International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

Cultivation Under Artificial Environment To Increase Productivity And Monitoring Required Parameters

Mr. R. Nagaraju[1], D. Poojitha[2], M. Mahitha[3], M. Pandu Ranga[4], B. Kiran kumar Reddy[5]
[1,2,3,4,5]Department of Electronics and Communication Engineering, Annamacharya Institute of Technology and Sciences (Autonomous), Tirupati - 517520.

ABSTRACT
In a recent survey of FAO, the plant growth rate in India is 1.9% but agricultural productivity is 1%. According to this survey, in the upcoming years of 21st century in India the food is inadequate for the continuous growth in population. To overcome this problem, there is a need to keep track of necessary conditions and parameters, which are required for plant growth and increases productivity. Hence, we came up with a solution by using sensors like soil moisture sensor to keep track of the moisture, temperature & humidity sensor to monitor the Humidity and Temperature and LDR to check the presence of light intensity. There are actuators like a cooling fan to reduce the heat, DC pump to maintain the enough soil moisture level and a light bulb to maintain the required light intensity and heat, from that we set up the artificial environmental conditions. Result shows that it is possible to grow a plant as early as possible, when compared to normal growth of a plant in natural environmental conditions. Through the IoT cloud base, the continuous monitoring of changes in environmental parameters like humidity, temperature, soil moisture and light intensity is able to modify them according to the plant requirements and ensure an increase in productivity.
Keywords: IDE board, Greenhouse, Sensors, Actuators, IoT Cloud base, Threshold values, Environmental parameters.

I. INTRODUCTION

The climatic conditions may prevent the growth of certain plants in certain areas. So, there arises a need to import fruits or vegetables at a higher price. The key aim of modern agriculture is to enhance the growth of the plants for a maximum yield. Greenhouse does justice to this by replicating a different climate and constantly growing food in a larger proportion. It maintains the microclimatic parameters in a correct ratio as per the requirement of the plants. It has also reduced the labour for the maintenance thus making the system useful for small-scale agriculturists. This paper proposes the adoption and control of soil moisture, temperature, humidity, light intensity using sensors and actuators. The main purpose of this project is to grow crops anywhere; however, the climatic parameters are. Usage of greenhouse replicates different climatic conditions, allowing the crops to grow that are not meant to be cultivated in that area. Meanwhile, making the greenhouse automated makes it much easier to monitor and control the growth of crops. This proposed system is used for single plant cultivation and can be developed for mass production. Our proposed system is economical, portable and has low maintenance which can be incorporated in rural areas.

II. LITERATURE SURVEY

[1] Previous systems used LCD to display the parameters of the greenhouse but in this project, we made this greenhouse automated as well as to display parameters using the GSM module. We also implement the operations of the greenhouse using the Arduino microcontroller. We have used Arduino UNO R3 for controlling and GSM module for data communication. Solar panel is used as the source of power for our project. Tomatoes have been planted inside this automated greenhouse for experimental purposes. The environmental parameters that we are controlling within our greenhouse are relative humidity, light intensity, temperature, and soil moisture value. The required environmental parameters for this tomato plant is Temperature – 26 C, Light Intensity – 650 lux, Soil Moisture – 65%, Humidity – 65%. Here all the sensors are connected with Arduino and actuators are connected with a 4-channel relay. We have used an exhaust fan to reduce the humidity and fresh air

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

comes through this vent to keep the system under normal conditions. A 40W bulb is used to provide artificial lighting. A motor pump is used for soil irrigation. Under these constant environmental parameters, the rate of plant growth is doubled.

III. SYSTEM DESIGN

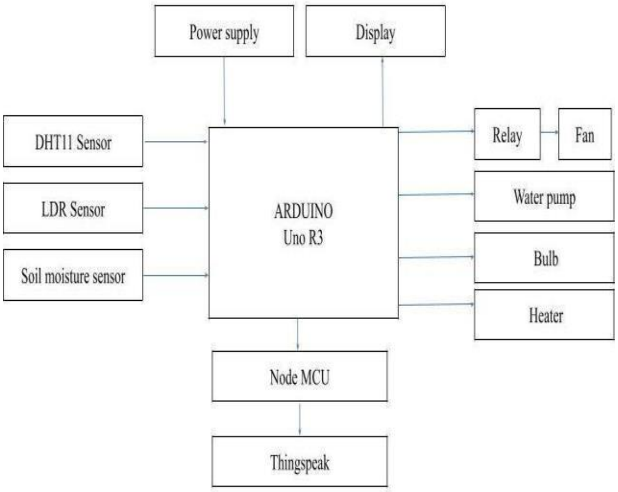

Fig.1: Block diagram of the proposed system

This proposed system consists of sensors, actuators, microcontroller and a relay module which is depicted in fig 1 Inputs from sensors are fed into the A/D converters to amplify their analog signals and are again fed into Arduino UNO. A four-channel relay module acts as the intermediate between actuators and the microcontroller. A threshold value has been set for each parameter based on the plant requirement. This is done with the help of Arduino IDE. The Entire system is divided into four units.

A. **Data Acquisition Unit**

Here three sensors are used to feed the input environmental values to the microcontroller. The microcontroller then compares these values with the threshold values and turns the specific actuators: - Temperature and humidity sensor, Soil moisture sensor and LDR.

B. **Data Processing Unit**

The microcontroller Arduino UNO is used as the data processing unit. This unit gathers the analog values from sensors and compares this value with threshold value and actuates the actuators.

C. Output Unit

The actuators used here are 12v cooling fan, 12v dc motor pump, 40w bulb and Heater. The four-channel relay multiplexes these output actuators into a single unit and turns on the actuators with a PWM signal from the microcontroller.

IV. HARDWARE COMPONENTS

The required hardware components are: NODE MCU ESP8266, 16X2 LCD display, ARDUINO Uno R3, LDR, Soil moisture Sensor, DHT11, DC Fan, DC motor, Bulb, and Relay. The additional components required are rod, cardboard, transformer for charging the battery, PCB and soldering gun.

1. ARDUINO Uno R3

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

Fig 2: Arduino Uno R3

2. 16X2 LCD display

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. It is a specific type of electronic display module that is utilized in a broad range of circuits and gadgets, including mobile phones, calculators, computers, TV sets, and other electronic equipment. It displays the digital format output as shown in figure 3.

Fig 3: 16x2 LCD Display

3. LDR

LDR is an acronym for Light Dependent Resistor. LDRs are tiny light-sensing devices also known as photo resistors. An LDR is a resistor whose resistance changes as the amount of light falling on it changes. The resistance of the LDR decreases with an increase in light intensity, and vice-versa.

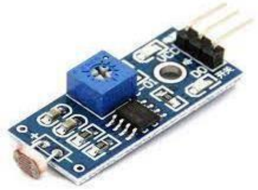

Fig 4: LDR Sensor

4. Soil Moisture Sensor

The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

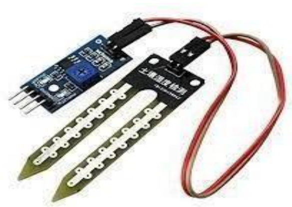

Fig 5: Soil Moisture Sensor

5. DHT11 Sensor

DHT11 is a low-cost digital sensor for sensing temperature and humidity. DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

Fig 6: DHT 11 Sensor

6. DC Cooling Fan

DC cooling fan is an important cooling device for modern industrial machinery, which is widely used in machinery cooling because of its good cooling effect. A DC cooling fan is a combination of rotor, stator, fan blades and other auxiliary components. There are many semiconductor components in the control circuit, which are now incorporated in one or more ICs. Different models of IC control circuits are different, but the main purpose is to provide more effective control and protection for the effective function of the coil and fan-related characteristics required.

Fig 7: DC Cooling Fan

7. Water pump

A DC water pump is an electric pump with low voltage. They are quiet and use little power. They are used for many applications, including automotive, household, and water wells. Various DC water pumps are available in the market, including the DC Fountain Pump VP30, a five-volt mini water pump perfect for a solar fountain.

Fig 8: Water pump

8. Bulbs

Different types of plant bulbs are used to maintain the proper light intensity and heat to the plants. Fluorescent lighting is generally used in a greenhouse only when low natural light is available. High-pressure sodium (HPS) lamps are the most common type of bulb used for HID lighting in greenhouses.

Fig 9: Plant Bulb

9. Relay

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations.

Fig 10: Relay

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

10. **NODE MCU ESP8266**

The open-source Node MCU firmware and development board are designed specifically for Internet of Things (IoT) applications as shown in figure 4.1. It has hardware based on the ESP- 12 module and firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems. It is perfect for IoT projects thanks to its high processing power, built-in Wi-Fi and Bluetooth, and Deep Sleep Operating capabilities.

Fig 11: Node MCU ESP8266

11. Power Supply

A power supply is an electrical device that supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters.

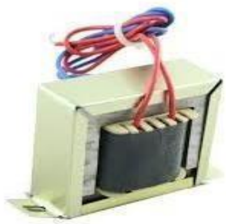

Fig 12: Power Supply

V. RESULTS

The results shown below are mainly based on the three factors: Lighting, Soil moisture level, Temperature and Humidity levels. According to the requirements of the above-mentioned parameters, the sensors and actuators work.

1. **Lighting: -**

When natural sunlight goes down, LDR senses it and automatically sends a low value to the microcontroller indicating that Bulbs (artificial light) must be turned on. This is represented in the following flowchart.

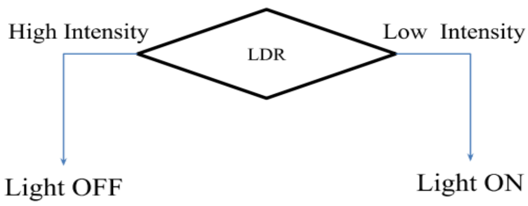

Fig 13: LDR mechanism

Fig 14: Result when there is enough sunlight

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

Fig 15: Result when there is not enough sunlight

2. **Soil Moisture level**: -

When soil moisture reduces below the specified value, then the soil moisture sensor urges the microcontroller to turn on the relay channel that is connected with the motor pump and turn off when it reaches the specified value.

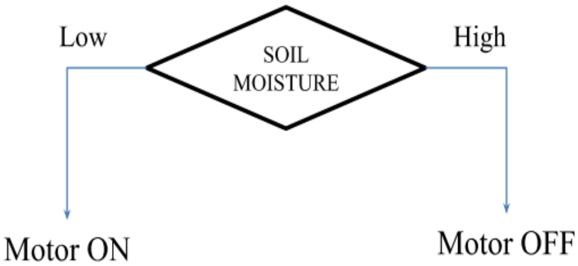

Fig 16: Soil moisture sensor mechanism

Fig 17: Result when there is not enough soil moisture

Fig 18: Result when there is enough soil moisture

3. **Temperature and Humidity**: -

Based on the present temperature and humidity values in the environment, we set the required temperature and humidity value for the specific plant.

A cooling fan and heater is employed in this system to provide the necessary temperature and humidity for the plant.

Fig 19: Normal condition

Fig 20: Temperature and Humidity values in normal condition

Heater works when the temperature is less than the threshold specified value and it is turned off when it reaches the required value.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

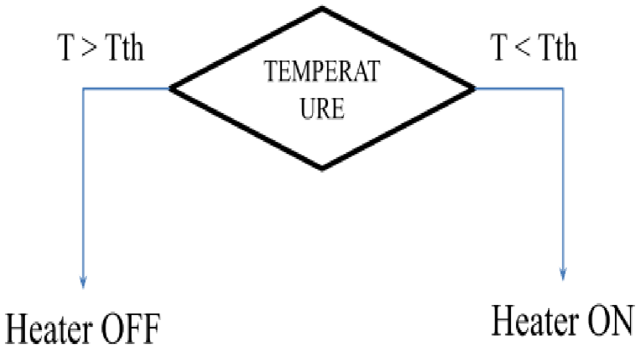

Fig 21: Heater mechanism

Fig 22: Cool condition

Fig 23: Temperature and Humidity values in cool condition

Fan comes into action when temperature exceeds the required value and when there is no sufficient humidity for the Plant.

Fig 24: Fan mechanism

Fig 25: Hot condition

Fig 26: Temperature and Humidity values in Hot condition

The above-mentioned parameters are continuously monitoring through the IoT cloud server with predefined user statements accordingly.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Special Issue: 1 Volume No.7 April – 2023
DOI:10.46647/ijetms.2023.v07si01.010 ISSN: 2581-4621

eld1":"CULTIVATION_UNDER_ARTIFICAL_ENVIRONMENT"}
eld1":"SOIL_DRY"},{"created_at":"2023-02-03T15:4
:30Z","entry_id":78,"field1":"CULTIVATION_UNDER_
eld1":"SOIL_DRY"},{"created_at":"2023-02-03T16:1
:19Z","entry_id":83,"field1":"SOIL_DRY"},{"creat
eld1":"HOT_CONDITIONS"},{"created_at":"2023-02-0
:04Z","entry_id":88,"field1":"HOT_CONDITIONS"},{
eld1":"HOT_CONDITIONS"},{"created_at":"2023-02-0
:50Z","entry_id":93,"field1":"HOT_CONDITIONS"},{
eld1":"SOIL_DRY"},{"created_at":"2023-02-03T16:2
:24Z","entry_id":98,"field1":"HOT_CONDITIONS"},{
ield1":"HOT_CONDITIONS"},{"created_at":"2023-02-
ield1":"HOT_CONDITIONS"},{"created_at":"2023-02-
:52Z","entry_id":105,"field1":"SOIL_DRY"}]}

VI. CONCLUSION

A system that sets up the environment by adopting and controlling the necessary parameters that are required for the specific plant with the help of sensors and actuators. This system is made automatic to provide constant microclimatic parameters in the specified ratio as per the requirements of the plants and monitoring those parameters continuously for checking the stability of the factors like Light intensity, Soil moisture, Temperature and Humidity. By using this system, plants grow in a precise manner that leads to the increases in yield irrespective of the external climatic conditions.

VII. REFERENCES

[1] Cultivation of plants under Artificial Environmental Parameters to Increase Productivity Rate, 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS) - Sri Krishna College of Technology Coimbatore, India.

[2] IoT based smart weather monitoring system for poultry Farm, 2nd International Conference on Advanced Information and Communication Technology (ICAICT), November 2020, Dhaka, Bangladesh, India.

[3] Real-Time Cloud based Weather Monitoring System, 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA), March 2020, Bangalore, India.