Smart Poly House

Abstract

Control and tracking of environmental parameters inside a Polyhouse farm, so as to ensure continuous maintenance of favorable crop atmosphere is the objective of this project. This project designs a very low cost automation poly house which can be used for light control, temperature, humidity and rain protection. The objective is achieved through the use of internet based technology.

This concept involves data acquisition through sensors, data storage, controlling the parameters and online transmission of data to a web server to monitor the parameters. This system contains sensors and IOT devices. Using these technologies, data from various sensors will be analyzed to help in decision making. It additionally specializes in incorporating smart irrigation techniques and technology like drip irrigation and many others inside the conservatory which could help farmers in preventing damage to their plants.

Introduction

Agriculture is the broadest monetary quarter which has main contribution withinside the improvement of India. India is likewise concentrating at the technological aspects. When technology and agriculture are integrated collectively it could yield properly results. Conventional approach of cultivation calls for outstanding quantity of time, human attempt and calls for continuous monitoring. There are numerous issues such as unpredictable climate situations and the plants may be effortlessly suffering from pest and diseases in conventional approach of cultivation. Hence to provide proper climatic condition to the crops a new type of farming called as poly house farming has been developed. A polyhouse is a closed environment where the plants are grown on a controlled platform irrespective of climate and location. Polyhouse gives a dependable and essential manner to generate better revenues. Basically, it is an automation system which alters the physical parameters in favor of the plantation and growth. There is a facility in polyhouse to control temperature, humidity and soil moisture level.

Literature survey

[1] Automation in Polyhouse is latest method in farming. With the help of poly house we are able to create fake as well as comfortable environment for the crop. This method helps to get more crop than the regular methods and it's more organic. Automation in polyhouse avoids the unnecessary errors by the farmer. We are monitoring the temperature, humidity, soil moisture, intensity of light inside polyhouse farm using different sensors. The whole polyhouse is monitored by the mobile application which is connected to internet.

[2] Agriculture plays a great role in the development of agricultural country like India. Issues related to agriculture have been always hindering the development of the country. Each year many crops go waste due to a lack of optimal climatic conditions to support the growth of crops. Losses of around 11 billion dollars are reported in India each year alone. The only way out to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence it aims at making agriculture smart using automation, Machine learning and IoT technologies. Polyhouse is one such method in implementing smart agriculture. Automated polyhouses are very useful in maintaining most of the adverse factors. It includes various types of sensors connected with a database. Smart Agriculture is a solution for monitoring air temperature, soil moisture, humidity, sunlight exposure, water required, etc. It becomes difficult for a human to maintain all these aspects at a time, thus smart agriculture becomes a necessary. Using this technology, data from various sensors will be analyzed to help in decision making.

Problem statement

To improve farming practices via internet of things (IoT) to fully automate the polyhouse in order to reduce the human effort.

Solution proposed

1. Measure temperature and humidity using DHT11 sensor and turn on fans when temperature is greater than 30˚C.
2. Calculate the moisture percentage of the soil using soil moisture sensor and turn on the water pump when the percentage falls below 20% so as to supply water to the plants.
3. Determine the intensity of light using LDR sensor and switch on the lights when the intensity of light decreases.
4. Transmission of sensor data to a web server to monitor the parameters.

Methodology:

Analysis of the Effect of Environmental Conditions in the growth of Crops

The effect of environmental factors such as temperature, humidity, soil moisture and light intensity for the plant growth is studied at the initial stage.

Temperature Effect: The optimum temperature is the temperature at which plant development is most rapid. The optimum temperature can be around 70 degrees F (21°C) for cool-season crops, or as high as 90 degrees F (32°C) for warm-season crops.

Effect of Soil Moisture: The majority of flowers, trees, and shrubs require moisture levels between **21% - 40%**, while all vegetables require soil moisture between 41% and 80%.

Effect of light intensity: Medium light intensity plants prefer 250 to 1,000 foot-candles. Best growth occurs above 750 foot-candles unless plants also receive extended periods of direct sunlight. Give them artificial light in the 500 to 1,000 foot-candle range, or 15 or more watts per square foot of growing area.

Different components and sensors required for the implementation of this project

For the measurement of temperature and humidity DHT11 is used as it is accurate in the measurement of data.

Soil moisture sensor for the calculation of moisture percentage is used.

LDR sensor is used for the measurement of the intensity of the light.

ESP8266 Wi-Fi Module is used to connect objects and let data transfer using the Wi-Fi protocol.

Develop a webpage to monitor real time data from the sensors. Temperature, humidity and soil moisture data are to be sent to the webserver using protocols.

Setting a threshold

Set a threshold value for sensors such that necessary action are taken depending on the environmental parameters. When temperature goes below the threshold, the dc motor is switched on. For low light intensity, the lights are switched on and for low moisture level the water pump is switched on.

Development of webserver

A webpage is created to monitor the sensor data regularly. The webpage needs to display the value of temperature, humidity and soil moisture regularly. HTML, CSS, JavaScript knowledge is required to develop this website. The sensor data is sent to the server using Wi-Fi network.

Block Diagram

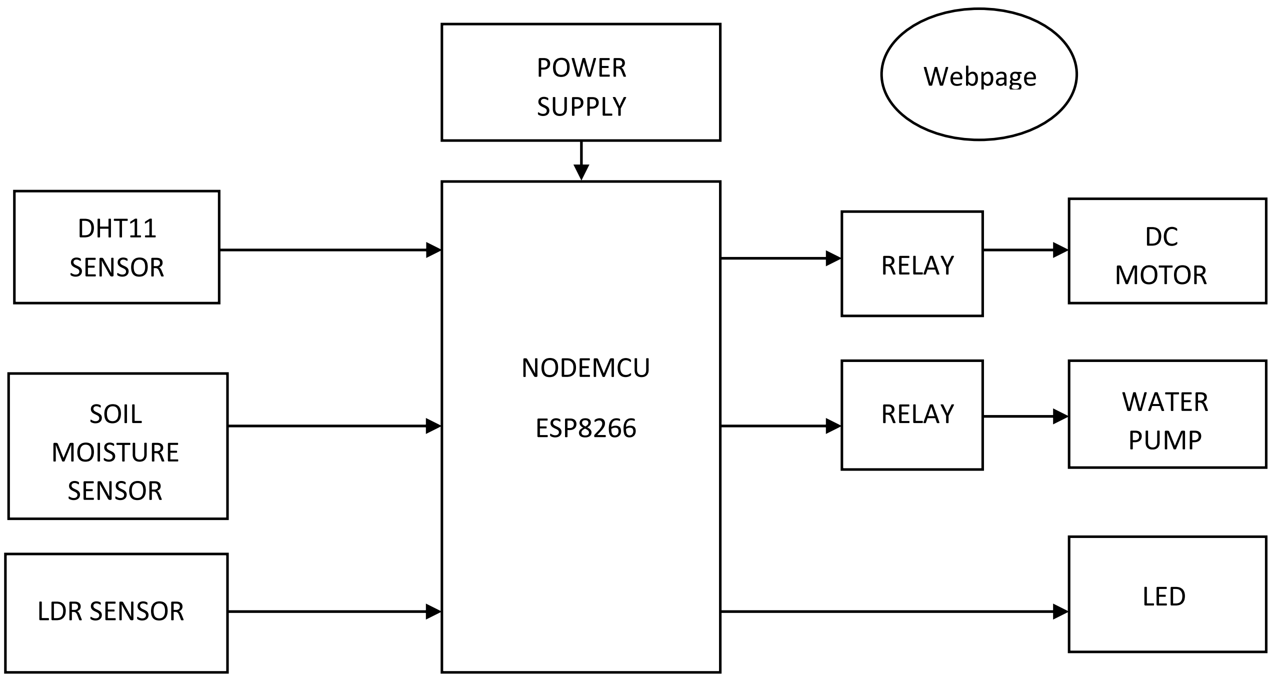

Figure 1. Block diagram for smart poly house

Implementation

NodeMCU is basically the same as other microcontrollers like Arduino Uno or Nano. But it has better speed, flash space, also has in-built Wi-Fi and Bluetooth. There are various models in the market which are very good and have both functionalities.

Components Required:

- NodeMCU (ESP8266MOD)
- Soil-Moisture sensor
- DHT11 sensor
- LDR sensor
- Relay module
- Water Pump
- DC motor
- Led with resistor
- Breadboard

- Jumper wire

There are three sensors and two motor and a led interfaced with the NodeMCU. Arduino IDE software is used to execute the project. In the beginning, some libraries needs to be include which are required for this project. Then pins are assigned to sensors, led and relay. Along with this WIFI SSID & password is also stored.

Soil moisture

Soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. They are cheap and simple devices that do not require a power source and are available for checking whether plants have sufficient moisture to thrive. After inserting a probe into the soil for approximately 60 seconds, a meter indicates if the soil is too dry, moist or wet for plants.

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. And hence when the moisture content falls below the set threshold, a signal is sent from ESP8266 to relay to make it low, which in turn sends a signal to water pump to turn it on. And if the moisture content is above the set threshold level, the relay stays in high state via signal sent by ESP8266 and the pump remains off. Thus, water requirement of the plant can be met without manual work.

Figure 2. Soil moisture sensor

A relay allows you to turn on or turn off a circuit using voltage much higher than what ESP8266 could handle. Relay provides complete isolation between the low-voltage circuit on ESP8266 side and the high-voltage side controlling the load. It gets activated using 5V supply, which in turn, controls electrical appliances like fans, lights and water pump. With this set up, when the plants needs watering can be analyzed by sensing how moist the soil is. The two probes on the sensor act as variable resistors.

DHT11 Sensor – Temperature and humidity sensor

The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor can measure temperature from 0°C to 50° and humidity from

20% to 90% with an accuracy ±1° and ±1%. The operating voltage is 3.5V to 5.5V and the operating current is 0.3mA (measuring) 60uA (standby). For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

Pin configuration:
Vcc: power supply 3.5V to 5.5V
Data: Outputs both temperature and humidity
NC: No channel
Ground: Connected to ground of the circuit

Figure 3. DHT11

The temperature values are measured in degree Celsius and humidity values are measured in percentage. We use readTemperature function for taking the readings of temperature and readHumidity function for taking the values of humidity**.** Here the Vcc is connected to the 3V3 pin, Data is connected to – pin and the grounds are connected. If the temperature is above 25°C a signal is sent from ESP8266 to turn on the DC motor(fan) and if temperature goes below 25°C it is turned OFF.

Light dependent resistor

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance.
These devices depend on the light, when light falls on the LDR then the resistance decreases, and increases in the dark. When a LDR is kept in the dark, its resistance is high and, when the LDR is kept in the light its resistance will decrease.

Pin configuration
LDR sensor basically contains 3 pins for analog input which is GND, VCC, SIG.

Pin Description:
GND: use to provide ground to sensor
VCC: use to provide power to sensor
SIG: use to provide analog output to devices

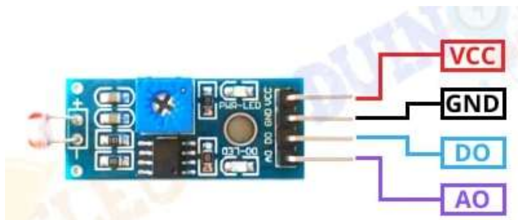

Figure 4. LDR sensor

The analog data pin connected to A0 pin of ESP8266.
When the light intensity is low, the resistance offered will be high. The threshold is set such a way that when the resistance is greater than 800 the LED turns ON. LED is connected to D1 pin, and is made high such that the LED turns ON. When the light intensity is high, the LED turns OFF.

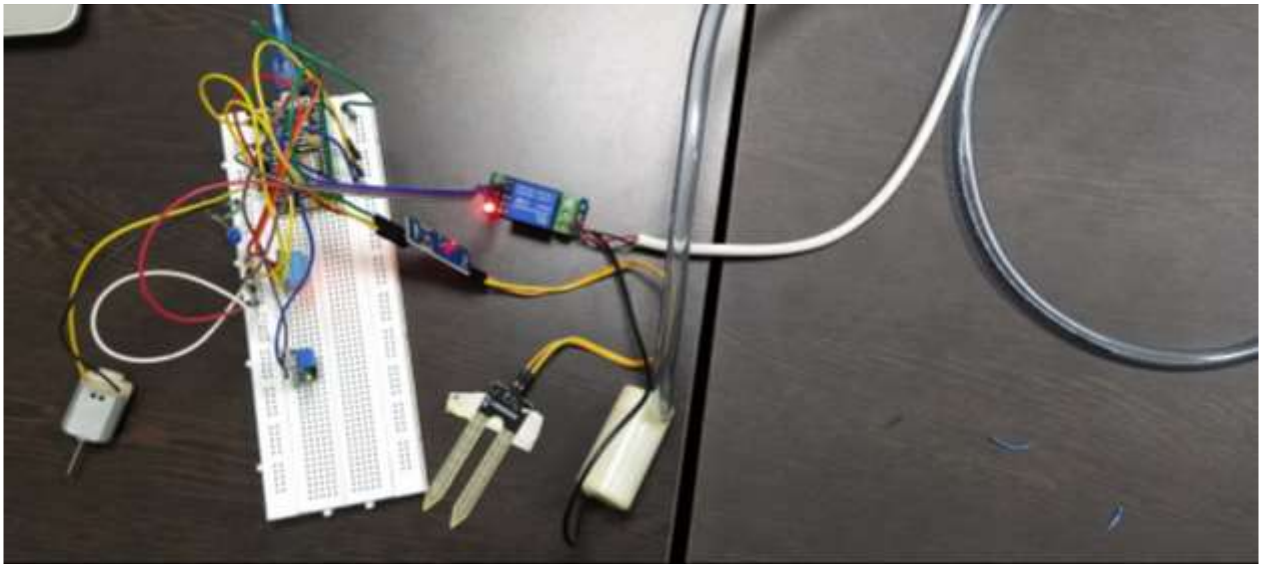

Figure 5. Project Setup

Testing

The setup needs to be arranged. All the sensors- DHT11, LDR sensor and soil moisture sensor are placed in the field of irrigation. The water pump need to be fully submerged in water. The outlet pipe is kept in the field for irrigation. DC motor and led are placed near the plants.

As soon as the power is turned on, the readings can be displayed in the serial monitor of the Arduino IDE. It shows real time data. When the soil moisture content is reduced the water pump turns on and irrigate the field until the required moisture is achieved. When the temperature is increased above the threshold then the fans are switched on and cools down the place. The fan is kept on until the temperature is reduced back to its normal state. When the intensity if the light is decreased, the led is turned on.

These data can be monitored online using a webpage from anywhere. The webpage displays the real time data of humidity, temperature and soil moisture percentage. All sensor data are collected in database and monitored on PC as well as web browser.

Applications

- It is fully automated, consuming less power from the man. Poly house is closed system for irrigation practices to protect plants from extreme weather and harmful diseases, namely: virus, high temperature and ultraviolet radiation
- Fruits that can be grown are Papaya, Strawberry etc.

- Vegetables that can be grown include Cabbage, Bitter Gourd, Capsicum, Radish, Cauliflower, Chili, Coriander, Onion, Spinach, Tomato etc.
- Flowers like Carnation, Gerbera, Marigold, Orchid, and Rose can also be easily grown.
- Crops can be grown throughout the year and will not have to wait for any particular season.

Future scope

Further enhancement can be done in the proposed system by controlling different factors which affect the growth of crops such as CO_2 level inside the polyhouse, pH of the soil. These factors can be monitored by using different sensors. Also, pest control can be fully mated. A sensor can be implemented to keep watch on the number of pests and accordingly release pesticides. That is, if the pests are less in number, pesticide released would be less. And if the number of pests increase in polyhouse, the sensor senses it and releasing of pesticides in larger amount is automated. The same technique can be implemented to sense the nutrient requirements of the roots and control the release of fertilizers as per the requirements. For this, the correct sensing of various nutrients like carbon, hydrogen, nitrogen, oxygen, phosphorus and potassium must be taken care of.

These features would be added benefits to automate the polyhouse. Added to this, the happenings at the polyhouse can be notified to the farmer via GSM module and Bluetooth. So that the farmer gets notification of all activities like temperature rise and soil moisture content drop occurring at the farm right on his phone.

Conclusion

Automation in polyhouse is enormously beneficial for farmers as they don’t have to screen the situations in the polyhouse physically and take the specified steps. Polyhouse is an answer for loss of agricultural lands. We can get more crops from much less area in Polyhouse farming. The system will screen the situations and take the respective steps required to hold the threshold situations in the polyhouse. Polyhouse cultivation provides proper irrigation system and reduces the wastage of water. The main advantage is that the system’s action can be controlled according to different atmospheric conditions for various types of crops. Such integrated approach greatly widens the socio-economic possibilities for farmers through interaction with modern technological resources.

Reference

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