

Crop Health Monitoring System using IoT

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Abstract: The Internet of things (IoT) is refashioning agriculture enabling the farmers with a decent range of techniques like precision and sustainable agriculture to face challenges within the sector. IoT technology accustomed collect information about environmental conditions such as soil moisture, atmospheric temperature, and atmospheric humidity that are favorable for various micro-organism to develop, and cause diseases in crops. IoT supports farmers to urge to connect his farm from anywhere and anytime in the world. Sensors connected to wireless networks are used for monitoring the farm conditions and microcontrollers are accustomed to control and automate the farm processes to look at remotely the conditions. A smartphone allows farmers to remain updated with the continued conditions of his agricultural land using IoT at any time and any part of the world. IoT technology can reduce the challenges and enhance the productivity of traditional farming. Farmers can access the info in real-time and it enables him to search out out the actual disease that arises because of favorable conditions of the environment. Hence farmers can take suitable steps timely to guard his crops from further damage because of disease. Real-time monitoring and accessing those data collected by sensors are also useful to agricultural ministry in formulating better policies for farmers.

Keywords: IoT, ESP-32 Dev Kit, ThingSpeak, AWS, WordPress, LabVIEW

I. INTRODUCTION

One of the most essential aspects of human survival is agriculture which is the main source of food. Unfortunately most of the farmers in our country use the normal way of farming which may be a hectic process to investigate data manually associated with soil and crops. This problem could be solved by using modern farming methods. The agriculture sector contributes a lot to the country's economic process, it's necessary to introduce the latest technologies such as IoT, automation, etc. in agriculture which relatively improves the crop production and helps in developing the economy. Implementation of automation in agriculture results in effective crop health monitoring without human involvement within the field. The Internet of things is that the network of physical objects embedded with sensors, software, and electronic components like microcontrollers, as sensors and microcontrollers cannot be connected to the internet directly. Crop productivity is dependent on a decent irrigation system, atmospheric conditions like temperature, humidity. IoT technology used in collecting information about conditions like weather, rainfall, humidity, temperature, and soil moisture. Wireless sensor networks are used for monitoring the farm conditions and microcontrollers are accustomed to control and automate the farm processes to look at remotely the conditions within the kind of image and video, wireless cameras are used. A smartphone allows farmers to stay updated with the continued conditions of his agricultural land using IoT at any time and any a part of the world. IoT technology can minimize cost and enhance the productivity of traditional farming. The use of cloud services and creating a graphical user interface will bring healthy monitoring very easy. Farmers need not to understand the concept of using the data, GUI will make it easier to take correct decisions.

II. LITERATURE SURVEY

Researchers developed a sensor network which is wireless, to observe the conditions of farming and increasing crop production and quality. Sensors are used to monitor environmental parameters such as rainfall percentage, atmospheric humidity, temperature, etc. The microcontroller ATMEGA328P and sensor nodes with wireless transceiver module supported Zig bee protocol is used in designing the system. Web application and database enables in retrieving and storing the data. In this experiment the sensor node failure and energy efficiency are monitored.

An experiment conducted on smart agriculture greenhouse monitoring system based on ZigBee technology. The system performs data acquisition, processing, transmission, and reception functions. The objective of the experiment is to understand the greenhouse environment system, where the system is efficient in managing the environmental area and reduces the cost of farming and also saves energy. The gateway has a Linux operating system and cortex A8 processor which act as a core. Overall the planning implements remote smart monitoring and control of greenhouse and also replaces the old wired technology to wireless, also reduces manpower cost. Operations and fulfillment are suitable places to prove efficiency gains.

Researchers studied the work of a rural farming community that replaces some of the traditional techniques. The sensor nodes have different external sensors namely soil moisture sensor, soil pH, atmospheric humidity, and temperature sensors connected to it. Based on the soil moisture, the sensor activates a motor for water discharging during the period of

water scarcity and switches off after the required amount of water is discharged. This leads to conservation of water and soil pH is shipped to the bottom layer and successively base layer intimates the farmer about soil pH via SMS using GSM model. This information helps the farmers to reduce the amount of fertilizers used. A development of rice crop monitoring using IoT is proposed to provide a helping hand in real-time monitoring and increasing rice production. The automated control of water discharge for irrigation and the ultimate supply of information is implemented using a wireless sensor network.

III. IOT HEALTH MONITORING SYSTEM

A. Existing System

Agriculture is the backbone of our Nation. In olden days farmers used to guess the fertility of the soil and assumed to grow which type of crop. They didn't know about the moisture, level of water, and particularly weather condition which terrifies a farmer more. They use pesticides based on some assumptions which made leads to a serious effect on the crop if the assumption is wrong. The productivity depends on the final stage of the crop on which the farmer depends.

Drawbacks of Existing System

- 1) Productivity may or may not be more
- 2) We cannot estimate weather conditions as pollution is increasing gradually etc.

B. Proposed System

To enhance the productivity of the crop thereby supporting both farmer and nation we have to use the technology which estimates the quality of crop and giving suggestions. The wireless sensor network is sensors of different types are used to collect the information of crop conditions and environmental changes this information is transmitted through the network to the farmer or devices that initiate corrective action. Some disadvantages in communication must be overcome by advancing the technology to consume less energy and also by making the user interface ease of use.

The main objective of this project is to design a smart Agriculture to monitor crop growth. The system mainly consists of ESP-32 Microcontroller, Humidity Sensor, Moisture Sensor, Temperature Sensor, Water level sensor along with LCD Display. Initially the system will collect all the parameters regarding the crop and displays in the LCD-Display.

All these parameters value is sent to the ThingSpeak server using the Wi-Fi feature of ESP-32. The server will display these values and send them to the webpage and on the GUI based on LabVIEW.

A GUI based on LabView software is made the will display the data send by the Thingspeak server. The GUI is made for agricultural ministry who can access the real-time data of a farmer's field. The GUI will also display which disease is probable to cause in particular crops due to changing environmental conditions.

The Overall system had been powered by using renewable energy resource i.e. Solar Energy. The Solar-powered system had solved the problem of sustainable development for agricultural fields. The system that we were proposing can be run on the energy derived from the sun as well as the water motor pump that is used to irrigate the fields that can also run on solar power.

The additional feature of this project is an automated irrigation facility. The farmer need not worry about watering his fields whenever the soil becomes dry. The System continuously monitors the soil moisture level and for the particular type of crop the requirement of water can be given automatically by activating motor ON/OFF.

The various environment parameters can be accessed by farmers through his phone. Farmers can access the website as well as the mobile app. The physical database that is given to farmers will help him in predicting the disease in crops. The physical database consists of different crops and their diseases with favorable conditions.

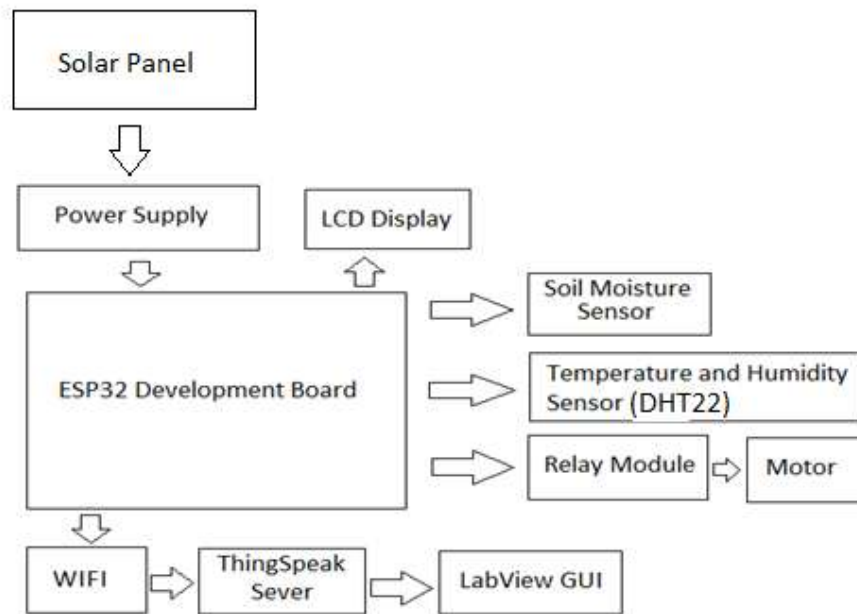


Fig. 1 Block Diagram of the System

C. Hardware Used:

- 1) *Microcontroller ESP-32* - ESP32 may be a series of a low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series engages a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules.
- 2) *16*2 Alphanumeric Display* - A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. They are used in a good range of applications including computer monitors, television, etc.
- 3) *ESP-32 Development Board* - ESP32-WROOM-32 may be a powerful, generic Wi-Fi+BT+BLE MCU module that targets a good sort of applications, starting from low-power sensor networks to the foremost demanding tasks, like voice encoding, music streaming, and MP3 decoding.

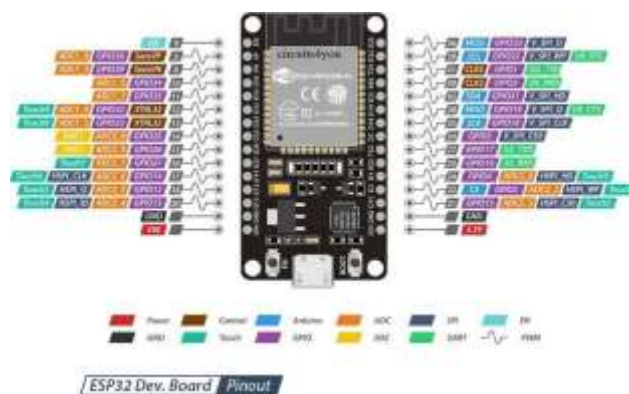


Fig. 2 ESP-32 Dev Kit

- 1) *Temperature and Humidity sensor (DHT22)* - The DHT22 Digital Temperature and Humidity Sensor Module AM2302 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to live the encompassing air and spits out a digital signal on the info pin (no analog input pins needed).
- 2) *Soil Moisture Sensor (Capacitive type)* - Soil moisture sensors measure the volumetric water concentration in the soil. Since the direct gravimetric measurement of free soil moisture needs removing, drying, and weighing of a sample. Soil

moisture sensors measure the volumetric water concentration indirectly by using some other property of the soil, like electric resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

D. Software and Platforms used:

- 1) *LabVIEW 2017 (National Instruments)* - LabVIEW is a systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights. The graphical language is known as "G"; to not be confused with G-code.
- 2)
- 3) *ThingSpeak IoT Platform* - ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieves data from things using the HTTP protocol over the web.
- 4) *AWS EC2 Server* - Amazon Elastic Compute Cloud (EC2) constitutes a central neighborhood of Amazon.com's cloud-computing platform, Amazon Web Services (AWS), by enabling users to rent virtual computers on which to run their computer applications



Fig. 3 GUI based on LabVIEW

IV. RESULTS

The project “Crop Health Monitoring System” is used to monitor the environmental conditions like atmospheric temperature, atmospheric humidity, and soil moisture. Depending on the values of these factors the health of the crop can be determined. Different pathogens that cause different types of diseases in different crops. In our project we have considered only three major crops of India i.e. Sugarcane, Wheat, and Maize.

The results of the collection of data i.e. atmospheric temperature, atmospheric humidity, and soil moisture level on ThingSpeak IOT platform and as well as on the website created based on WordPress is updated.

These data are also updated on the GUI based on LabVIEW and therefore agricultural ministry is also able to access those data.

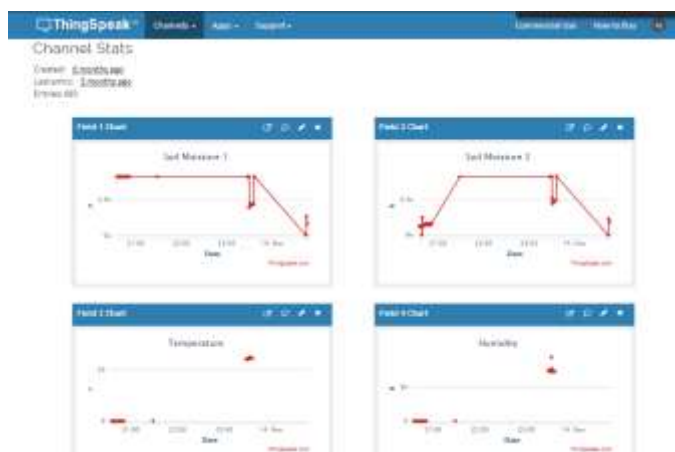


Fig. 4 Data Updated on ThingSpeak Channel



Fig. 5 WordPress Webpage for Wheat Crop

V. CONCLUSION

Monitoring plant health at a regular interval of time will help the farmers to increase the productivity at a large scale with minimum efforts. The cloud technology used will create a favorable environment for the farmers regarding the health of the plant.

The crop in farms can be yield very efficiently if the health of crop will be monitored continuously, the IoT based Crop Health Monitoring System is an embedded system based on Internet of Things and having the functionality to monitor the health of the crop efficiently and provide the information to the agriculture professionals to strengthen the agriculture sector by e-Agriculture or Agriculture Informatics.

Thus, the project proposes an idea of combining the latest technology into the agricultural field to turn the traditional methods of irrigation to modern methods thus making easy productive, and economical cropping. Some extent of automation is introduced allowing the concept of monitoring the sector and therefore the crop conditions within some long-distance ranges using cloud services. The advantages like water-saving and labor-saving are initiated using sensors that employment automatically as they're programmed. This concept of modernization of agriculture is simple, affordable, and operable.

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