J. Soils and Crops 33 (2) 392-396, December 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

PLANT PREDICTION SYSTEM USING ALGORITHMIC APPROACH BASED ON SOIL CONDITIONS

Kaushalya Thopate[1], Akshay Kale[2], Vaishnavi Kumawat[3], Sakshi Kotwal[4] and Nachiket Kulkarni[5]

ABSTRACT

An experiment was conducted during May 2023 at the Vishwakarma Institute of Technology in Pune on two different types of soil, namely black soil and red soil. Using an IoT-based project that includes pH, temperature, humidity, and soil moisture sensors, their values for moisture, pH, temperature, and humidity were taken. The moisture, humidity, temperature, and pH values for black soils were medium, 58%, 74°F, and 7, respectively and the values for red soil was nearby same. Then we entered these numbers into our Java programming algorithm, which compared them to the values of the 50 sample plants that we had selected as standard values and stored them in a CSV file. The file includes information on 50 plants, including their typical values for pH, moisture, temperature, and humidity needed in soil to support growth. The name of the bamboo plant and the names of the other four plants (Croton plant, Fiddle leaf plant, Majesty palm, Pilea) were then shown on the interface after the algorithm had compared the soil condition values to the standard values of plants. This experiment demonstrates above mentioned plants can be grown in that soil to produce plants with good growth. The current technique only uses soil testing, which does not result in suitable plants. After analyzing the soil, this system displayed the several types of plants that can be grown there. And we may be certain that the plant will undoubtedly produce positive outcomes.

(Key words: Plant Prediction System, Java, soil parameters, plant identification)

INTRODUCTION

Accurately identifying suitable plant species based on specific soil conditions is crucial for agriculture, horticulture, and environmental studies. Manual determination of optimal plant species for given soil conditions is time-consuming and prone to errors. To address this challenge, the Plant Prediction System is introduced, a Java-based application that automates plant identification based on measured soil parameters.

The system utilizes a pre-existing database of plant profiles with recommended ranges for soil pH, humidity, moisture, and temperature. By comparing measured values with these ranges, the system predicts the most suitable plant species. The Plant Prediction System aims to assist researchers, farmers, and gardening enthusiasts in making informed decisions, improving plant yields, resource utilization, and promoting sustainable practices.

The report will develop into the system's architecture, algorithmic approach, implementation in Java, database management, data processing, and user interface design. The Plant Prediction System provides a valuable tool for accurate plant identification, aiding in optimized plant selection and cultivation practices.

The Internet of Things (IoT) technology is suggested as a novel method for monitoring the health of Plant. The goal of the study is to build and create a system that uses sensors and wireless connectivity to track and monitor numerous Plant health indices in real-time. The suggested system can assist Nursery Owners and researchers in seeing the first indications of plant diseases, pests, and other issues so they can act quickly to protect Plants. This could be useful for us in making dataset of disease and its causes in future (Siddagangaiah, 2016). The goal of the study is to give a summary of the body of research on the subject and to point out the benefits and drawbacks of various IoT-based plant monitoring systems and talk about how IoT-based solutions can enhance plant growth, productivity, and quality, as well as the significance of plant monitoring in hydroponic farming. This study helped us in understanding current plants situation (Shewale and Chaudhari, 2018).

Research describes an Internet of Things (IoT)-based system for tracking plant health using image processing methods. The goal of the project is to create a system that uses machine learning and image analysis to automatically identify and diagnose plant illnesses. The suggested method takes pictures of crops and sends them wirelessly to a cloud server using a low-cost Raspberry Pi

1. Asstt. Professor, Dept. of Computer Engineering, Vishwakarma Institute of Technology, Pune
2,3,4 & 5. B. Tech Students, Mechanical Engineering Dept ., Vishwakarma Institute of Technology, Pune

computer and a camera module. This study can be useful for our project in future to identify health condition of plant automatically and to predict future disease using similar algorithmic approach (Pavel *et al*.,2019).

It examines the conception and execution of a Raspberry Pi-based smart crop monitoring and watering system. The system's goal is to use IoT technology to create an effective and automated approach to monitor and irrigate crops. This emphasizes the value of such systems in agriculture as well as the advantages they provide in terms of better crop development and less water use. (Anusha and Mahadevaswamy,2018.) The design and deployment of a smart farm system based on IoT technology are the system that seeks to enable real-time monitoring of numerous environmental parameters, including temperature, humidity, and soil moisture, that have an impact on crop development. It emphasizes how crucial these systems are for increasing agricultural output while using less resources, such as water and fertilizers (Mondal and Rehena,2018).

The system provides real-time monitoring of environmental parameters including temperature, soil moisture, and humidity with the goal of increasing crop output and decreasing water waste. They also focus on the value of these systems in precision agriculture as well as the advantages they provide in terms of enhanced crop development and decreased resource usage (Pravin *et al*.,2018).

The significance of these systems for precision agriculture as well as the advantages they provide in terms of higher output and lower costs. The many AI and IoT technologies employed in the system and how they work with the cloud platform are also important (Singh *et al*.,2020). The study highlights that adopting an integrated approach, such as the Integrated Plant Nutrient System (IPNS), based on yield targets and incorporating a combination of chemical fertilizers and organic manure, can lead to higher grain yields, improved fertilizer utilization, and increased profitability in rice-wheat cropping sequences. This approach emphasizes the importance of balanced nutrient management and promotes sustainable crop production practices (Keram *et al*.,2012). This system will assist us in predicting the name of the plant or, if possible, the crop if we use it to predict crops if we add certain nutrients criterion. Application of graded levels of fly ash was studied on the farm of Agriculture College, Nagpur, India, during the *rabi* season of 1993-94. Application of fly ash decreased bulk density and maximum water holding capacity of soil, while no marked effects on pH, EC, CEC and lime content were observed. The available NPK and micronutrients like Cu, Fe, Zn, Mn and exchangeable Ca and Mg increased with fly ash application (Deshmukh *et al*.,2000). This study may be useful if we expand the dataset by include some nutrient columns since, as the study mentioned above, we can utilize fly ash to raise the amount of any nutrient that is deficient in a plant's growth.

MATERIALS AND METHODS

Operation table

STEP 1· Getting the most out of our study, which involves measuring the temperature, humidity, pH, and soil wetness of a random soil.

STEP 2· Using the aforementioned value as input for the java programming language algorithm that we constructed.

STEP 3· Matching the input values to the plant's standard values.

STEP 4· Providing the plant names as an output value that can be planted in soil that has been tested for effectiveness.

Testing the soil

We brought two soil samples from a nursery in our neighbourhood of Bibwewadi, Pune, for the current scenario. The two samples were of black dirt and red soil, and I estimated the black soil's condition to be medium moisture, 58% humidity, 74°F, and 7 pH. And that for red soil was nearly the same, with the exception that the moisture value was higher than for black soil. The IoT-based project that contains the pH, moisture, temperature, and humidity sensors is where these values were taken. which, when buried in soil, evaluates the value and outputs the results on an LCD screen. The DHT11 humidity and temperature sensor was employed. Our microcontroller was an Arduino uno. Using Arduino programming, the sensors were incorporated.

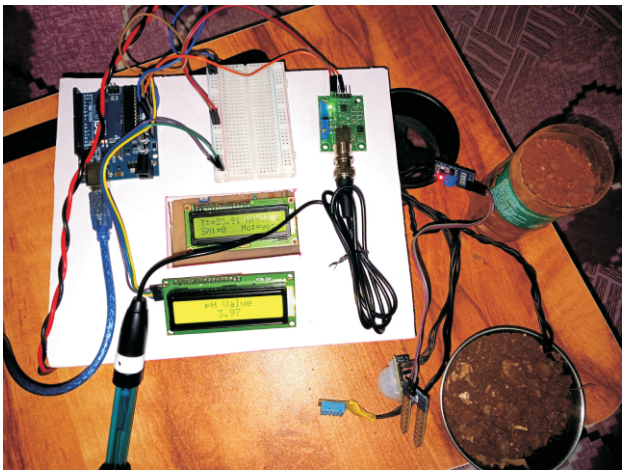

Figure 1. Image of the iot project which gives values of soil conditions

Entering the values in java algorithm

As we advanced, we developed the algorithm in a way that requires us to manually input the values of the soil conditions in the interface. We entered the value of the black soil's state on the interface because there isn't much of a difference between the two types of soil. We installed the necessary packages and utilised the decision tree method to make the accurate forecast. We filled out the interface with the data for soil pH, temperature, moisture, and humidity. In the event that the soil condition value is not precisely the same as the plant standard values, tolerances are included in the code.

The algorithm adjusts the given value using nearby values. If, for example, the soil temperature is 78°F and no plant can tolerate this temperature, the programme will automatically choose nearby values between 76 and 80 °F to make an accurate prediction. The same holds true for each parameter. We gave the code a tolerance so that if any 3 parameters match and only one parameter doesn't, it won't consider that parameter and will instead display the result using the remaining 3 matching parameters.

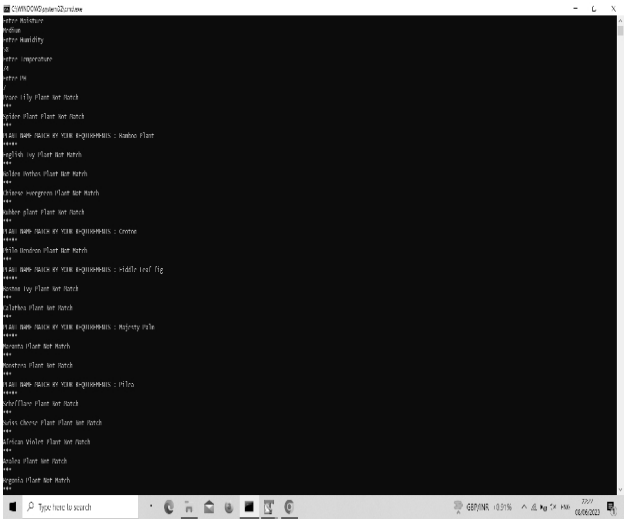

Figure 2. Java code interface where we enter values of soil condition

Data processing

We need to estimate the appropriate plant that can grow in that soil because we have standard values for black soil.

We have a data set with 50 sample plants and the standard values for the soil's pH, moisture content, humidity, and soil temperature. This data was set up in a csv file with four columns. The algorithm took our manually entered soil condition and compared it to each plant's standard value before returning the name of the plant that was most appropriate for that plant. We want a suitable data set of plants along with their standard values for this processing. We gathered this information by talking to nearby nursery owners and conducting research on Google, then we organised it in specific manner to give values to algorithm. For these processes we have taken data of 50 plants as follows.

Plant	Moisture	humidity	temperature	pH
Aloe Vera	Low	65	75	6
Snake Plant	Low	55	70	6.5
Peace Lily	Medium	50	65	6
Spider Plant	Medium	50	60	7
Bamboo Plant	Medium	60	75	6.5
English Ivy	Medium	50	70	6.5
Golden Pothos	Medium	60	67	6
Chinese Evergreen	Medium	50	50	6
Rubber plant	Medium	55	70	7
Boston Fern	High	70	65	5
Croton	Medium	60	75	5.5
Philo Dendron	Medium	60	80	6
Fiddle Leaf fig	Medium	60	75	6.5
Boston Ivy	Medium	50	65	7.5
Bird of Paradise	High	60	85	6.5
Calathea	Medium	70	75	6.7
Chinese MoneyPlant	High	50	70	7
Dracaena	High	50	75	6
Majesty Palm	Medium	60	75	5
Maranta	Medium	70	70	5.5
Monstera	Medium	60	65	6.2
Orchid	High	50	70	6
Peperomia	Low	50	70	6.6
Pilea	Medium	60	75	5.5
Ponytail Palm	Low	50	85	7
Schefflare	Medium	60	80	6.5
Swiss Cheese Plant	Medium	60	85	7
African Violet	Medium	50	55	7
Azalea	Medium	50	55	5

Figure 3. Standard values of condition required to grow a plant in specific soil

RESULTS AND DISCUSSION

It is interpreted that the plant we can grow in black soil the same can be grown in red soil because the difference between the two soils was not great enough. Following plants suggested by our model by giving the soil condition as an input:

Table 1. Observations after testing soil

Soil Conditions	Black soil	Red soil
Moisture	**Medium**	**High**
pH	**7**	**7.1**
Temperature	**74°F**	**74°F**
Humidity	**58**	**58**

Table 2. Plant name which came as an output

Soil condition required	Bamboo plant	Croton plant	Fiddle leaf plant	Majesty palm	Pilea
Moisture	medium	Medium	Medium	Medium	Medium
pH	6.5	5.5	6.5	5	5.5
Temperature	75	75	75	75	75
Humidity	60	60	60	60	60

By conducting this experiment, we were able to successfully predict that bamboo, croton, fiddle leaf, majesty, and pilea plants can be planted in the black soil as the necessary conditions are met by both the black soil and the red soil to nurture these plants. If we compare the values of Table 1 in both the tables with each plant's individual values, we can see that they match with each other 95%.goal of a plant detection system using a programming language algorithm and environmental factors such as soil pH, temperature, humidity, and moisture was to analyse these parameters to determine the most suitable plant for a particular area or to monitor the health and growth of existing plants. Here's a general approach that could have been implemented:

Sensor Integration

Appropriate sensors were connected to measure soil pH, temperature, humidity, and moisture levels. Various sensors were available for each of these parameters that could have been interfaced with a Arduino uno microcontroller.

Data Acquisition

The programming language of choice, such as java, was used to read the sensor data from the connected devices. Depending on the type of sensors, specific libraries or APIs were utilized to interact with the sensors and retrieve the data.

Data Pre-Processing

The acquired sensor data was cleaned and pre-processed to remove noise or outliers. Any necessary data transformations or normalization were performed to make the data suitable for further analysis.

Plant Database

A database was created or an existing dataset was used that contained information about various plants, including their preferred ranges of pH, temperature, humidity, and moisture.

Plant Recommendation Algorithm

An algorithm was developed that compared the acquired sensor data with the plant database. The algorithm evaluated the compatibility of the current environmental conditions (pH, temperature, humidity, and moisture) with the preferred conditions of different plants. It ranked the plant based on their suitability and generated recommendations. There are several algorithms there such as decision tree algorithm which can be used for this project in by considering future purpose. The project successfully utilized a soil pH, temperature, moisture, and humidity sensor, along with an algorithm implemented in a programming language. These components worked together to predict the appropriate plant name based on the input values and the standard values associated with different plants. By integrating the sensor data and applying the algorithm, and moisture levels. Various sensors were available for each of these parameters that could have been interfaced with a Arduino uno microcontroller.

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In conclusion, to start, we obtained readings from an IoT-based project that displayed data of soil condition using pH sensor, a soil humidity sensor, a soil temperature sensor, and a soil moisture sensor on an LCD screen using an Arduino uno microcontroller. Then, we entered values for this soil condition into our java-coded software. The algorithm was used by the programme to filter the data from the csv file, which contains the typical soil requirements for 50 different plants. The programme generated a plant name that matches the input values of soil taken and standard values of plants in

a csv file by comparing the input values of soil taken and soil condition. This is how a plant's suitability for a certain soil is determined based on the soil's state and We can also determine which component in the soil is missing in order to grow a certain plant there. This gives the initiative a wider scope in the agricultural and horticultural fields.

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Rec. on 02.06.2023 & Acc. on 14.06.2023