Soil Analysis and Crop Fertility Prediction

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Abstract - *In India, farming is done by traditional method, farmer's plant crops traditionally without knowing the content of soil and quality of that soil. As a result farmers will not gain sufficient profit from there farming. The existing method of soil testing is manual method which starts by taking soil samples and then sends to laboratories for testing. This manual process is time consuming and not so feasible. Due to human intervention there are chances of human errors so farmers may receive incorrect report. So there is need of automated process for soil testing and crop prediction. Testing of soil is important because soil testing helps to determine fertility of soil and thus crop prediction can be done. So we proposed a system which will have a handheld device which gives pH value and we will estimate Nitrogen (N), Phosphorus (P) and Potassium (K) from the pH of that soil. We are using classification algorithm to predict suitable crops based on the values we get from our device and we will also provide suitable fertilizers required for that land.*

***Key Words*: Soil Fertility Analysis, Machine Learning, pH meter, NPK, Crop Prediction, Fertilizer Suggestion.**

1.INTRODUCTION

In India, agriculture is one of the important sectors as 50% workforce is involved in agricultural activities. India accounts for 7.68% of total global agricultural output. GDP of Industry sector is $495.62 billion and world rank is 12. In Services sector, India world rank is 11 and GDP is $1185.79 billion. Contribution of Agriculture sector in Indian economy is much higher than world's average (6.1%). But Traditional farms in India still have some of lowest per capita productivity and farmer incomes[8]. This sector also require a lot of human efforts to do different kind of task like watering crop, cultivating crop, spreading pesticides etc. Soil analysis is important methodology as it gives nutrients present in soil such as NPK values and pH value. In automated soil testing human efforts will be reduced by monitoring the quality of soil using soil sensor. Depending on the values we get from our device suitable list of crops is predicted. Crop prediction is also important parameter in order to increase the yield production. So on the basis of NPK and pH value we predict the appropriate crop along with the required fertilizers so that farmers will overcome the exiting method drawback.

2. Literature Survey

Paper 1:

In this paper, their proposed system determined the basic constituents of soil like pH and electrical conductivity which majorly affect the quality of soil. This system includes portable device which is made up using pH and EC sensors and Arduino board along with the analog to digital converter. Sensors sensed the pH and EC of particular soil sample gives the value to the Arduino board in real time. Analog to Digital Converter is used to convert analog ph value to digital value. Arduino board requires 9V power supply which is given by adapter and sensors require 3.3V-5V power. With the help of Arduino, pH value is converted into Nitrogen , Phosphorus and potassium which determines the soil quality. Arduino displayed NPK values on display screen and farmer have to manually enter NPK values in his own remote device application. Application will give digitally generated fertility report which contain suitable crops and required fertilizer[1].

Paper 2:

In this paper, data mining algorithms are used on agriculture data. They collected the dataset from agriculture university which contain various attributes like sample no., block no., soil type, pH value, EC, NPK. Initially datasets was in excel sheets are converted in .CSV file format to be accessed in WEKA. They used WEKA tool which is open source software for data mining. Data sets contain instances with missing attribute value, noisy data and miss-match therefore they used WEKA filter techniques. Now the soil sample will be classified into two classes either suitable soil or non-suitable soil. The major condition for this classification is if the value of pH is greater than 8.5 then soil is non-suitable otherwise it is suitable for crop cultivation. Now they apply four different classification algorithms on preprocessed dataset and compare all the results and choose one classifier which gives best result. According to their system, J48 classifier gives best result with highest accuracy. Here we conclude that data mining plays a major role to improve the crop prediction in agriculture[2].

3 System Analysis

3.1 Problem Definition

Farmer must have knowledge about soil fertility for better crop yield. Farmers must be aware of macronutrients and micronutrients present in soil to gain maximum yield of particular crop and to know which fertilizer to use. Therefore Soil Testing is major factor in Farming. In current scenario soil testing in Central government Labs takes 2 to 3 months to test particular soil sample. There are chances that Soil samples may get misplaced and farmers may get wrong reports. So we are proposing a model to automate Manual soil testing process.

3.2 Scope

Our system will analyze the soil parameters and nutrients present in soil like NPK which will help to determine fertility level of that soil. Along with soil analysis our system will also predict the crops. System will also suggest list of fertilizers for that crop according to NPK values. Farmers can test the soil multiple number of times during cultivation process and take necessary precaution to get good yield. At the end reports will be generated so farmers can keep record of their fertility.

3.3 Proposed System

The main aim of our System is to Atomize current manual soil testing procedure. In our system we are building handheld device using pH meter which will give pH value of soil. pH is negative log of hydronium ion mole per liter **pH** = - log $[H_3O^+]$.[9] With help of this pH value we will estimate NPK of that soil, which are necessary Macronutrients of soil.

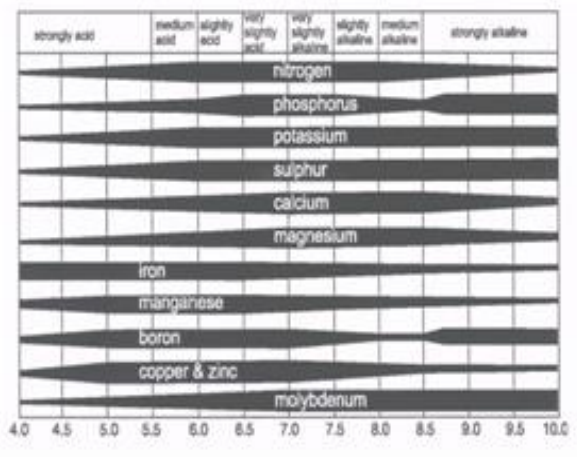

Fig -1: Nutrients present at particular pH value[1]

These will decide fertility of soil. For our software model we will be training crop database and we will classify that particular soil sample into particular class using classification algorithm. Depending on class determined by our system we will give list of crops suitable for that particular soil sample. Also provide suggestion of fertilizer for particular crop.

3.4 Working

Proposed System includes pH meter, Arduino board, ESP8266, MySQL server. Arduino board requires 9V power and ESP8266 also requires 5V power which is provided using adapter.

Fig -2: Soil Analysis Model

Our System consists of handheld device which is build using pH meter whose one wire is connected to ground and another to A0 pin of Arduino board. Initially when we insert pH meter into soil then it senses value and sends to arduino, where analog pH range is converted into actual pH range. Now this actual pH value of soil is sent to server using Wi-fi module (ESP8266). At server side we will convert pH to NPK and depending on these values we decide fertility level of soil and classify into either LOW, MEDIUM, HIGH class.

	A	B	C	D
1	List of crops	N	P	K
3	amla	400	400	250
4	baby corn	100	50	50
5	bajra	60	30	0
6	banana	400	150	440
7	beans	30	60	30
8	bitter gourd	120	60	30
9	black gram	25	50	0
10	bottle gourd	100	50	50
11	brinjal	150	50	50
12	cabbage	120	60	60
13	castor	60	40	0
14	cheak pea	25	50	0
15	chilly	150	50	50
16	cinnamon	20	20	20
17	cloves	20	20	50
18	corn(maiz)	120	60	60
19	cotton	80	40	40
20	cow pea	60	50	50
21	cucumber	135	60	30
22	drumstick	75	50	75
23	french bean	660	60	60
24	great millet	120	60	60
25	green gram	39	14.8	44.4

Chart -1: Crop Dataset[3]

This fertility class is decided by Machine Learning Classification Algorithm. Now list of crops suitable for that fertility class will be displayed. We will also provide a module where farmer can enter crop he want to grow and depending on that we will suggest fertilizer to improve yield of that crop in his soil.

4. CONCLUSIONS

In this project we implement automated soil testing method using a handheld device which will determine the pH of that soil. Then on basis of pH we will give values of nutrients i.e. NPK present in soil. On the basis of values we get from our device we predict list of suitable crops and

fertilizers. We will overcome drawback of manual soil testing process by replacing the process with our model which gives real time result. The proposed method is very efficient to use.

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