IoT Based Soil Quality Examination System

Atul Suresh Pawar[1] Prof. Priyanka Shingane[2] Pankaj Yuvraj Pawar[3] Saif Irfan Siddiqui[4]
[1,2,3,4]Department of Information Technology
[1,2,3,4]Ramrao Adik Institute of Technology, Nerul, India

Abstract— In Agriculture, India plays a significant role in developing food production. The sustainability of the environment can only be achieved by maintaining and improving the quality of soil. Soil quality is determined as an important factor, as it determines the capacity of a soil to function. Soil quality assessment or examination focuses on dynamic aspects of the soil for evaluating the sustainability that is avoidance or removal of the depletion of natural resources in the soil, in order to maintain an ecological balance on soil management practices. Considering the sustainability of the soil, the inherent and dynamic factors, are introduced. It focuses on applying the intelligent and skilled knowledge in land evaluation so that we can predict, examine and monitor the soil quality. In order to handle the soil quality examination challenge, the proposed system is based on web-based sensor technology for determining the various factors related to soil such as PH, Moisture, Humidity, etc. From an extracted information system, it provides the recommendations for the improvement of Soil Quality thereby increasing the productivity of the crops. This system aims to improve the quality of crops in order to maximize the development of the plant.

Keywords: pH Of Soil, The Moisture of Soil, A Conductivity of Soil, IoT based Soil Quality

I. INTRODUCTION

The results of exploiting land-use systems without consideration of the consequences on soil quality have been environmental degradation. Agricultural use and management systems have been generally adopted without recognizing consequences on soil conservation and the environmental quality, and therefore significant decline in agricultural soil quality has occurred worldwide. Other non-agricultural uses, such as industrial and urban uses, also have important negative consequences on soil quality, due to local contamination, soil sealing, and changes in the dynamics of the landscape systems. Changes in soil quality caused by imbalanced fertilizer use, acidification, salinity, alkalinity, and a decline in soil organic matter may take several years to appear.

The general purpose of the soil quality examination system is to develop and utilize android application technology for sensor systems with the help of sensors will determine the various factors related to soil such as PH level of soil, Moisture in the soil, Conductivity of the soil, etc. Thus, the sensor systems must provide soil quality management with intelligence on the soil of the crop, its water status, and soil moisturize on a continuous basis.

The concept of soil quality is useful to assess the condition and sustainability of soil and to guide soil research, planning, and conservation policy.

A soil quality examination system has three main characteristics:

- Soil Ph.
- Moisture.
- Humidity.
- Conductivity.

II. LITERATURE SURVEY

A. Humidity and Temperature:

In this system, the ZigBee technology of wireless sensor network is used. This system used wireless sensor nodes which can be easily arranged in different parts or position of the greenhouse. It includes the data acquisition and storage consists of the greenhouse temperature, soil humidity, and soil temperature. It also consists of the automatic control of the greenhouse equipment [1].

B. PH parameter:

This is based on IoT technologies; a designed system is used for monitoring of two parameters Noise & Air Pollution. This system is capable of sending the sensed parameters output to the cloud. These parameter values or data will be used for future analysis and can be easily shared by other users [2].

C. Moisture:

This system is designed using a Raspberry Pi 3 based circuit that continuously monitors & read the values of Soil moisture, Humidity, Temperature and light of the environment that have been changing constantly. This system aims to improve the quality of crops in order to maximize the development of the plant. By using this system it is seen that the product quality & quantity is increased significantly. This system is also based on the wireless sensor nodes to check the different greenhouse parameter [3].

D. Remote Connection:

This system uses the concept of the Internet of Things (IoT) because of which wireless sensor network interacts with the real outside world. It consists of various sensors which provide the connectivity of the field to the real world by giving the output values. This system improves the quality of the product. The wireless connection sets up the links upon among agronomists, farms thus improving the quality of the product[5]. This system is based on wireless sensor nodes using the Internet of Things (IoT) technologies. The system aims to monitor the greenhouse environment. It analyzes the different greenhouse models in Hanoi and Dalit cities of Vietnam. They used different protocols for extensive simulations of large size Greenhouse models using different routing solutions [6].

III. PROPOSED WORK

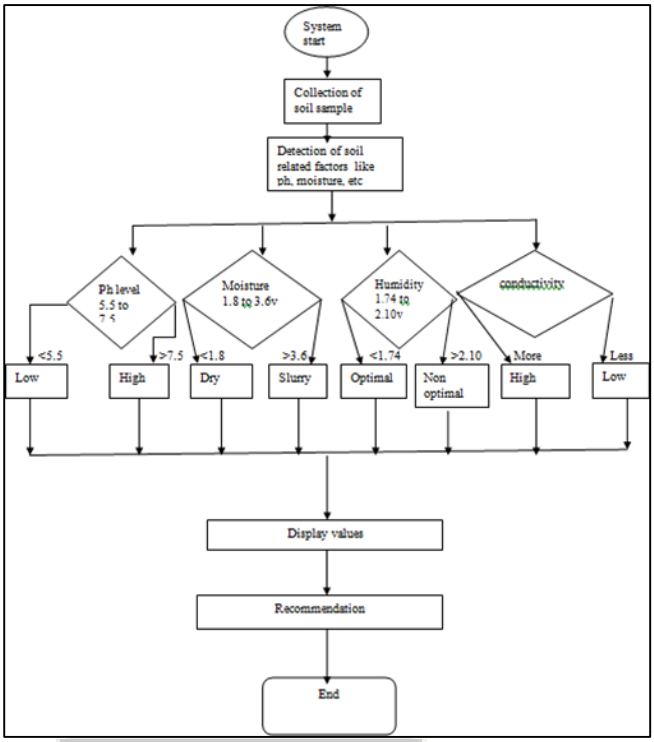


Fig. 1: Flow of working System

This system is known as "soil quality examination system" is a combination of hardware and software that acts as a supervisor with the purpose of monitoring, controlling and managing the quality of the soil. The hardware part of the project consists of the device which includes the different sensors tools and techniques to measure the several factors dealing with or affecting the quality of the soil. The factors that need to be considered while maintaining the quality of the soil is temperature fidelity, moisture, ph, conductivity, and the metal ion concentration in the soil. Out of these different factors what is our dealing factor which can also be considered as the main characteristics of the project are as follows:

A. *Temperature Sensor*

LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor does not require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. The voltage output of the LM35 increases 10.0mV per °C rise in temperature. LM35 can be operated from a 5 Volt supply and the stand by current is less than 60µAmp.

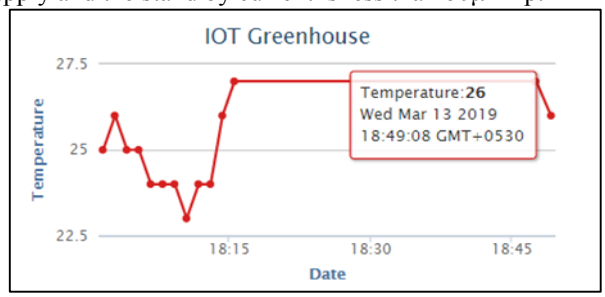
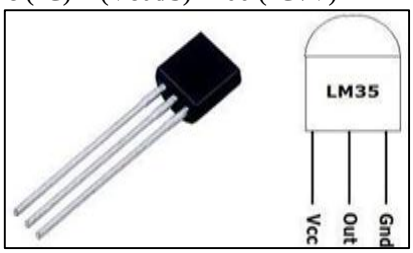


Fig. 2: Temperature Readings

1) *Formula:*

Temperature (°C) = (Vout/5) *100 (°C /V)



B. *Soil Moisture Sensor*

Soil moisture sensors measure the volumetric water content in the soil. Soil Moisture is a simple sensor for measuring the moisture content in soil and similar materials related to moisture. This sensor can be used by Opam comparator by simply inserting the sensor into the soil which is to be analyzed or tested, and thus it tests the volumetric water content in soil and records it in percent.

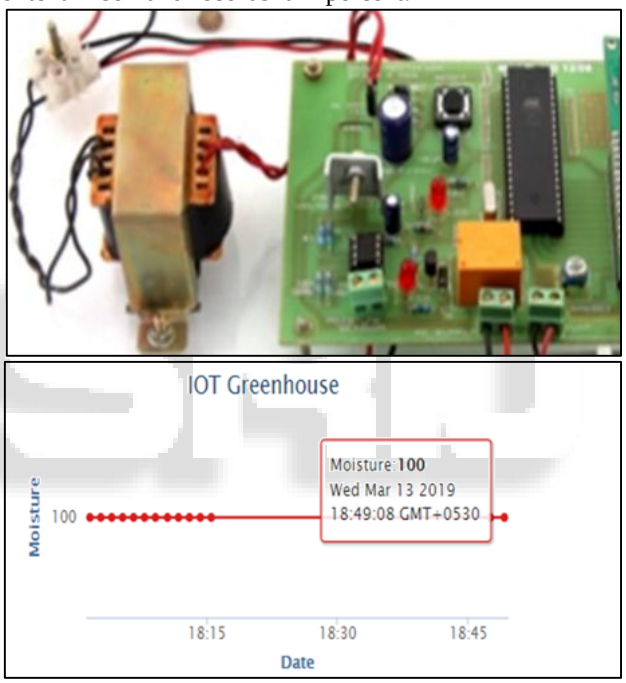


Fig. 4: Readings (Moisture)

C. *Ph sensor:*

PH strongly influences the availability of nutrients and the presence of microorganisms and plants in the soil. The pH-SOIL sensor or meter consists of a large multi- level LCD screen which displays both pH and temperature readings simultaneously with 0.01 pH resolution and an accuracy of ±0.05 pH. The LCD screen also has indicators for calibration status and stability, as well as on-screen tutorial messages.

Fig. 5: Ph Sensor

D. Humidity

Humidity is the presence of water vapors in air. agriculture field, measurement of Humidity is important plantation Protection (Dew Prevention).

FORMULA: Tolerance= ±0.1Volt

RH = ((VOUT / VCC) – 0.16)/0.0062, Typical at

25 degree Celsius, Where, Supply Voltage = 4.98 Volt

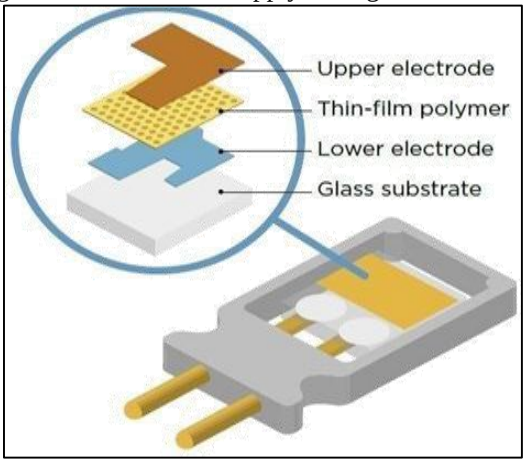


Fig. 6: SY-HS-220 Humidity Sensor

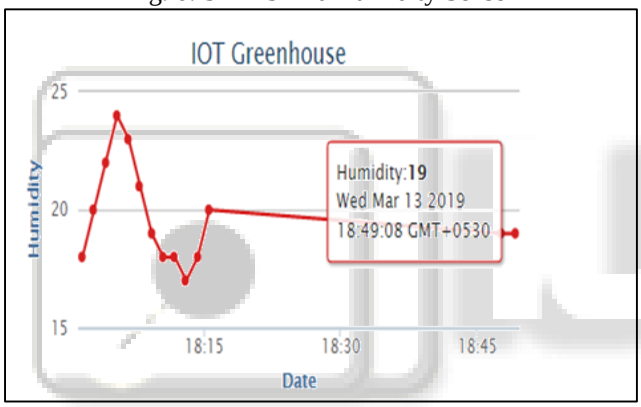


Fig. 7: Readings (Humidity)

IV. SYSTEM DESIGN

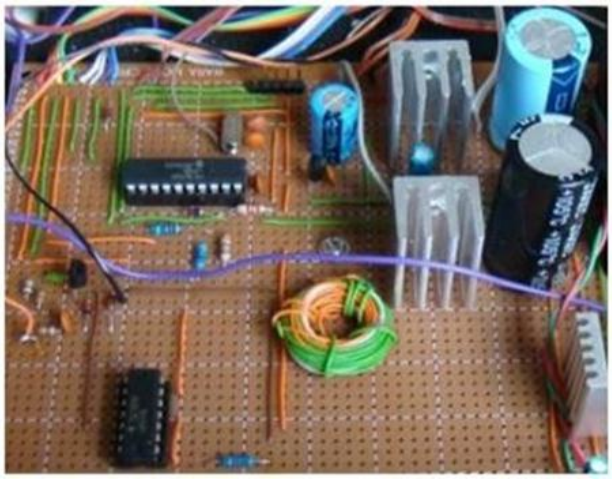


Fig. 8: Circuit Design

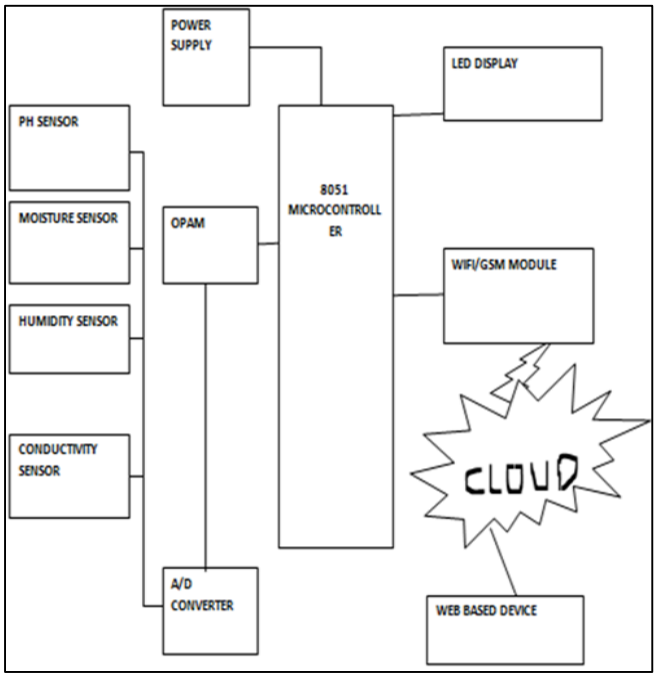


Fig. 9: block diagram of system component

The project design consists of the two parts hardware (sensors system) and the software (web application). The working starts by connecting all the sensor system to the microcontroller which is the main part of the system. We have designed a required Power supply to provide the power to a system. As the microcontroller requires +5 volt power to operate the same is given by the power supply. All the sensor such as ph sensor, moisture sensor, humidity sensor starts to sense its parameters from the soil and the desired output is in analog form. Thus we are using A/D converter to convert the analog signal output to the digital output. The Converted signal is then passed to a Operational amplifier(OPam) to convert the signal further into desired form which is suitably understood by the microcontroller. We have also using a timer 555 IC that can be used to provide time delays, as an oscillator, and as a flip-flop element. The oscillator output from timer is then passed to a microcontroller which determines the sensor output in desired reading understandable by the farmer. The microcontroller supports a c programming to examine the result and make it transferrable remotely to the web application which is basically a website. Here for the software and hardware connectivity we are using a wifi module to provide a desired a connection. The final reading is thus transferred to the website which can be read by the farmer remotely by using a browser supported phone or smart phone. Thus based on the examination the farmer can make a decision on hoe to improve the quality of the soil by balancing the related parameters.

V. SCOPE OF PROJECT

Our project team aims at providing a generic platform to enhance the quality of the soil by providing a farmer with the device which is capable of measuring all the main factors dealing with the quality of the soil with the help of hardware device and the web-based application running on the any device that is in budget for the poor farmer too.

It includes monitoring, managing and controlling the quality of the soil to prevent any harm to the soil. The hardware consisting of the sensors helps to measure the factors affecting the soil then this measurement is being transferred to the mobile application using cloud services which in turn notifies the farmer about the measuring units and that action should be taken next. Our project is designed to achieve the following targets:

A. Maintain ph of soil:

Ph determines the sourness and sweetness of the soil.

B. Maintain the Moisture Level of the Soil:

Moisture leads to germination if Wilting point goes beyond 1.2 and thus causes the seed to the dead and no crops can be grown from the seed thereafter.

C. Maintain the Conductivity of Soil:

The electrical conductivity of water is actually a measure of salinity. Conductivity basically means measuring the ability of the soil to conduct an electrical current.

VI. Conclusion

This examining system is built on the IoT technology to help the farmer to examine his field from remote location. The goal of the system is to give efficient and effective results to the farmers for the better growth of the crops and to maintain the level of the soil. In this System we have developed a prototype of an automated soil examination system which makes use of recent soil testing techniques to enhance the existing soil testing techniques. In this system, we test the soil quality and recommend the solutions in order to maintain the quality of soil by determining essential factors which also helps for the better growth of crops.

References

[1] Fang Chen, Linlin Qin, Xiaofeng Li, Gang Wu, Chun Shi, "Design and implementation of ZigBee wireless sensor and control network the system in the greenhouse", Proceedings of the 36th Chinese Control Conference July 26-28, 2017, Dalian, China
[2] Bulipe Srinivas Rao, Prof. Dr. K. Srinivasa Rao, Mr. N.Ome,"Internet of Things (IoT) Based Weather Monitoring system", IJARCCE ISO 3297:2007 Certified Vol. 5, Issue 9, September 2016.
[3] Prof. Naseem Siddiqui, Mr. Dattatraya Shinde, "Internet of Things (IoT) Based Environment change Monitoring &Controlling in Greenhouse using WSN", 2018 International Conference on Information, Communication, Engineering and Technology (ICICET) Zeal College of Engineering and Research, Narhe, Pune, India. Aug 29-31, 2018
[4] Gaurav Jadhav, Kunal Jadhav, Kavita Nadlamani," Environment Monitoring System using Raspberry-Pi", International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 04, Apr -2016
[5] Ojas Savale, Anup Managave, Deepika Ambekar, Sushmita Sathe "Internet of Things in Precision Agriculture using Wireless Sensor Networks"International Journal of Advanced Engineering & Innovative Technology Volume 2, Issue 3,December – 2015
[6] Thu Ngo Quynh, Nien Le Manh, Khoi Nguyen Nguyen, "Multipath RPL protocols for Greenhouse Environment Monitoring System based on Internet of Things".
[7] P. S. Asolkar & U.S.Bhadade ," Analyzing and Predicting the Green House Parameters of Crops", . International Journal of Computer Applications (0975 – 8887) Volume 95– No. 15,Jun-2014.
[8] Rana H. Hussain, Dr. Ali F. Marhoon, Dr. Mofeed T. Rashid," Wireless Monitor and Control System for Greenhouse", IJCSMC, Vol. 2, Issue. 12, December 2013
[9] Kiran Sahu, Mrs. Susmita Ghosh Mazumdar, "Digitally Greenhouse Monitoring and Controlling of System based on Embedded System" International Journal of Scientific & Engineering Research, Volume 3, Issue 1, January-2012 ISSN 2229-5518
[10] Akyildiz, W. Su, Y. Sankara subramaniam, and E. Cayirci, "A survey on sensor network", IEEE Communications Magazine, pp. 102–114, Aug. 2002
[11] http://www.cisco.com/web/solutions/trends/iot/introduction_to_IoT_ november.pdf

