Automatic Soil Parameters and Crop Detection Management System using IOT

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Abstract- This smart agriculture using IOT system is powered by Arduino, it consists of Temperature and humidity sensor, soil Moisture sensor, light sensor(LDR), gas sensor and Arduino module . This all is displayed on the serial monitor of arduino ide. This all is also seen in IOT where it shows information of Humidity, Moisture, temperature, light and gas level , based on this information the crop detection takes place.
Crop diseases are generally caused by pests, insects, pathogens, and have an adverse effect on the yield of the crop, amounting towards decrease in productivity of the crop. Farmers across the country are facing severe losses due to various crop diseases, and one of the main reasons preventing them from arriving at a solution is not being able to detect the disease at an early stage. To overcome this problem, we are proposing a Crop disease detect model using Machine Learning and IoT the proposed project is to develop a product which detects crop disease even from a remote area. As of now, due to lack of proper knowledge, farmers in remote places face a lot of problems in early detection of plant diseases which go unnoticed most of the time and cause severe problems.

Keywords- arduino, sensor, machine learning, data analysis.

I. INTRODUCTION

Agriculture is an utility of IoT that requires a good deal attention. By the use of IoT in agriculture field, farmers can increase the manufacturing of the crop, limit the decay of crops and minimize the value of fertilizers and other assets by means of using it time to time. Resources like water, fertilizers and seeds can be managed efficiently. Most of the farmers have small farm round the world. These farmers once in a while face the loss of crop, low yield, terrible fine of vegetation etc. Traditional methods to check out the crop and evaluation of soil is time consuming process. With the help of IoT and selections based on data, farmers can get the excessive charge of earnings and fields can be used efficiently. This reduces the value and improves the crop growth.
In today's 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, humidity, moisture content, light and gas present in soil. All these data are collected from all the 4 sensors. We have used ardinuo ide to collect data. That data is viewed using serial monitor. That data is analyzed using Machine Learning algorithms. Correct decisions are taken that which crops will be suitable for that particular environment where farmers will irrigate the crops based on the collected parameters.

II. 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.

III. PROPOSED SYSTEM

The sensors used in this system are temperature, moisture, light and gas. These sensors are attached with Arduino microcontroller and the data gathered from the sensors are stored in csv file. That data is analysed through Data analysis. The data is displayed. 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.

A. 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.

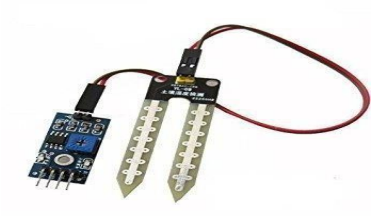

Figure 1: Soil Moisture Sensor

B. 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.

Figure 2: DHT11 Temperature Sensor

C. Light sensor:

It is apparent that plant life wants properly sun light to prepare its food and this system called photosynthesis. Plants want most appropriate amount of light not much less or no longer too much. The amount of light received on a plot of land can be measured the usage of LDR. The LDR changes its electrical resistance depending on amount of light incident on it. The quantity of light is transformed to 10-bit digital value and similarly converted to percentage out of one hundred. Zero potential no light and one hundred percent skill a lot of light.

Figure 3: Light Sensor

D. Air Quality Sensor/Gas Sensor:

The quality of air needed for the plants is measured by using gas sensor. So air pleasant is a very necessary parameter to decide the increase of crops, to do this we are using MQ 135 air excellent sensor. When MQ 135 detects poisonous gases the analog output value increases and vice versa. The analog output is transformed into 10-bit digital cost and converted to percentage out of 100.100% capacity lot of air infection and 0% capability least air contamination, so decrease the price higher the air quality.

Figure 4: MQ135 Gas Sensor

E. Microcontroller:

The Arduino Uno is an open source microcontroller board provides set of digital and analog input/output pins. It contains everything needed to support this IoT module. Using the board, it can easily connect to a computer and power source as well. There counseled range is 5v to 12v for Arduino Uno. Multiple calibrated sensors are directly connected to it for measuring the soil and environmental parameters.

Figure 5: Arduino Uno

F. Architecture of Proposed Model:

All four sensors are connected to Ardunio Microcontroller. The data collected from sensors are stored in Ardunio and that data obtained from the Ardunio is stored in the csv(coma separated file). Data analysis is done using machine learning algorithm. In basis of data collected the crop is predicted using decision tree classifier algorithm.

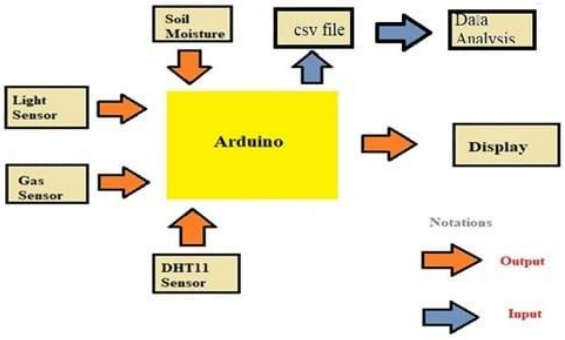

Figure 6: Block Diagram

IV. Data Analysis

Optimized use of resources is mandatory presently in agriculture to fulfill the excessive rising demand of crop manufacturing with confined quantity of minerals and resources. All the resources needed to put in the proper way to acquire the nice feasible results. Doing agriculture barring the applicable analysis of soil might also lead to wastage of time, money and land. There are a range of parameters that can impacts the evaluation part. In this lookup we have regarded 4 parameters, to take a look at whether the soil is suitable for crop production or not. These four parameters are: Temperature, humidity, moisture content, light and gas these four parameters play a very necessary position in the production of crops. As, vegetation require most beneficial temperature, moisture humidity, a appropriate amount of rain, need proper light & require gas to grow. For all the above mentioned parameters plant life have their optimum, minimal and maximal tiers for their production. Table indicates three stages of temperature for wheat and rice crop.

Table: Temperature Range for Wheat and Rice Crop

Crops --> Conditions	Wheat (Degree Celsius)	Rice (Degree Celsius)
Minimal	3-4	10-12
Optimal	25	30-32
Maximal	30-32	36-38

Analysis of accumulated information is the foremost cause of this research. Analysis section will encompass whether or not the parameters acquired from the sensors are appropriate for plant growth or not. Once this is decided with the assist of desktop learning algorithms, we can predict that these parameters got from the sensors are suitable for which crop.

After gathering the information with the help of sensors, we have transferred these facts to the microcontroller. Sensor values are stored in the csv(coma separated file). As we have now not worked on the present datasets, we have gathered the actual time records and that information was analyzed. Basis of collected parameters crop predictions is made using decision tree classifier machine learning algorithm.

Algorithm:

There are various methods available for analysis of data in machine learning. We have used decision tree classifier. A decision tree is a flowchart-like tree structure where an internal node represents feature(or attribute), the branch represents a decision rule, and each leaf node represents the outcome.

The working of the decision tree classifier algorithm is explained in the below steps:

Select the best attribute using Attribute Selection Measures(ASM) to split the records.

Make that attribute a decision node and breaks the dataset into smaller subsets.

Starts tree building by repeating this process recursively for each child until one of the condition will match:

All the tuples belong to the same attribute value.

There are no more remaining attributes.

There are no more instances.

V. Results:

We have used ardinuo ide to collect the data. The data is viewed using serial monitor. That data is analysed. Figure 7 shows the serial monitor data. Figure 8 shows the plot of serial plotter. Figure 9 shows the decision tree intermediate node. Figure 10 shows the final tree and result predicted.

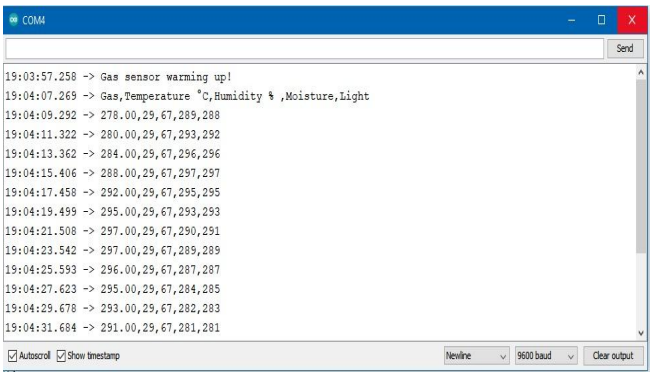

Figure 7: Serial Monitor

Figure 8: Serial Plotter

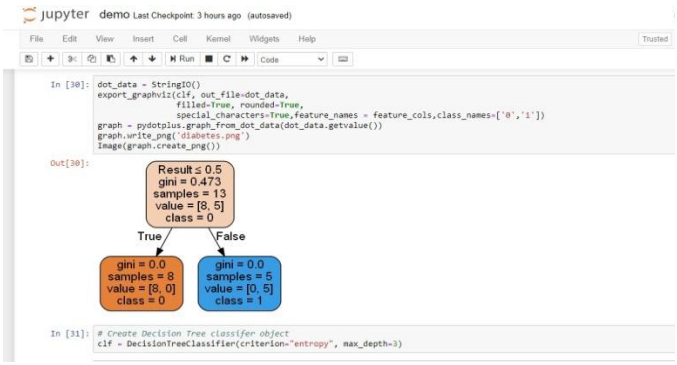

Figure 9: Decision Tree Intermediate Node

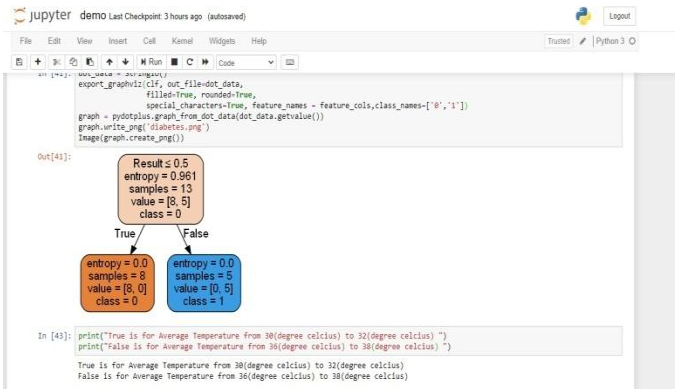

Figure 10: Final Tree & Result predicted

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 result 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 (IEEE2019)"	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 Agricultura land 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 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) Micro fluidics 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 reliablility.

VI. Conclusion & Future Scope:

The IOT Based "Automatic Soil Parameters and Crop Detection Management System using IOT" In this paper, a new model is proposed for real time soil and environment monitoring. Parameters (temperature, humidity, moisture content, light and gas) are monitored. Sensor values are stored in the csv(coma separated file). Data analysis can be done by using decision tree classifier algorithm (Machine Learning). On the basis of collected parameters appropriate decisions for crop predictions are made using decision tree classifier machine learning algorithm. Deployment model is proposed in this paper.

In the future, a greater number of parameters can be monitored. Application can be made to get visual and audible alert whenever there is any unfavorable condition. The system can be enhanced further to add following functionality: Use of soil moisture sensors, environment sensors, pH sensors to increase the accuracy while predicting the crop. Locations market requirements can be consider, and neighbor farmer's crop while suggesting the suitable crop.

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