RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

ULTRASONIC BASED CROP PREDICTION USING RASPBERRY PI

G Vijaya Bhai[1],S Gurudas Singh[2]
[1,2]Assistant Professor
Department Of CSE,ECE
Sree Chaitanya College of Engineering, Karimnagar

ABSTRACT

In India, the majority of people rely mostly on agriculture as their source of income and subsistence. While some nations have already embraced precision agriculture, more IoT and cloud computing technologies are still required for improved crop productivity. The current climate varies in many parts of India because to a variety of natural and human-caused factors, including proximity to the equator, wind direction, and the distance to the sea. Human-caused elements include air pollution, deforestation, and sewage. A farmer has to forecast which crop should be planted when based on climate variations. The crop details that must meet the standards, including maximum and minimum temperatures, maximum and minimum rainfall, soil type, and location, are stored in the dataset. Using a DHT11 temperature sensor and a soil moisture sensor attached to a Raspberry Pi, data on the current temperature and rainfall range may be gathered. The location, temperature, and range of precipitation of the gathered data are saved in AWS IoT. Message Queue Telemetry Transport, or MQTT, is one messaging protocol that makes it simple to establish connections with distant places. It takes a message broker to implement the publish-subscribe pattern. Depending on the subject of a message, the broker is in charge of sending it to prospective clients. In order to anticipate the crop that should be grown in a given place in accordance with climatic variations, decision trees are a flexible machine learning technique that can handle both classification and regression problems. By comparing the data with the training data, Amazon QuickSight facilitates data visualization.

I. INTRODUCTION

1.1 INTRODUCTION

Plants play a crucial role in the survival of human life in such a way that they provide oxygen when we need it. Meanwhile, Agriculture is also a beneficiary factor for living beings because it forms the basis for food security. To get a better crop, the most important things that should be there in the land that has accurate fertilizer, better irrigation facilities and best methods for cultivation. An adequate amount of fertilizer can help plants to produce better yield and quantity to meet the needs of world economy that is increasing the raise in need of food and its production. Over 58% of the rural population depends on agriculture for their livelihood and its export constitutes 10% of the country's exports.so, the farmers and even the nation's economy will be reduced if there are no proper yields due to lack of knowledge of the soil nature and unavailability of water. Therefore, the Indian government must take precautions for better and profitable agriculture.

This project is a smart farming system based on IoT (Internet of Things) which has brought changes to every field of common man's life by making everything smart and intelligent. This project aims to innovate a smart IOT based agriculture guides the farmers by the updated data like Temperature, Moisture, Humidity, pH value and Nutrient detection of soil which will enable them to do smart farming and increases the overall productivity of crops. Thus, it makes the farmers yield good profits and produce crops.

1.2 OBJECTIVES

- To measure the soil moisture
- To check the water level in the tank.
- Through Data Mining suggest the user which configuration is better, based on the classification of the soil and plant.
- To reduce the labour work and make a cost-efficient system.
- To work accordingly to the soil condition.
- To conserve energy and water resources.

II. LITERATURE SURVEY

Most of the farmers and land managers have the soil analyzed for finding Nutrients, Temperature and other parameters of the soil. Throughout the 1990s, people used to test and analyze the soil physically to measure the soil parameters. It is very difficult and time taking process and also not accurate. At present, IOT technology helps to monitor and analyze the basic parameter of the soil based on the sensing. Soil consists of weathered rock fragments, organic matters, and Minerals.

It provides a “Home” for countless microorganisms and plant roots. Its depth varies from few inches to several feet. Soil provides water, Nutrients, suitable minerals and physical support for the plants. Roots located in the soil are primary resources for getting nutrients from the dead cells, tissues and minerals present in the soil. Carbon dioxide (CO2) and water (H2O) are the basic sources for the life of plant. This project evaluated the variations of wired sensor networks and their potential for the advancement of various agricultural application improvements.

It features the main agricultural and cultivating applications and examines the appropriateness of wired sensor networks towards improved performance and profitability. Through sensor networks, agriculture can ome easier, can be attached to the Internet of things, which enables us to make connections among agronomists, farmers, and crops instead of the geographical differences. With the help of this methodology which gives real-time data through message about the lands and crops that will enable farmers to make the right decisions. The significant advantage is an implementation of Wired Sensor Network will reduce the usage of Water fertilizers maximizing the yield of the crops and further will help in experimenting with the weather conditions of the field.

It fluctuates Control of the entire deployed framework in a single system. Which will make it simple to deal with and better understanding the results by users. Just as it keeps the farmer updated by the notifications for almost every related event that happens in the field. It mainly focuses on the sensors. Our system using Raspberry pi and various sensors to monitor the different stages of plant cropping like moisture, Temperature, Humidity, pH value and Nutrients of the soil. In this, we are using the Raspberry pi model. It helps the processing, transmission, and reception of data between sensors and the Microcontroller . The main purpose of this project is to lower the cash and farming fee and also save electricity, protecting the soil from harmful chemicals and fertilizers, reducing the wastage of water and increasing the productivity of crop.

2.1 CROP PREDICTION

In recent years the advancement of Machine Learning plays a crucial role in every field including agriculture, here the crop prediction process done with consolidating the preceding data and the present data of the various sensors connected with IoT. The proposed system is described in following stages such as dataset collection, preprocessing step, feature selection and applying machine learning modules. It is shown in the figure.

DATASET COLLECTION

Data is collected from a variety of sources and prepared for data sets. And this data is used for descriptive analysis. Data is available from several online abstract sources like data.gov.in. We will use an annual summary of crops for at least 10 years. The data sets used in this paper are soil dataset, rainfall dataset, temperature, humidity, and crop data.

1	temperatu	humidity	ph	rainfall	label
2	20.87974	82.00274	6.502985	202.9355	rice
3	21.77046	80.31964	7.038096	226.6555	rice
4	23.00446	82.32076	7.840207	263.9642	rice
5	26.4911	80.15836	6.980401	242.864	rice
6	20.13017	81.60487	7.628473	262.7173	rice
7	23.05805	83.37012	7.073454	251.055	rice
8	22.70884	82.63941	5.700806	271.3249	rice
9	20.27774	82.89409	5.718627	241.9742	rice
10	24.51588	83.53522	6.685346	230.4462	rice
11	23.22397	83.03323	6.336254	221.2092	rice
12	26.52724	81.41754	5.386168	264.6149	rice
13	23.97898	81.45062	7.502834	250.0832	rice
14	26.8008	80.88685	5.108682	284.4365	rice
15	24.01498	82.05687	6.984354	185.2773	rice
16	25.66585	80.66385	6.94802	209.587	rice
17	24.28209	80.30026	7.042299	231.0863	rice
18	21.58712	82.78837	6.249051	276.6552	rice
19	23.79392	80.41818	6.97086	206.2612	rice
20	21.86525	80.1923	5.953933	224.555	rice
21	23.57944	83.5876	5.853932	291.2987	rice
22	21.32504	80.47476	6.442475	185.4975	rice
23	25.15746	83.11713	5.070176	231.3843	rice

PREPROCESSING STEP

This step is a very important step in machine learning. Preprocessing consists of inserting the missing values, the appropriate data range, and extracting the functionality. The kind of the dataset is critical to the analysis process. In this paper we have used isnull() method for checking null values and lable Encoder() for converting the categorical data into numerical data.

FEATURE SELECTION

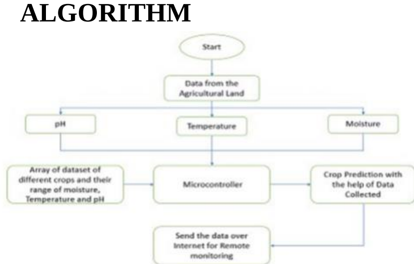
Feature extraction should simplify the amount of data involved to represent a large data set. The soil and crop characteristics extracted from the pre-treatment phase constitute the final set of training. These characteristics include the physical and chemical properties of the soil. Here, we have used Random Forest Classifier() method for feature selection. This method selects the features based on the entropy value i.e., the attribute which is having more entropy value is selected as important feature for yield prediction

SPLIT THE DATASET INTO TRAIN AND TEST SET

This step includes coaching and testing of input file. The loaded dataset is split into 2 sets, like train dataset and testing dataset, with a division ratios of 80 percentage or 20 percentage, such as 0.8 or 0.2. in learning set, a classifier used to make the obtainable input dataset. during this step, produce the classifier's support dataset and preconceptions to approximate and classify the operate. throughout the testing section, the dataset is tested. the ultimate data is created throughout preprocessing and is processed by the machine learning module.

pH Range		
5.0 - 5.5	5.5 - 6.5	6.5 - 7.0
Blueberries	Barley	Alfalfa
Irish Potatoes	Bluegrass	Some Clovers
Sweet Potatoes	Corn	Sugar Beets
	Cotton	
	Fescue	
	Grain Sorghum	
	Peanuts	
	Rice	
	Soybeans	
	Watermelon	
	Wheat	

III. ALGORITHM



Input

Real time agricultural data (temperature, soil moisture, pH).

Output

1. As per the sensor data from the agricultural farm the required libraries are imported.
2. Coding the microcontroller to read the moisture, temperature and pH data.
3. Setting the code to constantly monitor the changes is field environment at constant interval.
4. Collection of real-time data from the agricultural farm.
5. Load the array of dataset of different crops for various soil conditions.
6. Predict the crop for real-time data by choosing appropriate crops from the given dataset.
7. Send the data accumulated over internet for remote monitoring.

The data is taken over the course of 24 hours before and after irrigation to get the idea of water holding capacity of the soil. The moisture content, temperature, pH of the soil is collected for different time before and after irrigation. Plants display symptoms of extreme water deficiency when the required levels of moisture are unavailable in their habitat soil . while excess water may produce plant stress, water logging, runoff and leaching of fertilizers. Heavy rain or over irrigation can cause soil to be saturated.

Alluvial soil	Moisture in %	Temperature (°C)	pH
Pre irrigation	5.77%	30.21	-
After irrigation	89.18%	24.15	6.1
After 12 hours	31.15%	26	6.2
After 24 hours	20.52%	28	6.2

1.Sensor evaluation of the data on alluvial soil.

Black soil	Moisture in %	Temperature (°C)	pH
Pre irrigation	4.12%	26.04	-
After irrigation	84.22%	21.51	7.1
After 12 hours	51.62%	22.72	7.2
After 24 hours	32.11%	23.33	7.2

2. Sensor evaluation of the data on black soil.

Red soil	Moisture in %	Temperature (°C)	pH
Pre irrigation	9.1%	26.34	-
After irrigation	79.42%	22.33	5.5
After 12 hours	42.23%	22.82	5.6
After 24 hours	17.4%	23.2	5.8

3.Sensor evaluation of the data on red soil.

Here is a list of crops along with their preferred pH values, moisture requirements, water level, and general soil color preferences:

• **Corn:**

• pH: 5.8-7.0

• Moisture: Moderate to high
• Water level: Well-drained soil
• Soil color: Dark brown to black

• Wheat:
• pH: 6.0-7.5
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Light brown to dark brown

• Rice:
• PH: 5.0-7.0
• Moisture: High (requires standing water)
• Water level: Flooded fields
• Soil color: Grayish to dark brown

• Soybeans:
• PH: 6.0-7.0
• Moisture: Moderate to high
• Water level: Well-drained soil
• Soil color: Dark brown to black

• Potatoes:
• PH: 4.8-6.5
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Light brown to dark brown

• Tomatoes:
• PH: 6.0-7.0
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Dark brown to black

• Carrots:
• PH: 5.5-7.0
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Light brown to dark brown

• Peanuts:
• PH: 5.8-6.2
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Light brown to dark brown

• Apples:
• PH: 6.0-7.0
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Dark brown to black

• Grapes:
• PH: 5.5-6.5
• Moisture: Moderate
• Water level: Well-drained soil
• Soil color: Light brown to dark brown

IV. EXISTING SYSTEM

Previously, Farmers take soil to the geological technicians who collect and analyse the soil samples to determine whether they are suitable for agricultural, developmental or Natural uses. Further, the concept of IOT is introduced in Agriculture. There are many devices introduced in the market that allows farmers to get information about the nature of the soil through mobile phones. These devices are having a huge influence on reducing costs and reduce the time. Nutrients and acidic value of the soil plays a very vital role in the plant growth. Due to the ecological changes, the acidity and nutrient values of the soil are varying day by day because of this the plant growth is degrading. This existing system is limited to finding moisture, humidity, the temperature of the soil only.

V. PROPOSED SYSTEM

Our study is the extension of the existing system. As we are using the latest IOT technology, which helps in collecting information about conditions like moisture, temperature, pH, nutrients value of the soil, of the field. Sensors like moisture, temperature, pH, nutrients are used for the detection of the plant conditions and microcontrollers are used to control and automate the farm processing.

It depicts the overall process of this work. First, the input data is preprocessed to find the missing values, eliminate redundant data, standardize the dataset, and convert target attributes into factor attributes. Essential attributes are extracted from the preprocessed data using wrapper feature selection techniques.

The optimized attributes have classification techniques applied to them, prior to which the dataset is split into training and testing phases. Unknown samples from the training dataset are used to train the classification algorithm to determine the crop that is best suited for cultivation in a specific area of land. The testing dataset is used to predict the crop to be raised, using the trained classifier. Finally, a suitable crop is obtained and the results evaluated using different performance metrics. The analysis reveals the best feature selection technique with an appropriate classification method.

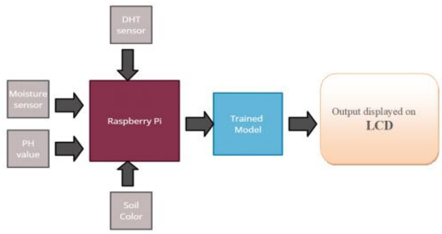


Fig 1. Block diagram of proposed model

VI. HARDWARE DESIGN

4.1 INTRODUCTION TO RASPBERRY PI

Fig 2. Raspberry Pi Board

4.1.1 What is Raspberry Pi?

Raspberry Pi is a small single board computer. By connecting peripherals like Keyboard, mouse, display to the Raspberry Pi, it will act as a mini personal computer.

Raspberry Pi is popularly used for real time Image/Video Processing, IoT based applications and Robotics applications.

Raspberry Pi is slower than laptop or desktop but is still a computer which can provide all the expected features or abilities, at a low power consumption.

4.1.2 OS for Raspberry Pi

Raspberry Pi Foundation officially provides Debian based Raspbian OS. Also, they provide NOOBS OS for Raspberry Pi. We can install several Third-Party versions of OS like Ubuntu, Archlinux, RISC OS, Windows 10 IOT Core, etc.

4.2 DHT11 SENSOR:

The DHT11 humidity and temperature sensor makes it really easy to add humidity and temperature data to your DIY electronics projects. It’s perfect for remote weather stations, home environmental control systems, and farm or garden monitoring system Here are the ranges and accuracy of the DHT11:

- Humidity Range: 20-90% RH
- Humidity Accuracy: ±5% RH
- Temperature Range: 0-50 °C
- Temperature Accuracy: ±2% °C
- Operating Voltage: 3V to 5.5V

The DHT11 measures relative humidity. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air. At the saturation point, water vapor starts to condense and accumulate on surfaces forming dew.

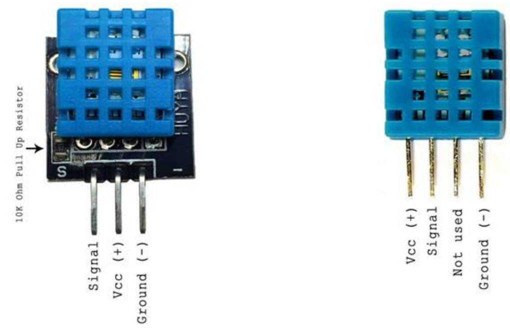


Fig 4. Pinouts of two versions of DHT11

4.3 SOIL MOISTURE SENSOR :

The soil moisture sensor is the first thing that springs to mind when it comes to building your smart irrigation system. With this sensor in place and a little Raspberry pi support, we can design a system that can water your plants when it's needed, avoiding overwatering and underwatering.

we are going to interface the soil moisture sensor with an and measure the volumetric concentration of water inside the soil. This sensor is designed in a way that it can output data in both digital and analog modes. We will read this data and display the output status with an LED for digital output and we will use the serial monitor or an LED with PWM for analog output. So without further ado let's get right into it.

4.4 PH SENSOR:

A pH sensor, also known as a pH probe or pH electrode, is a device used to measure the acidity or alkalinity of a solution. pH is a measure of the concentration of hydrogen ions (H+) in a solution, and it is expressed on a scale from 0 to 14. A pH of 7 is considered neutral, pH values below 7 indicate acidity, and pH values above 7 indicate alkalinity. pH sensors typically consist of a glass electrode that is sensitive to changes in hydrogen ion concentration. The glass electrode contains a thin bulb filled with a special solution, usually a potassium chloride (KCl) electrolyte, and a reference electrode immersed in a neutral electrolyte, such as a gel or liquid. When the glass electrode comes into contact with a solution, it generates a small voltage that is proportional to the pH of the solution.

This voltage is then measured and converted into a pH value by a pH meter or other measuring device. To use a pH sensor, it is important to properly calibrate it using standard buffer solutions with known pH values. This calibration process ensures accurate measurements. pH sensors are commonly used in various fields such as chemistry, biology, environmental science, food and beverage industry, water treatment, and many other applications where pH monitoring is essential. It's worth noting that pH sensors require regular maintenance and calibration to ensure accurate and reliable measurements. Additionally, some pH sensors are specific to certain types of solutions or environments, so it's important to choose the appropriate pH sensor for a particular application.A solution with a pH of less than seven is considered acidic. A solution with a pH greater than seven is considered basic or alkaline. A solution that has a pH equal to seven is a neutral liquid. Thus, pH is a measure of how acidic or basic a liquid is, ranging from 0 to 14.

Fig 5. PH Sensor

4.5 WATER SENSOR:

Connecting a water sensor to Raspberry pi is a great way to detect a leak, spill, flood, rain, etc. It can be used to detect the presence, the level, the volume and/or the absence of water. While this could be used to remind you to water your plants, there is a better Grove sensor for that. The sensor has an array of exposed traces, which read LOW when water is detected.

A water sensor, also known as a water detector or water leak sensor, is a device designed to detect the presence or absence of water in its vicinity. It is commonly used to prevent water damage by alerting users to leaks, floods, or excessive moisture in areas where it shouldn't be present.:

1. Conductivity sensors: These sensors utilize the electrical conductivity of water to detect its presence. When water comes into contact with the sensor's electrodes, it completes an electrical circuit, triggering an alert.

2. Moisture sensors: These sensors detect changes in moisture levels. They may use a variety of technologies such as capacitance, resistance, or surface tension changes to determine the presence of water or high levels of moisture.

3. Optical sensors: Optical water sensors use light-based detection methods to sense the presence of water. They typically emit a beam of light and measure changes in reflection or refraction caused by the presence of water..

Water sensors are often used in areas prone to water leaks or flooding, such as basements, bathrooms, kitchens, laundry rooms, and near water-related appliances. When a water sensor detects the presence of water, it can trigger an audible alarm, send a notification to a connected device (e.g., smartphone), or activate an automated system to shut off water supply valves.

These sensors are valuable for early detection of water-related issues, allowing users to take prompt action to prevent water damage and minimize potential losses.

Fig 6. Water Sensor

4.6 LCD(Liquid Crystal Display)

LCD stands for Liquid Crystal Display. It is a type of flat-panel display technology commonly used in televisions, computer monitors, smartphones, and other electronic devices.

LCDs work by manipulating the light passing through liquid crystal molecules. These liquid crystals are sandwiched between two layers of polarized glass. When an electric current is applied, the crystals align themselves to allow or block the passage of light. This controlled manipulation of light creates the images and colors that we see on an LCD screen.

LCD technology offers several advantages, including high-resolution displays, wide viewing angles, and low power consumption. LCD screens can produce sharp and vibrant images with good color reproduction. They are also thinner and lighter compared to older display technologies like cathode ray tubes (CRTs).

LCDs have become the dominant display technology in various consumer electronics due to their versatility and affordability. However, they do have some limitations. For instance, LCDs can suffer from slower response times, which can result in motion blur in fast-paced content. Additionally, LCDs require a backlight to illuminate the screen, which can lead to lower contrast ratios and difficulties in displaying true blacks.

In recent years, newer display technologies such as OLED (Organic Light-Emitting Diode) and MicroLED have gained popularity due to their improved performance in areas like contrast ratio, response time, and color accuracy. Nonetheless, LCDs continue to be widely used and are still found in many devices due to their cost-effectiveness and mature manufacturing processes.

: To interface an LCD (Liquid Crystal Display) with a Raspberry Pi, you will need an LCD module that is compatible with the Raspberry Pi's GPIO (General Purpose Input/Output) pins. There are several LCD modules available that can be connected to the Raspberry Pi using various interfaces such as I2C, SPI, or parallel GPIO.

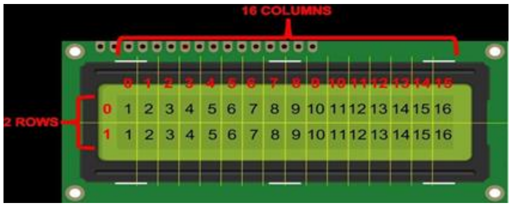


Fig 7. 16x2 LCD display

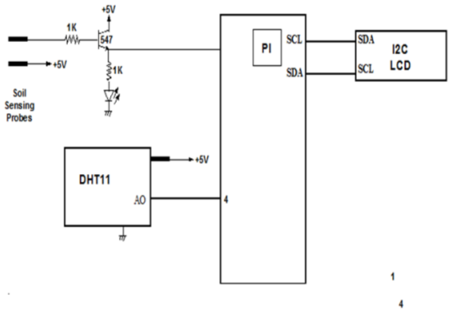


Fig 8. Schematic Diagram

VII. RESULTS

5.1 RESULTS

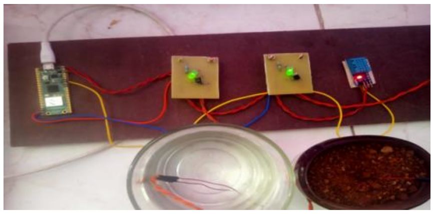


Fig 9. Hardware Kit Of Crop Prediction Using Raspberrypi

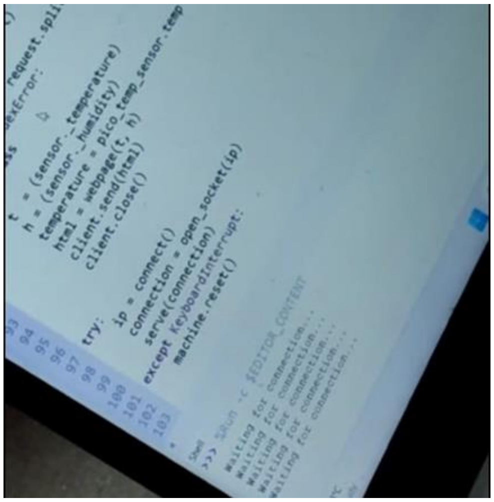


Fig 10. Socket Is Working

Open Thonny editor.

Look at the text in the bottom right-hand corner of the Thonny editor. It will show you the version of Python that is being used.

If it does not say 'MicroPython (Raspberry Pi Pico)' there, then click on the text and select 'MicroPython (Raspberry Pi Pico)' from the options.

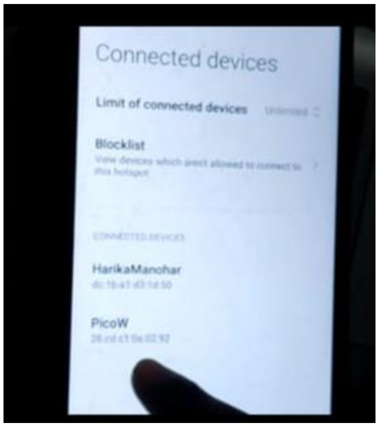


Fig 11. Wifi Connection

Password need to be kept securely and privately. In this step, you will add your Wi-Fi password into your Python file. Make sure you don't share your file with anyone that you wouldn't want to tell your password to.
To connect to a Wi-Fi network, you will need to know your service set identifier (SSID). This is the name of your Wi-Fi network. You will also need your Wi-Fi password. These can usually be found written on your wireless router, although you should have changed the default password to something unique.

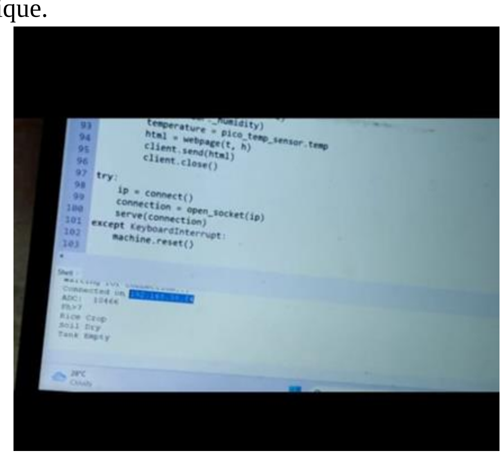


Fig 12. Selection Of IP Address

A socket is the way a server can listen for a client that wants to connect to it. The webpage you are currently looking at is hosted on Raspberry Pi Foundation servers. These servers have an open socket that waits for your web browser to make a connection, at which point the contents of the webpage are sent to your computer. In this case, your server is going to be your Raspberry Pi Pico W and the client will be a web browser on another computer. To open a socket, you need to provide the IP address and a port number. Port numbers are used by computers to identify where requests should be sent. For instance, port 80 is normally used for web traffic; Stardew Valley uses port 24642 when you're playing a multiplayer game. As you are setting up a web server, you will be using port 80.

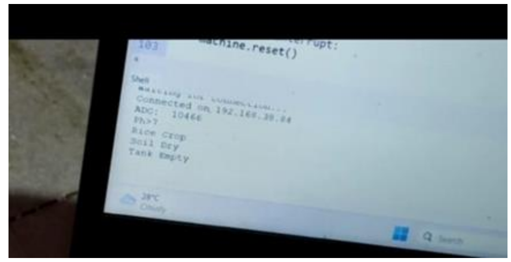


Fig 13. Display of Output values

In this step, you will create a webpage that the web server, running on your Raspberry Pi Pico W, can send to a client web browser. You're going to test the webpage on your computer first though, to make sure it displays as it should. In the next step, you can add the code to your Python script, so that your Raspberry Pi Pico W can serve the webpage.
In this step, you will start up your web server so that a client can connect to it, and control your LED and read the temperature,humidity,PH values.

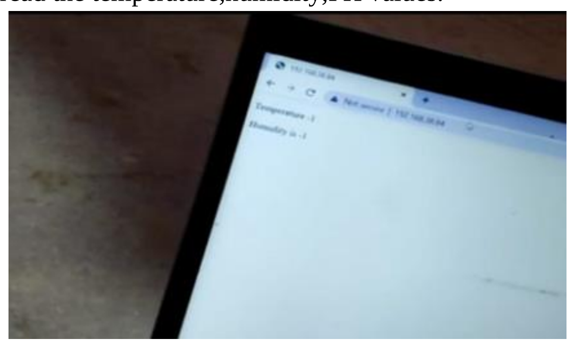


Fig 14. Look Up Of Web Page

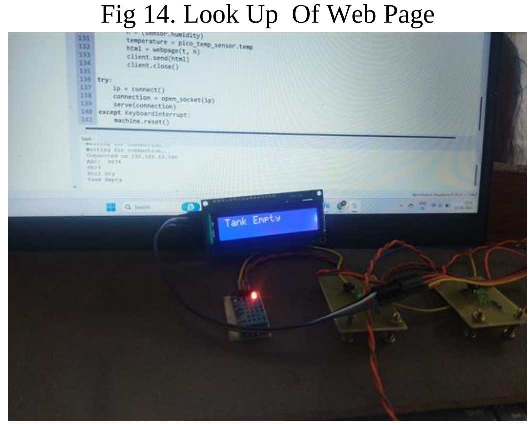


Fig 15. Output Of Crop Prediction

7.2 Advantages

Crop yield prediction systems provide for better planning and decision-making to increase production.
• Simple and compact.
• Very cost effective.
• No wastage of water due to automatic control.

• Product quality, higher crop productivity, resource conservation.

7.3 Disadvantages

• Increased use of chemicals, reliance on organic fertilizers, and increased food miles.
• Smart agriculture system is not very flexible.
• It is also not very user-friendly.

7.4 Applications

• Used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the quantity of crop in a given farmland over a given period.
• For detecting the content of Nitrogen(N), Phosphorous(P), and Potassium(K) in the soil, a soil NPK device is used. With the help of the Raspberry Pi, it assists in determining the fertility of the soil, thus enabling the analysis of the soil's nutrients.
• The Raspberry Pi drives a MOSFET which turns the relay coil on and off, which then turns the solenoid valve on and off. By default, when the GPIO pin is low, the relay is open so the valve is closed (water does not flow). When the GPIO pin goes high, the relay closes, and the valve will open (water will flow).

VIII. CONCLUSIONS & FUTURE SCOPE

8.1 CONCLUSIONS:

We may conclude from the project's development that farmers will find it highly beneficial. The crop production is increased by the projected outcomes, which also assist users in knowing what kind of crop to harvest given their environmental conditions.

Thus, farmers can obtain up-to-date information with great assistance from IOT-based farming. Farmers and landowners need to be aware of the existing market possibilities for IOT. Additionally, if we employ IOT technology properly, demand will rise quickly.

8.2 FUTURE SCOPE:

The goal of the project is to calculate an area's crop yield by analyzing a dataset that includes several features relevant to crop production, such as temperature, moisture content, rainfall, and crop output in prior years.

Regression models are used to predict a continuous variable. It's a method under supervision. When the regression model is being built and trained, the coefficients are preprocessed and fitted into the trained data. The primary goal is to identify the optimal fit-line in order to minimize the cost function. Error measurement is facilitated by the output function. In order to minimize the error function, the error between the predicted and actual values is decreased during the training period. Python is employed in this undertaking. We must gather the necessary information by providing GPS coordinates of the land, and by gaining access to the government's rain forecasting system, we are able to anticipate crops simply by providing GPS positions. Additionally, we can create a model to prevent food shortages and surpluses.

The goal of this method is to assist farmers in strengthening their financial position and to address the rising number of farmer suicides. The Crop Recommender system assists farmers in selecting which crop to plant and in estimating the output of a particular crop. Additionally, it notifies the user of the ideal time to apply the fertilizer.

REFERENCES

1. https://quartzcomponents.com/blogs/electronics-projects/crop-predictiont-using-raspberrypir
2. https://robocraze.com/products/raspberry-pi-pico-w
3. https://www.ecstuff4u.com/2019/08/ultrasonic-sensor-advantage-disadvantage.html
4. https://www.utmel.com/components/-raspberrypi-pinout-datasheet-and-features?id=152&gclid=Cj0KCQjw0tKiBhC6ARIsAAOXutkyLrUyAk5rPqJ6dOwYA5vuMrSHNsA8157-UfnySpmgl6BiI6CExcoaArSYEALw_wcB
5. https://components101.com/DHT11-pinout-datasheet
6. https://www.electronicshub.org/what-is-relay-and-how-it-works/
7. https://quartzcomponents.com/products/18650-li-ion-2500mah-rechargeable-battery?variant=37862622036152&currency=INR&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&gclid=CjwKCAjw9pGjBhB-EiwAa5jl3PP2S2TIUEKt1Ni7vOOTqfo38kux7zw2Zy58YoaKQLeL1KuCxIjUMhoCKCwQAvD_BwE
8. https://projects.raspberrypi.org/en/projects/get-started-pico-w/4.