Automated Precision Farming using Internet of Things

Himanshu Gupta, Vinita Pareek, Richanshu Mishra, Lavanya K

Abstract: **Smart farming has gained worldwide popularity and has been growing rapidly in the agricultural field. The main factor for the success of the precision farming is the use of sensors for continuous and automatic measurement of different field values. In our system, these sensors are attached to the depth of the soil which helps detects the soil pH and moisture which in turn determines the physical and chemical properties of the soil. The sensors check for soil moisture and start the irrigation automatically after the soil becomes too dry. The pH of the soil determines the nutrients availability in the soil. The system determines the nutrients which are deficient in the soil and sends a message to the farmers informing about the same.**

Keywords: Precision Farming, Automated Agriculture, Arduino, Internet of Things, Humidity Sensor, pH sensor

I. INTRODUCTION

The world is currently facing a situation of the food crisis, as the population is expanding immensely while the amount of food produced all over the world is not sufficient. This crisis places a stress on the amount of quantity and quality of food produced globally. This has heralded a change in the methods and ways of agricultural management which will ensure food security for years to come.

As far as farming is concerned, traditional farming was restricted to a family or within a village. Usually, these methods and practices are passed down the family for generations to come. When problems used to arise, humans used to inspect the problems and come up with solutions. The major limitation of this traditional method is that a multitude of the factors influencing farming is dependent on natural environmental conditions i.e., weather, soil conditions and global warming issues such as famine and drought. Usually, such traditional and age-old methodologies fail to help the farmers combat the issues. This calls for newer methods to be developed which are adept with various factors pertaining to farming, for instance, precision agriculture. In this approach, productivity maps are produced which provide in-depth information and knowledge for extensive farming zones. [1].

The basic idea of the lOT is that virtually every physical thing in this world can also become a computer that is connected to the Internet. To be more accurate, things do not turn into computers, but they can feature tiny computers [2]. The use of IOT improves production and lifestyle through dynamic methods. This is useful for integration and harmony between human society and the physical world and is regarded as the third wave of information industry development following computer and the internet [3].

Precision agriculture concentrates on providing the means for observing, assessing and controlling agricultural practices. It covers a wide range of agricultural concerns from daily herd management through horticulture to field crop production [4, 5, 6].

One key idea of new practices in agriculture is the use of technology to measure or monitor field and crop conditions in order for farmers to make informed decisions in various parts of their farming process. Sensors for continuous and automatic measurements of different field values are one of the main success factors for precision agriculture. Characterizing spatial variability of soil nutrients in relation to site properties, including climate, land use, landscape position and other variables, is important for understanding how ecosystems work and assessing the effects of future land use change on soil nutrients [7].

II. RELATED WORKS

In this paper[8], the author explains about automated irrigation system with the goal to increase the productivity by achieving the optimum water supply. The increasing worldwide shortages of water and costs of irrigation are leading to an emphasis on developing methods of irrigation that minimize water use. The system has been developed by creating a wireless network of soil moisture and temperature sensors which are placed in the root zone of the plants. The system controls the water quantity with the help of the moisture sensors being programmed in a microcontroller.

In this paper[9], author has proposed a microprocessor-based controller which is used for providing watering to different zones of an area of land with help of solenoid water valve in series with spray heads or drip irrigation tubes. Moisture sensors are associated with each zone and provide an electrical signal proportional to the degree of moisture in the soil to the microprocessor. This system monitors the soil condition and controls the flow of water on an “as needed basis”.

In this paper[10], the author explained that soil pH is probably the single most informative measurement that can

be made to determine soil characteristics. pH is an important factor which tells a lot about the soil than merely indicating whether it is acidic or basic. This pH helps us determine the soil properties, the various minerals and nutrients.

III. SYSTEM ARCHITECTURE

The use of sensors which are compatible with Arduino makes our system cheap and power effective. It allows the farmers to automate the farming process which reduces the farmer's labor task exponentially. The suggested system consists of three segments i) Sensor Segment ii) Arduino iii) Server Segment. These different segments of the framework incorporate switching the irrigation based on the soil properties as well as determine the nutrients which are deficient in the soil. The components of each of the three segments are discussed in the following section

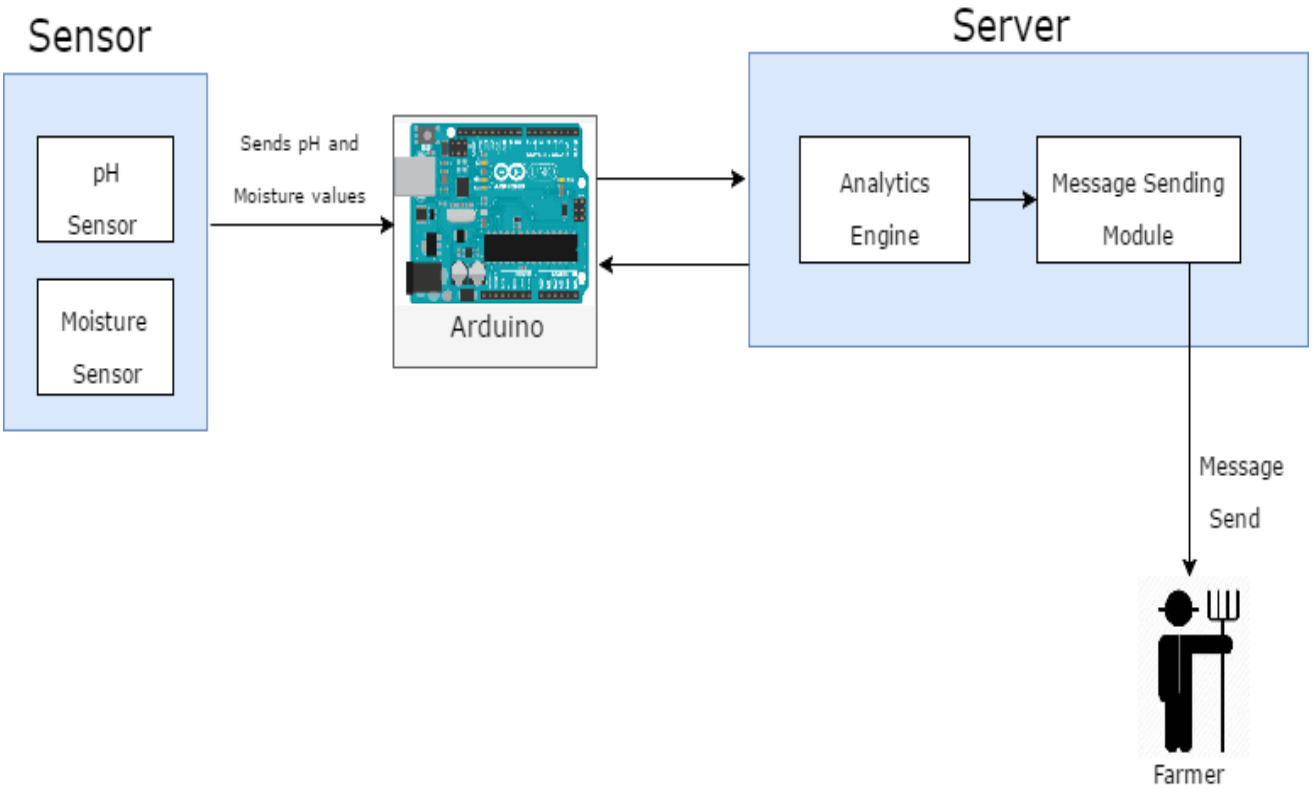

Figure 1. Proposed Precision Agriculture System

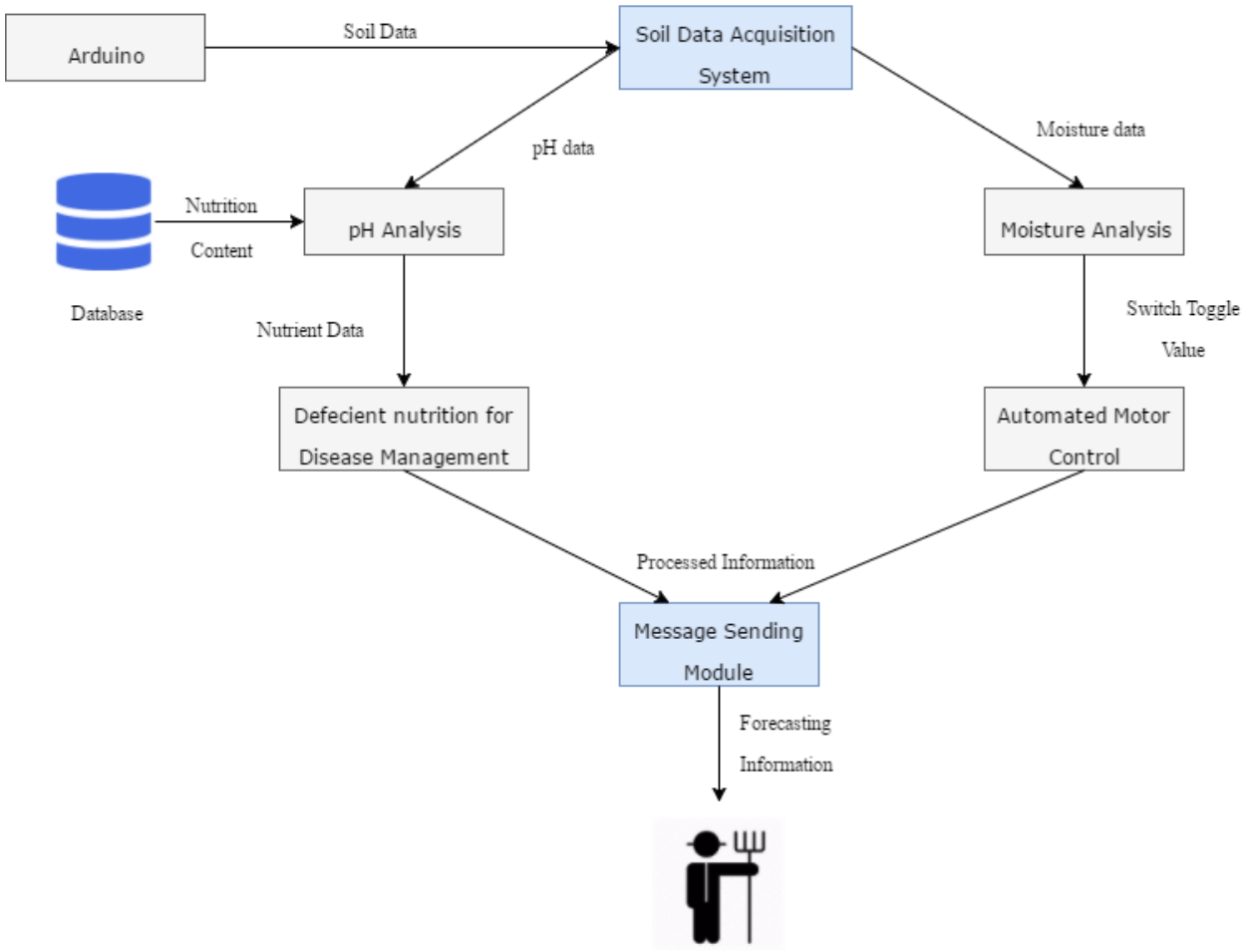

Figure 2: Analytics Engine

IV. COMPONENTS

1. *Sensor Kit*

This module consists of two sensors**:** pH sensor and Soil moisture sensor. These sensors are attached to the root of the soil.

The soil moisture sensor measures the amount of water per unit volume indirectly by using certain properties such as electrical resistance, dielectric constant or interaction with neurons.

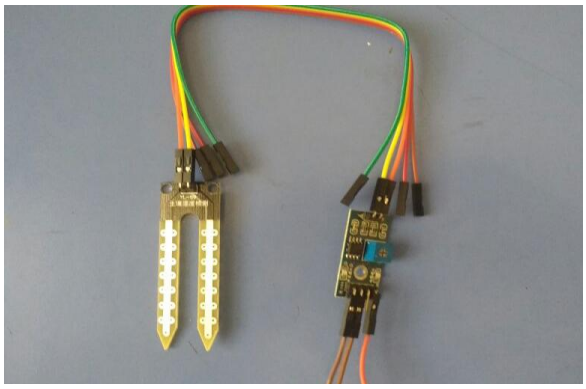

Figure 3: Yl-69- Soil Moisture Sensor

2. Arduino Uno

Arduino is an open source electronic platform which uses a variety of microprocessors and controllers. The board consists of various input/output pins (analog and digital) which can be connected with various circuits and sensors.

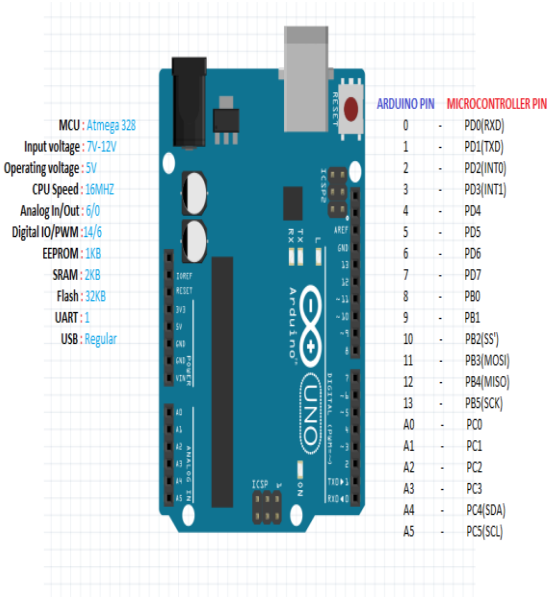

Figure 4: Arduino Uno Board

The Uno is a microcontroller board in light of the ATmega328P. It has the following component types:

1. MCU- Atmega 328

2. Input Voltage- 7V-12V

3. Operating Voltage- 5V

4. CPU Speed-16MHz

5.Analog in/out- 6/0

6. Digital I/O/PWM- 14/6

7. EEPROM- 1KB

8. SRAM- 2KB

9. Flash- 32KB

10. UART-1

11. USB-Regular

3. Server

The sensor readings are parsed from Arduino to Python scripts. The Python script sends this data to the remote server by making HTTP requests. The two fragments which constitute the server segments are i) Analytics Engine ii) Message Sending Module.

a. Analytics Engine

Figure 2 depicts our Analytics Engine. The pH and moisture values of the soil are uploaded to the server where the role of analytics engine is to analyze the values. The analyzing of the pH values determines the nutrient content of the soil. The standard nutrient data (Table 1) is stored in the database. The analytics engine matches the soil nutrients with the pre-defined data. The analyzed data results in determining the nutrients which are deficient in the soil. The analyzing of the soil moisture values helps in determining the dryness of the soil. The analyzed results determine the action of the motor in the field.

b. Message Sending Module

The message sending module is used to inform the farmers about the nutrient content of the soil. This helps farmers in realizing the nutrients which are deficient in the soil and in turn selecting the appropriate fertilizers to balance the nutrient content in the soil.

V. WORKING OF THE SYSTEM

In our proposed precision farming system, the farmer can install the sensors in the soil. The moisture sensor reads the moisture content of the soil. The sensor sends the information remotely to our remote server which gathers the information, analyzes it and display as required. The knowledge base of our system is based on Internet of Things which reads these values and compares with our threshold values. If the moisture goes below the minimum threshold value, the system will trigger the motor which will start the irrigation system.

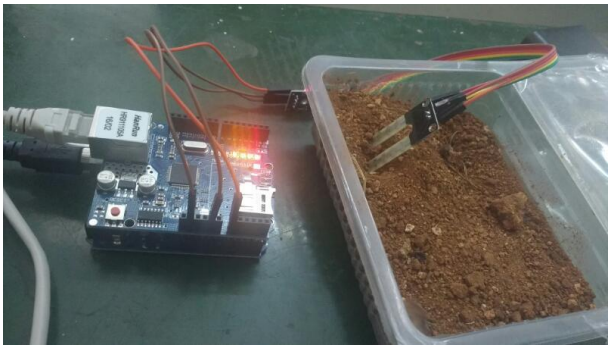

Fig 5 : YL-69 sensor in soil attached to Arduino

As soon as the moisture of the soil reaches the maximum threshold value, the system will automatically stop the irrigation. This will prevent the unnecessary flow of water to the field and result in a better yield of crops. The farmer can set the maximum and minimum threshold values according to the requirement of the various crops.

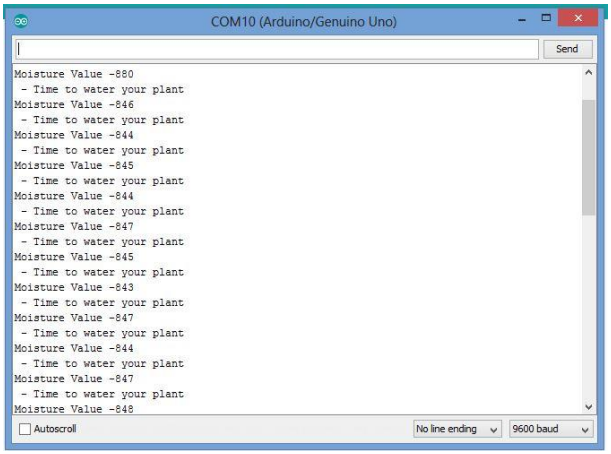

Fig 6: The moisture Reading showed on Serial Monitor

The server will do the pH data analysis which helps in determining the nutrient content. It will help in realizing the nutrient deficiency (if any) in the soil.

ID	pH	Nutrient
1	6.3	Potassium and Nitrogen Sufficient. Phosphorus Defecient
2	7.2	All Nutrients Sufficient
3	5.2	All nutrients defecient
4	7.4	All Nutrients Sufficient
5	8.2	Potassium Sufficient. Nitrogen and Phosphorus Defecient
6	6.9	Potassium and Nitrogen Sufficient. Phosphorus Defecient
7	7.6	All Nutrients Sufficient
8	6.4	Potassium and Nitrogen Sufficient. Phosphorus Defecient
9	5.2	All nutrients defecient
10	7.4	All Nutrients Sufficient
11	8.3	Potassium Sufficient. Nitrogen and Phosphorus Defecient
12	7.2	All Nutrients Sufficient
13	6.6	Potassium and Nitrogen Sufficient. Phosphorus Defecient
14	5.3	All nutrients defecient
15	6.2	Potassium and Nitrogen Sufficient. Phosphorus Defecient
16	7.3	All Nutrients Sufficient

Fig 7: Analysis of pH values of soil

The message sending module sends a message to the farmers notifying them about the current moisture and pH level along with the nutrient analysis results.

Fig 8: Message regarding the soil conditions

With the above results, we can say that the system is working properly and there is hardly any chance of any error unless a system breakdown occurs. The system works efficiently with a good response time making it reliable.

VI. CONCLUSION

The proposed precision farming system is an integrated system to help the farmers to automate the entire process in order to get a better yield. The system helps in reducing the labor task by eliminating the need to check the moisture level in the soil manually. The system controls the irrigation process by reading the moisture level in the regular interval. The entire control of the system is with the farmers, beginning from setting the threshold values to getting the messages from the system about any actions performed. The farmers can override any task according to their needs in case of any failure.

VII. REFERENCES

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