



RRSC - Project

Internship Project Report



**TOPIC**

IOT data collection and mapping

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**Introduction:**

In plant production, controlled environment is mainly used in greenhouses. In order to provide an optimal environment for plants, variables such as temperature and humidity inside the greenhouse should be known. In intensive greenhouse production, power cuts or malfunctioning of greenhouse appliances may occur and effects greenhouse climate suddenly. This situation causes rapid spread of plant diseases and frost. It is necessary to prevent these unwanted conditions in terms of intensive processing and production of greenhouses. Nowadays, continuous measurement of many physical parameter is needed in technological greenhouses. Systems are developed to measure and record temperature, humidity, gas sensitivity, light intensity, soil moisture. Initially, mechanical and electro-mechanical devices were used. When these systems were used, instant remote monitoring was not possible and unwanted conditions were learnt lately. With the recent developments in technology, number of the applications which makes remote monitoring and controlling possible are increasing. In this application, a system is developed that is based on the Wireless-Fidelity network (Wi-Fi) that allows the farmer to monitor and control the microclimatic parameters via NodeMCU (A Micro-Controller device with Wi-Fi Capabilities).

**Motivation:**

Most of the agricultural practices today still rely on the human manpower to maintain the facilities without proper control system. Manpower is prone to error. To run the plant efficiently, a control system must be applied that can simultaneously reduce the cost of operation, without having to rely too much on the manpower. It also can improve the production of the plants, hence increase the profit of the organization. Besides, for equatorial climate with hot and humid condition throughout the year, this application will enable the crops to grow in perfect condition and increase the productivity without having to depend on the weather and environment conditions naturally. Several problems with the current practices have been identified and taken care of like global warming: an important issue in the world today. The world has been relying on non-renewable energy and causing the average temperature of the earth rising since. With the application of the technology like the greenhouse, somehow it can help to maintain the balance of the global warming now, either directly or indirectly.

* Traditional open field cultivation engages lot of time and labor, which is very tiring at times and might face labor shortage often.
* productivity is also low, and the farmers must choose the crop depending on the climatic conditions of his/her geographical location owing to limited choice of crops.

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* Since it is open field farming, crops are more likely to get infected by pests and insects for which pesticides are used to protect the crops. Hence the crops are not so healthy.
* Global warming and changing climatic conditions of the world pose great challenges for the growth of plants. Thereby leading to food scarcity.

**Objectives:**

The main incentives of the project are:

* To automatically monitor and control greenhouse conditions required for proper growth of money plant.
* To understand the working principle of typical greenhouse control system and its main parameters like Humidity, Soil moisture, light, temperature.
* To provide an effective solution to the existence problem related to the greenhouse control system technology by applying tools and techniques of problem solving.

**Block Diagram:**

Sensors

NodeMCU

Microcontroller

Oled – 120x 64

Display

Arduino – Uno Board (Atmega 328P)

Air - Quality

Sensor

Soil – Moisture

Sensor

Light-Intensity sensor

DHT-22

Humidity sensor

DHT-22

Temperature sensor

Figure 1: Block Diagram of the project model

The block diagram shown in figure 1 consists of an Arduino UNO, NodeMCU module, an OLED display, various sensors. The sensors include Temperature and humidity sensor (DHT22), LDR sensor, soil moisture sensor and an Air-Quality sensor. The various sensors data is fed into Arduino UNO as input and code is dumped into it. For any deviations of the current data read from the threshold values mentioned in the code, appropriate actions are taken through alerts using NodeMCU.

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**Scope:**

This project involves the evolution of temperature, light, humidity, soil moisture content automatically. The automatic controlling of the parameters in system is used in a greenhouse. Sensor used to control the temperature is temperature sensor. Other than that, this system should also monitor the temperature level. The automatic monitoring system can be implemented in various conditions such as in monitoring temperature, humidity, light and soil moisture levels. However, this project focuses solely in remotely monitoring levels of these parameters in greenhouse. By utilizing existing technology, the natural environment and resource which we get naturally, the temperature is very important criteria for the plants to be monitored efficiently. Previously, human labor played major role in the monitoring farm and plants in the agriculture field. For some crucial plants such as vegetarian and flowers plants, which need 24 hours attention from human so that the plant quantities and qualities are controlled with proper management by the collected data and information from the fields. This will provide enormous foundation for future growth and future development of their plants in the green house. However, with the increasing size in farming areas, this type of manual practice is increases time consuming and cost of the labor. However, with the growth of management in agriculture techniques and with modern telecommunication technologies which provide great assistance with the implementation in the agriculture industry.

**Advantages and Disadvantages:**

* Increased production this project could be seen as an implementation of intensive agriculture and can provide an increase in crop production. This since we will have more control for creating the optimal climate conditions needed for plant growth and are able to grow more plants per square feet compared to growing crops in an open field.
* Minimizing production risks and protection from animals Since it’s an enclosed space, it can help prevent crops suffering damage from climate change related events such as sudden increases or drops in temperature, as well as keeping crops away from birds and other animals.
* Ability to grow year-round produce, even off-season a greenhouse is relatively independent to the world outside, which eliminates the limitation of growing crops only on a specific season. Even in the harsh winter or intense summer temperatures high quality crops can be grown, provided you have the necessary means to create the right climate inside the greenhouse.

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* More stability and security Since the farmer don’t depend on climate conditions, an increase in stability and security, not only for the crops but also for the workers, can be obtained by greenhouse farming.
* Ability to grow exotic plants Since the conditions in greenhouses can be optimized for all kinds of different plants, it is possible to grow all sorts of exotic plants that would never survive when planted outside on the fields. Thus, greenhouses give farmers the opportunity to switch from conventional local plants to more exotic versions if they like to do so.
* Pollination issues However, since greenhouses are closed systems and no insects will be around, the farmers must manually pollinate the plants in order to ensure their crop yields.
* Significant maintenance efforts are necessary in maintaining the optimal conditions of greenhouses. It can be a time-consuming task and may also be quite expensive over time.

**Literature survey:**

In paper [1], the Authors "M. N. Hassan, A. S. Noor and S. I. Abdullah”, explains about the traditional way of farming that involves human intervention, this paper helps us in viewing farming in an automized way. Automation of farming helps to monitor the various parameters that help a plant grow without human intervention. This paper discusses the different climatic conditions like temperature, humidity, soil moisture, light intensity that are necessary for a plant to grow. A greenhouse helps in providing these requirements to a plant to give its best at all climatic conditions. In this paper, they have proposed a framework that can gather the data identified with greenhouse environment and yield status and control the greenhouse consequently given the gathered data to foresee and follow up on circumstances for splendidly controlled climatic conditions. By observing climatic conditions, this exploration has the reason for making the relationship between sensors flags and reference estimations, breaking down the development, advancement of yields, and the natural variables to which they are uncovered. Control programming will give information procurement and control, genuine-time graphical show, dates and time labels the data and stores it for present or later utilize. Also, by consistently observing various natural variables without a moment’s delay, an agriculturist has the capacity to see how development conditions are fluctuating and respond to those progressions with a specific end goal to expand effectiveness.

In paper [2], the Authors "MD Jiabul Hoque, Md. Razu Ahmed and Saif Hannan”, discuss the flaws in the traditional way of farming that does not give much produce and one of the reasons behind it can be climatic conditions that are necessary for any plant to grow. They have

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proposed an automated greenhouse system where the parameters can be controlled within the environment with the help of Arduino UNO and detailed data of the measured values is stored for analysis purposes. GSM technology is used to send messages via SMS to the user(farmer) about the values measured for a better understanding of the growth of the plant. They make use of various sensors like temperature and humidity sensors to monitor the temperature in the plant environment, an LDR sensor to monitor the amount of light a plant gets, a grove soil moisture sensor to calculate the amount of moisture content present in the soil. The moto of this paper is to develop a cost-effective system to monitor plant growth.

In paper [3], the Authors "Temu¸cin G¨okt¨urk SEYHAN, U˘gur YEG¨UL, Musa AYIK”, points out the necessary to provide an optimized environment to plants in the greenhouse. A continuous monitoring device would be help-full in such a case, but due to the power cuts and malfunctioning of the equipment, they are trying to use electronic sensors, record, and control appliances of greenhouse in an algorithm. The various measuring devices used are Thermometer, Hygrometer, PAR sensor, Anemometer, CO2 Sensor. It also discusses the various systems used to store the measured values for future usage. Arduino UNO is used to store and process the data. GSM communication system is used to send messages to the farmer about the calculated parameters. The calculated parameters are then compared with the standard outputs.

In paper [4], the Authors "Jonathan Enokela, Theophilus Oremu Othoigbe”, puts across the information on how the greenhouse works better when automated. An embedded system is used which closely monitors the microclimatic parameters of a greenhouse round the clock and activates actuators when safe thresholds are exceeded in order to restore optimum conditions. Arduino UNO is interfaced along with the Liquid Crystal Display (LCD) which display the measured values. A Wireless Sensor Network (WSN) with smart irrigation capability is also discussed in which the system monitors the microclimatic parameters around each row of crops and activates appropriate pumps for irrigation when the moisture level drops below a safe threshold. The design proposed is observed to work in two stations Sensors/Actuators station and the Remote Monitoring station. The controller is used to read the conditions of the actuators and transmit the same along with the calculated controlled variables via the XBee MODEM. The system proposed in this paper doesn’t require any form of assistance once set up.

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**Hardware used:**

The Hardware requirements are easily available and are compatible to run on most of the systems.

* Arduino UNO
* Temperature and Humidity sensor
* Soil moisture sensor
* LDR
* Air Quality Sensor
* OLED display

With all this we used a windows 11 PC, with Ryzen 5 processor

**Software used:**

Software requirements were basic frameworks and IDE

* Pycharm IDE
* Arduino IDE
* Flask Python Web framework
* Bootstrap
* MySQL

**Description of Hardware used:**

Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz crystal oscillator, 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. The Arduino Uno differs from all preceding boards in that it does not use the FTDI USB to-serial driver chip. Instead, it features the Atmega8U2 microcontroller chip programmed as a USB to-serial converter. “Uno” means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Arduino Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards,

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and the reference model for the Arduino

Technical specifications: -

* Microcontroller: ATmega328
* Operating Voltage: 5V
* Input Voltage (recommended): 7-12V
* Input Voltage (limits): 6-20V
* Digital I/O Pins: 14 (of which 6 provide PWM output)
* Analog Input Pins: 6
* DC Current per I/O Pin: 40 mA
* DC Current for 3.3V Pin: 50 mA
* Flash Memory: 32 KB of which 0.5 KB used by bootloader
* SRAM: 2 KB (ATmega328)
* EEPROM: 1 KB (ATmega328)
* Clock Speed: 16 MHz
* Length: 68.6 mm
* Width: 53.4 mm
* Weight: 25 g

Temperature and Humidity Sensor

DHT22 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any microcontroller such as Arduino, Raspberry Pi etc. to measure humidity and temperature instantaneously. DHT22 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor. DHT22 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form. 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.

Features and Specifications:

* Humidity measurement range: 20 – 90
* Temperature measurement range: 0 - 60℃

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* Working voltage: DC 5V
* PCB size: 2.0 x 2.0 cm
* Humidity measurement accuracy: ±5
* Temperature measurement accuracy: ±2℃

Grove soil moisture sensor

Grove soil moisture sensor used to measure the water content(moisture) of soil. When the soil is having water shortage, the module output is at high level, else the output is at low level. This sensor reminds the user to water their plants and monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening. A resistive soil moisture sensor works by using the relationship between electrical resistance and water content to gauge the moisture levels of the soil. The fork-shaped probe with two exposed conductors that are inserted directly into the soil sample., acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the soil. The soil moisture sensor consists of two probes that measure the volume of water in the soil. An electrical current is sent from one probe to the other, which allows the sensor to measure the resistance of the soil between them. When the water content in the soil is high, it has a higher electrical conductivity (water is a good conductor of electricity). Hence, a lower resistance reading is obtained which indicates high soil moisture. When the water content in the soil is low, it has poorer electrical conductivity. Hence, a higher resistance reading is obtained, which indicates low soil moisture. The dielectric constant can be thought of as the soil’s ability to transmit electricity. Moisture levels are then outputted ether in percentage of water volume or in m3.m-3 (how much of a cubic meter is water as compared to the entire cubic metre of soil sample).

Technical specifications:

* Operating Voltage- 3.3V to 5V
* Operating current- 35mA
* Range of ADC value- 0 to 1023

LDR

A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulfide (CdS) cell i.e., shown in Figure 3.5 is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is

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mostly used in light varying sensor circuit, and light and dark activated switching circuits. Some of its applications include camera light meters, streetlights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.

Gas Sensor MQ2 sensor

It is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected.

Features and Specifications:

* Operating voltage 5V
* Load resistance 20 K
* Heater resistance 33 ± 5percentage
* Heating consumption 800mw
* Sensing Resistance 10 K – 60 K
* Concentration Scope 200 – 10000ppm
* Preheat Time Over 24 hours

OLED display

The organic light-emitting diode (OLED) display i.e., shown in Figure 3.8 doesn’t require backlight, which results in a very nice contrast in dark environments. Additionally, its pixels consume energy only when they are on, so the OLED display consumes less power when compared with other displays. The model we are using is the SSD1306 model: a monocolor, 0.96-inch display with 128×64 pixels as shown in the following figure. It has only four pins and communicates with the Arduino using I2C communication protocol.

PIN and WIRING TO ARDUINO:

* Vin - 5V
* GND – GND
* SCL - A5
* SDA - A4

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**Software implementation:**

We begin with uploading the Arduino uno code into the microcontroller through as USB port from laptop, UNO supports UART Protocol for communication.

The code instructs to dump the output into a python serial reader, from where we read and upload the sensor values into a database, here we are using MySQL database, with table name sensorvalues and column for each sensor.

Then we create a web app using python and Flask framework, it is set to run in a localhost server, the webapp is used to get data in real time from the individual sensors. Along with some basic information such as the optimum values for a particular crop growth. In our example we have taken Money plant as a study plant.

**Conclusion:**

The automated greenhouse monitoring system has been successfully designed and built in this work. This system produces healthier crops since pests are usually kept away from the greenhouse enclosure. The system is fully automated as it does not require any form of adjustment from the user. The microclimatic parameters are also available at a remote terminal for the user to read and to monitor the performance of the greenhouse. The greenhouse parameters present in the environment may affect the crops very badly in some seasons and areas. So, by using this system we can avoid all those conditions. This system is easy to understand and operate. In addition, we can reduce the food scarcity in India with the help of this system. The framework has effectively overcome a very few inadequacies of the existing frameworks by lessening the force utilization, upkeep, and intricacy, in the meantime giving an adaptable and exact manifestation of keeping up nature. Moreover, the consistently diminishing expenses of equipment and programming. The traditional system for greenhouse monitoring is labor-intensive and time consuming. The proposed system saves time, money and human effort. It provides a controlled environment for the plants to prevent them from damage and thus increasing the overall produce.

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**Future scope:**

Although the proposed project is implemented on a small scale, the same can be extended to a large scale by replacing the sensors with a network of sensors. So, the concept of smart greenhouses need not be confined to one or few plants and hence it can supersede conventional agricultural practices as well.

The future scope of this project is enhanced application with the addition of the required features: -

* One such application is to detect the soil parameter and suggesting the proper fertilizer and its feed time. Such Sensors can be incorporated in the design.
* The program can extend for n-controlling greenhouse parameters.
* It can also be designed to detect the disease on the plant and suggest the proper curative measures on it.
* In the same way one can predict the exact weather if system is made to communicate with the nearer weather station through satellite communication.
* The project can be extended by using the webcam at the monitoring side.

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