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Design and Layout of Automatic Soil Moisture, Temperature and Humidity Regulation in Polyhouse

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ABSTRACT
This paper proposes an automated irrigation and temperature cum humidity regulation system which monitors and maintains the desire Soil Moisture, Temperature & Humidity content accordingly within a polyhouse. Microcontroller ATMEGA328P on Arduino UNO platform is used to implement the control unit. The setup uses soil moisture sensor and DHT22 temperature and humidity sensor to measure the exact value of moisture, temperature and humidity levels. An LCD display is used to monitor the required levels.

***KEYWORDS:** Soil moisture, Temperature, Humidity, Automation, Sensors, Arduino*

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1. INTRODUCTION

Agriculture is the largest livelihood provider in India. With increasing population, there is a need for raise in agricultural production too. To support greater production over the past 15 years, farmers began using computers and software systems to manage their financial data and keep track of their farm and also survey crops more effectively. In the Internet era, where information plays a key role in people's lives, agriculture is rapidly becoming a very data intensive industry where farmers need to collect and evaluate a huge amount of information from a diverse number of devices (ex, sensors, faming machinery etc.) in order to become more efficient in production and communicating appropriate information.

Financially profitable polyhouses are the ones that are fully automated ones. The producer defines the monitoring limits for the ideal growth environment and then the system automatically adjusts to maintain the said parameters at optimum levels. This paper proposes an automated irrigation and temperature cum humidity regulation system which monitors and maintains the desire Soil Moisture, Temperature & Humidity content accordingly within a polyhouse.

With the advent of open source Arduino boards along with cheap moisture sensors, it is viable to create devices that can monitor the soil moisture content and accordingly irrigating the fields or the landscape as an when needed. The proposed system makes use of microcontroller ATMEGA328P on Arduino uno platform which enable farmers to remotely monitor the status of Polyhouse by knowing the sensor values thereby, making the farmers' work much easier as it saves them a lot of work and time.

1.1. LITERATURE REVIEW

Shubangi Bhosale& S.S. Sonavane (2016)it says about the controlled environment and about the parameters that the crop production depends .This also says about the plant nutrient related parameters and about irrigation through automation. In poly house, condition and growth of the plant is influenced by the relevant conditions. Internal environment can be monitored and controlled by different mechanism. The cultivation of crops in the polyhouse is better manageable compared to conventional farms. The sensor data can utilized through data storage, data transfer to multiple users logged on to browsers.

Srishti Rawal (2017), it says about IOT based smart irrigation system is for to create an IOT based automated irrigation mechanism. Automation of farm activities leads to higher production with lesser human super vision. This journal proposes an automatic and regulated irrigation system which controls and regulates the necessary soil moisture content through automatic mechanisms.

AparajitaDas,et,al.(2018), it says about the design of an operative prototype based on IOT concepts for real time monitoring of various environmental conditions using certain commonly available and low cost sensors. The various environmental conditions such as temperature, humidity, air pollution, sunlight intensity, rain, are continuously monitored, processed, controlled by an Arduino uno micro controller board with the help of several sensors such as soil moisture sensor, humidity sensor. In conclusion this journal represents the design and implementation and testing of a low cost IOT based environment monitoring system and apart from all the system occupies less space and can install anywhere .

Pavithra D. S, M. S .Srinath (2014),it says about making a gsm (global system for mobile communication)based automatic irrigation system In this system the automation irrigation mechanism in a place can be monitored by gsm by the user The system uses sms to send the information about the status of electricity, dry running motor, increased temperature, water content The irrigation system can be controlled by the user according to the crop, rise in temperature and humidity level.

Dae-Heon Park and Jang-Woo Park 2011, in this paper it says that dew condensation on the leaf surface of greenhouse crops can promote diseases caused by fungus and bacteria, affecting the growth of the crops and it present a WSN (Wireless Sensor Network)-based automatic monitoring system to prevent dew condensation in a greenhouse environment. The system is composed of sensor nodes for collecting data, base nodes for processing collected data, relay nodes for driving devices for adjusting the environment inside greenhouse and an environment server for data storage and processing. Using the Barenbrug formula for calculating the dew point on the leaves. It also says how they constructed a physical model resembling the typical greenhouse in order to verify the performance of the system with regard to dew condensation control.

Niamul Hassan, et.al.,2015,this journal shows that a framework that can gather the data identified with greenhouse environment and yield status and control the system automatically in view of the gathered data. Control programming will give information finding of ongoing show. Through long time running and functional utilizing, the framework has been demonstrated that it has numerous points of interest. To monitor the environment inside greenhouse different parameters have been considered such as light, temperature, humidity, soil moisture etc. using different sensors like DHT22 temperature and humidity Sensor, LDR, grove-moisture sensor etc. which will be interfaced with microcontroller. It is a closed loop system that will execute control action to adjust temperature, humidity, light intensity and soil moisture if any unwanted errors (high/low) occur.

P. JavadiKia,et.al., the paper presents a solution for an irrigation controller based on the fuzzy-logic methodology. First, it describes the general problem of irrigation. Then, it discusses the physical control model. The developed Fuzzy Logic Controller (FLC) prototype is based on a Mamedani controller and it is built on MATLAB software. Following the discussion and the formal presentation of the fuzzy controller, the paper provide examples that will show the simplicity in designing and constructing such a system and other advantages of using fuzzy logic in the feedback control problem. The developed fuzzy logic controller can effectively estimate amount of water uptake of plants in distinct depth using the reliable irrigation model, evapotranspiration functions, environmental conditions of greenhouse, soil type, type of plant and another factors affecting the irrigation of greenhouse.

Tanvir Malhotra, et.al., 2014,this journal says about designing a simple and efficient "programmable logic controller" For automation of polyhouse The project features monitoring, recording and controlling the temperature, light intensity and soil moisture inside the polyhouse. It offers the most optimum solution for the growth of genetically engineered plants and micro propagated vegetables varieties and hybrids Depending upon the response received from the sensors, PLC gives respective output to control the fans, bulbs, irrigation system. In conclusion this system can be used to grow plants in extreme weather conditions, since indoor climate can be automatically controlled.

2. EXPERIMENTAL SETUP

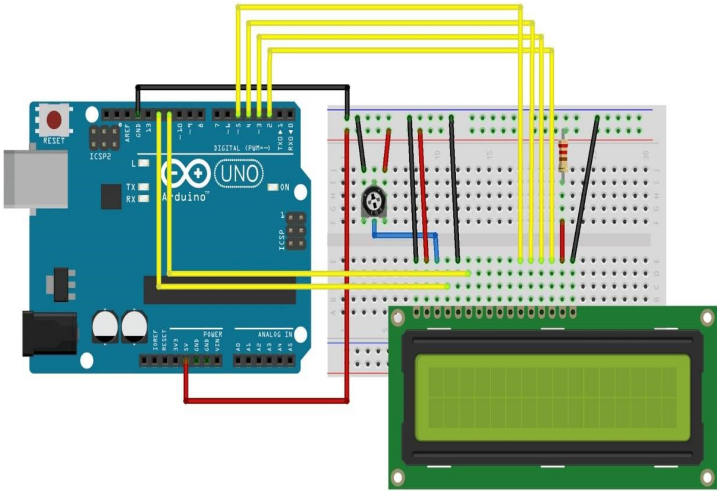
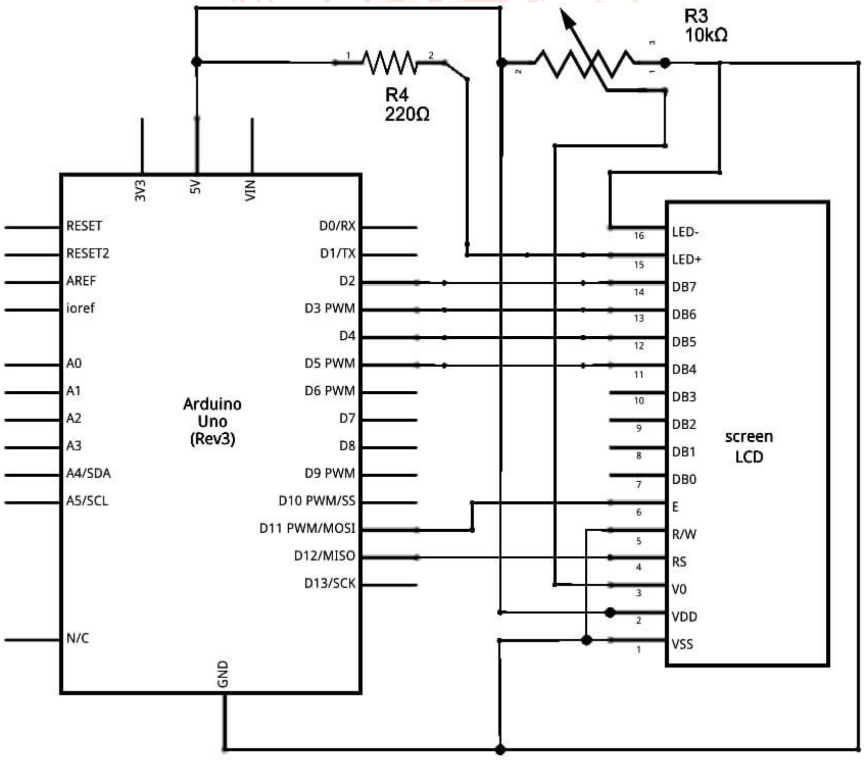


Fig no 1 Micro-controller interfacing

2.1. ARDUINO BOARD

Fig no:2 Arduino board

Arduino is an embedded system with on board micro controller which can be programmed to perform a variety of tasks which in our case is to automate the functioning of our polyhouse. This board can be interfaced with other Arduino board and can control relays, LEDs, servos, and motors as an output.



Line diagram 1

2.2. SOIL MOISTURE SENSOR

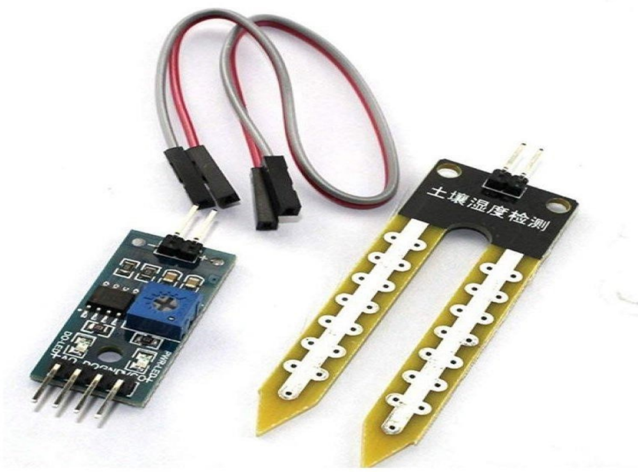


Fig no:3 Soil moisture sensor

There are two moisture sensors placed inside the polyhouse where it will check the level of moisture of the soil that will determine the dryness level of the plants and based on it will act a pump that will automatically water the plants under the polyhouse**.**

2.3. TEMEPERATURE AND HUMIDITY SENSOR

Fig no: 4 Temperature and Humidity sensor

In this project, sensor are placed on the polyhouse, which transmit various values depending on the brightness of the external environment. Subsequently you will average the values and according to it will turn on an internal light to feed the plants or you will act a servo motor that is tasked with opening the upper panel allowing the light of the external environmental radiate the plants inside the polyhouse.

2.4. LCD DISPLAY

Fig no: 5 LCD Display

Liquid Crystal Displays (LCD), are easily interface able, cheap and versatile display devices used in a wide range of devices such as calculators etc, to display output, information and data. In our project it is used to display sensor data which includes the result as well as the working condition of the system.

3. RESULTS AND DISCUSSION

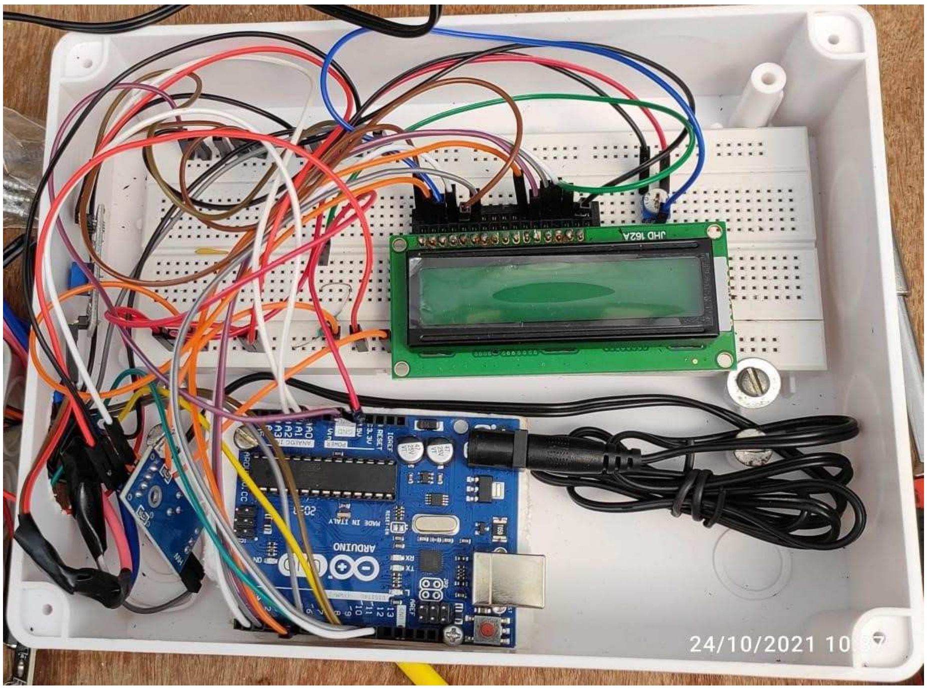


Fig no: 6 on site Set up

Our automation setup seen in the above Fig is designed to automate the various operations that are necessary in order for a healthy growth of crop. This system is designed in such a way that the three most important parameters that needs to be regulated namely Soil Moisture, Temperature, Humidity, are continuously monitored and regulated on its own without the need for external interference nor human intervention.

The Fig depicts the entire framework of the automation setup on site. It consists of the microcontroller along with the LCD Display and the entire set of relays that operate the required set of components namely the Solenoid valves for irrigation, 1.5 HP submersible pump for the fogger system and the two exhausts on the opposite sides of the end of the polyhouse. The Micro controller receives the data from the various sensors which are placed at the appropriate positions inside the polyhouse where required parameters are to be monitored. The board which is programmed verifies the data and transfers commands to the relay systems.

The relay systems act as the switch which operates the electrical components on or off as required under the control of the microcontroller which in turn is governed by the programming given to it by us. Additionally a LCD is used to display the Temperature, soil moisture level and the humidity readings for the awareness of the user. This can also be used to infer the operational condition of the automation setup.

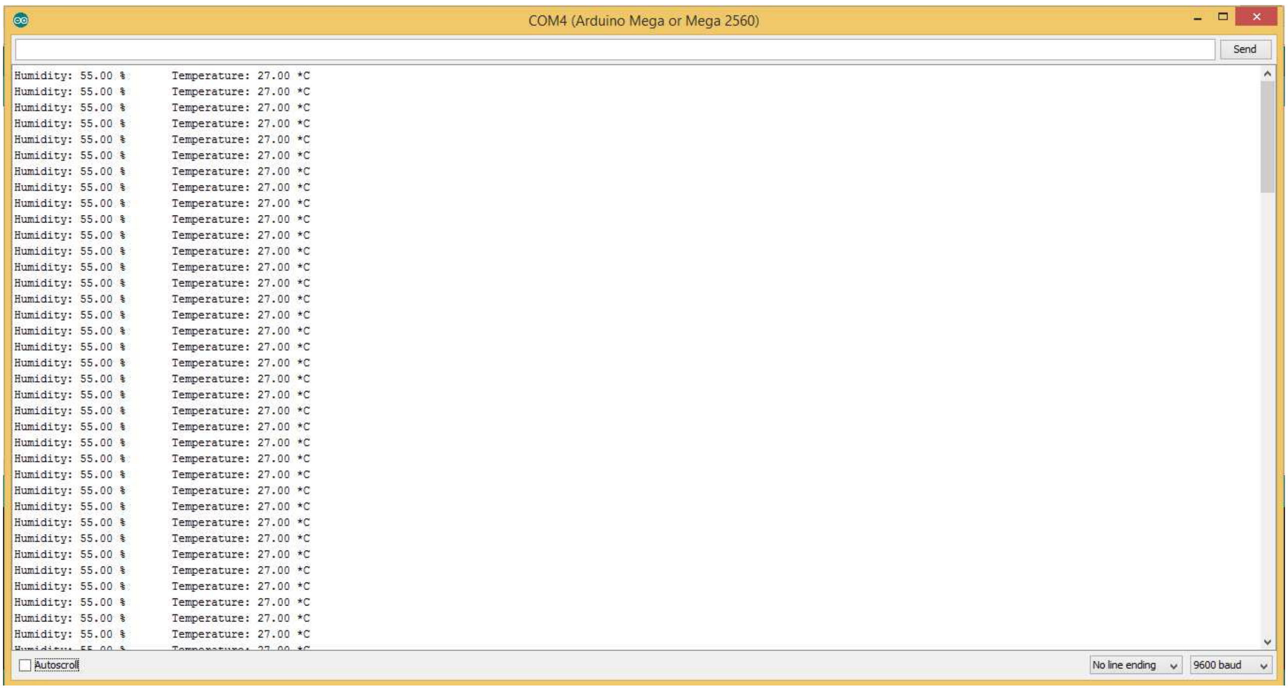


Fig no: 7.1Arduino Output of DHT22 Sensor

This automation system is completely programmable and the microcontroller is completely capable of turning on the fogger for temperature control and the exhaust for humidity regulation on its own provided the user has given the required temperature and humidity levels at which it is to be regulated. The below figures shows the readings of the soil moisture sensor readings in various conditions. These values help us determine the water level of soil and enables us to program accordingly.

Based on the type of crop, the water requirements vary and so does the water requirement and so will the values of soil moisture change. These values help us to irrigate any type of crop with versatile amount of irrigation scope.

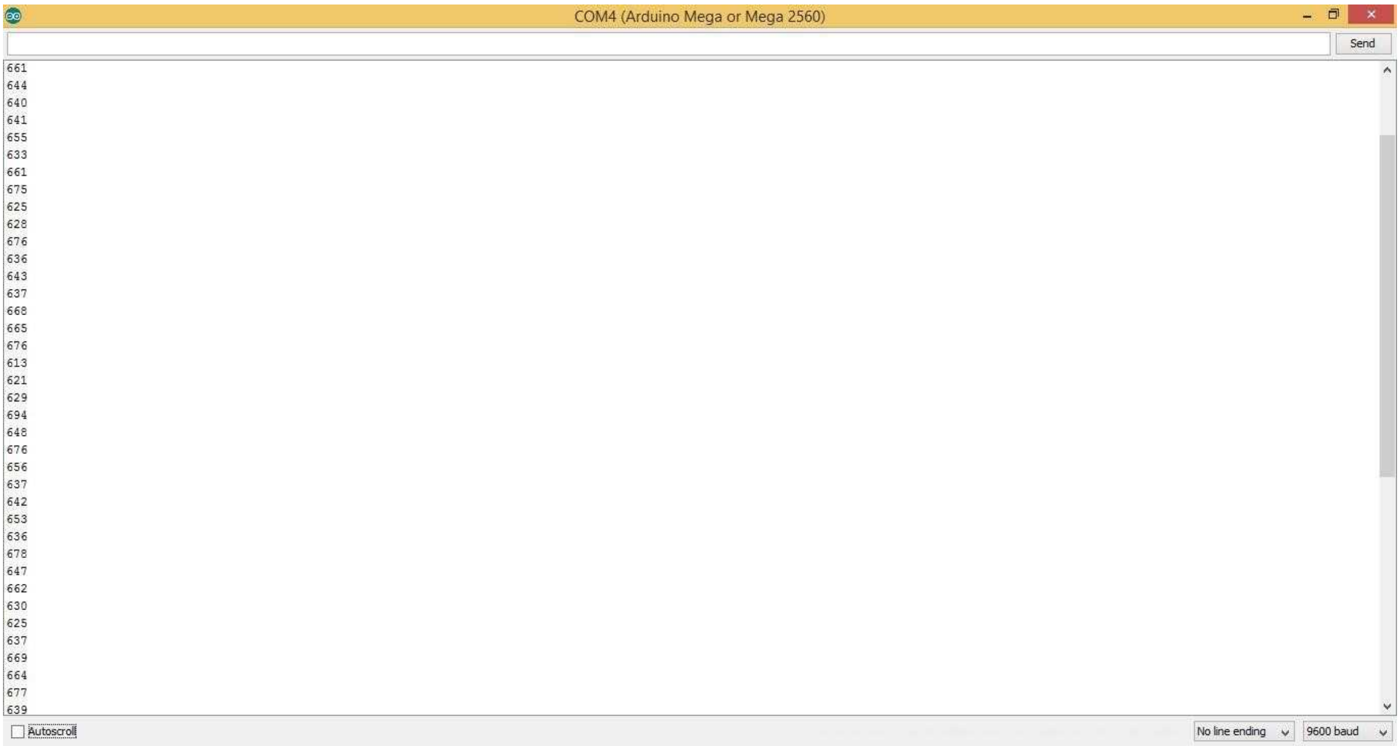


Fig no: 7.2 Arduino output of grove soil moisture sensor

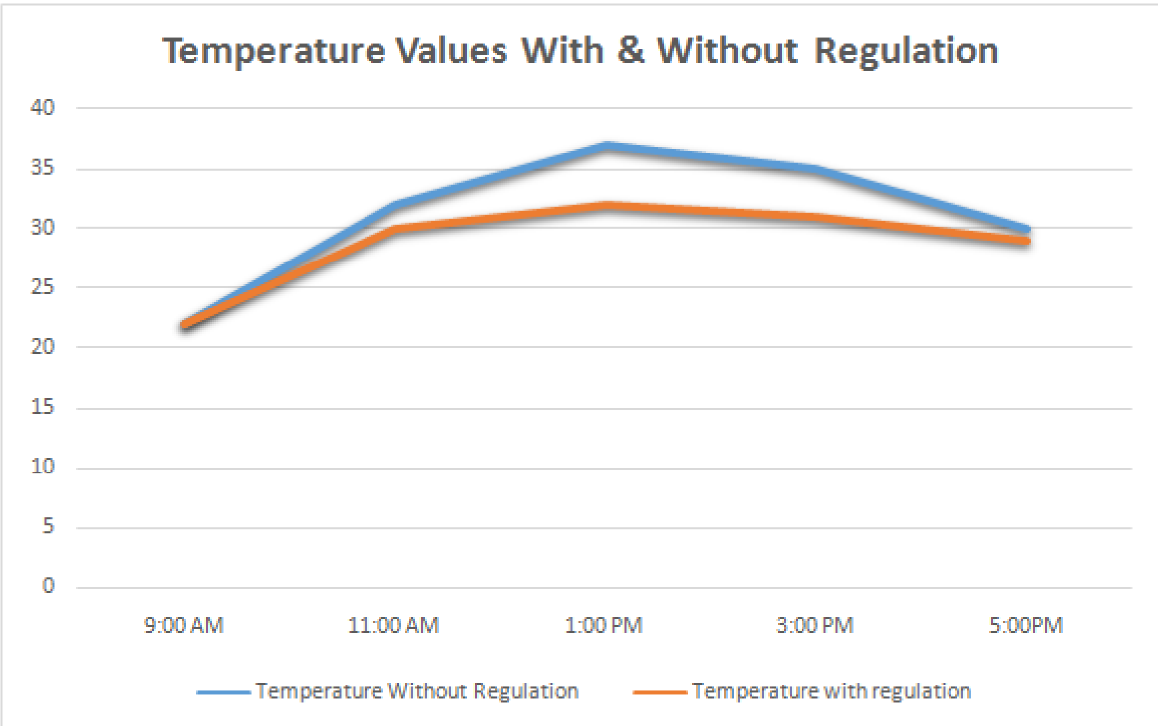


Fig no: 8.1 Graph of Temperature with and without regulation

In Fig 8.1 the graph represents the data of temperature inside a polyhouse with and without Automatic regulation. As can be inferred from the graph, temperature inside the polyhouse varies a lot without regulation, while with regulation it stays within the expected range.

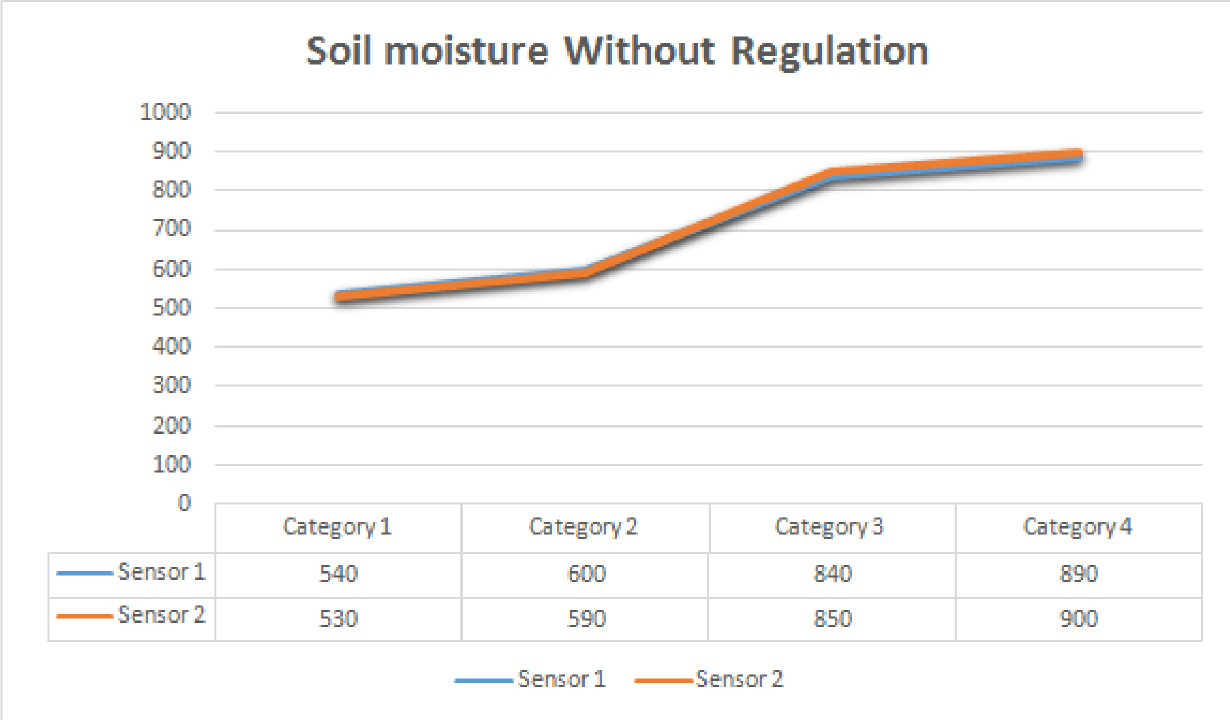


Fig no: 8.2 Graph of soil moisture without regulation

Above is8.2 represents the reading of soil moisture sensor inside the polyhouse without automation. As seen the soil moisture reduces over time with plants experiencing stress due to absence of water after 5:00 PM.

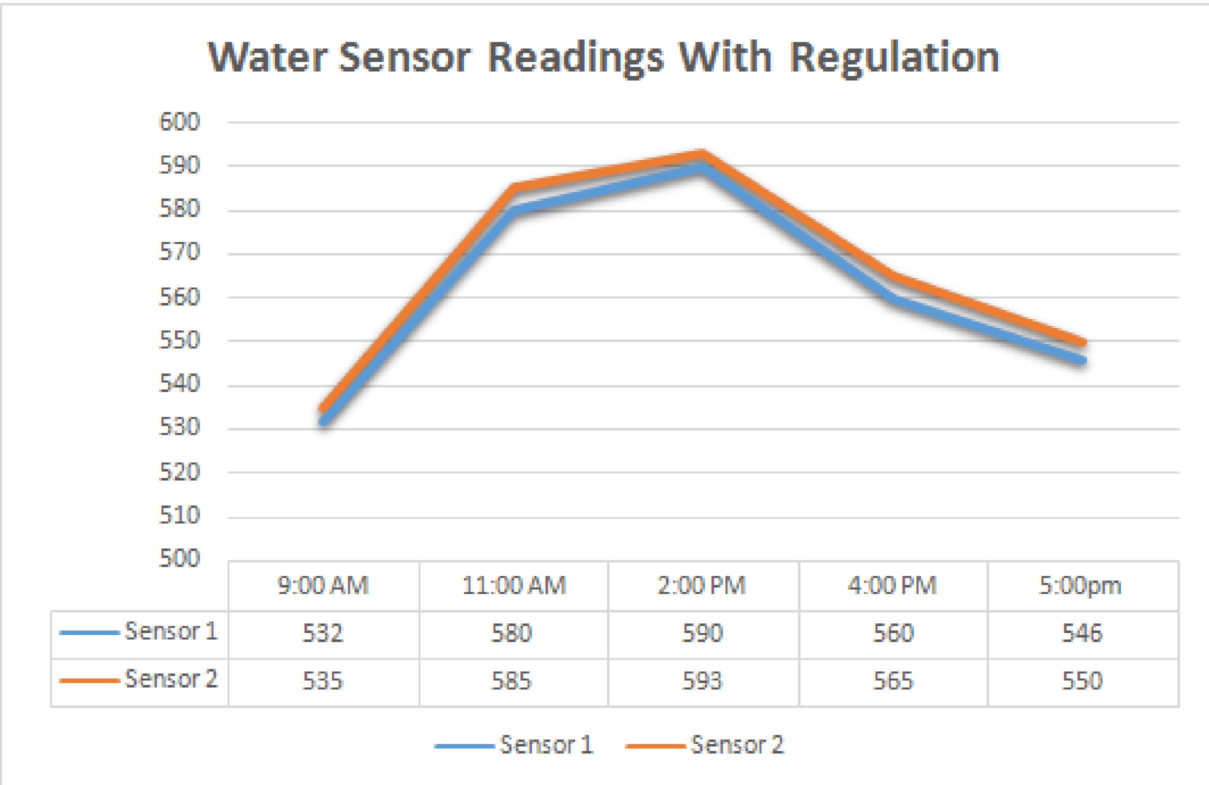


Fig no: 8.3 Graph of water sensor readings without regulation

The below Fig 8.3 Shows the data of Water sensor readings inside the polyhouse when the automation system is online. As seen the readings clearly depict that soil moisture has been maintained within required parameters.

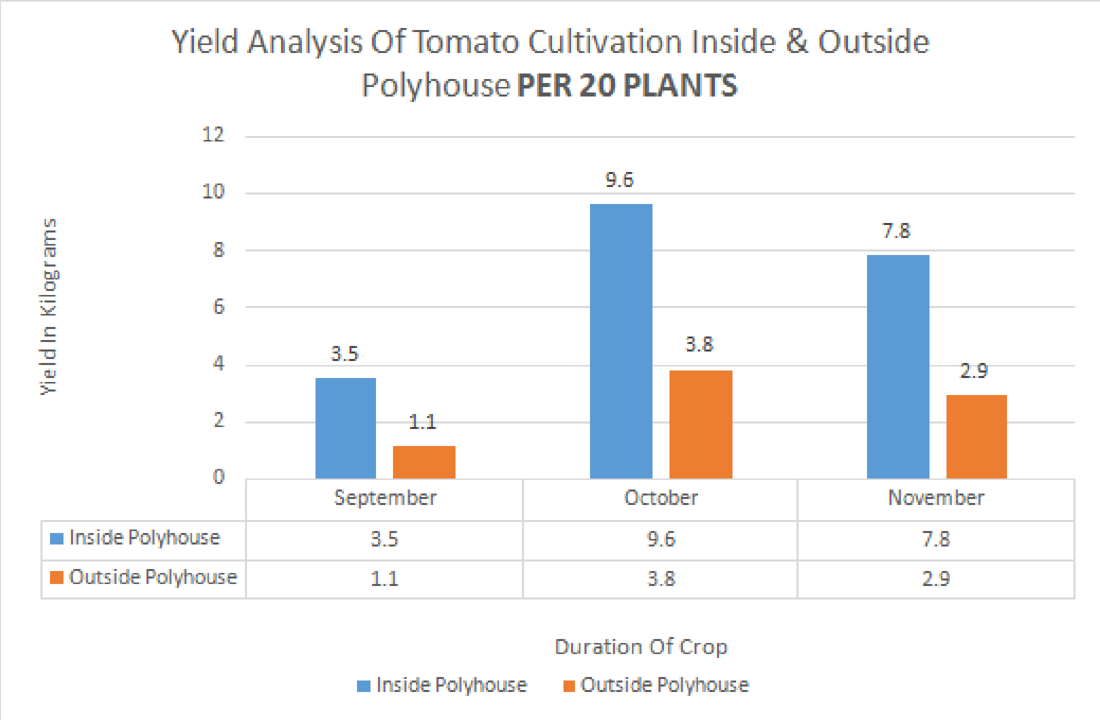


Fig no: 8.4 Graph of Yield analysis of tomato cultivation inside and outside polyhouse

The below Fig 8.4 represents the most crucial data that has been collected so far. It shows the yield difference between crop cultivated inside the polyhouse and the crop cultivated outside the polyhouse. As is clearly visible for the month of September 20 plants inside the polyhouse has yielded 3.5 kgs of tomato while the same no of plants outside the polyhouse has yielded around half of that of a meagre 1.1 kgs of tomato. When looked in the month of October usually the duration or period in which the yield is more in the crop of tomato 20 no of plants inside the polyhouse has produced 9.6 kgs of tomato while those grown outside the polyhouse has produced just 3.8 kgs of tomato. Clearly the yield of tomatoes inside the polyhouse is 2x times of that outside the polyhouse.

In the month of november the yield of tomatoes inside the polyhouse per 20 plants is 7.8 kgs while the plants outside has yielded just 2.9 kgs of tomatoes which is considerably less than inside the polyhouse.

The values obtained through moisture sensors enable the system to switch the drip on and off. The values from the temperature and moisture sensor enable the system to switch the fogger and exhaust on and off.

4. CONCLUSION

A system to observe soil moisture levels in the soil was innovated and this project provided an opportunity to study the existing systems, along with their features and limitations. The proposed system can be used to switch on/off the water drip and fogger according to soil moisture levels thereby automating the process of irrigation which is one of the most time consuming activities in farming. Agriculture is one of the most labor intensive activities. The system uses information from soil moisture sensors to irrigate crop which helps to prevent over irrigation or under irrigation to crop thereby avoiding crop damage. Through this project it can be inferred that there can be huge development in farming and production with the use of automation. Thus, the system is a potential solution to the problems faced in the existing manual and very difficult process of irrigation by enabling efficient use of water resources.

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