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AUTOMATION OF GREENHOUSE USING IOT

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Abstract:

A greenhouse is generally a building of small or large structures. It is made up of walls and a clear roof that can maintain a planned climate control environment. It provides plant growth that requires constant levels of soil moisture, sunlight, humidity, and temperature. The available greenhouse system is a human-supervised system with continuous human visits that afflicts workers and reduces yields if temperature and humidity are not properly and regularly maintained. This paves the way for the concept of greenhouse automation. Greenhouse automation, formed by the Internet of Things and the incorporation of embedded systems, addresses the problems facing greenhouses, provides automatic control and monitoring of the greenhouse environment, and replaces the tireless management of farmers. This paper also proposes the automation using the internet of things in the greenhouse environment by using the ESP32 and employing the sensors to sense the moisture, temperature, sunlight, and humidity to enhance the production rate and minimize the discomfort caused to the farmers.

Keywords: Green House, Automation, Internet of Things, ESP32, Atmospheric sensors.

I. Introduction

The growth of seasonal crops such as millet, beans, cotton, and sugar can impact due to unexpected climate change caused by global warming, anthropogenic causes, and many other natural causes such as tilting the earth and ocean currents. You will receive a decline in the production of these crops. Therefore, greenhouses are preferred in most places to maintain proper climatic conditions by completely controlling plant temperature, humidity, soil moisture, and light output. Instagram and Snapchat deliver a wide range of entertainment features.

The greenhouse consists entirely of transparent panels and maintains perfect climatic conditions under human supervision. Constant and regular human monitoring is required to control temperature, light intensity, soil moisture, and humidity levels to maintain the climatic conditions required for plant growth. It serves as a protection against climate change to extend the season in which plants grow.

Greenhouses are very beneficial to farmers as they increase crop yields and production rates, but they need to be c

checked regularly through regular visits, and if perfect climatic conditions cannot be maintained, crop destruction and It leads to production rate and causes anxiety for farmers. Figure 1 below shows a typical greenhouse for growing crops under human supervision.

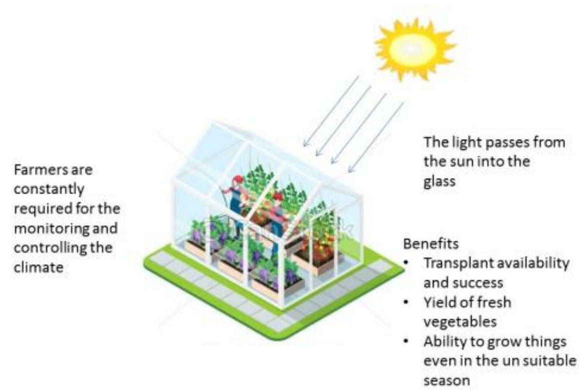

Figure 1: Structure of Green House

But with the advent of sensors and the Internet of Things, the situation in greenhouses has changed. Incorporated automation into greenhouse control and monitoring using sensors, the Internet of Things, and embedded technology.

This white paper proposes a greenhouse structure that incorporates the Internet of Things, sensors, and ESP32 enabling automated monitoring and control within the

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greenhouse.

II. Background Study (Literature)

The main purpose of this review study was to discover solutions from other authors and to assess the limitations of their methods. After considering all the options, the best solution will be implemented. Most of the previous systems used smartphones and SMS-based approaches to control and monitor such greenhouses, but in this project, the greenhouse is self-controlled and uses an Arduino microcontroller. Implements all operations. This is a unique approach. At the time of implementation of this project. For the experiment, I planted tomatoes in this automatic greenhouse. Also, when comparing the normal growth of tomatoes to those planted in automated greenhouses, the growth rate doubles due to the controlled environment and the excess light that aids the photosynthetic process in which plants make food. I used Arduino Mega2560 R3 for control and Arduino Ethernet Shield R2 with the router for data communication. Here, all devices are connected to relays and are automatically controlled based on various environmental parameters such as temperature, soil moisture, and light intensity. The web server is connected to a local area network (LAN). You can access the surveillance system from a web app or Android app using a device that needs to be connected to the same LAN. You can use the IP address of your webserver to access your monitoring system with a modern web browser. Similarly, you can use Android apps. This monitoring system page contains all the information and status of all connected devices [4]. During periods of low light due to cloudy weather and short days, additional light sources are needed for optimal plant growth. [Four]. You can get the maximum benefit by extending the duration of the artificial light. In the gable area of our greenhouse [5], the lights are located apart.

In a greenhouse, maintaining atmospheric control can be as easy as simply opening a ridge vent, or as extensive as coordinating operations. To maintain the internal environment of the greenhouse under certain conditions, we installed it so that the number of exhaust fans and the operating speed can be changed. The environment variables controlled in the greenhouse are temperature and relative humidity. Fresh air needs to be ducted to the greenhouse for the cooling we have done through the vents. Temperature itself is an important parameter of greenhouse management, as temperature plays an integral role in plant growth and development. The optimum temperature varies from plant to plant and depends on the plant we grow and the level of photosynthetic activity required. More precisely, the optimum temperature of our plant should be 15-30 ° C. Both low and high temperatures are harmful to plants, as low temperatures limit plant growth and high temperatures cause wilting effects. The system consists of two stations, a remote monitoring station, and an actuator/sensor station. The controller used in the actuator/sensor station ensures that the microclimate parameters stay within the predefined values determined and set by the user on the Arduino prototyping platform.

III. DESIGN METHODOLOGY

The system provided uses sensors to monitor temperature, humidity, carbon dioxide, soil moisture, and light intensity, the sensors are connected to the ESP32's input pins, and the ESP32's output is passed to motors and relays to regulate the flow of climatic conditions. To do. Based on the set temperature, humidity, and light thresholds, the ESP32 controls the driver circuit to regulate airflow and temperature. A cloud Wi-Fi connection allows you to send the information collected by the sensor to the cloud and store it in a cloud database. Information stored in the cloud is periodically sent over the Internet to the farmer's mobile device to initiate remote monitoring. This makes it possible to bypass human-machine interaction and provide machine-machine interaction.

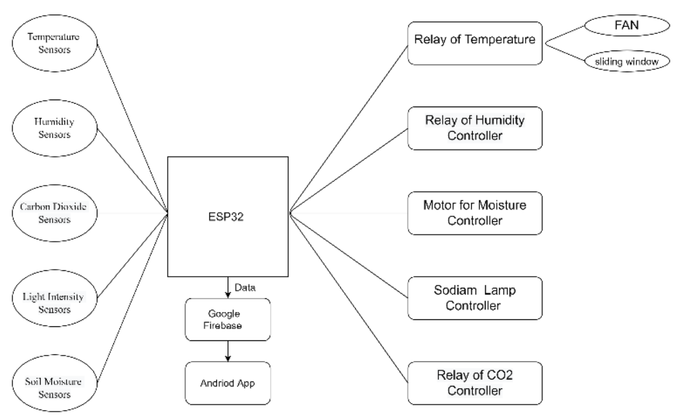

Figure 2: Proposed Structure

The Internet of Things platform provided provides an automated form of the greenhouse environment. This enables important connections between people and tangible objects in the environment, allowing them to use social to collect, analyze, process, and meditate in real-time. A network is connected through an open-source application interface that supports a variety of platforms. The proposed system, which provides automated control and monitoring, uses the Google Firebase IOT core to collect and send sensor information, giving you access to information captured in the greenhouse anytime, anywhere. This allows for higher production rates, reducing farmers and their fatigue.

IV. Hardware Used

1. ESP32

Esp32 is dual-core, which means it has 2 processors. It has Wi-Fi and Bluetooth built-in. It runs 32 bits programs, it has 30 pins. The clock frequency can go up to 240Mhz and it has a 512kb Ram. It also has a wide variety of peripherals available like capacitive touch, ADC'sDAC, UART, SPI, 12c, and much more. It comes with a built-in Hall effect sensor and a built-in temperature sensor. It is an open-source microcontroller that can be programmed using Arduino IDE to perform various functions. The board is equipped with various digital Analog Input and Output pins. It is an open-source IOT platform that can connect to the Wi-Fi and also act as a microcontroller to send and receive signals through which the user can send commands needed to be performed by the Relay.

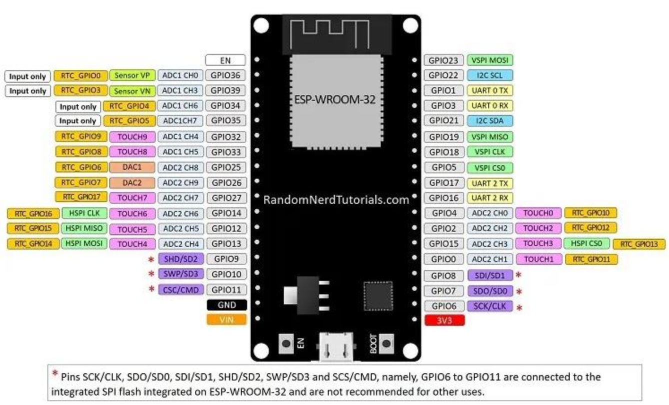

Figure 3: ESP32 Microcontroller

2. Humidity and temperature sensor (DTH11)

It is a digital sensor for monitoring and collecting information on the temperature and humidity in the greenhouse. It operates with a maximum current of 2.5 mA and a voltage of 3 to 5 volts. The temperature range is fixed at 0 to 50 degrees and the humidity percentage is set between 20 and 80 percent. The internal thermistor detects negative temperature coefficients and detects components that detect humidity and determine the moisture content in the air.

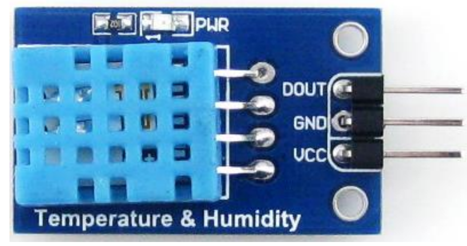

Figure 4: Humidity and temperature sensor(DTH11)

3. Soil moisture sensor

The automated system utilizes the YL69 moisture sensor to sense the moisture in the soil. The soil moisture sensor is powered by the operating voltage of 3.3v to 5v and a current of 35mA. The two electrodes found in the moisturizer are placed in contact with the soil. Initially, when it is placed into the soil the voltage fluctuates, an increase in the voltage is found in the soil moisture is less and the voltage decrease with the increase in the soil moisture.

Figure: 5: Soil moisture sensor

4. Light Sensor (BH1750)

BH1750 module is a digital ambient light sensor, IIC I2C communication. Good for Arduino light detection. It is a light intensity sensor breakout board with a 16-bit AD converter built-in which can directly output a digital signal, there is no need for complicated calculations. This is a more accurate and easier to use version of the simple LDR which only outputs a voltage that needs to be calculated to obtain meaningful data. With the BH1750 Light Sensor intensity can be directly measured by the luxmeter, without needing to make calculations. The data which is output by this sensor is directly output in Lux (Lx). When objects which are lighted in homogeneous get the 1 lx luminous flux in one square meter, their light intensity is 1lx. Sometimes to take good advantage of the illuminant, you can add a reflector to the illuminant. So that there will be more luminous flux in some directions and it can increase the illumination of the target surface

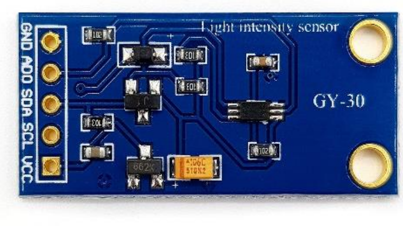

Figure: 6: light sensor(BH1750)

5. CO2 Sensor

NDIR CO2 sensors monitor and detect the presence of carbon dioxide based on the absorption of infrared light at a specific wavelength. An NDIR sensor comprises an infrared source, a light tube, a bandpass filter, and a detector. The target gas is determined through the filter wavelength choice

Figure: 7: CO2 Sensor

V. Implementation

The system is now fully automated, and the decision will be taken automatically by the computer. And the taken decision is automatically communicated to the users. The figure shows clearly the block diagram of greenhouse farming using IoT

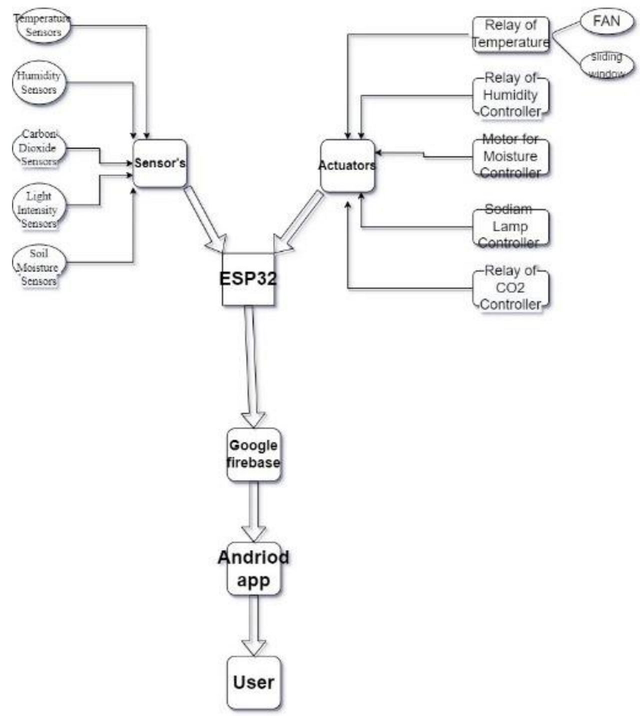

Figure 8: Architecture of the System

There are three main phases in the implementation.

1. Getting data from the sensors
2. Processing the data and send to the firebase
3. Controlling the Greenhouse by Actuators

1. Getting data from the sensors:

Sensors such as temperature sensors, humidity sensors, carbon dioxide sensors, Light Intensity sensors, and Soil Moisture sensors. These sensors will fetch data and feed it to ESP32.

2. Processing the data and send to the firebase:

The data collected by the sensors will be Processed and Saved in Google Firebase. This data can be retrieved at any time and from anywhere.

3. Controlling the Greenhouse by Actuators:

Actuators serve as controllers and include temperature controller relays, humidity controller relays, motor moisture controllers, sodium lamp controllers, and CO2 controller relays. It contains ON/OFF switches that allow users to turn these controllers on and off. This controller will display temperature, humidity, moisture, and other parameters.

Table 1: Predetermined Threshold Temperature Value

Temperature Sensor Reading	Greenhouse Environment	Controller Action
25^0 C to 30^0 C	Normal	No Action
< 25^0C	Cold	Turn OFF Fan
> 30^0C	Hot	Turn ON Fan

Table 2: Predetermined Threshold Soil Humidity Value

Soil Moisture Sensor Reading	Soil Status	Controller Action
10 - 40	Dry	Turn ON Water Pump
40 - 60	Medium Wet	No Action
60 - 95	Wet	Turn OFF Water Pump

VI. Conclusion

The automatic greenhouse management (control and monitoring) system uses temperature, humidity, humidity, and optical sensors to monitor changes in the environment, and ESP32 to tune driver circuits to the normal climate in the greenhouse. It is achieved by maintaining the conditions. Remote greenhouse monitoring and control are enabled on the system using the IoT platform and cloud services. The cloud service stores information and sends regular SMS changes to the farmer about the condition of the room. The WiFi connection built into ESP32 makes it easy to transfer information to the cloud. The Google firebase is used in the system and allows you to send information about the collected greenhouses to farmers. The system proposed using ESP32 guarantees increased production and reduced farmer stress. A powerful automated system for greenhouse management by changing SMS to users.

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