International conference on Advanced Techniques in Communication Networking and Automation

RESEARCH ARTICLE OPEN ACCESS

Soil nutrients research and smart crop protectionusing IoT

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***Abstract*—IoT based soil nutrients research and smart crop protection for agriculture that leverages advanced technologies to enhance the productivity and sustainability of agriculture operation.The collected data is then used to make informed decisions on crop protection measures,including the temperature,humidity,soil moisture and soil ingredients.The system utilizes combination of sensors,actuators and IoT to automate the entire process,thereby reducing human intervention and improving overall efficiency.The proposed system has the potential to revolutionize the agriculture industry by providing farmers with the tools they need to optimize crop yield,reduce waste,and improve sustainability.The system is designed to collect and analyze data from environmental factors.**

Keywords—IoT,Cloud,AHT10,PIR sensor,NPK sensor,Soil moisture,Node MCU

I. INTRODUCTION

Agriculture is the consequential sector and backbone of our country.In India most of the people depend on agriculture .Approximately 53.90% GDP of Indian economy contributed by agriculture,the GVA of agriculture was 18.3%.It depends on monsoon and rainfall,It is still under development.IoT based smart crop protection food agriculture is yield to monitoring arrangements for farm safety against animal attacks and climate changes condition.

The farmer can't protect the entire farm by staying in the farm all day. So,the PIR sensor is kept in the field to watch out for the animals' motion.Soil moisture sensor detects the moisture level in soil when it starts getting wet.it will automatically start a water pump.Ensuring a more sustainable and effective food protection system.

Unfortunately, only a limited portion of the earth's surface is suitable for agriculture uses due to various limitations, like temperature, climate, topography, and soil quality, and even most of the suitable areas are not homogenous. When zooming the versatilities of landscapes and plant types, many new differences start to emerge that can be difficult to quantify. Moreover, the available agricultural land is further shaped by political and economic factors, like land and climate patterns and population density, while rapid urbanization is constantly posing threats to the availability of arable land.

II. RELATED WORKS

The numbers of research papers that are related to IoT based smart crop protection for agriculture with different techniques have been reviewed to identify various approaches to control the environmental factors of crops.As well the different methods are reported in the research paper to have also been reviewed to get ideas on how to model our irrigation system and measuring the ingredients in soil to achieve the healthy growth of a plant on the farm
Soil nutrients are elements of agriculture. Much work is being done around the world to improve soil nutrients. Estimating the nutrients present in the soil is an important factor. To improve crop management, there is now a traditional soil testing method in which farmers collect soil samples from their fields and farms and send them to nearby laboratories for soil nutrient testing[1].

Nitrogen (N), Phosphorus (P), the amount of potassium (K) can be measured with soil fertility test kits and capsules. The system consists of three different capsules, each testing for nitrogen, phosphorus and potassium. Mix the soil sample with the capsule and shake well until a complete color change is observed. The output color is compared with the rest of the existing colors. Then you can predict approximate nitrogen, potassium, and phosphorus deficiencies. Soil nutrient levels based on soil testing can be correlated with yield levels. Based on this, fertilizer recommendations are made not only to increase yields[2], but also to apply the right amount of nutrients for immediate and long-term benefits. Provided to ensure yield. LEDs and photodiodes have been successfully developed and tested with Arduino microcontrollers as alternative methods for determining N, P, or K deficiency in soil [3].

This project can solve the problem of determining the amount of nutrients in soil at a lower cost than other techniques. It can also reduce the unnecessary use of fertilizers added to the soil, which can lead to plant death and reduce plant quality and quantity. This can be determined by thresholds developed for each nutrient that determine nutrient levels at voltage levels [4]. Thissystem would be very helpful for the illiterate people as well.Furthermore, it aims to help both the educated and illiterate people by providing assistance for growing the best suitable crops in a particular land. As we are already in the

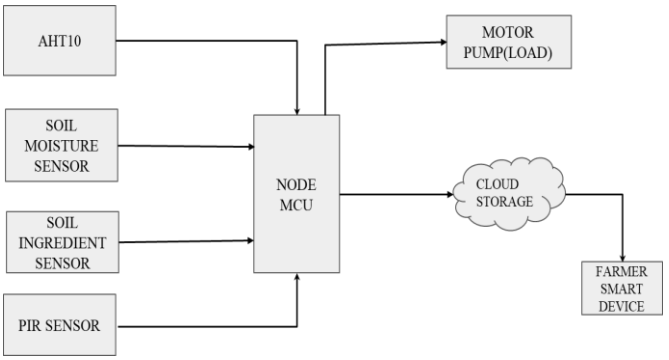
shortage of arable lands, our model will reduce the chances of growing wrong crops in a land without judging the overall outcome and will maximize the possibility of suitable crop production,which will enhance the growth of overall production[5].This summary of this paper uses with Raspberry pi is the main controlling unit in this system which activates the valve when the signal from the sensor indicates the moisture level of the soil is low or not enough. We can see all this operation from a remote location using ThingSpeak and mobile API. We can also see all this sensor data on the telegram app using bot API. Telegram is an instant messaging service like Whatapp but telegram allows you to create a new bot through which you can fetch the sensor data from raspberry pi from a remote location.bot is nothing but a small chatbox. bot API is a third party application that allows the telegram to interact not only a user but also a machine[6].using similar software applications like thingspeak cloud to get the values by the use of internet of things.There are multiple sources to show the information .

[7] The device have indicated that the performance is well, especially in collecting, logging and analyzing the sporadic data from the sensors that is transferred to central node for farmers.The device is put to test with the water and small area of soiled plantation. Further investigation is required in the aspects of water and soil variety of various places of India. Further investigation is planned for developing mobile and desktop based applications for monitoring, controlling of the device.

I. Soil essential nutrients

Elements	Abbreviation
Nitrogen	N
Phosphorus	P
Potassium	K
Sulfur	S
Calcium	Ca
Magnesium	Mg
Iron	Fe
Zinc	Zn
Manganese	Mn
Molybdenum	Mo
Copper	Cu
Boron	B

III. PROPOSED SOLUTION/METHODOLOGY



IoT sensors placed in the field can monitor various parameters such as soil moisture, temperature, pH and nutrient levels. This data can be collected and analyzed in real-time, enabling farmers to make informed decisions about when to irrigate, fertilize, and apply pesticides. Deploying IoT sensors in the field can provide real-time data on soil moisture, temperature and humidity, motion detection and soil ingredients are important parameters. This data can be analyzed to determine the optimal conditions for plant growth and protection.

Irrigation systems enable farmers to ensure that their crops have the right amount of water at the right time. These systems can be programmed to adjust the amount of water supplied based on soil moisture. You can automate your irrigation system to provide just the right amount of water according to your plant's needs. This will help prevent over- or under-watering that can damage the plant.

IoT sensors can also be used to measure nutrient levels in soil and can be used for precise fertilizer application. This reduces the amount of fertilizer needed and prevents over-fertilization that leads to nutrient runoff. This reduces fertilizer waste and minimizes the risk of nutrient contamination.

Farmers can use mobile apps to access real-time crop data, monitor weather conditions, and receive alerts when problems arise. This enables farmers to make informed decisions and act quickly.

1. Soil nutrients analysis

Soil is the stomach of crops, and its sampling is the first step of examination to obtain field-specific information, which is then further used to make various critical decisions at different stages.The main objective of soil analysis is to determine the nutrient status of a yield so that measures can be taken accordingly when nutrient defect are found.

The factors that are critical to analyze the soil nutrient levels include soil type, cropping history, fertilizer application, irrigation level, topography, etc. These factors give insight regarding the chemical, physical, and biological statuses of a soil to identify the limiting factors such that the crops can be dealt accordingly

2. Environmental analyzing factors

The system consists of esp8266 (NodeMCU),soil moisture sensor,AHT10,PIR sensor.This actuators help to gather other environmental moments and information around the crop.The farmer can access the information by owning their digital technology.

IV. RESULTS AND DISCUSSION

In this work, the system utilizes a combination of sensors, actuators have automated the entire process, thereby reducing human intervention and improving overall efficiency. The proposed system has the potential to revolutionize the agriculture industry by providing farmers with the tools they need to optimize crop yield, reduce waste and improve sustainability.

The AHT11, PIR sensor, Soil moisture sensor and NPK sensor were connected with the ESP8266.Then the ESP8266 compiles the data and sends it to the cloud by internet. And the information received by farmers' digital devices.The IoT platform levels the collected data from the field. Farmer's can watchover the field information when he is out of field at any time. Thus collected data shown in figure below.

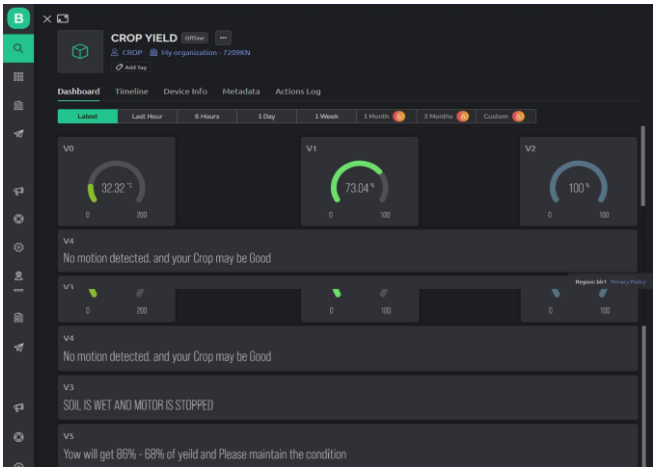


fig.1.1

The above figure shows the data of temperature and humidity, motion detection, soil moisture level. And also when the soil gets dry then a water motor starts to refine the soil, after it gets off when the amount of water level is enough to the field.

fig 1.2

The implementation of the NPK sensor detects the nutrients in the soil.where soil contains 12 major nutrients for growth for plants. The main three environmental minerals are detected, they are Nitrogen, Potassium and phosphorus, Then other essential minerals are called macronutrients and intermediate.

V. CONCLUSION

The focus on smarter and efficient crop methodologies is needed in order to meet the growing food demand of the increasing world population. the development of new methods to improve crop yield and handling, innovative younger people adopting farming as a profession or passion.Agriculture is meant as independence from fossil fuels,tracking the crops, safety and nutrients labeling, partnerships with growers, suppliers, retailers and buyers.This paper considered all these aspects and highlighted the various sensors, technologies and IoT things.Then it make the agriculture smarter and more efficient to meet future expectations.a deeper insight on recent to agriculture application.A summary of current challenges facing the industry and future expectations are listen to provide guidance to engineers and researchers.

Based on all of this content, it can be concluded that every inch of farming land is vital to maximize crop protection and also sense the soil nutrients among sufficient crops.However, to deal with every inch accordingly,the use of sustainable IoT based technologies or not optional, it is necessary.

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