IoT-BASED SMART CONTROL SYSTEM FOR MONITORING AGRICULTURE

A PROJECT REPORT

Submitted by

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Bachelors of Engineering

IN

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Under the guidance of the Supervisor

Dr. Ruchi Mam (E10374)

BONAFIDE CERTIFICATE

Certified that this project report "**IoT-BASED SMART CONTROL SYSTEM FOR MONITORING AGRICULTURE** " is the bonafide work of Gargi Ghosh and Muskan who carried out the project work under my supervision.

SIGNATURE **SIGNATURE**

GARGI GHOSH

MUSKAN

SUPERVISOR **HEAD OF THE DEPARTMENT**

Submitted for the project viva-voce examination held on ________________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

It gives us the privilege to complete this mid-semester project. This is the only page where we have the opportunity to express my emotions and gratitude. It is a great pleasure in expressing sincere and deep gratitude towards my supervisor and guide ***Dr. Ruchi*** for her valuable suggestions, guidance, and constant support throughout the completion of this project named "***IoT Based Smart Control System For Monitoring Agriculture***". This project, though done by us, wouldn't be possible without the support of varied people, who by their cooperation have helped us in bringing out this project successfully. I am really very thankful to Chandigarh University for providing me with such a great opportunity to make such a wonderful project which can solve real-life problems and for extremely valuable hands-on experience along with crucial soft skills such as working in a team, communication skills, and much more. I also offer my most sincere thanks to every team member of our group who was working rigorously on this project and staff members of the Computer Science Department, University Institute of Engineering, Chandigarh University for their cooperation provided by them in every possible way. We thank all the faculty members and other supporting staff for the help they provided to us for the completion of our project.

Gargi Ghosh

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(Student BE CSE AIML, 2nd Semester)

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ABSTRACT

Farming is a complex yet important process that has been on the course in townlets since mortal civilization. There are numerous aspects that growers need to take into consideration while farming. Cultivating factors involve soil, irrigational installations, temperature, rainfall, water level, etc. To produce successful crop growth, an agronomist needs to be well set and be conscious of the accurate or absolute values for these factors, rainfall conditions, or climate changes because the overall affair of the crop is largely dependent upon these factors. The main goal of this research study is to develop an automated experimental strategy using the Internet of Things to intelligently operate systems for monitoring agriculture.

CHAPTER 1.

INTRODUCTION

1.1 Identification Of Client / Need / Relevant Contemporary Issue

Farming is a complex yet important process that has been on the course in villages since human civilization. There are many aspects that farmers need to take into consideration while farming. Farming factors involve soil, irrigational facilities, temperature, rain, weather, water level, etc.

To produce a successful harvest growth, an agriculturalist needs to be well prepared and be conscious of the accurate or absolute values for these factors, weather conditions, or climate changes because the overall output of the crop is highly dependent upon these factors.

Rainfall and Water availability in India have a huge Regional Imbalance. There is a huge temporal and spatial variation in rainfall and water availability in the country. While the average annual rainfall is 1170mm, some parts of the northeast get around 10000 mm per year, while parts of western Rajasthan get only 100 mm.

As per the Report of the Task Force on Irrigation (2009) constituted by the then Planning Commission, for a gross irrigated area of about 91 mha, the water use is 634 BCM, which gives a delta of 0.68 m per ha of gross irrigated area. The average annual rainfall is 1170 mm (1.17m).

Taking 70 percent of the rainfall as effective for crop consumptive use, the gross water use is about 1.45 m (4.8 feet) per ha of the gross irrigated area. This is very high compared to water use in irrigation systems in developed countries, such as the USA, where water allocation is about 90 cm. This overuse in the country reflects low irrigation efficiency, of about 25 percent to 35 percent in most irrigation systems, with an efficiency of 40 percent to 45 percent in a few exceptional cases.

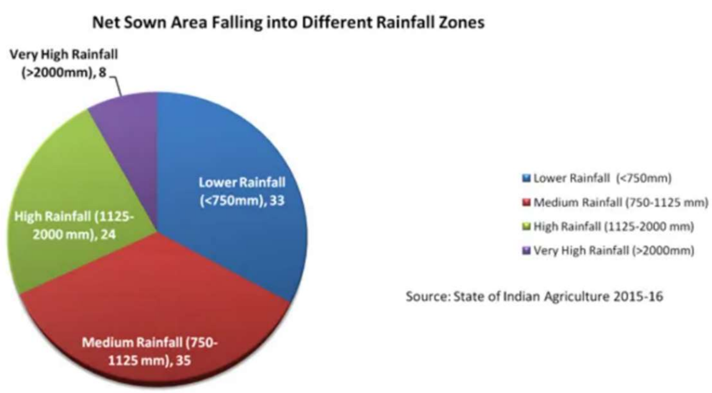


Figure 1. Net Sown Area Falling Into Different Rainfall Zones

An IoT-based smart agricultural monitoring system is being developed to create a model that can predict the weather, soil temperature, moisture, and water level with accuracy as well as include extra features like automated roof shading. Because weather and agriculture interact, accurate weather forecasting is necessary for agriculturalists to make informed decisions that would not lead to losses.

The various agriculture monitoring systems have important ramifications for predicting the weather and tracking agricultural variables including moisture, temperature, and soil level. The farmers would benefit from having a basic grasp of their land and the yields they should cultivate in the proper places. They would even be able to identify the elements influencing crop ripening and receive early alerts about climatic changes. It is affordable to improve water resource preservation tactics and optimize them for agricultural systems with an automated Smart irrigation system that makes use of the Internet of Things. It helps the farmer by intelligently and seamlessly identifying the right stretch of land to receive water by embedding multiple sensors in the soil. As a result, the development of an IoT-based Smart agricultural model may have a positive impact on society, the economy, and the environment.

1.2 Identification Of The Problem

The problem statement of an IoT-based Smart agriculture monitoring system is to devise a model that can accurately harbinger the weather forecast, soil temperature, moisture, and water level, also with additional attributes such as automatic roof shading. This model will be designed to predict every aspect required for a perfect agricultural environment in real-time or for forthcoming periods, facilitating users to recede costs and save time.
As a result of the interaction between weather and agriculture, precise weather forecasting is required for agriculturalists to make knowledgeable determinations that will not result in losses.

The model has significant implications for weather forecasting and monitoring agriculture factors such as water level, soil temperature, and moisture. This would help the farmers to have a brief understanding of their grounds and the yields they should grow at appropriate locations. They even would be able to pinpoint the factors concerning the ripening of crops and would also get preceding warnings about climate differences.

This automated Smart irrigation system using IoT is cost-effective for enhancing the techniques to preserve water resources and for optimizing them for agriculture systems which helps the farmer by working automatically and smartly by placing multiple sensors in the soil, so water can be only provided to be required piece of land.

Therefore, the successful development of an IoT-based Smart agricultural model can have far-reaching benefits for society, the economy, and the environment.

1.3 Timeline

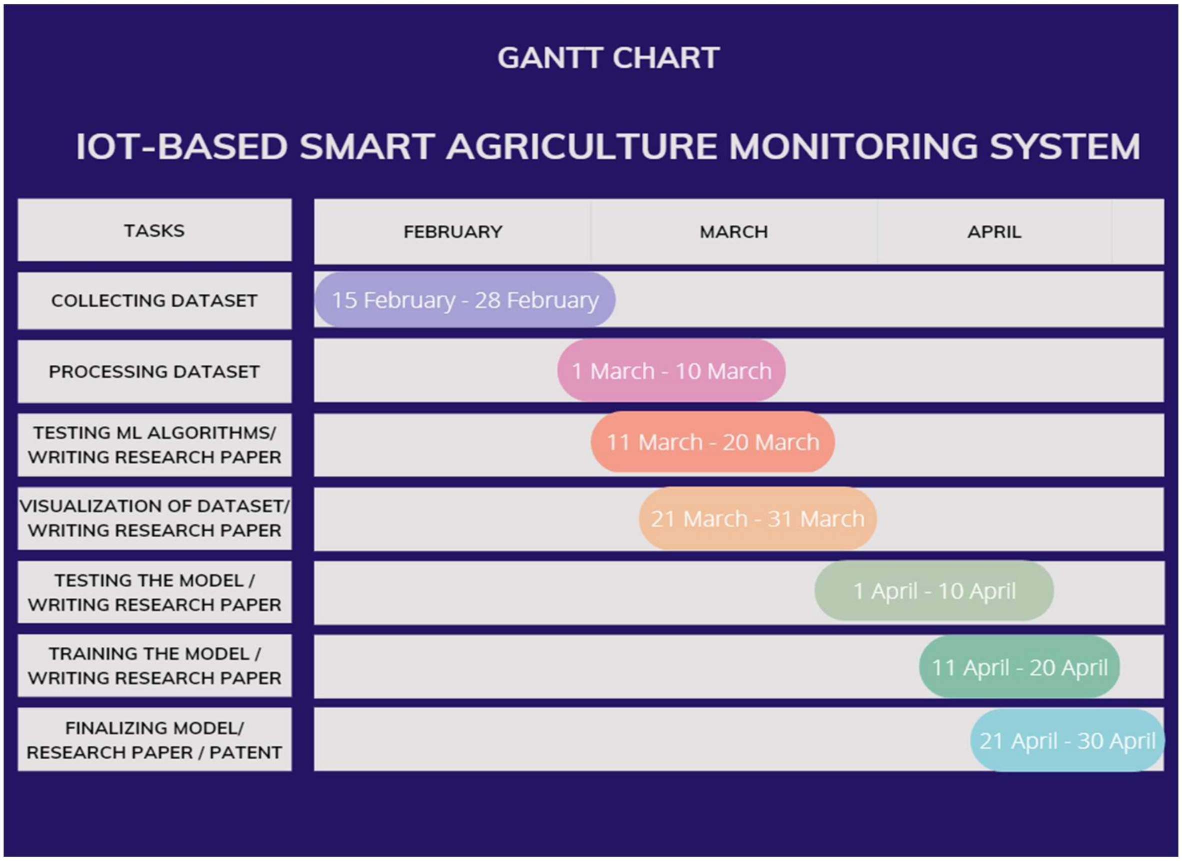


Figure 2. *Gantt Chart Of Project Timeline*

15 February – 28 February: Decide the Topic for the Project, Collect Dataset, Project Scope, Planning, Hardware Devices to be used, and Software/Online Services usage.

1 March – 10 March: Read Research Papers, Do Problem Identification, Process The Dataset, And Literature Review.

11 March – 20 March: Develop A Temporary/ Preliminary Prototype for the Project Based On Hardware Connections and Devices. Process the Dataset and Visualize Of the Dataset. Research Paper Writing Including Patent Filing.

21 March – 31 March: Programming Part, Connecting To the Cloud-Based Application Adafruit and OpenWeather API. Research Paper Writing and Patent Filing during the Process.

1 April – 10 April: Testing the Model and Touch-up By Making It More Interactive. Research Paper Writing and Patent Filing.

11 April – 30 April: Final Touch-up To the Prototype. Completing Research Paper Work and Patent Filing.

1.4 Identification of Task –

Our objective is to provide a system that will benefit the farmers in crop growth. The features of this project will not only reduce the manual labor of the farmers but also will help the agriculturists keep in check the soil requirements and the weather. As weather forecast plays an important role in the growth of crops and the time of applying fertilizers, we have devised this project where the farmer can easily have access to the weather through his mobile application. An automatic roof shedding is also implemented to reduce the damage faced after heavy rainfall. Sometimes crops are required to be kept as dry before selling them to markets and farmers usually are unable to provide a larger area to keep those crops safe from heavy rainfall or adverse weather conditions. That's when the automatic roof shedding is used.

Members	UID	Roles
Gargi Ghosh	22BAI71138	• Idea Generation • Assembly Work and Testing • Presentation PPT • Research Paper • 3D-Modeling • Report Making
Muskan	22BAI71150	• Coding and Testing • Assembly Work • 3D- Modeling • Research Paper

Table 01: Work Plan and Work Distribution

1.5 Organization of the Report

Throughout this report, we present a detailed explanation of how we implemented the IoT Based Smart Control System for Monitoring Agriculture. First and foremost, we came across the work that has already been done by some other researchers throughout the world. We highlighted the approach and figured out the new approach where we can make the robot cost-effective and work efficiently. We used the knowledge acquired from the work of our peers in combination with our own ideas to come forth with this report. The next chapters provide all the information about how we went to implement our project. The whole process and the actual working design of the project are given below. Our results, validation, the conclusion of the project as well as the future scope of this concept have been included as well.

CHAPTER 2.

LITERATURE REVIEW/BACKGROUND STUDY

2.1 REVIEW OF LITERATURE

S.no	Author(s)	Focus/Findings
1.	Abhimanyu Pandit : IoT Based Smart Irrigation System Using Soil Moisture Sensor and ESP8266 NODEMCU; International Journal of Computer Science and Information Technology Research ISSN 2348-120X; ISSN 2348-1196	The purpose of the study in Abhimanyu Pundit's Research Paper is to monitor and control various problems in the soil to sustain agriculture. In this study, the root zone of the plant is covered with a wireless network of soil moisture sensors measuring temperature. To incorporate modern technology into important activities such as agriculture,
2.	Harika Pendyala, Ganesh Kumar Rodda; IoT Based Smart Agriculture Monitoring System; International Journal of Scientific Engineering and Research (IJSER); ISSN (Online): 2347-3878; Impact Factor (2020): 6.733	The case study by Harika Pendyala, and Ganesh Kumar Rodda focused on the use of rain devices to alert rescuers and was set up in an agricultural setting. Rain measuring devices were installed in the project, which are designed to keep important information that rain will not cause job loss, especially in agriculture.
3.	Mr. Mohit Tiwari, Priya Goel; Weather Monitoring System using IoT AND Cloud Computing; International Journal of Advanced Science and Technology; Vol. 29, No. 12s, (2020), pp. 2473-2479	In the paper by Mr. Mohit Tiwari and Priya Goel, a weather-based and IoT-based weather monitoring system is proposed. The weather overlay system is used to find and record the apparent precipitation in various locations for research or precipitation forecasting. The mission is accomplished through the use of technologies such as Pal and the Internet of Things (IoT).
4.	Puja Sharma and Shiva Prakash; Real-Time Weather Monitoring System Using IoT; ITM Web of Conferences 40, 01006 (2021) ICACC-2021; Department of Information Technology and Computer Application	The model outlined by Puja Sharma and Shiva Prakash in their paper – Real-Time Weather Monitoring System Using IoT involves collecting data and making data-based decisions. Farmers can benefit as the environmental information it collects can be used to predict new agricultural jobs.

Table 02: Review of the literature authors

2.2 TIMELINE OF THE REPORTED PROBLEM

Agricultural Problems have been an issue for decades. In 9000 BCE, modern-day Iraq previously known as Mesopotamia was the first one to come up with the idea of breeding plants and animals using natural and innovative methods to make them edible. Over thousands of years, the demand for the agricultural sector has been growing but still, the farmer's face severe problems successful growth of the crops. Both demand and supply side factor plays a crucial role in the adoption and diffusion of improved agricultural technologies and advancements.

Irrigation facilities, proper irrigation tools, the weather being a major problem, etc. There is a list of problems that are still being faced by the farmers and only a few of them are being highlighted through this project. Even though a lot of innovations and technologies have been created to increase the annual yield of crops, there are some major problems that have been ignored adversely.

And using the dynamics of the control environment [9]-[11] many projects and solutions have been developed over time. IoT is used in agricultural science to improve crops, reduce costs and improve quality. The article in [12] examines several strategies that can be used to generate our farmer's income over time, as doubling the income is so difficult.

ATMA (Agricultural Technology Management Technology) located in Andhra Pradesh, India is one of the agricultural sectors that is monitoring the growth of crops all around India. There are several more of these sectors which are keeping the crop growth rate in check.

2.3 EXISTING APPROACHES

There have been many existing approaches made to resolve the problems that arose during the successful growth of crops. IoT (Internet of Things) has been implemented in various ways to solve the problems like introducing a smart agricultural system. In the research paper [2], rain-measuring devices are installed in the project to keep the crops intact and not the loss of crop yield for farmers.

CHAPTER 3.
DESIGN FLOW/PROCESS

3.1 CONCEPT

While our team is primarily focused on the sustainable idea, our work has begun by discussing the idea and its value, which demonstrates a significant impact on society and offers hope for the issue. We have talked about the various issues related to agriculture.

IoT-based Smart agriculture monitoring system is to devise a model that can accurately harbinger the weather forecast, soil temperature, moisture, and water level, also with additional attributes such as automatic roof shading. This model is designed to predict every aspect required for a perfect agricultural environment in real-time or for forthcoming periods, facilitating users to recede costs and save time. As a result of the interaction between weather and agriculture, precise weather forecasting is required for agriculturalists to make knowledgeable determinations that will not result in losses. The model has significant implications for weather forecasting and monitoring agriculture factors such as water level, soil temperature, and moisture.

This would help the farmers to have a brief understanding of their grounds and the yields they should grow at appropriate locations. They even would be able to pinpoint the factors concerning the ripening of crops and would also get preceding warnings about climate differences. This automated Smart irrigation system using the Internet of Things is cost-effective for enhancing water resource preservation strategies and optimizing them for agricultural systems that aid farmers in that water can only be supplied to the necessary area of land by using a system of several embedded sensors that runs automatically and intelligently.

Therefore, the successful development of an IoT-based Smart agricultural model can have far-reaching benefits for society, the economy, and the environment.

A. *Weather Forecasting Using Open Weather API*

The prediction of atmospheric conditions based on location and time is known as weather soothsaying. Growing professionals in farming will be able to reasonably easily determine when and how to move because each position will have its own rainfall protrusions. Because of the relationship between rainfall and farming, it is essential to accurately predict the amount of precipitation in order to provide growers the information they need to make decisions that are unlikely to result in losses. Because rainfall and agriculture are intertwined, accurate rainfall forecasting is necessary for growers to come up with selections that will not result in losses.

B. *Automatic Roof Shading*
When excessive rain falls on the harvested crops, which have been allowed to dry out, they decay and are destroyed, forcing the growers to solve a conundrum. Some crops need to dry before being offered for sale at the agriculture request yard, a space that the majority of growers don't have and takes a long time to do. The planters' resources and time are wasted because they committed approximately three to four months of their labor and an enormous sum of capital in the yield, which is then destroyed by failure. In order to protect growers from extreme loss when they encounter loss, this piece of equipment has been constructed.

C. *Smart Irrigation and Water Conservation System*
Irrigation is the process of applying water to land instinctively to increase agriculture product and farming. Irrigation, as we all know, is the process of providing stores with predetermined intervals of controlled water supply. In dry locations and during periods of below-average precipitation, it aids in the growth of agricultural crops, the maintenance of geography, soil, and connections, and the revegetation of disturbed soils.

D. *Monitoring Agriculture Factors*

The goal of this design is to support producers in obtaining real-time data (temperature, moisture, soil humidity, and soil temperature) for efficient terrain evaluation, allowing them to improve both the yield and quality of the product.

3.2 DESIGN CONSTRAINTS

3.2.1: Economics of the project:

When we started designing the IoT Based Smart Control System for Monitoring Agriculture also focused on reducing the manufacturing cost of the project to normal. Earlier, the devices used for motor research are heavily priced and hard to handle in adverse conditions. Having good generation capacity with best the efficiency helps to get a better return on investment on the project in the long run without compromising the quality.

3.2.2: Environment Impact:

Bioplastic is biodegradable and environmentally friendly. The sensors, motors, and other electronic devices used don’t have any environmental impact negatively. They can be used in building up the proper system without creating any impact on nature.

3.2.3: Health Impact:

Our project doesn't have any sort of pollution output, and does not have any harmful health impact. Humans can easily access it without having any thoughts of getting harmed in the process. Moreover, it can actually make the lives of agriculturists and farmers better if implemented.

3.3 DESIGN FLOW

3.3.1 CIRCUIT DIAGRAM

Below we have shared the CIRCUIT Diagram of the project to depict how the entire system will work.

All the hardware connections are done as shown in Fig. 11 circuit diagram for smart irrigation, monitoring factors and automatic roof shading and all these connections on PCB board are shown in Fig. 12.

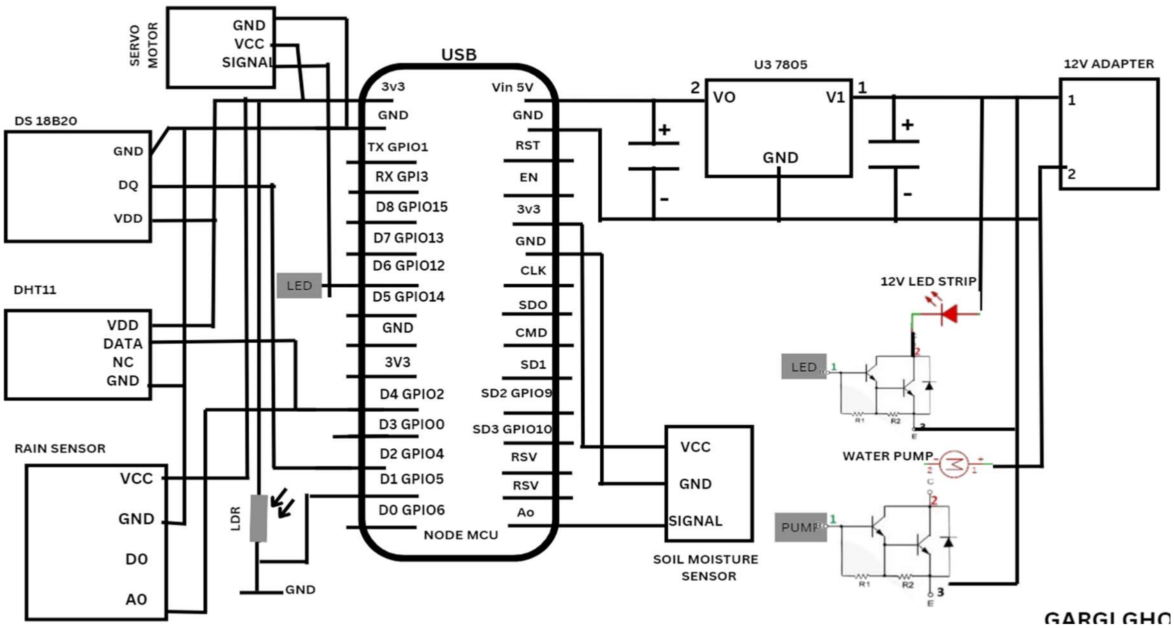


Fig. 3 Circuit diagram for hardware connections

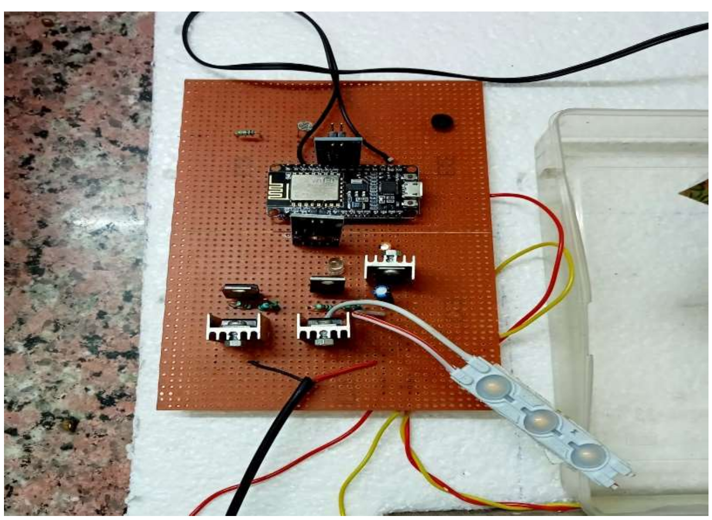


Fig. 4 Hardware connections on PCB

3.3.2 CODING

independent_project.ino

```
#include <ESP8266WiFi.h>
#include <DallasTemperature.h>
#include <OneWire.h>
#include "DHT.h"
#include "Adafruit_MQTT.h"
#include "Adafruit_MQTT_Client.h"
#include <ArduinoJson.h>
#include <Servo.h>
const char *ssid =  "vivo 1929";     // Enter your WiFi Name
const char *pass =  "12345678"; // Enter your WiFi Password
WiFiClient client;
#define MQTT_SERV "io.adafruit.com"
#define MQTT_PORT 1883
#define MQTT_NAME "MuskanSangwan" // Your Adafruit IO Username
#define MQTT_PASS "aio_fVVW7163peKLHU1PkAf6vCbCBsDl" // Adafruit IO AIO key
const char server[] = "api.openweathermap.org";
```

independent_project.ino

```
 Adafruit_MQTT_Subscribe LED = Adafruit_MQTT_Subscribe(&mqtt, MQTT_NAME "/f/LED");
 Adafruit_MQTT_Subscribe Pump = Adafruit_MQTT_Subscribe(&mqtt, MQTT_NAME "/f/Pump");
void setup()
{
  Serial.begin(9600);
  delay(10);
  dht.begin();
  sensors.begin();
  mqtt.subscribe(&LED);
  mqtt.subscribe(&Pump);
  pinMode(sensor_pin,INPUT);
  tap_servo.attach(tap_servo_pin);
  pinMode(motorPin, OUTPUT);
  pinMode(ledPin, OUTPUT);
  pinMode(ldrPin, INPUT);
  digitalWrite(motorPin, LOW); // keep motor off initally
```

independent_project.ino

```
}

void loop()

{

 val = digitalRead(sensor_pin);
  if(val==0)
  {
    tap_servo.write(0);
  }
  if(val==1)
  {
    tap_servo.write(180);
  }

 unsigned long currentTime = millis();

 MQTT_connect();

 if (millis() - lastConnectionTime > postInterval) {

    // note the time that the connection was made:

    lastConnectionTime = millis();

    makehttpRequest();

  }

//}

 int ldrStatus = analogRead(ldrPin);
```

independent_project.ino

```

  if(weatherLater == "few clouds"){

    icon = "Few Clouds";

    Serial.print(icon);

  }

  else if(weatherLater == "rain"){

    icon = "Rain";

    Serial.print(icon);

  }

  else if(weatherLater == "broken clouds"){

    icon = "Broken Clouds";

    Serial.print(icon);

  }

  else {

    icon = "Sunny";

    }

}
```

3.4 IMPLEMENTATION AND METHODOLOGY

A. *Implementation of Weather Forecasting*

First an account is created on the Open Weather API using the gmail account and a password has been created. Then logged in using the same credentials as shown in Fig. 8(a) and after that a free plan for weather data has been selected and a key is created for the project as shown in Fig. 8(b). The data is collected for the required city using the key as shown in Fig. 8(c) and later on it is kept in code using ArduinoJson Assistant as shown in Fig. 8(d) and at last it is linked to adafruit to directly see the weather. In Fig. 8(a,b,c,d), API for weather forecasting is displayed.

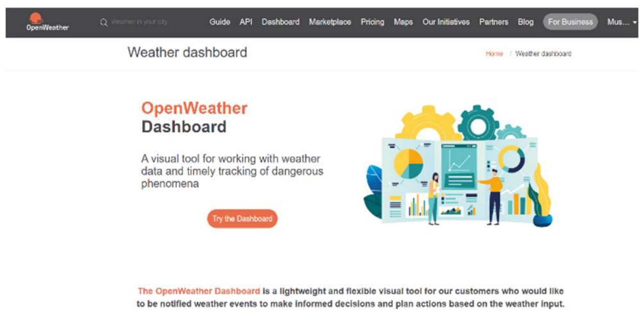
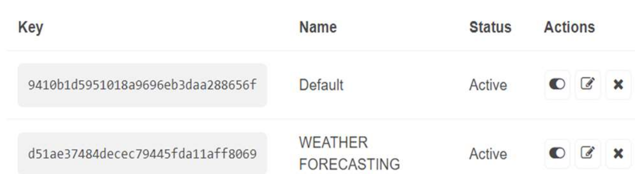


Fig. 5 Open weather API screen



Key	Name	Status	Actions
9410b1d5951018a9696eb3daa288656f	Default	Active	
d51ae37484decec79445fda11aff8069	WEATHER FORECASTING	Active	

Fig. 6 API Key created

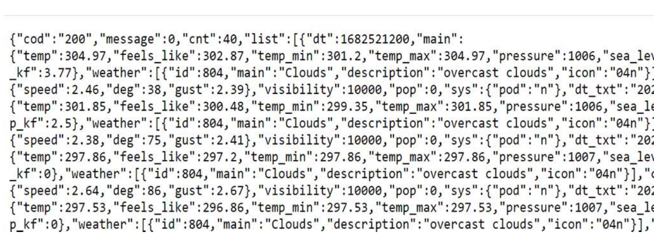

{"cod":"200","message":0,"cnt":40,"list":[{"dt":1682521200,"main":
{"temp":304.97,"feels_like":302.87,"temp_min":301.2,"temp_max":304.97,"pressure":1006,"sea_lev
_kf":3.77},"weather":[{"id":804,"main":"Clouds","description":"overcast clouds","icon":"04n"}
{"speed":2.46,"deg":38,"gust":2.39},"visibility":10000,"pop":0,"sys":{"pod":"n"},"dt_txt":"20
{"temp":301.85,"feels_like":300.48,"temp_min":299.35,"temp_max":301.85,"pressure":1006,"sea_le
p_kf":2.5},"weather":[{"id":804,"main":"Clouds","description":"overcast clouds","icon":"04n"}
{"speed":2.38,"deg":75,"gust":2.41},"visibility":10000,"pop":0,"sys":{"pod":"n"},"dt_txt":"20
{"temp":297.86,"feels_like":297.2,"temp_min":297.86,"temp_max":297.86,"pressure":1007,"sea_lev
_kf":0},"weather":[{"id":804,"main":"Clouds","description":"overcast clouds","icon":"04n"}],"
{"speed":2.64,"deg":86,"gust":2.67},"visibility":10000,"pop":0,"sys":{"pod":"n"},"dt_txt":"20
{"temp":297.53,"feels_like":296.86,"temp_min":297.53,"temp_max":297.53,"pressure":1007,"sea_le
p_kf":0},"weather":[{"id":804,"main":"Clouds","description":"overcast clouds","icon":"04n"}],"

Fig. 7 Collection of weather data of Chandigarh city using created key

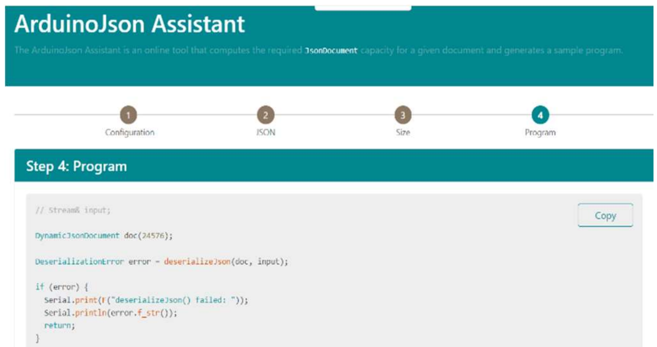


Fig. 8 Use of ArduinoJson Assistant to get the program code to implement the collected weather data

B. *Implementation On Adafruit IO*

In this Online service first an account is created using gmail account and a password is created.Then using the same credentials it is logged in and username and key is checked which is created by the system itself as shown in Fig. 9(a) and account status is as shown in Fig. 9(b). Later a dashboard is created for project as shown in Fig. 9(c) and feeds have been added as per requirement as shown in Fig. 9(d) and then blocks are added for each feed as shown in Fig. 9(e) and then output screen is seen and edited according to creativity as shown in Fig. 9(f). Adafruit's implementation is depicted in Fig. 9(a,b,c,d,e,f) :

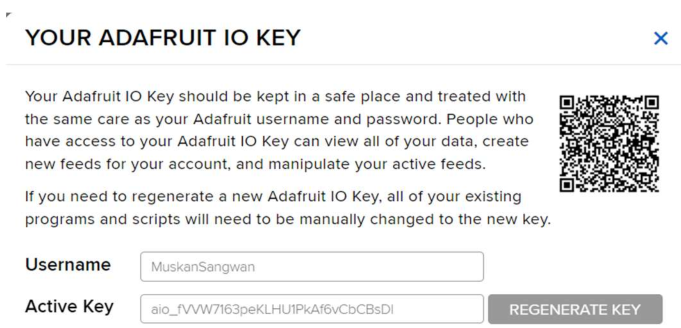


Fig. 9 Key generated

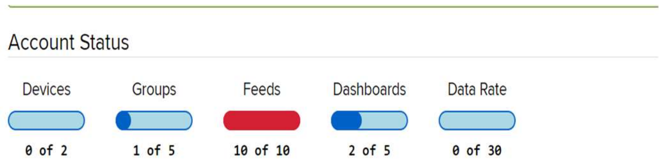
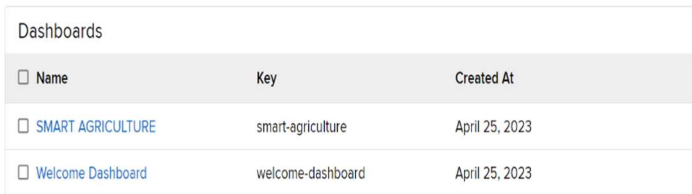


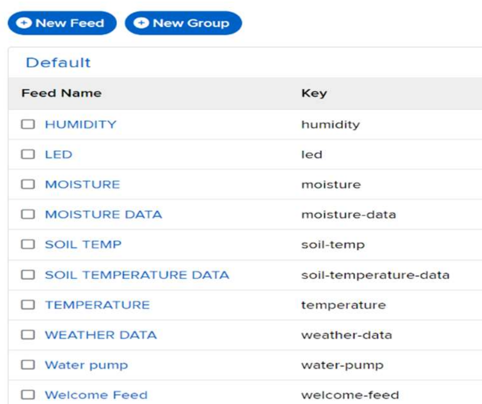
Fig. 10 Account status on service



Dashboards

Name	Key	Created At
SMART AGRICULTURE	smart-agriculture	April 25, 2023
Welcome Dashboard	welcome-dashboard	April 25, 2023

Fig. 11 Creation of dashboard



New Feed New Group

Default

Feed Name	Key
HUMIDITY	humidity
LED	led
MOISTURE	moisture
MOISTURE DATA	moisture-data
SOIL TEMP	soil-temp
SOIL TEMPERATURE DATA	soil-temperature-data
TEMPERATURE	temperature
WEATHER DATA	weather-data
Water pump	water-pump
Welcome Feed	welcome-feed

Fig. 12 Creation of feeds

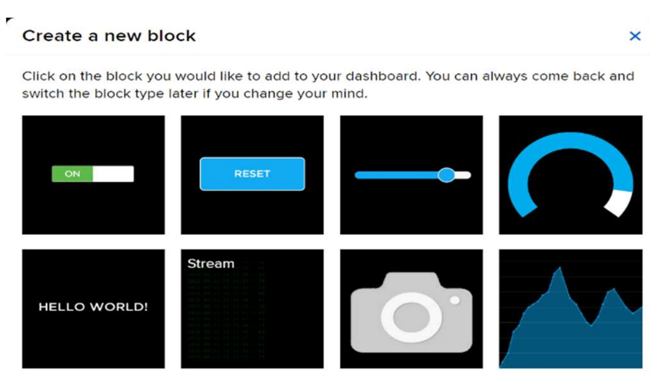


Fig. 13 Creation of blocks

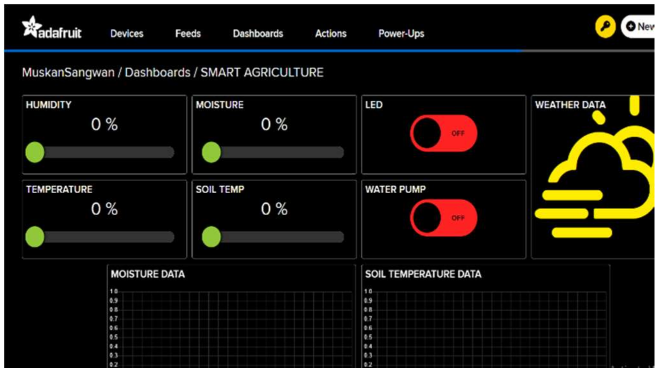


Fig. 14 Output screen on Adafruit IO for monitoring factors and weather

C. *Automatic Roof Shading Using Servo Motor*

Further, an automated roof is created using 180^{0} servo motor which has three connections to rotate the roof. When roof senses the rainfall it rotates motor which is connected to roof means will expand the roof in 180^{0} direction over crops which will save them from destroying as shown in Fig. 10.

Fig. 15 Automatic Roof Using Servo Motor

3.4.1. Hardware Requirements

3.4.1.1 *Soil Sensor*

The soil moisture sensor shown in Fig. 1 is used to measure the amount of water in the soil horizon as well as to keep track of the water content of the soil. Water in the soil cannot be detected instantly by soil moisture sensors. Instead, they keep an eye on a different soil element that is thought to be connected to water concentration.

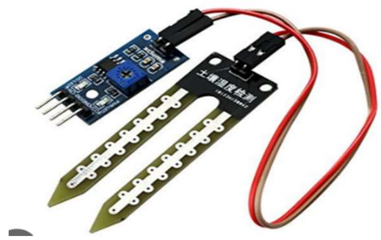


Fig. 16 Soil Sensor used for measuring soil moisture

The Specifications for the component are given below :

Chip	*LM393 comparator chip*
Panel PCB	*3cm * 1.5cm*
Soil Probe	*6 cm*
Cable length	*21cm*
Operating voltage	*3.3v~5v*
4 Wires	*VCC, GND, A0 and D0*

Table 03 : Specifications of Soil Sensor

3.4.1.2 *DHT11 Sensor*

The DHT11 is a simple, incredibly affordable digital temperature as well as humidity sensor, as seen in Fig. 2. It delivers a signal that is digital on the data port without the need for analogue input pins by monitoring the air's humidity using a heating element and a capacitance humidity sensor.

The Specifications for the component are given below :

Brand	Robodo
Item Dimensions	50*50*50 millimeters
Item Weight	10 grams
Voltage	5 volts
Humidity measuring range	20 to 90 percent RH
Temperature measuring range	0 to 50 degree
Humidity measurement accuracy	+- 5 percent RH

Table 04 : Specifications of DHT11 Sensor

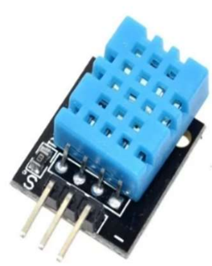


Fig. 17 DHT11 Sensor used for measuring humidity

3.4.1.3 *Rain Sensor*

A rain sensor or rain switch, as depicted in Fig. 3, is a detecting device that is activated by rainfall. The air's moisture is measured using a thermistor and a moisture sensor that is capacitive, and it does so without the usage of analogue input ports by generating a digital signal that is sent on the data pin.

The Specifications for the component are given below :

Brand	*Robodo*
Working Voltage	*3.3v to 5v*
Pcb size	*3.2cm * 1.5cm*
Output format	*Digital switch output(0 and 1)*
Treatment	*Nickel plating*
High Quality for	*4 double material*

Table 05 : Specifications of Rain Sensor

Fig. 18 Rain Sensor used for sensing Rainfall

3.4.1.4 *DS18B20 Waterproof Temperature Sensor*

The DS18B20 digital thermometer, as shown in Fig. 4, provides temperature measurements in the 9-bit to 12-bit Celsius range. It also has an alarm function with upper and lower trigger points which are user programmable and more stable.

The Specifications for the component are given below :

Product type	*Temperature sensor Module*
Tube Material	*Stainless steel*
Tube dimensions	*6mm diameter by 30 mm long*
Length	*100 cm*

Table 06: Specifications of DS18B20 Waterproof temperature Sensor

Fig. 19 Temperature Sensor used for measuring temperature

(e) 3.4.1.5 Rotation Servo Motor

The servo motor, such as the 180-degree servo in Fig. 5, may rotate to a certain angle in response to the signal. This capability allows for the direction and positioning of this kind to be controlled in several remote-controlled vehicles, robotics, and other sectors.

The Specifications for the component are given below :

Brand	*Robotbanao*
Voltage	*4.8 volts*
Item dimensions	*15*10*5.5 centimeters*
Material	*Nylon*
Item Weight	*150 grams*
Operating Temperature	*30 to 60 degree Celsius*
Wires	*Red:Positive* *Brown:Negative* *Orange:Signal*

Table 07 : Specifications of 180-degree Rotation Servo Motor

Fig. 20 Rotating servo motor used for rotating roof

3.4.2 Software Requirements

3.4.2.1 Open Weather API

The OpenWeather Ltd.-owned webservice Utilizing its API, Open Weather Map provides access to weather data from all around the world, including predictions, now casts, and historical data for each location. The company provides a minute-by-minute hyper local precipitation forecast for any location.

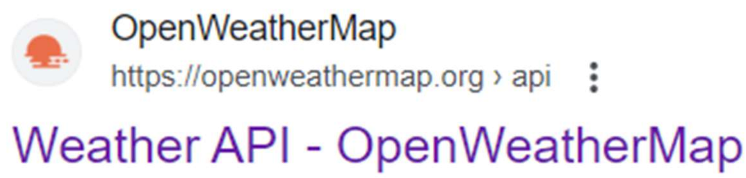


Fig. 21 Open Weather API

3.4.2.2 Adafruit IO

With Adafruit IO, devices can be linked using unique WipperSnapper firmware without writing a single line of code. Just add credentials, load the WipperSnapper firmware onto your board, and connect it to power. The board will immediately sign up for an account with Adafruit IO.

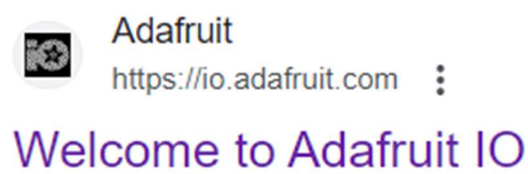


Fig. 22 Adafruit IO

3.5 COST OF PROJECT

3.5.1 COST OF COMPONENTS :

COMPONENTS	QUANTITY	COST (Rs.)
DHT11 TEMPERATURE AND HUMIDITY SENSOR FOR ARDUINO	1	249 x 1 = 249

180 DEGREE ROTATION SERVO MOTOR MICRO/MINI SG90	1	327 x 1 = 327
100 V 5A DIP POWER TRANSISTOR	2	89 x 2 = 178
WATERPROOF DIGITAL TEMPERATURE SENSOR PROBE	1	199 x 1 = 199
NODEMCU ESP8266 CP2102	1	451 x 1 = 451
LED STRIP WATERPROOF 12V	1	299 x 1 = 299
7805 VOLTAGE REGULATOR IC	1	277 x 1 = 277
TOTAL COST		1980

Table 08 : Approximate Cost of Project

CHAPTER 4.
RESULT ANALYSIS AND VALIDATION

4.1 NOVEL METHOD :

1. Weather Forecasting Using OpenWeather API
2. Automatic Roof Shedding Using ESP2866
3. Irrigation System And Water Conservation
4. Monitoring Agricultural Factors

4.2 ADVANTAGES OF THE INVENTION:

This invention helps in:
1. Getting live weather data
2. Have automatic roof shading to save crops
3. Smart irrigation system which helps to conserve water
4. Getting absolute values for various agriculture-affecting factors

4.3 RESULTS AND DISCUSSIONS:

The effective layout of an IoT-based smart control system reduces the time and resources required when monitoring agriculture manually. This system makes use of a technology called the Internet of Things. This device measures soil pressure, temperature, and humidity in addition to automating roof shading. Additionally, it regulates the irrigation system and makes weather forecasts. Under ideal conditions, this approach works well, but when those criteria fail to meet requirements, as when there is not enough lighting or lightning, additional improvement may be accomplished.

Overall, our team's efforts have resulted in a successful and groundbreaking project that has the potential to change the way we monitor and understand different agricultural and weather conditions. By creating an innovative and sustainable solution, we have taken a major step forward in safeguarding our planet's precious resources.

4.4 PROJECT MANAGEMENT :

Our project IoT Based on Smart Control System For Monitoring Agriculture will eradicate the problems faced by a farmer during the successful growth of the crops. Those problems include irrigation, appropriate weather, crops for drying, and monitoring soil temperature, moisture, water level, etc. Therefore, to help farmers go through this problem and come up with a solution, our project is created. We first, made a circuit diagram of all the connections which needed to be made and then ordered the required electronics. Tested and configured those items before soldering them onto the PCB. All the members of the group have participated in the creation of this prototype.

CHAPTER 5.
CONCLUSION AND FUTURE SCOPE OF WORK

5.1 FUTURE SCOPE

- Smart farming has a real potential to deliver a more productive and sustainable form of agricultural production, based on a more precise and resource-efficient approach. Smart farming refers to managing farms using modern information and communication technologies to increase the quantity and quality of products while optimizing the human labor required.

- This automated smart irrigation system using IoT is found to be cost-effective for enhancing the techniques to preserve water resources and to optimize them for agriculture system helps the farmer by working automatically and smartly by placing multiple sensors in the soil, water can be only provided to be required piece of land. This system requires less maintenance so it is easily affordable for all farmers. This system helps to reduce water consumption with this system crop production increases to a greater extent.

- Weather forecasting helps farming to know when the correct time is to apply fertilizer along with the applicating rate and type of fertilizer. The bad timing of fertilizer and its application may spoil the crop's growth. The field must be dry enough for the fertilizer to not wash away, but moist enough for the fertilizer to penetrate the soil.

- Automatic roof shading is also used to protect small crops which require only some amount of water for their growth and cultivation at a particular time. This device is simple but very useful for farmers to save the money which they have invested and their time.

S.no	Name of the prior art	Key features of prior art	Key features of our invention
1.	Weather data	No live weather data	Helps in getting live weather data
2.	Automatic roof shading	No Automatic roof shading	Have automatic roof shading to save crops
3.	Irrigation System	No Smart irrigation and wastage of water	Smart irrigation system which helps to conserve water

4.	Agricultural Factors	No Agricultural Factors are measured	Getting absolute values for various agriculture affecting factors

Table 09: Key features of Invention

5.2 CONCLUSION

The proposed system is intended to offer a new element to the agricultural backdrop for farming in order to help farmers produce better-quality and higher-yielding crops. The data used to construct the proposed system makes it clear that there are number of steps that must be performed to create a completely IoT-based smart control system for monitoring agriculture that was successfully created and deployed. This approach will reduce the farmers' demand for labour as well as save them money and time. Although this policy would have an impact on the economy, it would ultimately be a significant step in the direction of a more sustainable and healthy national economy.

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