International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.002 ISSN: 2581-4621

GREENHOUSE MONITORING AND CONTROL USING IOT

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ABSTRACT

The population of the world has been increasing gradually in recent times. Under excessive climatic conditions, the plants can be grown with the help of Greenhouse. Green houses help to maintain the temperature within a limited range, used for cultivating plants out of season. The greenhouse control system is powered by ESP-WROOM 32 Wi-Fi Microcontroller and it consists of temperature and humidity sensor, soil moisture sensor, PIR sensor and MQ Gas sensor to monitor and the Incandescent Bulb, air blower and water pump to maintain the environmental conditions. Temperature and humidity sensor senses the level of temperature and moisture and send the bit signal to the controller, which controls the operation of the incandescent lamp to and blower. The moisture content in the soil is sensed with the help of Soil Moisture sensor and it controls the operation of water pump. PIR sensor is used to detect the movement of any organisms such as rodents and send the signal to the buzzer. The Air quality is sensed by the MQ2 Gas Sensor. The data sensed by the sensor is sent to the cloud through Wi-Fi and so that it can be monitored and controlled at any location using the laptop.

Keywords--Wi-Fi, Tender Plant, Greenhouse, Microcontroller, Cloud

1. Introduction

The ecosystem plays a very important role in plant development. The amount of temperature and humidity which is present inside the greenhouse cannot be adequately understood by farmers in the greenhouse. The condition in the green building is difficult to understand manually, and experience by our own. A greenhouse is a structure that is built of sheets and a transparent roof. It is designed to maintain regulated climatic conditions inside the greenhouse. These structures are used for the cultivation of tender plants, fruits, and vegetables which require a particular level of sunlight, temperature, humidity, and soil moisture. IoT and ESP WROOM 32 Wi-Fi Microcontroller based Greenhouse Environment Monitoring and Controlling is designed to maintain these conditions in the greenhouse. The greenhouse can be controlled by IoT using Wi-Fi which involves cooling, ventilation, moisture level of the soil, etc. This System can be managed by concentrating on environmental criteria such as temperature and humidity. The need for ON/OFF switchgear functions eliminates the use of IOT and automation plays an important role in performing things automatically. Here, assuming that the greenhouse owner will monitor the greenhouse from anywhere by the use of monitoring system. The owner must remain in one position and constantly track and manage the number of greenhouses at the same time by the use of the data’s in the display unit. Wi-Fi Module plays an important role in transmitting data to the network, removing the need for cable or wired links that automatically minimize the costs.

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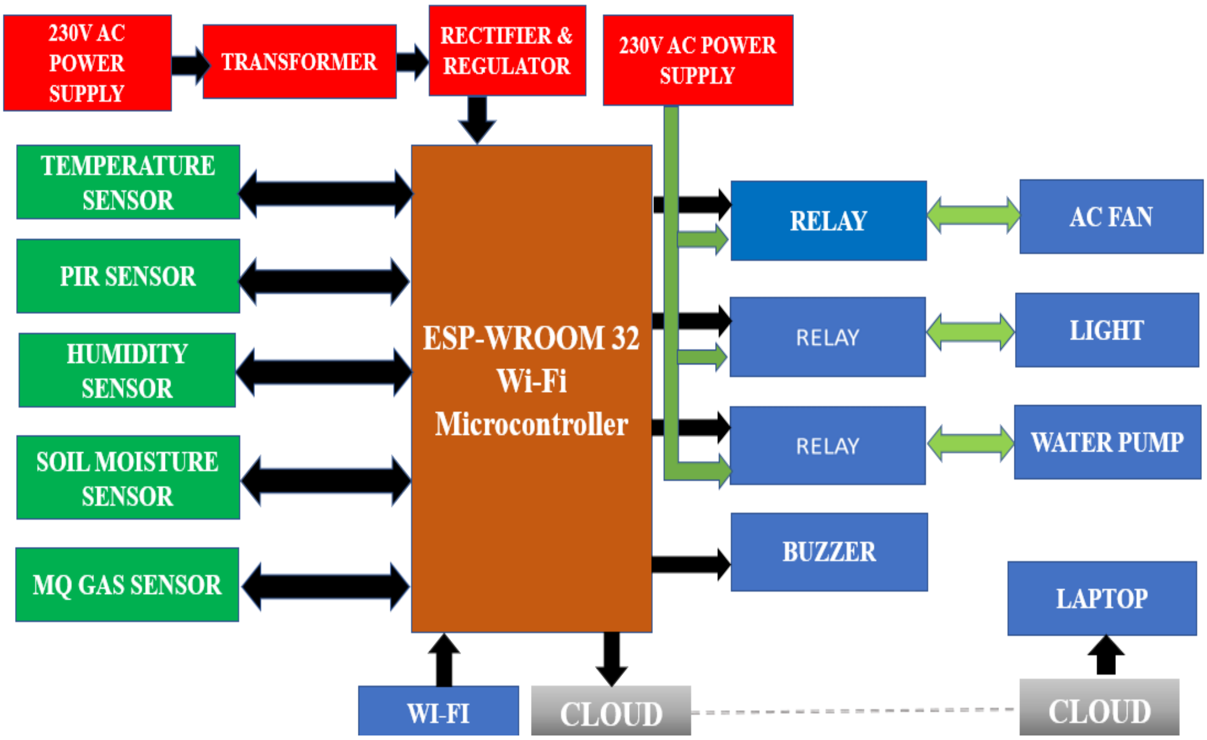

Fig. 1. BLOCK DIAGRAM

2. Modules Description

From the above Fig. 1 we can see the components of the hardware required 2.1 ESP WROOM 32 2.2 Temperature and Humidity sensor 2.3 PIR sensor 2.4 Soil Moisture Sensor 2.5 MQ gas Sensor and the control system.

2.1 ESP WROOM 32

The ESP WROOM 32 Wi-Fi Module is a self-contained SOC module which is an integrated TCP/IP protocol stack that can give any microcontroller access to the Wi-Fi network. The ESP WROOM 32 is capable of perform hosting an application or transferring all Wi-Fi networking functions from another application processor.

2.2 Temperature and Humidity Sensor

The DHT-11 Digital Temperature and Humidity sensor is a compact device, that consist of both temperature and humidity sensor in a single sensor pack which is used to find out the temperature and the humidity value which is present inside the greenhouse. DHT-11 sensor helps to maintain a certain condition which is suitable to the growth of the plant and the temperature and the humidity can easily be controlled by the ESP WROOM.

2.3 PIR Sensor

PIR sensor is used to sense motion. It is used to detect the movement of any objects within its sensing range. PIR sensors are small, low-power, inexpensive, simple to use and doesn't wear out. For that reason, they are commonly found in object sensing applications and gadgets. They are referred to as PIR, "Pyroelectric" or "Passive Infrared" or "IR motion" sensors.

2.4 Soil moisture Sensor

Irrigation and water management requires timely application of right amount of water at right time. Competition for water scarcity, high pumping costs, and concerns for the environment makes good water management to be considered as more important.

2.5 MQ gas Sensor

The most widely used MQ series sensor is MQ2 gas sensor. It is a MOS sensor which stands for Metal Oxide Semiconductor sensor. Metal Oxide sensors are also known as Chemoreceptors because sensing is based on the change in resistance of the sensing material when exposed to gases. The operating voltage is 5v DC and it consumes approximately 800mW. It can detect various gases such as LPG, Smoke, Propane, Alcohol, Hydrogen, Methane and Carbon.

3. Methodology

ESP WROOM 32 Wi-Fi microcontroller is a wireless, vast controlling and monitoring device. It is easily implementable, record parameters on Cloud servers, userdefined and has automatic modes and reduce the use of water and pesticides. It is also easy to find the solution of the food quality and to find the condition of food using IOT devices. The maintenance cost is also low.
To always sustain a suitable climate inside the greenhouse and to retain appropriate moisture content in the soil we have designed an automatic temperature control and irrigation system by monitoring the various parameters such as temperature, humidity and soil moisture content with the help of the temperature & humidity sensors and soil moisturesensor. The soil moisture sensor is connected in the ESP 32 Wi-Fi controller which give the condition of the soil humidity and how to maintain the level of moisture. The output is in the form of digital form, which indicates the moisture content in the soil is adequate or not.

The experimental plant used is Potato.
Soil Humidity - 80%
Air Humidity - 40%
Temperature - 18 degree Celsius
Threshold value = Temperature + (Humidity*0.1) =18+ (40*0.1) = 22.

The percentage of temperature and humidity indicate the level of the temperature and moisture content inside the greenhouse.
If the level of Temperature for Potato cultivation is higher than the threshold value it indicates that the fan is to be turned on to reduce the temperature inside the greenhouse. If the threshold value is low it indicates the light or heater is to be turned on to increase the levelof temperature. The data will be fed to the cloud by using theESP 32 Wi-Fi microcontroller.

4. Hardware Implement and Result Analysis

The proposed system consists of the sensing part, a controlling part, a monitoring part and a message sending andreceiving part. The sensors included in the monitoring systemare temperature sensor, humidity sensor, soil moisture sensor and motion detection sensor. These sensors will sense the various parameters of the environment and the values and convert the environmental parameters to the digital signal. These sensors are connected to the microcontroller ESP WROOM 32 which is the controlling part. The actuators (Fan, Pump, Bulb or heater, Buzzer) are switched ON based on the instruction passed to the microcontroller. Amonitoring display is employed to show the parameters which is inside the greenhouse. The system works in such a way that when the environmental parameters cross a safety threshold or limits, the sensors detect a change and the microcontroller reads the data's from its input ports and performs the necessaryaction in order to bring the greenhouse parameter back to its required level which is suitable for the crop. The microprocessor will continuously display Environmental conditionsand will send this data over internet and the user by using IoT application will get the greenhouse parameters periodically.
For Example, The essential temperature for a tomato crop:
a) The user shall set the temperature suitable fora tomato at 27°C
b) The user shall set the value of Humidity suitable for a tomato at 60%
c) The user shall fix the Light intensity at 80%

With respect to the temperature, humidity, soil moisture and light intensity, the microcontroller passes the optimum threshold value so that the relay will perform the required action which is to either bring the temperature down by turning on the cooler and turning on the light when thetemperature is not

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suitable for the crop. Similarly, when the set value for humidity gets higher than 60%, the heater gets turned on. Also, with the light intensity fixed at 80%, if the value happens to get higher, the light is turned off which results in a reduction of light intensity in order to avoid low rate of production.

4.1 Overview

In respect to the implementation, the input devices and output devices which are the sensors and the actuators are all connected to the ESP 32 microcontroller in order to monitor and control the greenhouse. In detail, the actuators respond to fluctuations (Increase/Decrease of the set threshold for temperature, humidity, and CO_2 level) of the environment variables in the greenhouse environment.

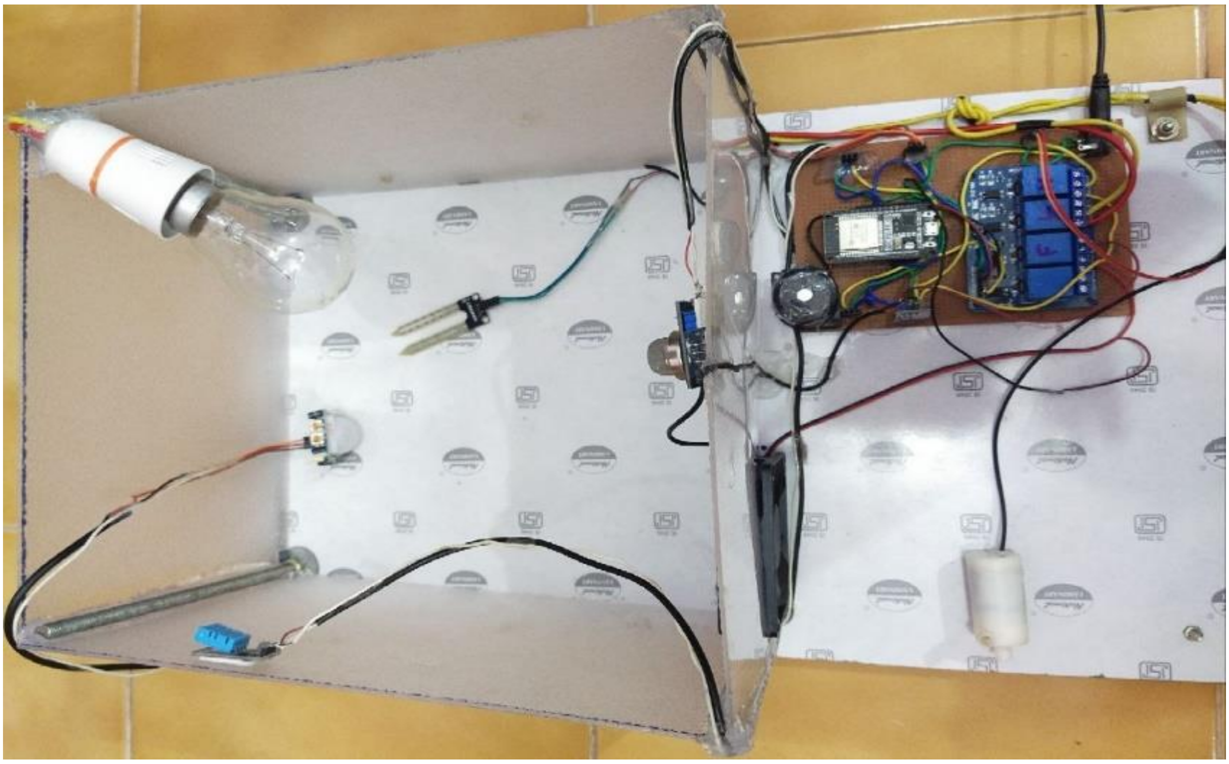

Fig. 2 represents the hardware model of the greenhouse system using IoT. The ESP WROOM 32 is connected to the sensor and the control system. Based on the output of the sensor the control system operates automatically and there is no need for human involvement. The operation of the system can be easily monitored on a laptop screen with the help of the cloud.

Fig. 3 represents the result window which denotes the working conditions of the actuators and the sensors that can be easily controlled by the use of Wi-Fi technology.

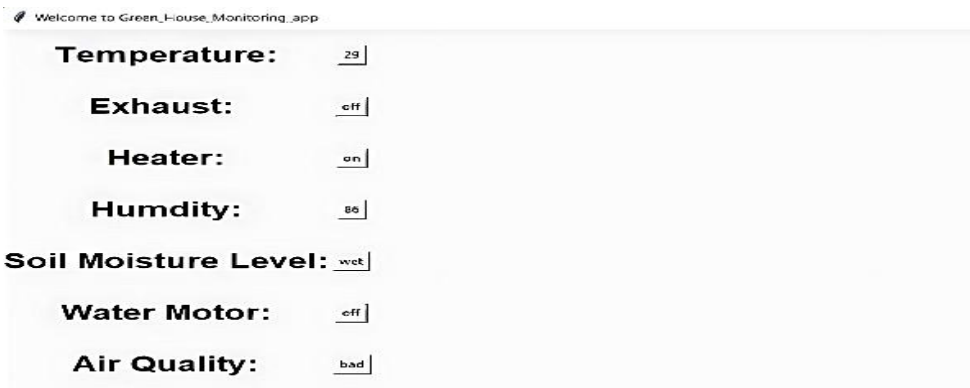

Fig. 3. Result Window

5. FUTURE SCOPE`

The advantage of Smart Greenhouse over conventional farming is that we are able to produce insecticide and pesticide free crops and create a climate for the proper growth of plants. Moreover, the system can be installed by any individual houses (Rooftop greenhouse), who do not have knowledge about farming. It is possible to cultivate any type of crop in the greenhouse because we can control any environmental conditions. The smart greenhouse can be further upgraded and expanded in many ways and can be used in wide agriculturalapplications. Any kind of vegetation can be cultivated under any environmental conditions. Non-conventional energy sources such as solar panels, windmills are used to supply power to the automatic greenhouse equipment. Soil-less farming can be performed hence in further improvement in monitoring of the nutritional value. Integration of farming with IoT can make it a much more efficient and profitable activity. Smart Greenhouse has a bright scope future in the agriculture field and it will create a revolution in the way agriculture is carried out in India.

In future, the Greenhouse Monitoring and Control system can be designed for large scale farming with higher efficiency.

CONCLUSION

Greenhouse Monitoring and Control System is the method through which farmers in rural regions will get profit from the Greenhouse environment. This paper focuses on the Generic architecture, which may be used for a variety of different automation-based applications. Direct human monitoring will be phased out. We proposed the system in response to the constraints of the monitoring and control system.

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