A Survey on IOT based Digital Agriculture Monitoring System and Their impact on optimal utilization of Resources

Prosanjeet J. Sarkar, Satyanarayana Chanagala

Dept. of Electronics and Communication Ballarpur Institute of Technology Bamni Ballarpur (M.H), India
Principal, BIT Polytechnic Ballarpur Institute of Technology Bamni Ballarpur (M.H), India

---

Abstract: *IoT is continuously one of the hottest areas that are developing at a fire speed, where all things which are used in regular life connected with the internet and can be monitored and can be operated remotely. IoT has many applications in all domains, one of the wonderful applications is in agriculture domain. Monitoring of environment parameter is very essential for maximizing the yield. In particular, monitoring various agriculture parameters such as temperature, moisture, humidity, Ph value of soli and along with other parameter which affect the crops. A traditional way of measuring these agriculture parameters means manual measurements, monitoring them at various levels and at different times. This paper deals with remote monitoring system based on IoT protocol used by different researchers to increase agriculture production and optimal utilization of resources along with the proposed system which is useful in monitoring data.*
Keywords: *IOT (Internet of things); wireless sensor network; IoT protocol; Bluetooth; ZigBee; GSM; Wi-Fi; FPGA*

I. Introduction

Agriculture is one of the important part for development the country's economy. Agriculture is the basic thing for food and raw material for the living on the earth. The agriculture plays an important role in providing large scale employment. Agriculture development is necessary for the development of countries. Agriculture continues play an important role for the growth of economies. Three fourths of the India population workforce is related with agriculture and its allied fileds.

In most of the countrys, farmers use traditional ways of farming. The most farmers observed that the yield of crops and fruits have not been increasing in contrary yield is decreasing day after day. In India, Vidharbha area of Maharashtra state is facing the same problem. More development can be possible in agriculture with automation. It will replace human by machine that could result in much more information about agricultural environment,reduces labor intensity in farm, utilise agriculture resources reasonably, reduces the production cost and would result in improved ecological environment [1]. The agriculture concern on three major areas that is inadequate water supply (irrigation), attack of crops by pests and insects and thirdly failure in properly storing the produce which in turn might be attacked by pests and rodent [2]. Therefore there is need to grab technology for the solution for the above causes and improve the production. The concept of IOT can be used in agriculture field. In this, smart node involves the use of sensors, RFID, GSM/GPS, ZigBee and other wireless device with internet stack in built into the device for sensing the agriculture parameter and send to the base station or internet. The wireless sensor network collects data provide information about environment parameter transmitted to the cloud which is helpful for monitoring and analysis remotely. In agriculture domain researchers have proposed architecture based on IoT for monitoring agriculture management system [3,4].

This paper provides the information related to basic concept of IoT and previous work that had been done in the field of agriculture using IoT and wireless sensor network for monitoring and controlling the agriculture parameters.

II. Generalized concept of IoT

Bill Gates wrote a book -"The road ahead" in 1995, in this book he has brought up the concept about connection of "thing to thing" means connection between machine to machine. EPCglobal united consists of more than 100 enterprises and created the international Telecommunication Union and formally brought up the concept of IoT , the general concept of ITU is the technology of IoT mainly solve the interconnection problem between thing to thing, human to thing, and human to human [3].By now, there is no precise definition about Internet of things. There is a general definition of IoT which is defined as a kind of network that can connect object with network for information exchange and communication to realize intelligent identification, location and tracking, monitoring and management [1]. IoT can consist of sensor device (such as RFID, Bluetooth, ZigBee, GSM, RS, Laser, scanner, Wi-Fi) and these devices are capable of collecting information about themselves, their environment and associated devices and communicate this information to other devices and system via the all connecting internet shown in fig. 1.
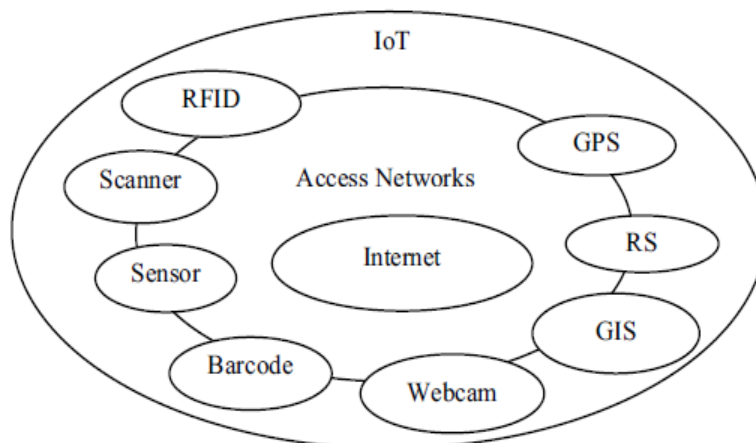

Fig.1. General concept of IoT [3].

The farmers observed whole cycle form seeding to selling using IoT based decision support system due to this directly affect the product quality can be improved. The IoT based technology in agriculture improves production, quality of agriculture products and also helps in prediction of supply, demand, real time management and quality maintenance during entire life of agriculture products [5].

III.   Agriculture monitoring system
Now a days, different organizations, government departments etc., are taking interest in implementing the technology for agriculture parameters measurement. Manual collection of parameter for desired factors can be sporadic, not continues and produce variations from measurements results in difficulty in controlling agriculture environment. IoT and wireless sensor node can reduce time and efforts required for monitoring the agriculture environment. The IoT also avoid the loss of agriculture parameter database and save it into storage device or cloud for long life. Also it will allow monitoring in critical place without the need to put personnel in hazardous situations. Monitoring system should have quicker response time, better quality control of the crop and lower labor cost. This technology solving the problem on water management, mechanical and intelligent agriculture, high quality, high yield and pollution free agriculture [3]. In agriculture there are several parameters such as soil moisture, soil nutrient, Ph value, precipitation, temperature, air humidity, light intensity, CO_2 concentration [4], this parameter can be monitor on real time basis using IoT. This organization and researchers find the root causes for decrease in yield and tried to develop the efficient system that will help to increase the production.

IV.   Related work and technology used
Researchers provides different technologies used in the field of agriculture which would increase the production as well as in reducing the extra man power effort without causing pollution. Some of the researches carried out in field of agriculture are summarized here.

Yue Shaobo et al. developed a Bluetooth based system for monitoring agriculture parameter like temperature with the use of microcontroller which works as a smart weather station. The system provides low cost wireless solution. This system is used for real time monitoring agriculture filed data. The drawback of the system were its communication range limited and connectivity configuration must be required Bluetooth with android mobile for continues monitoring [6].

M. Haefke et al. developed a ZigBee based smart sensing platform for monitoring environmental parameter such as temperature, relative humidity, pressure and sunlight with the use of microcontroller which work as a smart weather station. The research was based on characteristics such as use of low cost equipment, accurate sensor and high data rate. The XBee module have the ability to provides wide range of data rate, low operated voltage and also reduces the current consumption of the circuit. This system working on mesh network so each and every node can communicate each other and also send data to main station. The platform is working for 24 Hrs and real time data observed on GUI based application in PC [7].

A remote sensing and control irrigation system using wireless sensor network aiming for variable rate irrigation, real time in filed sensing, controlling of sites, this is only possible to develop a system based on feedback system. Pavithra D. S. et al. developed a GSM based system for automatic irrigation system. This system uses android application for measuring environmental parameter such as temperature, humidity and dew point and also controlling the water level in agriculture filed. The objective of the system is to develop a low cost wireless technology. The drawback of the system is to know the command for getting the agriculture parameters and actuate the field motor [8].

A ZigBee and GSM based smart sensor network for agriculture was developed by G. V. Satynarayana et al. used for measuring environmental parameter such as temperature, humidity and moisture of the soil. This is ARM processor based technology which is work as a base station, which can collects data from sensors node and transmitted to monitoring system in wireless. In this technology uses internet protocol for data storage and monitoring. It is low cost and low power based technology having advantages such as minimizing excessive use of water and ensuring rapid growth of crop system may be more effective by considering other environmental parameter [9].

W. Medny developed a system based on FPGA and GSM used for measutring greenhouse environment such as temperature and humidity. This technology is providing real time monitoring, timely provided information of crop and soil status due to this it is easily possible to take decision for crop production improvement. The system is low cost, user friendly. The system can be made effective by considering other environmental parameter [10].

A smart wireless sensor network for agriculture parameter based on Wi-Fi developed by G. Mendez et al. considering measuring parameter such as temperature, humidity, pressure, light intensity, soil moisture and water level. The objectives of the system were developing a smart wireless sensor network for agriculture, implementing to acquire data to PC which is connected to network from various sensor nodes. Wireless, to reduce the cost and effort of incorporating wiring, to enhance the flexibility and mobility for the system. This system provides transmitting and logging data into the cloud. It reduces the setup difficulty. The system completed when interchangeability of nodes and power taking from renewable sources [11].

The researchers found out the way for agriculture parameter control and acquisition is most important for future calculation for crop production for this SCADA based system developed by P. Silva et al., which is work on hierarchical three layer model that is filed layer, control layer and supervision and management layer. The filed layer related with sensor node, control layer concern on actuator network and supervision and management layer concern on heavy calculation. The main objective of this system can be built using the plug and work model, there in no need to install device driver and software application whenever the changes network. This system is a low cost wireless technology with the use of microcontroller and CAN protocol for measuring agriculture parameter. There is a one common problem some of the system do not support an embedded JVM. The work can be done if it is implementing of Java based Bluetooth stack [12].

V.   Proposed Monitoring system

Agriculture products depends on various environmental parameters such as temperature, relative humidity, soil moisture, pH of soil, light intensity etc. Small changes in any of these parameters can cause problems like improper growth of plants, diseases, etc. Mainly result in decreasing the yield. The block diagram of the proposed shown in fig. 2 consist of different types of sensing unit such as temperature sensor, soil moisture sensor and relative humidity sensor.
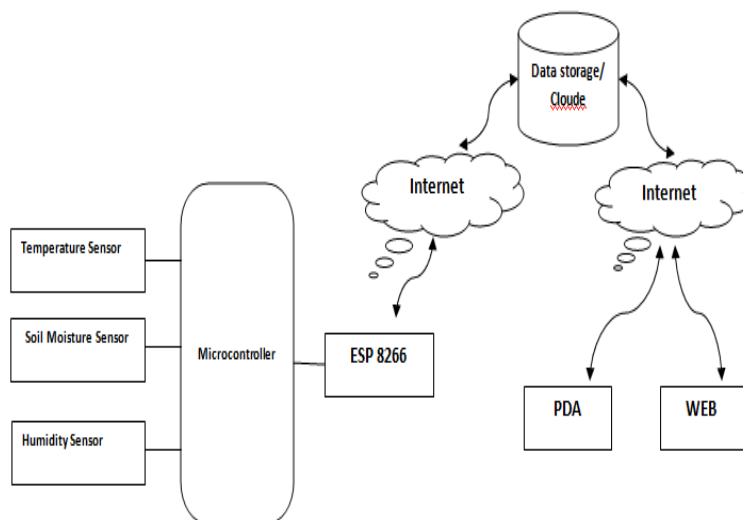

Fig.2. Basic block diagram of proposed system.

These three are the most important for the agriculture production for measurement of such parameters microcontroller can be used and digital data is transmitted to cloud through esp8266 which acts as an internet gateway. The esp8266 module for wireless data transfer and receiver uses serial protocol that is UART. The

monitoring system like PDA, Computer, etc. can be use webpage for observation of graphical variation of environmental parameter.

VI. Conclusion

The last decade of years has witnessed the growth of IoT technology. IoT based monitoring system for agriculture has been used to maximize the yield of crop by monitoring the environmental parameters and thus providing the necessary information to the farmer remotely. The proposed system is mainly developed for the betterment of farmers. The use of IoT over the other technology one helps for deploying it in any type of environment for monitoring, making it flexible and robust. The use of microcontroller and esp8266 in the system for low cost and re-programmability according to different environmental conditions is proposed.

References

[1]   Weimei Zhang, "Study about IOT's Application in "Digital Agriculture" Construction," ICECE, pp. 2578-2581, 2011.
[2]   Sudhir Rao Rupanagudi, Ranjani B. S., Prathik Nagaraj, Varsha G Bhat, and Thippeswamy G, " A Novel Cloud Computing based Smart Farming System for Early Detection of Borer Insects in Tomatoes," ICCICT, pp.1-6, 2015.
[3]   Duan Yan-e, "Design of Intelligent Agriculture Management Information System Based on IoT," Forth International Conference on Intelligent Computation Technology and Automation, Volume-1, pp. 1045-1049, 2011.
[4]   Tianchen Qiu, Hang Xiao, and Pei Zhou, "Framework and Case Studies of Intelligence Monitoring Platform in Facility Agriculture Ecosystem," Second International Conference on Agro-Geoinformatics (Agro- Geoinformatics),pp. 522-525, 2013.
[5]   Meonghun Lee, Jeonghwan Hwang, and Hyun Yoe, "Agricultural Production System based on IoT," CSE, pp. 833-837, 2013.
[6]   Yue Shaobo, Cai Zhenjianng, Suo Xuesong, Meng Qingjing, Li Tingjiao, and Wang Kezheng, "The application of bluetooth module on the agriculture expert," IIS, volume-1, pp. 109-112, 2010.
[7]   M. Haefke, S. C. Mukhopadhyay, and H. Ewald, "A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters," Instrumentation and Measurement Technology Conference (I2MIC), pp. 1-8, 2011.
[8]   Pavithra D. S, and M. S. Srinath, "GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile," IOSR Journal of Mechanical and Civil Engineering, Volume-11, pp. 49-55, 2014.
[9]   G. V. Satyanarayana, and SD. Mazaruddin, "Wireless Sensors Based Remote Monitoring System for Agriculture Using ZigBee and GPS," Conference on Advance in Communication and Control Systems, pp. 110-114, 2013.
[10]   Gerard Rudolph Mendez, Mohd Amir Md Yunus, and Subhas Chandra Mukhopadhyay, pp.2640-2645, 2012.
[11]   Pedro M. Mestre A. Silva, Carlos M. J. A. Serodic, and Joao L. Monterio, "Ubiquitous SCADA Systems On Agricultural Applications," International Symposium on Industrial Electronics, Volume-4, pp. 2978-2983, 2006.