

## IoT based Crop Yield Prediction System using Arduino

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**Abstract**— India is known as an agriculture country, where most villagers have agriculture as a main income source. Agriculture plays a vital role in the Indian economy. India has over 16% GDP based on agriculture. The production of various crops cultivated in India has its own role in the economy as importation and exportation is also important for India's GDP. As we are progressing through this time, so called 'progress'; is affecting the Indian crop cultivation rate. The land has been utilized for industrialization and urbanization therefore reducing the land used for cultivation. The Increase in population is also becoming a problem with a smaller number of resources, there can be various resources but the most important of all is food. As per human basic needs include Food, Clothes and House, crop cultivation should be increased in an efficient and effective way. The land should be cultivated as per the soil capacity in whole amount or percentage; to find if soil's capacity of producing specific type of crop, which can be predicted using various parameters such as soil Nitrogen, Phosphorus and Potassium level present in the soil, and various outside parameters like temperature and humidity. The soil changes its property to 10 km around the globe.

**Keywords**- Temperature, Humidity, Nitrogen, Phosphorus, Potassium, prediction

### Introduction

Many farmers are not aware of these facts, the lack of knowledge of their own land soil; they decide based on the market need or profit. Farmers not able to identify which crop should be cultivated in their land can also result in the loss. Farmers has been following what their ancestor cultivated in their land which is a necessity for their own welfare but they must study their land and do all the studies to find out the best resulting crop, but in order to start a new cultivation of crop we need vast amount of study and data which may take a lot time, if we tried it by experimenting on the soil, it may also affect the soil due to number of experiments and can lead to decreasing yield capability of the soil. Which crop should be cultivated in land and which will give the most production. The objective of this proposed work is to develop an Internet of Things (IoT) based crop prediction system that is capable of predicting the types of crops that can be cultivated in a given environmental condition or a need of particular soil nutrients present and required in the soil. Farmers are using uncontrollable amounts of pesticides in order to increase the soil health and soil yielding capacity. The use of pesticides helps in healthy cultivation of crops but using it in an out of control manner can result in side effects on soil's capacity. The pesticides interfere into soil properties resulting in changing the land cultivation capability. Based on the above issues we have developed a system which will suggest to a

farmer which crop is best for their soil type. For the agriculture section, this system will help increase the percentage of cultivation of land. The methods in machine learning can result in precise prediction.

## LITERATURE REVIEW

Gupta et al discovered in 2021 that crops use ML algorithms by giving environmental conditions. They discovered Smart Crop Prediction using IoT and Machine learning in 2021 using unsupervised and supervised learning algorithms and IoT device (NodeMCU) with soil moisture sensor and pH sensor, environmental sensors. The Agri cloud module consists of storage predicts temperature, moisture and pH value for crop prediction using the ARIMA model [1]

Vijay Nidagundi et al discovered IoT Based Smart Prediction System for Crop Suitability in 2021 that uses different sensors for collecting data.[2]

Wani et al discovered Crop Prediction using IoT & Machine Learning Algorithms. Digital Temperature and Humidity Sensor is used to detect the ambient air, LDR, Rain Sensor, Photovoltaic Panel are used to predict crop. [3]

Kiruthika et al discovered IoT-based professional crop recommendation system using a weight-based long-term memory approach in 2023 that uses different type of Algorithm and sensors to collect data. [4]

Khosla et al discovered Crop yield prediction using aggregated rainfall-based modular artificial neural networks and support vector regression in 2020 that uses support vector regression using rainfall data in regions to predict crop.[5]

Raghuvanshi discovered the IoT Based Smart Agriculture System in 2021 that contains sensors for collecting data and data from sensors are displayed on app. A mobile app provides access to continuous data from sensors and accordingly helps the farmer to take action to fulfill the requirements of the soil.[6].

Viswanath et al discovered An IoT Based Crop Selection And Productivity Enhancement System For Indian Farmers in 2021 used to monitor and analyze various parameters affecting soil productivity. This is done with the help of sensors that work based on the wireless sensor network concept.[7]

Varadarajan et al discovered IoT Framework for Measurement and Precision Agriculture: Predicting the Crop Using Machine Learning Algorithms in 2022 ML is used to collect data on cloud with help of sensors and gives suitable crop.[8]

Padhy et al discovered IoT-Enabled Soil Nutrient Analysis and Crop Recommendation Model for Precision Agriculture in 2023 it involves different processes, namely data acquisition using sensors, storage with FFO-based parameter optimisation, and crop recommendation.[9]

Prabhu et al discovered Soil Analysis and Crop Prediction in 2020 soil samples from different regions are collected and analyzed based on temperature, moisture and humidity .application is being designed for crop prediction Temperature, Soil Moisture Sensor are used.[10]

Dias et al discovered the system is based on the conditions of the farm field, such as temperature, humidity, soil type, crop kind, and so on will suggest the best fertilizer to ensure that the soil's nutrients are preserved. Using the GSM Module, all information about the farm field will be sent to the owner.[11]

Dhabarde et al discovered in 2022 used IoT for Sensors Sensing, M.L for Prediction Purpose, Web Technologies for Front End U.I design.[12]

## II. SURVEY EXISTING SYSTEM

Soil testing centers are helping farmers to make suitable decision about the farm. Krushi center in part of the villages are playing crucial roles in giving suggestion to the farmers for betterment of their field. They help for crop management, fertilizers suggestion so that farmers take a wise decision for their crops, and increasing the health of the soil. These soil testing centers analyze the soil using highly advanced equipment to check the soil nutrient content by collecting the soil from the analyzing site of a farmer's farm. Agriculture officers provide a report format where all the analyzed data is present on it in simpler manner so that farmer can understand it well. This produces a precise decision with optimized crop production for the field.

Services Provided:

Soil Nutrient Analysis:

Soil testing centers check for the Nitrogen (N), Phosphorous (P), Potassium (K) and other nutrient for establishing the report presenting the amount required selecting a fertilizer based on the soil need.

PH Measurement:

Soil ph can also play crucial role in determining which crop is suitable for their soil. The ph of soil changes as we go through different regions of nation. It determines if the soil is alkaline or acidic.

Organic Matter Analysis:

How much amount of organic matter is present in the soil which provides the extra nutrition to the crop, which helps in providing the health for crop and growth factor It also contributes in water holding capacity, soil structure, and fertility.

Texture Analysis:

What type of soil is present in farmer's field can also determine which type of crop is suitable for a particular crop. Soil texture contains sand, silts, clay and other materials which have an effect on the soil.

Recommendation Reports:

Report provides the analyzed soil details, soil condition, recommendation, suggestions, including fertilizer types and quantities.

## III. SCOPES

This prediction system will be used to predict the soil yield capability using statistical data rather than the market trend. Based on soil nutrients like Nitrogen, Phosphorus, Potassium and environment content like humidity, temperature it will be easier to predict the crop. It can be also used to determine the health of farmer's soil as well as it will be possible to compute the need of fertilizers according to the result of the amount of nutrients present in the soil.

## IV. PROPOSED SYSTEM

According to the fig 1; the arduino is connected to the sensors namely NPK sensor and DHT11 sensor. After interfacing the above mentioned sensors, the arduino is powered by laptop. This circuit will read the data from the respective sensor which will print the output on the serial monitor of the arduino. This technique will assist the farmers to make a decision about which crop is most suitable for such type of soil, along with the statistical data; Nitrogen, Phosphorus, potassium, Temperature and humidity sensor reading are used to predict the accurate result. The project analyzes the soil nutrient content from soil and processes that data for further computation. It can be possible to predict the suitable crop based on the type of the soil and nutrients requirement for increasing yield capability. This system collects data from sensors like Nitrogen, Phosphorus, and Potassium which are the most important characteristics of the soil and the environment factors like temperature and humidity will play an important role in the prediction. This system can also print out the output so we can send the result of the prediction to the respective farmer.

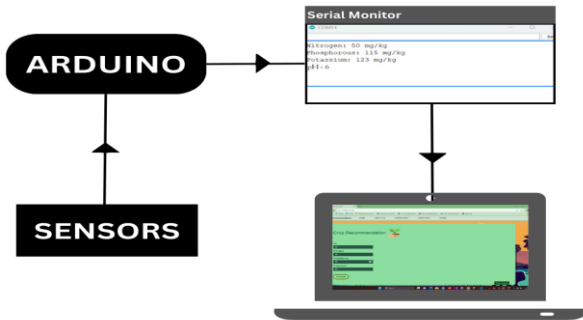


Fig 1. System connection

### A. Methodology

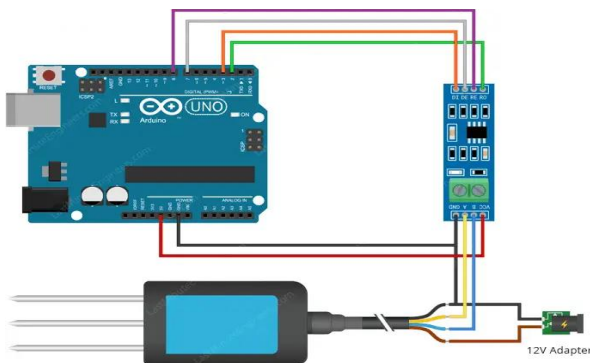


Fig 2: circuit diagram of the proposed system

1. The Arduino based crop yield prediction system will provide the crop yield predictions.
2. When we put the Sensors inside the soil it will sense the nutrition's values of NPK.
3. It will send it to the Arduino.
4. The Website will read the values through Arduino's serial port.
5. Soils nutrition values will compared to data base and final result will shown.

### B. Algorithm

- STEP 1: Start.
- STEP 2: Take a soil sample.
- STEP 3: Put the sensor in it.
- STEP 4: Read the soil's nutrition values.
- STEP 5: Read the arduino's serial port, if there are no readings then go back to step 4.
- STEP 6: Compare soil's reading with database.
- STEP 7: Provide the final result of predictions
- STEP 8: End

### Software

#### i) Django:

Django is used for the web page creation; django is a framework which let a programmer to manage both frontend and backend. It is fast, simple and easy to maintain.

#### ii) HTML, CSS, JavaScript:

Html is used to create the skeleton of this project webpage which gives a user-friendly look with the styling of css which make webpage to look more attractive for the user using it, and then the JavaScript is frontend technology which makes the website more productive and provides actions to the webpage.

### Hardware

#### i) Arduino:

Arduino is an open-source electronics platform based on user-friendly hardware and software. It consists of a microcontroller and a development environment used to write, compile, and upload code to the board. Arduino boards come in various shapes and sizes and are equipped with input/output pins that can be used to connect to sensors, actuators, and other electronic components. The main feature of the software and the programming language is its simplicity and ease of use.

#### ii) NPK:

NPK sensor is used for measurement of the soil nutrient like Nitrogen (N), Phosphorous (P), and Potassium (K). These nutrients are well known for the crop growth, health and other parameters which make the yield of the crop better. By interfacing the NPK sensor with arduino and inserting the probes of the NPK sensor into the soil calculate the present amount of nutrients in it. This arduino requires an embedded C code for the implementation of the sensor with arduino so it can work accordingly.

#### iii) DHT11 Sensor:

DHT11 sensor consists of a capacitive thermostat sensing element for sensing temperature and capacitor sensing element for humidity. Change in these elements gives the proper results. IC converts the resistance value into human readable form. It will be used to measure the temperature

and humidity content from the outside environment which is present around the crop.

iv) MAX485 TTL to RS-485 Module:

Interfacing MAX485 with sensor which is used to have a communication mode between the arduino board and soil NPK sensor. It receives the TTL (Transistor-Transistor Logic) signal from the arduino and converts it to an RS-485 signal, which is then sent to the soil NPK Sensor.

## V. EXPERIMENTATION AND RESULT

Creating a Proteus simulation for an IoT based Crop Yield Prediction system using arduino, NPK and DHT11 sensors are taking participate in this process. First, one needs to open the Proteus software and initiate a new project. Components for the arduino microcontroller are NPK sensor, DHT11 sensor, and an arduino must be either found within Proteus libraries or created from scratch. These custom components must be designed to mimic the behavior of their real-world components. As shown in Fig 2 we connected these components within the workspace, we worked on programming the arduino that involves data acquisition, NPK values detection, and this must be incorporated into the arduino component in Proteus. Testing and debugging the simulation to ensure accurate system behavior is crucial before proceeding to real-world hardware deployment as shown in figure 3 to figure 6.

We also designed the Website which compares the soil values to the standard database and it will give the crop yield prediction of that soil.

Website is build with help of Django which is the framework and Language used is HTML, Python, CSS.

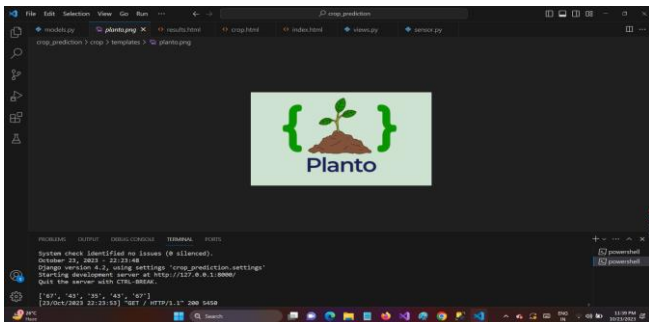


Fig 3 coding page

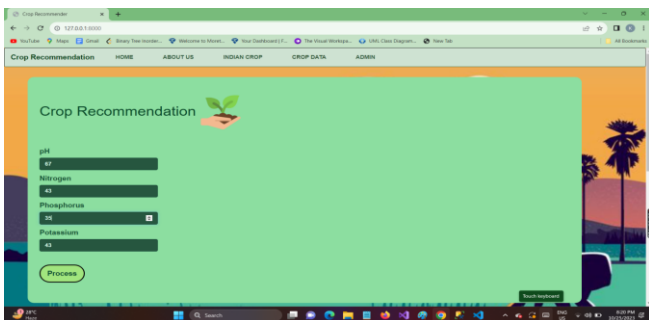


Fig 4 crop recommendation and comparison page

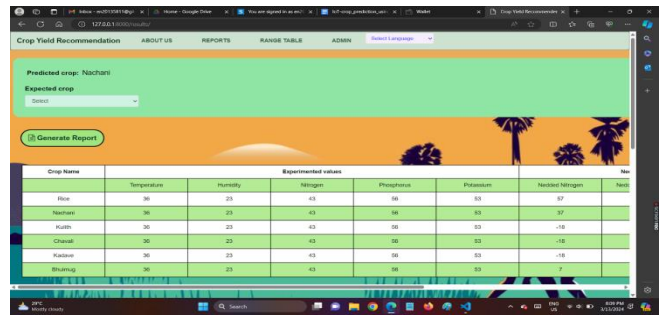


Fig 5: example of comparison of crops



Fig 6. Details of Crop associated with Farmers

## VI. CONCLUSION

The proposed system is predicting the Crop Yield using Standard Database This system based on Internet of Things. This system is implemented with a NPK sensor and DHT11 sensor which is interfaced with an arduino Board. The simulation of this system is implemented on Proteus Software. The Website has designed with Django framework for the project which will be the web framework of the project which predict and display the result. The readings from sensors will automatically print on the input box of website page through the serial port of the arduino.

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