volts DC and can be powered by a basic 12-volt battery without any issues. The fan is capable of running at speeds ranging from 6800 to 13000 revolutions per minute.

E. ***WATER PUMP***

This device is a mini submersible water pump that operates on a 3-6V DC power supply, and is available at an affordable price. Its usage is incredibly easy, requiring only for the pump to be submerged in water, a suitable outlet pipe connected, and the motor powered with 3-6V to initiate water pumping. It is well-suited for a variety of applications including science projects, fire-extinguishers, fire fighting robots, fountains, waterfalls, plant watering systems, and more.

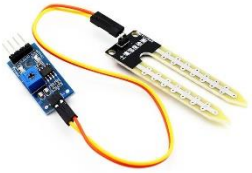
WATER PUMP

F. ***LCD WITH GREEN BACKLIGHT***

The 16x2 LCD display is widely used and recognized. It is built around the HD44870 display controller, making it simple to interface with most microcontrollers. The display operates on 5V and features a Green Backlight that can be turned on and off as required. Additionally, the contrast of the screen can be managed by adjusting the voltage at the contrast control pin, which is located on Pin 3.

G. ***Soil Moisture Sensor***

Soil moisture sensors are not only useful for lawn maintenance but also for agriculture, where they help farmers to determine the right amount and timing of water supply for their crops. By monitoring the soil moisture levels, farmers can prevent overwatering and reduce water waste, leading to more sustainable and efficient irrigation practices. Additionally, soil moisture sensors can be used to detect soil nutrient levels, pH, and temperature, providing farmers with valuable information to optimize crop growth and yield. Overall, soil moisture sensors are a powerful tool for precision agriculture, enabling farmers to make data-driven decisions for optimal resource utilization and crop production.



H. ***Jumper Wires***

Jumper wires are indeed an essential tool for any electronic project, especially for prototyping on a breadboard. They come in different lengths and colors and can be easily inserted and removed from the breadboard. The flexible design of the wires allows you to create complex circuit connections and make changes quickly and easily. Some jumper wires have a male-to-male or male-to-female design to connect header pins on the Arduino or other components, while others have female-to-female ends for creating longer connections. Overall, jumper wires are a versatile and cost-effective solution for creating temporary circuit connections in electronic projects.

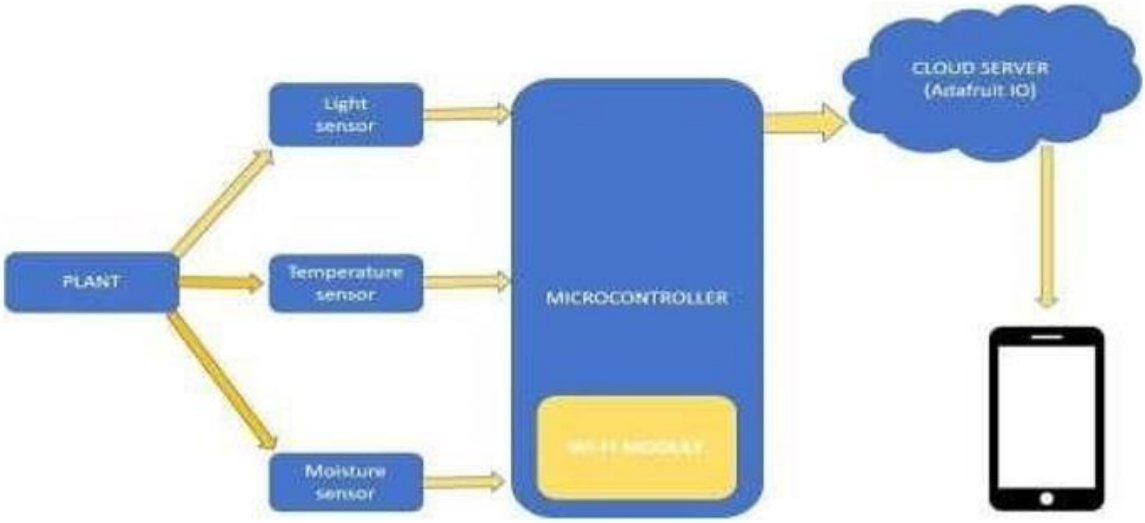
I. ***Relay 5v***

Coil Voltage : DC 5V;
Rated Load : 7A/250V Number of Pins : 5;
Contact : SPDT Switching capacity to 7A.

Relay 5v 2 channel

IV. **METHODOLOGY**

Arduino is a company and community that creates open-source computer hardware and software solutions. Arduino boards can be preassembled or DIY kits and are built around microprocessors and controllers with digital and analog I/O pins. Serial communication interfaces and an IDE based on Processing language are also included. NodeMCU is the primary microcontroller for the proposed Plant Monitoring System and features an ESP8266 WiFi module for connection to the Blynk app via WiFi. The system's control program is uploaded through the Arduino IDE. The Soil Moisture Sensor monitors soil moisture levels and displays them on the Blynk app's Virtual LCD widget. If levels drop below the threshold, the user is notified and can activate the Water Supply button widget to turn on the water supply. The DHT11 temperature sensor provides real-time temperature readings that are also displayed on the virtual LCD widget. The system includes a green shade that can be drawn over the plant using two DC motors to protect against excessive heat. When the temperature exceeds 30 ºC, the motors rotate to move the shade automatically. The user is notified of each step through the Blynk app's notification feature, and the system enables remote monitoring and control of plant requirements.



Block diagram.

V.CONCLUSIONS

The proposed project aims to provide a solution that can benefit farmers in several ways. The primary objective is to help farmers make their harvest more economical and enhance their security while traveling or attending college. The system also focuses on reducing water wastage and power consumption by motors, which can help conserve resources for future use. The project involves the use of sensors for comprehensive monitoring of fields, making it easier for farmers to control their fields and ensure the security of their plants. By implementing this system, farmers can have remote access to their fields and receive real-time information about the soil moisture level and temperature, helping them make informed decisions about irrigation and other necessary actions. Overall, this system provides an efficient and effective solution for farmers to optimize their crop yield while conserving resources and ensuring the security of their fields.

VI.FUTURE SCOPE

1.Using a more advanced microcontroller can improve the performance of the plant monitoring system. This would increase the system's processing speed and memory capacity, and also allow for more sensor channels.
2.Including a data logger and graphical LCD panel can provide a more detailed and visual representation of the data collected from the sensors over time.
3.Incorporating a speaking voice alarm can provide an additional level of notification when the system detects a potential issue.
4.Using a renewable energy source can make the system more environmentally friendly and sustainable.
5.Applying fertilizers, insecticides, and pesticides on a time-bound schedule can help optimize plant growth and minimize waste.

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