AUTOMATIC AGRICULTURE SYSTEM USING IOT AND LORAWAN

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Abstract - *The progress in the technology makes everything around us smarter. Especially, the Internet of Things (IoT) plays a crucial role in each and every field these days. Even the remodeling of conventional agriculture into precision agriculture becomes simpler with the IoT. Besides, the long range analysis of the farm using low power is admissible by means of LoRaWAN. Further, a number of sensors are integrated for measuring agricultural parameters like temperature, humidity, moisture, pH values and NPK ratio. This paper elucidates the idea of automated agricultural management using IoT and LoRaWAN which in turn considerably increases the efficiency of crop yield with minimal resources.*

Keywords: IoT, LoRaWAN, Sensors, Wi-Fi module, Relay, LCD Display, Fertilizer and pesticide sprayer

1. INTRODUCTION

Agriculture is a key factor for human survival and a country's economic growth. The efficacious outcome in cultivation of crops is indispensable to meet the requirements of growing population. Hence, the implementation of technology in agriculture has been emerging in recent years. The main objective of the project "Automatic agriculture system using IoT and LoRaWAN" is attaining optimum growth by effective usage of agricultural resources. This system comprises a set of integrated sensors that collect sufficient data from the field for automating the irrigation process and the process of spraying fertilizers and pesticides. The sensors deployed in this system include soil moisture sensor, temperature sensor, humidity sensor, NPK sensor and soil pH sensor. By use of the IoT technology, these sensor data can be analyzed from anywhere at any time in the world. LoRaWAN, expanded as Long Range Wide Area Network, is deployed for analyzing a large coverage area.

2. BASICS OF IOT

IoT allows devices to be remotely controlled across the Internet, thus providing opportunities to connect and integrate the physical world into computer-based applications using sensors and the Internet directly. Connecting these multiple embedded devices will lead to automation in almost all fields and enable advanced applications. This results in improved accuracy, efficiency and economic benefits by reducing human intervention.

3. METHODOLOGY

In the accustomed way of agriculture, the irrigation method, fertilizers and pesticides spraying methods are done manually. Hence, the input may be erroneous and imprecise. This may lead to undesirable outcome and affect the crop yield as well. These difficulties can be overcome by our proposed method. In the proposed method, the agricultural based sensors are integrated to the PIC controller for gathering data that include soil moisture content, NPK value, pH level, temperature and humidity. From these data, agricultural management and monitoring is automated. Besides, the LoRaWAN protocol is included for wide coverage area. The irrigation system is controlled based on sprinkling water to the field automatically whenever the water level reaches below its threshold value. Similarly, the spraying of fertilizers and pesticides is self-regulated based on the NPK values. Further, the pH value of the soil should be maintained neutral. This is because if the soil pH value has more acidic or alkaline content, it will decay the growth of crops. Hence, soil pH is attempted to maintain almost neutral. As all the parameters are monitored and maintained the field accordingly, the outcome will be almost ideal. In addition, the sensor data are communicated to the farmers through the IoT web server for monitoring the field from anywhere at any time.

4. HARDWARE COMPONENTS

4.1. PIC CONTROLLER

PIC controller is a kind of microcontroller designed by Microchip Technology. The name PIC was initially referred to Peripheral Interface Controller, and is now being referred as a Programmable Intelligent Computer. It possesses modified Harvard architecture. PICs are considered to be fast and reliable because it is less likely to malfunctioning. Specifically, PIC 16F877A is used in this concept. This controls the functioning of sensors and other components.

Fig: PIC controller

4.2. SENSOR INTERFACING

Fig: Sensor interfacing

The sensors implemented in this system are described below:

4.2.1. Soil moisture sensor

Soil moisture sensor is used for computing the volumetric content of water present in the soil. Soil moisture sensor FC-28 is used here. It comprises two probes which is inserted into the earth. These probes let the current flow through the soil. Thus, the moisture content is estimated based on the resistance in which moisture is inversely varies with resistance.

4.2.2. Temperature sensor

Temperature is one of the important factors in agriculture for proper crop growth. Temperature sensor is used for calculating the temperature of soil and surroundings. Specifically, LM35 temperature sensor is used here. The output of LM35 is in terms of mV. For every increase in 1°C, the output voltage will raise to 10mV.

4.2.3. Humidity sensor

Humidity control is very essential in irrigation. Thermal conductivity based humidity sensor is used here for this purpose. Two thermistors with negative temperature coefficient are deployed in this sensor. Absolute humidity is measured based on the difference in the resistance values of thermistors.

4.2.4. Soil NPK sensor

Soil NPK sensor is used for estimating soil nutrient content. This measures the quantity of Nitrogen, Phosphorus and Potassium (N-P-K). The most expected NPK ratio is 4:2:1 for effective growth of crops. However, this ratio varies based on the soil. Its probe contains rust resistance, electrolytic resistance, salt and alkali corrosion resistance for long lifetime. This makes NPK sensor more appropriate for all kinds of soil.

4.2.5. Soil pH sensor

Soil pH sensor is used to determine the nature of soil based on whether it is acidic, alkaline or neutral. The ideal pH range lies between 5.5 and 7.5. If soil pH goes below or above this range, it affects the nutrient uptake of the soil which reduces the growth potential. The calibration of the hydrogen ion activity helps to determine pH range of the soil.

4.3. ESP8266 MODULE

ESP8266 is a cost effective Wi-Fi module developed by Espressif Systems in Shanghai, China. It helps to collect the data from sensors and upload those data to IoT web server. Then, the data from the IoT web server is transmitted to the farmers for their reference which in turn helps them to monitor the field easily from anywhere.

Fig: ESP8266 Wi-Fi module

4.4. LCD DISPLAY

LCD, expanded as Liquid Crystal Display, is a kind of electronic display module. It is extensively used in various applications to display any outcome as it is cost effective and it doesn't possess any limitations to display custom and special characters. Here, it is used for intimating the NPK content of the soil which is collected from NPK sensor.

Fig: LCD Display

5. SOFTWARE REQUIREMENTS

5.1. Embedded C

Embedded C has an important role in enabling the microprocessors and microcontrollers for performing preferrable actions. It plays a crucial role in monitoring and controlling external devices. It has significant role in any embedded systems similar to hardware devices for desirable outcome.

5.2. CCS C Compiler

CCS C Compilers are the advanced compilers with highly developed library packages. These compilers include a complete library of built-in functions, pre-processor instructions, and example programs that are ready to quickly start any project. CCS IDE C Integrated Products offers a unique Profile Tool to track time and usage information, code blocks, and live streaming data from active systems. Proven tool chains include a full line of programmers and debuggers, hardware operating systems, and software development kits
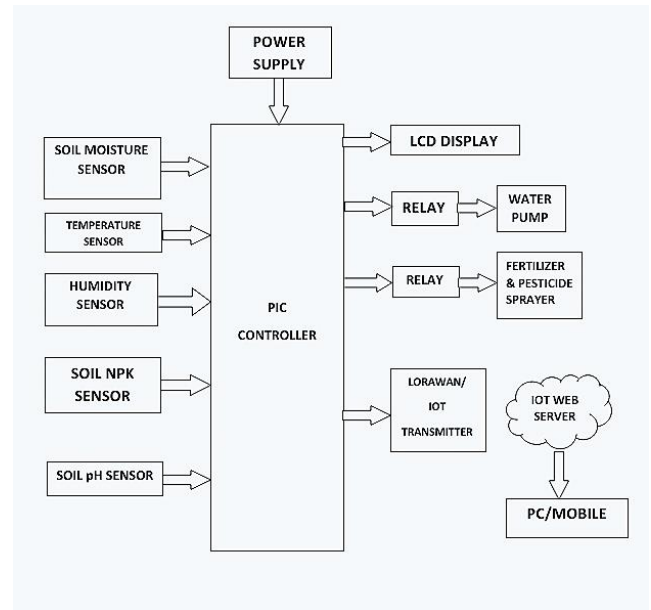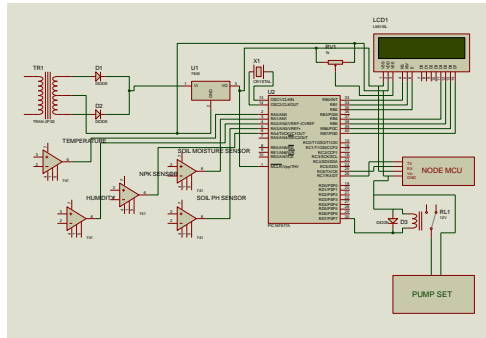
6. BLOCK DIAGRAM

Fig: *System block Diagram*

7. CIRCUIT DIAGRAM

Fig: Circuit Diagram

8. CONCLUSION

This paper elaborates the idea of integration of automatic irrigation and spraying of fertilizers and pesticides which will promote the crop growth highly as it analyzes all the parameters effectively. Besides this, it insists efficient usage of resources. In order to meet the growing food demand due to raising population, it is very crucial to focus on smarter, better and more efficient crop growing methodology. This smart agriculture system based on IoT and LoRaWAN provides a one-step solution for almost all agricultural requirements. Thus, conclusively, this concept provides promoted crop yield to resolve food demand as well as reliable communication to the farmers. This will ease the process of maintenance of farm in a well efficient manner.

9. REFERENCES

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