AUTOMATIC SOIL NUTRIENTS AND CROP DETECTION MANAGEMENT SYSTEM USING IOT

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ABSTRACT

The soil fertility is scaled by the amount of area where the soil will support the life of plant, as the soil fertility measures the quality of the soil. The nutrients and ingredients present in the soil describes its fertility, as the soil fertility is evaluated by the different types of nutrients (macro nutrients and micro nutrients), amount of water and pH level. As the nutrients of the soil is reduced after garnering so it must be filled up and to do that we should maintain the nutrients level in the soil, if deficiency found nutrients must be added to the soil.
Mostly famers add the fertilizers manually, as fertilizers play an important role for garnering the soil, the amount of fertilizer should be given in the right amount as it can harm the plant if more or less fertilizers are added. Now a days advanced Technology is used as it promises to solve the problem. Many Technologies are used for irrigation of soils and its garnering but none of them meet the actual expectation for maintaining its fertility. This research focuses on the macro and micro nutrients present in the soil and Through chemical processes nutrients are evaluated. We are presenting an automated system that controls and checks the scale of fertilizers whether the fertilizers present in the soil are in right amount or not.

Keyword : - *microcontroller, sensor, soil testing, ThingSpeak, machine learning*

1. INTRODUCTION

The soil macro nutrients are essential for the healthy growth of crops which are Nitrogen, Phosphorus, Potassium. The application of these macro nutrients has played a very great role to increase in the scale of agricultural production of crops in different parts of the world. But excess use of fertilizers can cause harm to the crops as it is a origin of contamination on surface and at ground water level. Similarly, most of the farmers have small area of land for irrigation of crops in different parts of the world. These farmers face a lot of problems and issues due to poor quality of imbalance addition of fertilizers and due to climate conditions too. Traditional methods takes a lot of time for inspection, investigation and analyzing the condition of the soil.

In to days period, modern methods and advance technologies are used to get accurate results and time consumption are also very less. So, to resolve this problem, we have come up with a proposed model that will help the farmers to measure the different parameters of the soil like temperature of soil, humidity, climatic condition(rain) and moisture present in soil. All these data are collected and transferred to the cloud known as ThingSpeak Cloud.

Various Machine Learning algorithms are implemented on the collected data. After this process, analysis of data is done which are stored on ThingSpeakCloud and after getting the results, decisions are taken that which crops will be suitable for that particular environment where farmers will irrigate the crops. Farmers can analysis and see the result of parameters using ThingSpeakApplications.

2. PRIOR AND RELATED WORK

"Amrutha A, Lekha R, A Sreedevi" [1] develops a model which detects the soil nutrients and dispenses the fertilizer on that bases using IOT. The main aim of this project is to provide dispense adequate amount of fertilizer to the field which in turn helps the farmers to get more yield. The device is basically designed to take care of the soil having micronutrients NPK insufficiency and its dispensary. This system monitors soil macronutrients such as NPK(nitrogen, phosphorous and potassium) in all situations. The Arduino board is used to compare the observed values and predefined value. An intelligent system is developed along with it so as to estimate and control of flow required amount of fertilizers.

"Vaibhav Ingale, Rashmi Vaidya, Amol Phad, Pratibha Shingare"[2] develops a standalone system which is used to test soil macronutrients as it is done in the laboratory. The color testing of soil is however done using the photo diodes, light emitting diodes, analog-to-digital converter(ADC) and FPGA. This device takes less time as fresh soil samples are directly taken into test tubes, reagents are added to that and then the solution color changes. It is also a low cost system and affordable for the farmers. It helps the farmers by saving their time and even the cost and the efforts of going to lab and testing the soil. According to the results obtained the fertilizers are recommended to increase the yield.

"Rishika Anand, Kavita Sharma, Dimple Sethi, Pooja Gambhir" in [3] developed a system whose main aim is to observe quality of the soil so that the farmer can plan and grow the crops according to the monitored data. A portable devise is prepared to monitor the same. Sensors are utilized to monitor the parameters and store the read data to cloud using microcontroller. The collected data is analyzed using hybrid algorithms(Machine Learning). With help of collected data and analysis result suitable crop is predicted.

"Arun Kumar, Abhishek Kumar, Akash De, Shashank Shekhar, Rohan Kumar Singh" in [4] has come up with a system that determines and optimizes the soil productivity and understanding the climatic conditions. It has proposed a scientific smart agro based model to fit the socioeconomic position for small scale farmers in developing countries. The system concentrates on the color solutions of soil samples to check the nutrient level. The kit gives the basic information about the pH and nutrients. A mobile application is developed for the farmer to get access to the data and visualize the results.

3. PROPOSED SYSTEM

The sensors used in this system are temperature, color, moisture and rain. These sensors are attached with node MCU microcontroller and that node MCU microcontroller is attached with cloud storage that is thingSpeak with help of Wi-Fi. The data received from the cloud is examined through android application. The crop growth depends on the environment conditions. This system is proposed to help farmers to get the data from sensor and grow the crops accordingly.

3.1 Soil moisture sensor

The soil moisture sensor is used to detect the amount of water content in the irrigation area. This sensor is used to calculate how much water is in the soil and how much irrigation is required. The water content of the soil is very important because it consists of nutrients that are necessary for the growth of plants. For plant growth, soil water is the best self- nutrient. The soil moisture is recognized using the FC28 sensor system. For measuring the water content in the soil, the FC28 unit is a simple eruption. The more water in the soil, the greater the conductivity between crops and the lower the resistance will result.

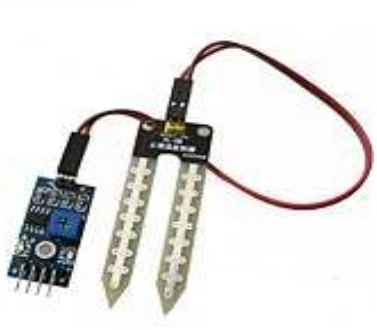

Fig -1: Soil Moisture Sensor

3.2 Temperature sensor

The temperature sensor is designed to detect the humidity and temperature of the atmosphere in which our crops need to be grown. The DHT11 sensor system is used to detect the ambient environment's temperature and humidity. The humidity range should be between 20-80% and the temperature range should be between 0-50 ° C. This sensor uses a 'thin-film capacitive' humidity sensor and a 'thermistor' to test the ambient air.

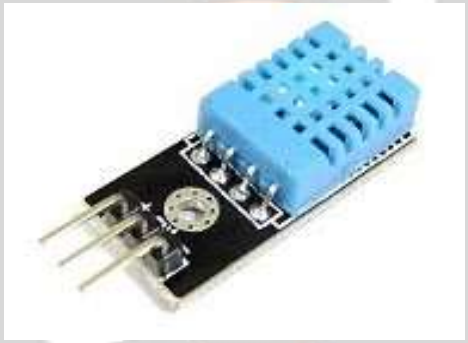

Fig -2: Temperature Sensor

3.3 Color sensor

Red-Green-Blue Frequency (RGB) is detected using color sensor. AS9100 sensor device is used in this model. These sensor consist of 4 types of filters. Red, Green and Blue filters which has 16 photodiodes and remaining 16 photodiodes has zero filters. Each has their respective color filters. The chip AS9100 is a Color Light-to-Frequency. It consists of 8 pins and 4 LEDs are used to detect the object color correctly. This chip is used to observe different colors and gives the output in respective frequency.

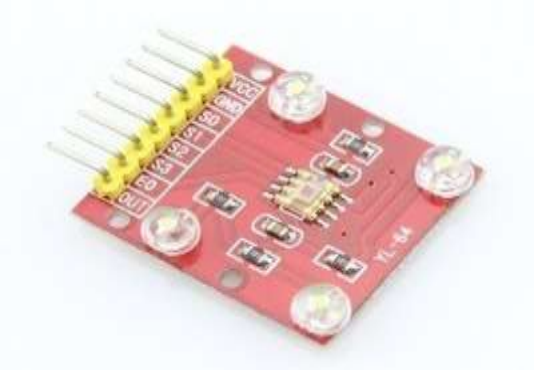

Fig -3: Color Sensor

3.4 Rain Sensor

This sensor is used to detect the rain and generate an alarm. This rain sensor is also known as rain shutoff device used to pause irrigation while there is huge amount of rain. This sensor is used to get frequently caution of rainfall, during rain irrigation is not done. If we are unaware of weather forecast this sensor will make sure the irrigation field is overwatered.

Fig -4: Rain Sensor

3.5 Microcontroller

In this model Node MCU 1.0 is used as a microcontroller. There is in-build Wi-Fi model which is used to connect SOC board with cloud storage to send observed data to cloud which can be used for improving crop production. ESP8266 is an Wi- Fi microchip this chip is fixed to microcontroller to get examine to Wi-Fi network.

Fig -5: Microcontroller

3.6 ThingSpeak -Cloud storage

Cloud storage helps to store large quantity of sensors data in devices. Data collected from sensors are preserved in servers. The cloud storage used in this model is ThingSpeak. ThingSpeak is an open IOT platform.

3.7 Android Application

The main aim of this application creation is to help farmers to get the reports directly to their mobiles. This android application is running on android platform. This is used to show the soil test reports. Required data is collected from cloud storage by using android application.

3.8 Architecture of Proposed Model

With the aid of wired connections, all four sensors connect to the Node MCU. This Node MCU connects via Wi-Fi to ThingSpeak Cloud storage, which is an integrated module in the Node MCU. Data on sensors is obtained from the Node MCU and stored in the ThingSpeak Cloud. An application called ThingSpeak View is used to help farmers use their cell phones to search soil test results.

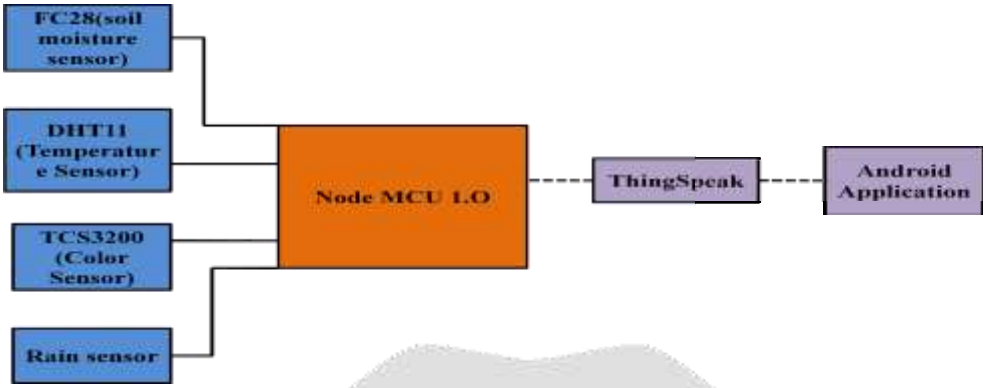

Fig -6: Block Diagram

4. LITERATURE SURVEY

The existing framework analyzes the soil test is to see the supplement extent, soil composition, and diverse characteristics as well as sharpness or pH level. Such soil take a see at will confirm ripeness, or the anticipated development potential of the soil. It shows insufficiency of supplements, potential increment in harmfulness since of over the top fertilization and thus the nearness of non-essential follow minerals.

In another framework the HSI values over RGB values is more viable. The HSI values comparing to a specific test do appear a Design. whereas the Tone esteem is diverse for diver Supplements but alter exceptionally marginally extent for a specific Supplement test. The Immersion esteem diminishes whereas the Concentrated esteem increments down the Chart for a Specific test. The Programming and Usage of the framework are done on F in this way giving an ASIC for Color Discovery.

Unexpected upon these oil sorts, climate and gather created amid prior a long time the compost prerequisites move interior a field and reliably. The Large scale supplements (Nitrogen, Phosphorous and Potassium) and Miniaturized scale supplements (Press, Zinc, and Copper) are essential for strong plant improvement. Full scale supplements are required in tremendous whole and smaller than expected supplements are required in more unassuming entireties. Both scaled down and expansive scale supplements are ordinarily procured by the roots from the soil. There are different thoughts of soil pH area strategies and developments. Soil pH may be a basic boundary for trim productivity. Soil pH impacts the soils physical, engineered and natural properties and accordingly plant engineer. Soil pH could be a extent of hydronium molecule (H+) obsession generally attempted in labs to select how much fertilizer to apply to the field. Moreover, they are utilized to screen the impact of past productivity practices on changes in a field's supplement status. Identifying all the over boundaries is conceivable with the optical diffuse reflectance recognizing, electrochemical identifying and electro conductivity identifying, and for agrarian areas a Genuine time Inserted based soil analyzer can be made with rapid and reliable robotized system which is utilized to break down distinctive soil supplements with the help of pH regard. Concurring to the availability of supplements, recommendations of creating the particular gather and authentic fertilizer will be given.

NUTRIENT UPTAKE BY MAJOR CROPS (pounds per acre)

CROP	N	P_2O_5	K_2O
Corn (180 bu)	240	100	240
Soybeans (60 bu)	325	65	140
Wheat (55 bu)	12	45	85
Rice (7,500 lbs)	120	60	170
Cotton (1,500 lbs)	180	65	155

Source: IPNI (International Plant Nutrition Institute)

Table -1: Nutrients Requirement Table

COMPARISON				
TITLE	OBJECTIVE	TECHNOLOGIES USED	ADVANTAGES	DISADVANTAGES
[1] "Automatic Soil Nutrient Detection and Fertilizer Dispensary System(IEEE 2016)"	Measuring the amount of soil nutrients & testing the level of nitrogen, phosphorous, potassium. The presence of nutrients is recognized by chemical processes and measured using sensors.	Hardware- Arduino, color sensors, relay values for fertilizers, and LCD display. Software- Arduino-mega 2560	1. Based on reading fertilizer dispensary takes places. 2. Low budget project.	Only one of the factors is measured and dispensary is decided.
[2]" A Sensor Device for Measuring Soil Macronutrient Proportion using FPGA(IEEE 2016)"	A standalone device are used to measure soil macronutrients as done in laboratories. Color is detected with exact measurement.	Xilinx ISE and FPGA.	1. The test results of fresh soil sample is detected within very less time. 2. Also the budget of the equipments is low and buyable to the farmers.	As programming language if any new value arrives the code need to be changed.
[3] "Soil moisture and atmosphere Components detection system using IOT and Machine Learning (ICIRCA 2018)"	1. Test the soil quality according to the appropriate crop to be grown as per that figure. As a microcontroller, the projected model uses the Node MCU ESP8266. 2. Temperature sensing element, rain sensing element and wet sensing element area unit usually collect completely different parameters from the farm.	Numerical modeling theory, Hydrous simulation, XBee technology and "K means, ARIMA model, KNN algorithm, data mining techniques"	1. To verify whether or not the parameters acquired from the sensors are sufficient for plant growth. 2. Think View application is used to show the test results on users mobile phone.	In unfavorable conditions the application is built to get visual and audible alert.

[4]" IoT Based Farming Recommendation System Using Soil Nutrient and Environmental Condition Detection (IEEE 2019)"	It demonstrates how an IoT (Internet of Things) based model can increase soil production. Specially, this paper describes the amount of soil nutrients and environmental conditions.	Cloud Storage – ThingSpeak, Android Application, and Sampling are done for soil testing form NPK and pH chemicals.	1. Homogeneous units based on visual observation. 2. System performance is accurate and reliable.	Both the use of hardware and software applications was solely on a technical basis in the present work.
[5] "Nutrients Detection in the Soil. International Journal on Emerging Technologies (Special Issue on ICRIET-2016) **7**(2): 257-260(2016)"	This paper focuses primarily on the study of soil micro nutrient content and soil macro nutrient content in the soil. For healthy plant growth, detecting all the macro nutrients (nitrogen, phosphorus and potassium) and micronutrients (iron, zinc and copper) is important. Parameters are useful for sensing the optical diffuse reflection factor, sensing chemistry and sensing astrophysical phenomena.	Wireless sensor networks.	1. The technology of the sensor network is very useful for farmers understand the needs of the soil, which will help them take better choices and preventive steps at the right time. 2. This will save time, labor, money and make vital use of resources.	It needs a history of crop grown during previous years and the applied throughout the year.
[6]"Sensor Technologies for Precision Soil Nutrient Management and Monitoring Published : (American Journal of Agricultural and Biological Sciences 7 (1): 43-49, 2012"	On-the-spot observation of soil nutrient consolidation at a very low budget provides the potential for higher density computation.	On-the-go soil sensor and Electrochemical sensor.	On-the-go sensors have the benefit of delivering non- toxic and rapid soil alternation measurements to alter the correctness of soil nutrient management and observation.	The presentation of soil nutrient management and observation equipment, techniques can be a step in the right direction.

[7] "Automatic Investigation of Micronutrients and fertilizer dispense System using Microcontroller (ICRIEECE) 2018"	The main objective is to detect soil nutrients and automatically distribute the requisite fertilizer.	Soil Dispenser Technology.	Soil pH and NPK detection in soil is very quick and less time-consuming.	The mainly concentrated on soil dispensing.
[8]" Soil pH Mapping of Pineapple Crop: A Feasibility Study using Aerial Photo"	Application of a standard drone camera to predict pineapple crop humate soil pH scale.	Pix4D software, MATLAB.	The relation between laboratory research and theoretical pH shows good results with a 51 percent R-squared.	The use of multi-spectral camera sensing element. In short, the following area unit predict important result of the study in the digital economy: a. Yield: maximum-regulation structural soil nutrient map. b. Massive knowledge systematic of the crop allow economical crop management. c. Forecast crop yield control, understate of capital(water, fertilizer, labor) and increase in benefit. d. Property farming incorporates the method of digital farming.
[9]"Electrochemical cal sensors for soil Nutrients detection IEEE(2018)"	Soil testing is based on nutrient guidance and developed fertilization. This consists of potentiometric chemical science sensors(ISE and ISFET) for soil NPK detection. The opportunities and challenges for chemical science sensors in soil testing were mentioned.	Micro Macro Mechanical system(MEMS) Microfluidics and Lab on valve(LOV).	Potentiometric chemistry sensors are a device that stimulates the interest of their soil nutrient detection applications. They need the ability to rapidly detect soil nutrients automatically with multi-targets.	Faced with the challenge for reliability

5. CONCLUSIONS

The IOT Based "Automatic Soil Nutrients and Crop Detection Management System using IOT" This paper reveals, but outrageous laboratory soil can be shipped to an inexpensive and value-effective soil control exploitation package to take a look at. The package is designed and the device is also coded and checked, taking into account all potential error occurrences. The soil sample is taken by the expected method since the input carries out victimization reagents for the chemical reactions. The color sensors detect related variations in the color of the sample and address them using quantitative analysis techniques. The soil wetness detector and the temperature detector were used jointly to analyze the degree and temperature of the wetness. A GPS was used to obtain the sector condition in order to realize the weather forecast from the nearest meteorological observation. The research has prompted the farmers to have different indications that finding the soil reports victimization mobile IoT - cloud-based mostly soil package - instead of counting on time daunting lab soil paper. In addition, in the system, chemicals and sensors are used rather than chemical sensors to make it reasonable for the tip farmers. Conjointly the special planning of the kit has increased the property of the system.

6. REFERENCES

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