

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 11, November 2017

## Precision Agricultural Monitoring Systems Using IoT

Terteil A. A. Ali<sup>1</sup>, Viraj Choksi<sup>2</sup>, Dr. M B Potdar<sup>3</sup>

M.E. Student (ECE), PG School, Gujarat Technological University, Gandhinagar, India<sup>1</sup>

Project Scientist, Bhaskaracharya Institute for Space Applications and Geoinformatics, Gandhinagar, India<sup>2</sup>

Project Director, Bhaskaracharya Institute for Space Applications and Geoinformatics, Gandhinagar, India<sup>3</sup>

**ABSTRACT:** The Precision agriculture monitoring system has an effective impact to overcome all the existing challenges in the agriculture domain by replacing conventional methods of doing agricultural functionalities in the much precise way to assist farmers monitoring and controlling their farms remotely. There are many existing systems incorporating Internet of things (IoT) to do agricultural operations, and reduce the greenhouse effect, but later on the need for reducing greenhouse effect for IoT itself is rising up, so to achieve that we can deploy Green Internet of Things technologies in agriculture, which it will help to conserve the energy and utilize the agriculture resources effectively.

**KEYWORDS:** Precision agriculture monitoring system, IoT, agricultural system using IoT, cloud, energy, cost, user-friendly interface.

### I. INTRODUCTION

The traditional strategies of farming [13] practiced in developing countries area unit inadequate in fulfilling the ever-increasing demand for agricultural merchandise attributable to the increasing population. The use of traditional manned large machines help to ease most of the operations in the farm, however, these large machines damage the soil and consuming lots of energy which it also increases the costs [14]. So to beat the agriculture challenges downside, new technologies have been applied in agriculture domain to help collect and process the information from the farm to increase the net productivity.

Smart farming technologies which are include; farm management information system, precision farming and agricultural automation and robotics are one of the promising methodologies assist to achieve agriculture sustainability [21]. The precision agricultural system is based on the Global Positioning Systems (GPS), Machine to Machine Communications (M2M), IoT technologies, sensors and Big Data to optimize crop yields, reduce the waste of resources and minimizing the environmental impact of farming.

The farmers are facing a number of challenges to increase the productivity of the crops without affecting the product quality in the agriculture domain. Precision agriculture systems aim to 1) minimizing the cost by managing the agriculture resources precisely 2) reduce the time and efforts 3) conserve the water and energy; which are the most important resources in agriculture and their availability in arable farming areas is one of the existing challenges by implementing green computing technologies to conserve power, and the automatic irrigation methods instead of the traditional scheduled irrigation methods to conserve the water 4) reduce the time and efforts 5) design a user friendly interface assist farmers to monitoring and controlling their farms remotely from anywhere and anytime [1], [3], [4].

### II. RELATED WORK

The IoT has different applications in agriculture such as smart irrigation management systems, pests and disease control, water quality monitoring, cattle movement monitoring, diary monitoring, greenhouse condition monitoring, soil monitoring, precision agriculture using UAV [1]. In this survey, we will discuss all the existing

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 11, November 2017

precision agriculture applications based on IoT, and also all the existing challenges and the future road maps by deploying Green IoT technologies to help attain a green environment.

As highlighted in [17], Precision Agriculture system can be used managing farm by deploying modern technologies to observe and respond to farm variability depending on the computational analysis of observations. Technology such as automation can be used in these applications; however, the agricultural operational environment is dynamic and complex infrastructure and facilities with costly machines are required to completely automate an agricultural process. The disciplines and skills currently needed for agriculture include monitoring systems, robotics, computer-based imaging, GPS technology, and science-based solutions climate forecasting, technological solutions, environmental controls and more.

### III. LITERATURE REVIEW

As outlined in [1], paper defined the IoT, and the recent advancement research in agriculture domain. Also the paper outlined the IoT agricultural framework as shown in Figure 1, and it also discussed the several IoT technologies such as, a) hardware platforms, where there is a range of various IoT supported hardware platforms such as Arduino Uno, Arduino Yum, Arduino Nano, Intel Edison, BeagleBone black, Raspberry-pi, and the various b) wireless communication technologies employed in numerous agricultural applications; communication Protocols type the backbone of IoT systems and enable network connectivity and coupling to applications. In addition to that, it discussed different c) IoT cloud service suppliers that are being well-liked at the current marketplace for use in these applications. IoT cloud solutions pave the facilities like real-time data capture, visualization, data analytics, decision making, device management etc. The paper differentiates and discussed different eight case studies based on IoT in smart farming. Moreover, it stated the challenges and discussed the future roadmap by specifying the important factors which are required to be improved to assist get a precision agriculture system and finally it discussed the futuristic applications in the agriculture.

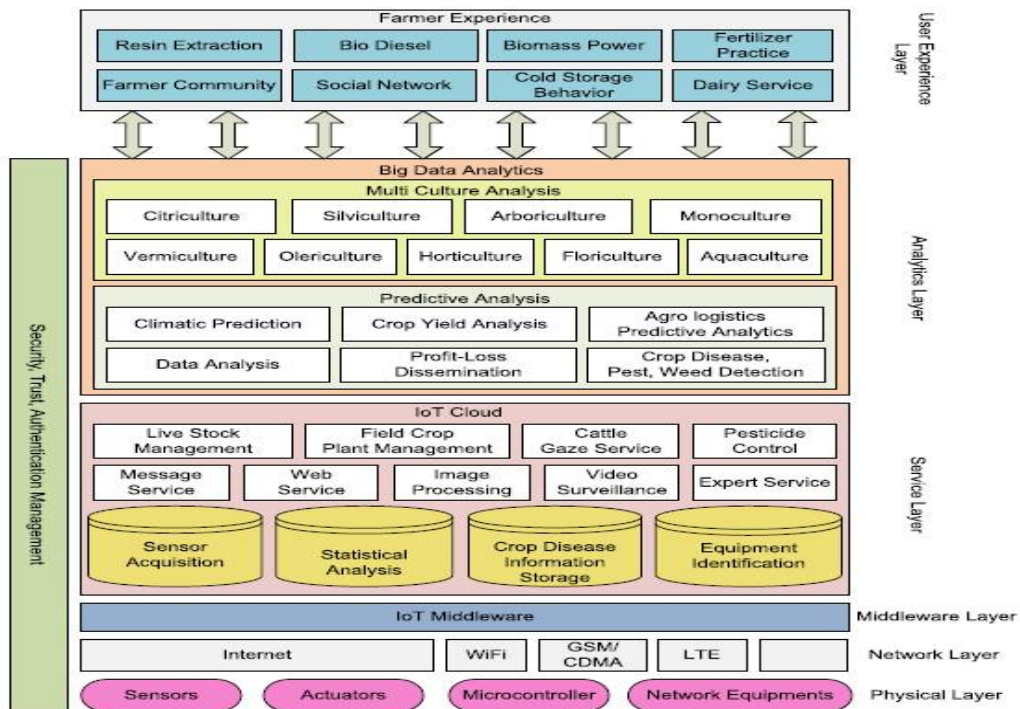


Figure 1 IoT based Agriculture Framework [1]

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 11, November 2017

As it is discussed in [2], the energy efficiency needs is highly increased, so recently lots of efforts is done by many researchers and designers, paving the way for an emerging area called green IoT. The paper also gives n overview of the Green IoT enablers as shown in Figure 2. Also, the authors identified the efficiency of proposed enabling technologies for IoT and its impact to achieve a green environment. It also reviewed how to utilize the advantages of these techniques to enable energy efficiency. Furthermore, this paper also reviewed the IoT under process applications, projects and standardization efforts that are going on to be delivered. Finally, the paper identifies some of the emerging challenges such as, defines the standard architecture, and highlighted the need to give a smooth interaction across different domains of green IoT that need to be addressed in the future to enable a green IoT.

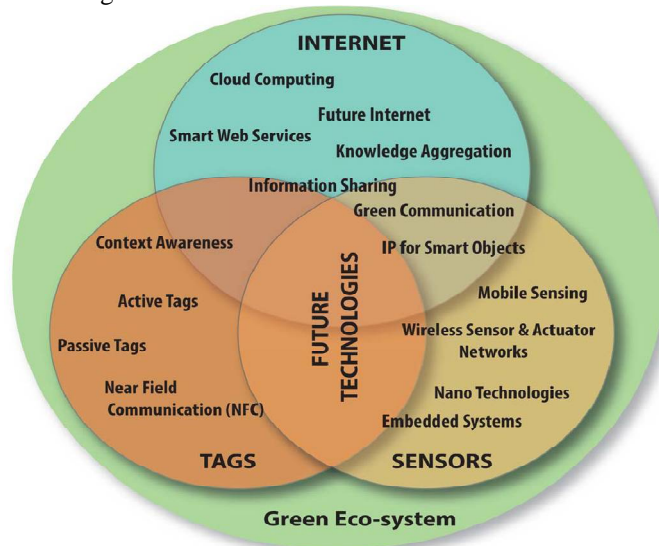


Figure 2 Green IoT Enablers [2]

As discussed in [3] there are various green IoT technologies and issues, which further reduce the energy consumption of IoT. Then, the paper mentioned the hottest green information and communications technologies (ICTs) which will result in enabling green IoT, and the paper also summarized the general green ICT principles. It also, explained the latest developments of sensor-cloud and future vision about sensor-cloud, which is a novel paradigm in green IoT, are reviewed and introduced, respectively. Finally, it identifies the future research directions and it also turns the attention into the open problems of green IoT.

This paper [4] explained the IoT Applications, also they are explained the IoT communication architecture and energy efficient in IoT. They explained EER- Energy Efficient Reliability for green IoT, Challenge of employing efficient activity scheduling techniques for achieving green IoT.

This authors in [5] used IoT to demonstrate that the empower of irrigating crops based on the its needs using soil moisture sensor to read the percentage of the moisture in the sensor periodically and based on that then the irrigation will be decided if needed they will turn on the pump unless waiting for next reading in the next period of time. In this study, Precision agriculture (PA) utilized WMSN will empower proficient watering system. They design an automated watering system based on sensing modules (soil moisture sensor, DHT22 sensor), processor modules, and communication modules (ZigBee), they had taken 1000 chilli tree as a sample in a greenhouse for their design, and their design results compared to the scheduled irrigation method and it is indicated that using automated irrigation method will help to save 1,500 ml of water and fertilizer per tree. In this specific application, GHMS will be used to deal with the greenhouse state. GHMS peruse those heats of the air in the greenhouse by utilizing temperature sensor. Dependent upon the sensors perusing GHMS will naturally choose on with respect to or off gadgets for example, such

# International Journal of Innovative Research in Science, Engineering and Technology

*(A High Impact Factor, Monthly, Peer Reviewed Journal)*

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 11, November 2017

that water pump to irrigation, the fan for air coursing library What's more fog for including water circulating everywhere Also to increment that stickiness.

Authors in [6] explained IoT agriculture supporting techniques and how much are help farmers and make them connected to their farms anywhere and anytime based on WSN using their Smart-phones. The authors introduce the IoT advantages and recent enhancements in the IoT based agricultural systems. They also give an overview of all WSN crop monitoring systems, its working principle, components, advantages, and limitations.

As introduced in [7], smart farming technologies, Agri-IoT and its role in facilitating decision making by farmers. Agri-IoT applications offer interoperability. The proposed system introduces an open standard and semantics framework based on IoT enabled smart farming applications in medium to large farms. This research has been supported by the P-SPHERE project, which has received funding from the European Union's Horizon 2020 research and innovation program. They have not taken power consumption considerations, and the research still under process expected to prove in 2020.

From [8], the authors proposed to have an intelligent multi-sensor frame-work based on BeagleBone Black. The proposed schemes try to overcome the challenge of creating multi-purpose hierarchical network composed of smart nodes able to gain and manage heterogeneous data and spaces according to the Internet of Things paradigm. However, there is a challenge in creating multipurpose hierarchical networks. No energy considerations and also no IoT concept discussed in this paper.

As explained in [9], authors designed an automated irrigation and fire alert system based on Hargreaves equation using weather forecast and ZigBee Protocol, in this design they have using sensor nodes for irrigation and weather forecasting and these nodes communicate to the coordinator using ZigBee protocol and updates send to farmer via SMS using GSM protocol. The proposed system based upon the calculated crop evapotranspiration from the equation and rainfall forecast obtained from the internet, irrigation cycle of the crop has been modified. But the design consumed more power because it is based on GSM protocol.

Paper [10], it is explain design a WSN using low cost and low energy efficient framework for precision agriculture. They have to build Peer-to-Peer communication between sensor nodes using XBee router. The system designed based on cost-effective and high accuracy sensors. The prototype system results confirmed how the framework will help farmers in PA; however, the proposed system has not taken an account for user-interface.

Paper [11], provide an overview of Time-Reversal Wireless Paradigm for Green Internet of Things, Advantages of TR for IoT. TR system reduces in power consumption and interference alleviation, which means that TR system, can provide better battery life and support multiple concurrent active users. The proposed architecture reduces computation complexity and cost of terminal devices various QoS options can be easily supported in TR systems. The system also enhances privacy and security because of the unique location-specific signature in TR system. It doesn't explain how to implement this method in PA.

As explained in [12], UAV can be used to detect weeds in sugar beets. Also, they have discussed the advantages of UAV in smart farming. The experiments were done in Germany and Switzerland, using RGB camera+NIR. The design can exploit the spatial arrangement of crops through geometric features. The design didn't make any considerations for cost and energy, and also the controlling interface panel is not outlined in this system.

These paper authors [13] designed a sustainable agriculture system using Eco-friendly and energy efficient Sensor technology. They design an automated farm monitoring and an irrigation technique, the system working principle is based on proposed algorithm formulated with threshold values. The design components consist of MCU, relay, cloud base, user-friendly interface. The overall system cost was effective compared to other PA systems. The communication between sensor nodes based on Wi-Fi.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 11, November 2017

The authors from [14] outlined the existing systems limitations; by replacing the large complex machines with small fleets and implement AgBot and SwarmBot's and discussed their pros and cons, and designed a cost-effective agriculture robot, but these robots are unsuited for long-term operation in the harsh environment.

## IV. CONCLUSION

IoT has been applied in precision agriculture monitoring systems efficiently to increase the productivity of the crops and also increase the farmer profits. The existing agriculture monitoring systems based on WSN and different types of sensors to collect the farm parameters conditions, process it and transmitted through the network using one of the wireless communications technologies to the farmer to enable him to take the corrective decision at anytime and anywhere. However, these existing monitoring systems have some challenges need to beat downside in terms of cost, energy, communications technology, fault-tolerance, autonomy, interoperability, climate, water and soil monitoring, operability and also designing a user-friendly interface ease farmer's missions.

## REFERENCES

- [1] Ray, Partha Pratim. "Internet of things for smart agriculture: Technologies, practices and future direction." *Journal of Ambient Intelligence and Smart Environments* 9.4 (2017): 395-420.
- [2] Shaikh, Faisal Karim, Sherah Zeadally, and Ernesto Exposito. "Enabling technologies for green internet of things." *IEEE Systems Journal* (2015).
- [3] Zhu, Chunsheng, et al. "Green Internet of Things for smart world." *IEEE Access* 3 (2015): 2151-2162.
- [4] Mat, Ibrahim, et al. "IoT in Precision Agriculture applications using Wireless Moisture Sensor Network." *Open Systems (ICOS), 2016 IEEE Conference on*. IEEE, 2016.
- [5] Sreekantha, D. K., and A. M. Kavya. "Agricultural crop monitoring using IOT-a study." *Intelligent Systems and Control (ISCO), 2017 11th International Conference on*. IEEE, 2017.
- [6] Sirohi, Kshitij, Aastha Tanwar, and Poonam Jindal. "Automated irrigation and fire alert system based on Hargreaves equation using weather forecast and ZigBee protocol." *Communication Control and Intelligent Systems (CCIS), 2016 2nd International Conference on*. IEEE, 2016.
- [7] Math, Rajinder Kumar, and Nagaraj V. Dharwadkar. "A wireless sensor network based low cost and energy efficient frame work for precision agriculture." *Nascent Technologies in Engineering (ICNTE), 2017 International Conference on*. IEEE, 2017.
- [8] Lottes, Philipp, et al. "UAV-Based Crop and Weed Classification for Smart Farming." *IEEE International Conference on Robotics and Automation (ICRA) Singapore, May 29 - June 3, 2017*, ©2017 IEEE
- [9] Srisruthi, S., et al. "Sustainable agriculture using eco-friendly and energy efficient sensor technology." *Recent Trends in Electronics, Information & Communication Technology (RTEICT), IEEE International Conference on*. IEEE, 2016.
- [10] Ball, David, et al. "Farm Workers of the Future: Vision-Based Robotics for Broad-Acre Agriculture." *IEEE Robotics & Automation Magazine* (2017).
- [11] Mohan, S., E. Praveen Kumar, and B. Paulchamy. "Certain investigation of precision agriculture robot using lab view." *Current Trends in Engineering and Technology (ICCTET), 2013 International Conference on*. IEEE, 2013.
- [12] Chen, Yan, et al. "Time-reversal wireless paradigm for green internet of things: An overview." *IEEE Internet of Things Journal* 1.1 (2014): 81-98.
- [13] Chen, Yan, et al. "Time-reversal wireless paradigm for green internet of things: An overview." *IEEE Internet of Things Journal* 1.1 (2014): 81-98.
- [14] Chianese, Angelo, Francesco Piccialli, and Giuseppe Riccio. "Designing a smart multisensor framework based on beaglebone black board." *Computer Science and its Applications*. Springer, Berlin, Heidelberg, 2015. 391-397.
- [15] Sreelakshmi, P., et al. "Automated Agrobot." *Indian Journal of Science and Technology* 9.30 (2016).
- [16] Kamilaris, Andreas, et al. "Agri-IoT: A semantic framework for Internet of Things-enabled smart farming applications." *Internet of Things (WF-IoT), 2016 IEEE 3rd World Forum on*. IEEE, 2016.
- [17] Aravind, Krishnaswamy R., Purushothaman Raja, and Manuel Pérez-Ruiz. "Task-based agricultural mobile robots in arable farming: A review." *Spanish Journal of Agricultural Research* 15.1 (2017): 02-01.
- [18] Prasad, Shyam Sundar, and Chanakya Kumar. "A green and reliable internet of things." *Communications and Network* 5.01 (2013): 44.
- [19] Chikankar, Pravina B., Deepak Mehetre, and Soumitra Das. "An automatic irrigation system using ZigBee in wireless sensor network." *Pervasive Computing (ICPC), 2015 International Conference on*. IEEE, 2015.
- [20] Suma, Dr N., et al. "IOT Based Smart Agriculture Monitoring System." *International Journal on Recent and Innovation Trends in Computing and Communication* 5.2 (2017): 177-181.
- [21] Gondchawar, Nikesh, and R. S. Kawitkar. "IoT based Smart Agriculture." *International Journal of Advanced Research in Computer and Communication Engineering* 5.6 (2016).
- [22] Tinker, David, et al. "Disseminating and Promoting Smart Farming Technologies—The SmartAKIS Network." *1st AXEMA-EurAgEng Conference" Intensive and environmentally friendly agriculture: an opportunity for innovation in machinery and systems", Paris, France, 25 February 2017*. European Society of Agricultural Engineers, 2017.
- [23] MAKSIMOVIC, Mirjana, and Enisa OMANOVIC-MIKLICANIN. "GREEN INTERNET OF THINGS AND GREEN NANOTECHNOLOGY ROLE IN REALIZING SMART AND SUSTAINABLE AGRICULTURE."
- [24] GS, Haritha Sree, and S. Marry Praveena. "A Survey of Futuristic Approach on Smart Agriculture Technologies Using Internet of Things."
- [25] Mandal, Subrata Kr, and Atanu Maity. "Precision farming for small agricultural farm: Indian scenario." *American Journal of Experimental Agriculture* 3.1 (2013): 200.
- [26] Cheein, Fernando Auat, et al. "Human-robot interaction in precision agriculture: Sharing the workspace with service units." *Industrial Technology (ICIT), 2015 IEEE International Conference on*. IEEE, 2015.
- [27] Zhu, Chunsheng, et al. "Trust assistance in sensor-cloud." *Computer Communications Workshops (INFOCOM WKSHPS), 2015 IEEE Conference on*. IEEE, 2015.