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IOT Based Soil Monitoring System for Smart Agriculture

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Abstract:

Agriculture is done in every country. Technology brings a remarkable advancement in every area and it is necessary to update on agriculture too. Internet of Things (IOT) plays a key role in smart agriculture. In the field of agriculture, the major challenge is monitoring soil parameters such as soil moisture, temperature, pH level. In this paper, we proposed an IOT based soil monitoring system to monitor real time parameters of soil and environment using various sensors such as soil moisture sensor, soil pH Sensor and temperature sensor. The proposed system helps the farmers to maximise yield, reduce disease and optimise resource. In this system, soil is monitored using various IOT sensors. Data from the IOT sensors are then transmitted to a cloud for analysis. Based on the analysis result farmer can cultivate the appropriate crops that suit for the soil

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I. Introduction

Agriculture plays a vital role in supporting human life. The rise of population is proportional to the increase in agriculture production. Agriculture was the key development in the rise of sedentary human civilization. Agriculture is done manually from ages. As the world is trending into new technologies and implementations it is a necessary goal to trend up with agriculture also. IOT plays a very important role in smart agriculture. IOT sensors are capable of providing information about agriculture fields. The IOT allows to automate and control the task that are done on a daily basis, avoiding human intervention.

Soil moisture sensors measure the water content in the soil and can be used to estimate the amount of stored water in the soil horizon. pH sensors provide critical feedback regarding soil nutrient deficiencies or the presence of unwanted chemicals. Soil temperature sensor is a soil temperature sensor that can monitor the temperature of soil, atmosphere and water

Soil test reports will generally provide appropriate fertilizer application recommendations for nitrogen, phosphorous, potassium and limestone. Soil testing also determine the micronutrient requirements of different crops. If too little fertilizer is applied to the crops, the returns will be lower. Similarly, too much of fertilizer will waste the time, money and risk environmental damage due to nutrient runoff.
In this paper we proposed soil monitoring system to effectively test the soil properties. This system provides a farm management tool with a potential benefit to the farmer of increasing yields, reduced operating cost and superior environmental risk management.

II. Literature Review

[1] This paper focuses on literature of the development of a wireless sensor network on agricultural environment to monitor environmental conditions and deduce the appropriate environmental parameters required for the high yield of crop production on a given farmland.
[8] A novel wireless sensor network architecture is proposed in this paper for most of the crops in Indian environment in order to achieve less water consumption and more productivity. Densely populated sensors with

low power are suitable for short term crops and thinly populated sensors with high power are suitable for long term crops.

[12] This paper presents a wireless sensor network of low-cost sensor nodes for soil moisture that can help farmers optimize the irrigation processes in precision agriculture. Each wireless node is composed of four soil moisture sensors that are able to measure the moisture at different depths. Each sensor is composed of two coils wound onto a plastic pipe. The sensor operation is based on mutual induction between coils that allow monitoring the percentage of water content in the soil.

[13] Wireless sensor networking is gaining popularity for managing precision agriculture through real-time monitoring of agricultural parameters and climatic conditions. Reasonable simulation tools exist for evaluating large scale sensor networks; however, they fail to capture practical aspects of wireless communication. Real life test-beds bring out actual challenges and important aspects related to large-scale deployment of sensor networks. This paper presents a testbed implementation of a wireless sensor network for automatic and real-time monitoring of soil and environmental parameters influencing crop yield.

III. System Architecture

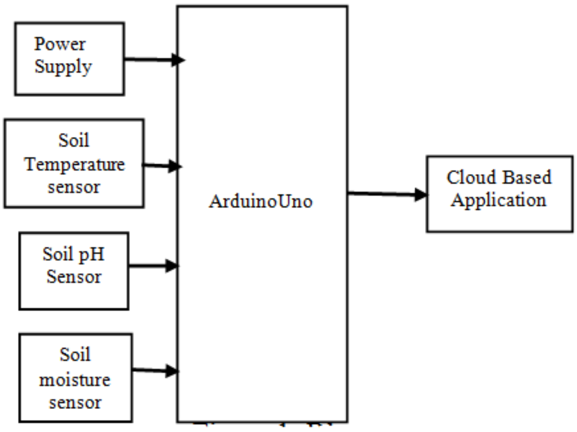

Figure 1: Block Diagram

System Requirements:
1. Soil temperature sensor
2. Soil pH sensor
3. Soil moisture sensor
4. Arduino Uno
5. Arduino IDE
6. Cloud Based Application

Soil temperature sensor:

Figure 2: Soil temperature sensor

Soil temperature sensor is a soil temperature sensor that can monitor the temperature of soil, atmosphere and water, and is used in experiments and scientific research. Soil temperature is abbreviated as ground temperature, which is the general term for surface temperature and ground temperature. The soil temperature is closely related to the growth and development of crops, the decomposition of fertilizers and the accumulation of organic matter. It is an important environmental factor in agricultural production. Soil temperature is also an extremely important factor in the formation of microclimate, so the measurement and research of soil temperature is an important part of microclimate observation and agrometeorological observation. The rise and fall of soil temperature is mainly determined by the size and direction of soil heat flux, but it is also related to soil thermal properties such as soil volume heat capacity, thermal conductivity, density, specific heat and porosity, and soil moisture content. For non-horizontal surfaces, it is also related to the position and size of the slope.

Soil pH sensor:

Figure3: Soil pH Sensor

A pH meter relies on a voltage test to determine hydrogen ion levels and thus pH. The more hydrogen ions in a solution, the more conductive it will be. So, the more acidic a solution, the more electricity it will conduct. This is what the pH meter relies on. In order for electricity to flow around a circuit, it must be complete. A pH tester circuit is completed by the test sample. The sample soil comes into contact with two electrodes which are found on the probe.

An electrode is a part of a circuit which comes into contact with non-metallic elements. The electrons travelling around the circuit are attracted to the electrodes' membrane. pH meters have two electrodes, a glass electrode and a reference electrode. The glass electrode has a permeable membrane made from specialised glass, which houses a chemical solution and a silver-based wire. The reference electrode is also made up of a wire in a chemical solution.

The reference electrode is stable and works as a buffer and a reference against which the other electrode can be compared, and the pH determined. The glass electrode attracts the hydrogen ions. This then creates a small voltage which can be compared to the reference electrode. The voltage difference between the two electrodes is then sent as a signal to the indicator, which is translated into a pH reading.

Soil moisture Sensor:

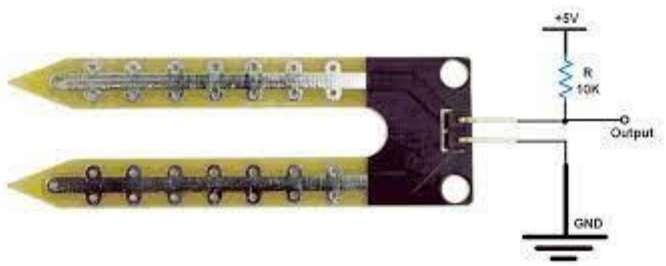

Figure 4: Soil moisture Sensor

The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

The relation among the calculated property as well as moisture of soil should be adjusted & may change based on ecological factors like temperature, type of soil, otherwise electric conductivity. The microwave emission which is reflected can be influenced by the moisture of soil as well as mainly used in agriculture and remote sensing within hydrology.

These sensors normally used to check volumetric water content, and another group of sensors calculates a new property of moisture within soils named water potential. Generally, these sensors are named as soil water potential sensors which include gypsum blocks and tensiometer.

ArduinoUno:

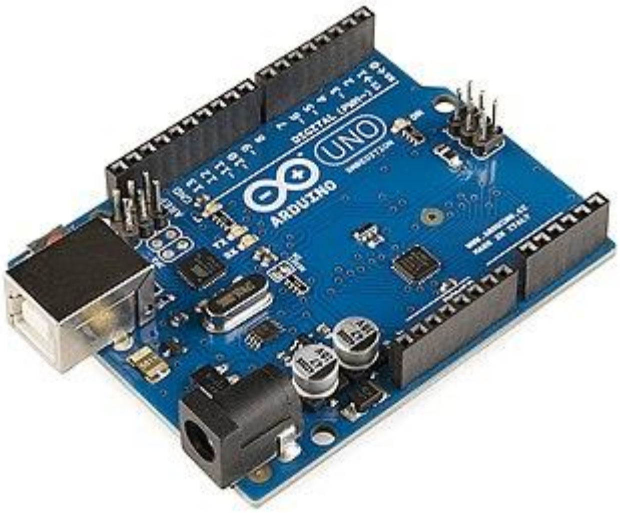

Figure 5: ArduinoUno

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

Cloud based Application:
Cloud based application consists of front-end UI design to get various input data, Decision tree algorithm for analysing the data, final output that contain the crop recommendation.

Decision Tree Algorithm:
Decision tree Algorithm plays a vital role in prediction by making decisions at every level in the binary tree. Decision tree can be used to visually and explicitly represent decisions and decision making. It uses a tree-like model of decisions. Though a commonly used tool in data mining for deriving a strategy to reach a particular goal, it’s also widely used in machine learning.

The Basic Decision tree learning algorithm:
1. INPUT: A set of learning instances.
2. OUTPUT: A regression tree.
3. If the stopping criterion is satisfied then
4. Create a leaf that corresponds to all remaining
learning examples
else
5. Choose the best (according to some criterion)
attribute Ai
6. Label the current tree node with Ai
7. For each value Vj of attribute Aido
8. Label an outgoing edge with value Vj
9. Recursively build a subtree by using a corresponding
subset of learning examples
10. end for
11. end if

IV. System Implementation

- At First, the Arduino UNO R3 is connected with various Analogue sensors such as soil moisture sensors, pH sensors and temperature sensor
- Arduino board sends the collected sensor information to the cloud-based application.
- Cloud based application stores the data in database.
- This data is processed using decision tree algorithm
- At last, the Final output is displayed on the screen.

V. Experimental Results

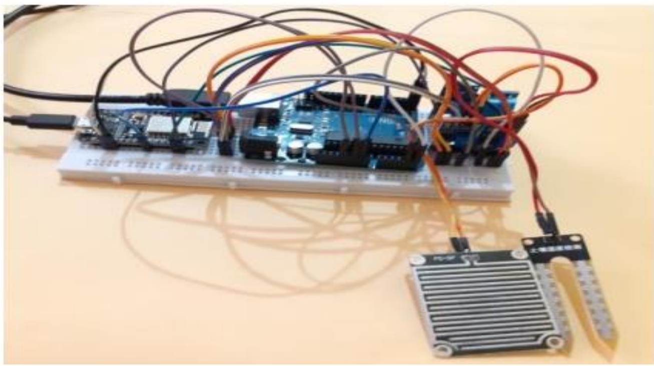

Figure 6: IOT Module

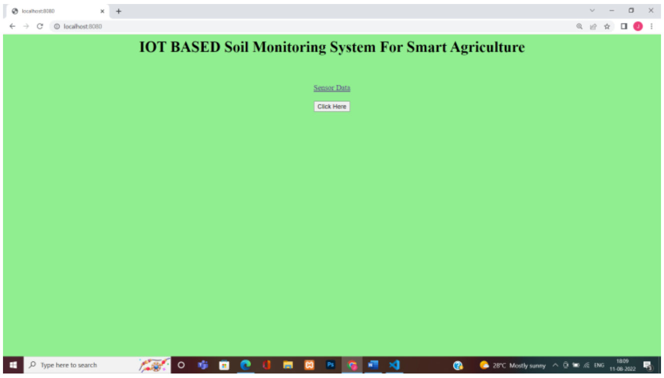

Figure 7: Front UI Design

Figure 8: Predicted Sensor Data

Figure 9: Result

VI. Conclusion

The crop prediction is an important task in agricultural domain. Farmer or Agriculturist may tend to choose the non-favourable crop without considering soil parameters. This Soil monitoring system helps in obtaining the nature of the soil by extracting the behavioural content of the soil using different IOT sensors. This system reduces the farmer's difficulty to find appropriate crops for their fields. Also, this system provides the suggestion to the former to choose appropriate crops for their fields. The proposed system helps to increase the agriculture production by suggesting the right crops.

References

[1]. Joshi P , Dr.Kanade S , Dr.Joshi S , Wireless Sensor Network and Monitoring of Crop Field, IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 12, Issue 1, Ver. II (Jan.-Feb. 2017), PP 23-28,www.iosrjournals.org

[2]. Oliveira, L. M., & Rodrigues, J. J., Wireless Sensor Networks: A Survey on Environmental Monitoring. JCM, 6(2), 2011, 143-151.

[3]. Wang, N., Zhang, N., & Wang, M., Wireless sensors in agriculture and food industry—Recent development and future perspective.Computers and electronics in agriculture, 50(1), 2006, 1-14.

[4]. Srbinovska, M., Gavrovski, C., Dimcev, V., Krkoleva, A., & Borozan, V., Environmental parameters monitoring in precisionagriculture using wireless sensor networks. Journal of Cleaner Production, 88(1), 2015, 297-307.

[5]. Akyildiz, I. F., Su, W., Sankarasubramaniam, Y., & Cayirci, E., A survey on sensor networks, IEEE Communications magazine,40(8), 2002, 102-114.

[6]. Abbasi, A. Z., Islam, N., & Shaikh, Z. A., A review of wireless sensors and networks' applications in agriculture, ComputerStandards & Interfaces, 36(2), 2014, 263-270.

[7]. Kim, Y. D., Yang, Y. M., Kang, W. S., & Kim, D. K., On the design of beacon based wireless sensor network for agriculturalemergency monitoring systems. Computer standards & interfaces, 36(2), 2014, 288-299

[8]. S.Tamilselvi, Dr.S.Rizwana, Monitoring Agricultural Crops through Wireless SensorNetworks, IOSR Journal of Engineering (IOSRJEN) www.iosrjen.orgISSN (e): 2250-3021, ISSN (p): 2278-8719PP 77-80 . Y. Zhu, J. Song, and F. Dong, "Applications of Wireless Sensor Network in the agriculture environment monitoring," ProcediaEng., vol. 16, pp. 608–614, 2011.

[9]. L. Zhao, S. Yin, L. Liu, Z. Zhang, and S. Wei, "A crop monitoring system based on wireless sensor network," Procedia Environ.Sci., vol. 11, no. PART B, pp. 558–565, 2011.

[10]. A. Tagarakis, V. Liakos, L. Perlepes, S. Fountas, and T. Gemtos, "Wireless sensor network for precision agriculture," Proc. - 2011

[11]. Panhellenic Conf. Informatics, PCI 2011, no. September, pp. 397–402, 2011.

[12]. N. Sakthipriya, "An effective method for crop monitoring using wireless sensor network," Middle - East J. Sci. Res., vol. 20, no. 9,pp. 1127–1132, 2014.

[13]. Jaime Lloret,Sandra Sendra, Laura Garcia, and Jose M. Jimenez, A Wireless Sensor Network Deployment for Soil Moisture Monitoring in Precision Agriculture, Sensors (Basel). 2021 Nov; 21(21): 7243.Published online 2021 Oct 30. doi: 10.3390/s21217243

[14]. Manijeh Keshtgari, Amene Deljoo,A Wireless Sensor Network Solution for Precision Agriculture Based on ZigBee Technology,Vol.4 No.1(2012), Article ID:16586.