A Soil Quality detection and Crop Management System Using IOT

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***Abstract* = Indian population based upon agriculture and one third of the income of nation arises from agricultural practices. Hence it plays a vital role in the development of the country. Various issues related to farming is continuously hampering the development of the country. Possible solution for these problems is to opt for modernized agriculture that comprises of modern trends. Hence, agriculture can be made smart using IoT and other technologies. Smart agriculture increases crop yield, decreases water wastage and imbalanced use of fertilizers. In agriculture to grow healthier yield nutrients existing in the soil should be managed properly. Continuous growing of plants affects the soil fertility and its fertility level goes down. Farmers needs to consult soil testing laboratory for their soil quality to decide fertilizer dose. Consequently, by using technology the fertility of soil can be verified using various sensor-such as temperature / humidity sensor, pH sensor, and Sodium-Phosphorous- Potassium (NPK) sensor. The soil condition monitoring using IoT produces real data, which can be analyzed to decide various crop management parameters, such as watering cycle, fertilizer and pesticide cycles. Internet of Things has capacity to transform the lives of people in the India in an efficient manner. The ever-growing population would touch more in few years. So, to feed such an immense population, agriculture industry needs to embrace IOT. The demand for more food has to address challenges that include excessive climate conditions, weather change and different environmental affects that results from farming practices.**

I INTRODUCTION

The yield of agriculture is dependent on the factors like climate, minerals, soil nutrients etc. Out of these some factors cannot be changed. The only factor that can change the yield of agriculture is soil nutrients. The most important factor that stipulates the condition of the soil is pH. pH is the measure of the acid and base content of the soil. The methods to maintain soil pH by Nitrification and Liming. The main factor that changes the pH of the soil is the leaching happening to the soil. Due to the heavy rainfall, the leaching of the soil increases which results in the decrease of pH soil. The main nutrients that can increase the pH of soil is Nitrogen (N). Nitrogen is one of the main nutrients that has to be tested frequently to monitor the soil condition

About 79% of the air that we breathe contains nitrogen. Plants cannot directly use this nitrogen. The chemical nitrogen that we add convert the atmospheric nitrogen into the form that is usable by the plants. The overdose of nitrogen decreases the chlorophyll content and eventually the plant dries up. Next nutrient to be checked is phosphorus (P).

It affects the yield of the plant. Similar to Nitrogen, excess amount of the Phosphorus dries up the plant. Potassium (K) in the soil is responsible for the overall development of the plant. Potassium deficiency affects the overall development of the plant its fruit, leaf, colour, taste etc. Potassium helps in the intake of the CO2 from the soil. Moisture content of the soil is also an important factor that is needed to be monitored.

It is very important to monitor the soil nutrients for a good agriculture yield. It is proposing a new model that detects the soil nutrient contents using various chemical sensors and suggest the fertilizers that is to be added to normalize the soil. The farmers from the remote locations would need not go to the soil lab for soil testing. Instead, the sensor module would be dipped into the soil. These values would then be pushed to the recommendation server of the research lab responsible for that area. The farmers would get back the recommendation over their mobile phones. This is a lightweight, compatible, low cost fully equipped system with a web framework.

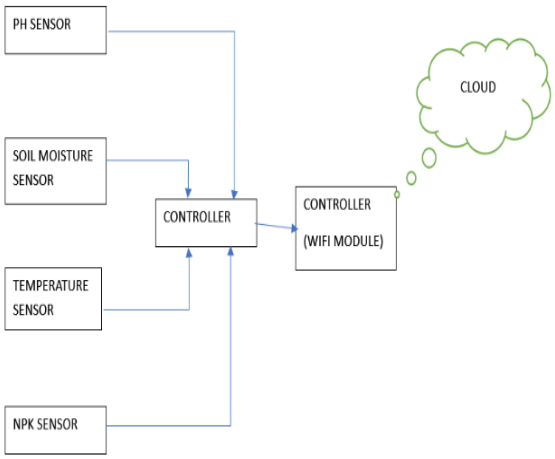
Farmer test the soil two times yearly from government entity but study says soil condition must be checked

by 4 to 5 times a year for benefits of crops. Two times checking yearly will not give accurate condition of soil, this is the disadvantage of two times testing yearly but 4 to 5 times yearly testing will give accurate information and results to crop management.

II. LITERATURE REVIEW

In literature, the problem and the earlier methods used is described. Akhil R, Gokul S, Shruti M [1] Proposed model that distinguishes the soil supplement content using different sensors and recommend the manures that will be added to standardize the soil. Shylaja N, Dr. Veena B [2] the point is to investigate the nutrients of soil progressively by estimating Nitrogen (N), Phosphorous (P), Potassium (K) values by using sensors. Divya J, Divya M, Janani V [3] the reason for this model is to give embedded based framework to soil monitoring, and irrigation to reduce the manual detecting of the field, and get the data by android application. The framework is proposed to assist the farmers with increasing the agricultural production. Prachi Sharma, Dr. D.V. Padole [4] Proposed framework is mainly for handheld device for soil analysis and results are sent using IoT. Framework is microcontroller-based gadget connected with EC sensor, pH sensor and colour sensor. Akshay Badhe, Sandeep Kharadkar, Prof. Shilpa Chavan [5] this proposed model delivers a brief indication of soil detection system with sensors. Numerous soil sensors are utilized to estimate temperature, moisture, humidity and pH information.

III. PRACTICAL SET UP



In this process we are going to test soil condition like PH of soil, NPK concentration in soil, Humidity of surrounding air, etc. This process is done by using some sensors and systems. To control all the sensors, we used raspberry pi, this will control the data flow gives the output as we needed to know. The moisture sensor is mainly used to measure the volumetric water content in soil. The soil moisture sensor that has been used in the present work is having two probes which can be inserted into the soil. The soil moisture sensor gives the output in the analog form which is converted into digital form. The final output is in the form of percentage of water level in the soil. Moisture sensor is used in various field like irrigation system and agriculture. The temperature sensor is used to detect the temperature level. This sensor consists of three pins. This sensor is very small in size and takes very low amount of energy.

This sensor comes with a waterproof module so that it can withstand in any climatic condition. NPK sensor is suitable for detecting the content of nitrogen, phosphorus, and potassium in the soil. It helps in determining the fertility of the soil. The sensor can be buried in the soil for a long time. Soil pH deals with corrosiveness or alkalinity of the soil. It is a proportion of the grouping of free hydrogen particles (H+) that are in soil. Soil pH is estimated in water (pHw) or a weak calcium chloride solution (pHCaCl). The pH ranges from 0-14, with estimation of 7 being impartial. Soil pH esteems are, Strong acridity if under 5.0. Moderate acridity in range 5.0 to 6.0. Neutral somewhere in the range of 6.5 and 7.5. Strong alkalinity for estimations of 8.5 or more. ESP8266 is an inexpensive Wi-Fi microchip. ESP8266 has integrated TCP/IP protocol stack. It has the ability to hosting an application. Every ESP8266 Wi-Fi module are in-built set up with an AT command. The range of ESP8266 Wi-Fi module is 479 meters along with rubber duck antenna. Humidity is the measure of water vapor present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important.

IV. HARDWARE USED

SR.NO.	SESNSOR	RANGE	DESCRIPTION
1	Ph Sesnor	The pH scale ranges from 0 – 14	To check ph level of soil
2	Soil Moisture Sensor	Range of 30cm to 120cm (0% -100 %)	The moisture sensor is mainly used to measure the volumetric water content in soil.
3	Temperature Sensor	-50 to +275°C	The temperature sensor is used to detect the temperature level.
4	NPK Sensor	0-1999mg/kg	It is necessary to determine how much additional nutrient content is to be added to soil to increase crop fertility

V.STANDARD DATA AND RESULT

The expected results should have comparison of PH and NPK with the standard data of PH and NPK by agriculture department which identifies the type of soil and Crop plantation, the results are as follows.

Sr. no	Sensor	Sensor std Range	Before crop seeding	Intermediate	After Crop cutting
1	PH	0-14	5-7.5	7.5-8.5	3-4
2	NPK	0-1999	130,180,110	140,195,126	125, 160 ,95
3	Soil Moisture	0-100%	50	70	30
4	Temperature	-50-275 C	29-30	25-27	31-36

VI DATA SET

The soil sample is collected at Akkalkot Road in Solapur to assess the soil's quality based on the parameters listed below. The system will recommend which crop to sow in the soil based on the machine learning algorithm's prediction of the dataset below.

Sr.no.	Nitrogen	Phosphorous	Potassium	PH soil	Soil Moisture	Temperature	humidity
1	250	0.2	0.2	6.5	30	26	35
2	270	0.4	0.4	6.8	35	27	39
3	252	0.5	0.3	6.3	60	25	41
4	258	0.6	1	6.5	62	28	42
5	256	0.7	1.2	6.2	61	26	45
6	253	0.2	1.1	6.9	60	29	48
7	252	0.8	1.6	7	58	27	43
8	261	1	2.3	7.1	54	24	55
9	262	1.1	2.5	7.3	48	21	52
10	263	1.5	2.6	7.4	56	25	53

VII DATA ANALYSIS

For analysing above dataset there are multiple approaches are there but for this system machine learning technique is used. Machine learning algorithms are methods for mathematical model mapping that are used for finding and learning about underlying patterns in data. A collection of mathematical techniques known as machine learning can recognise sensed data, regress it, and make predictions by picking up new skills from training sets of data. By using this technique, to regress which crops to be sowed based on the detected values of above parameter's regression model of machine learning is used. In theory, regression is a set of mathematical techniques used in machine learning that let data scientists forecast an ongoing result using the value of a number of predictor variables. For instance, if a sample of soil is tested and the NPK, pH, etc. values and kind of crop are displayed, it implies the system compared the data from the dataset (the training dataset) and from the sensors, matched the data, and then displayed it. Using this method, which provides 94% accuracy for soil analysis. All of the input data for the model, including pH data from a pH sensor, soil moisture data from a sensor, and NPK data from an NPK sensor, are processed by a nano-controller before being transformed to output data by a module (WIFI-module).

VIII CONCLUSION

It is feasible to track the current state and health of the soil using sensors and IoT infrastructure. The important phases involved in crop cultivation preparation of soil, sowing, adding manure, irrigation

and harvesting. Using the portable IoT device farmers can check soil quality frequently to decide fertilizer and irrigation cycle to ensure expected growth of the crop. The data generated during regular testing analyzed with machine learning algorithm can be used to prepare adequate plan to ensure proper growth of crop.

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