REVIEW ON IoT BASED SMART AGRICULTURE

M. Ananya, T. Karthikeyan, S. Aravind Kumar, S. Hariharasudhan,
L. Manoj, S. Deepak
Department of Electronics & Communication Engineering,
Easwari Engineering College (AUTONOMOUS), India

Abstract – ***The Internet of Things (IoT) is a breakthrough of advancement in technology that helps to interconnect among smart devices and helps to reduce human intervention. Internet of Things is a booming concept in the field of Smart Agriculture. Smart agriculture can act as a backbone for the development of our country. The main objective of using an IoT in Agriculture is to provide a technology-oriented and low-cost system to make it advanced for those who are away from their field and wants to control the devices remotely. The information generated by IoT devices helps the farmers track farm operations and performance makes it a better-informed decision to improve farm productivity and responds more quickly to their condition which saves time and money.***

Keyword – Internet of Things, Smart Agriculture

---

1. INTRODUCTION

In a country like India, the concept of a smart agriculture has a substantial relevance as it has to sustain 130 crores population. Further, most of the products we consume or use either directly or indirectly have a basis in agriculture. Smart Agriculture is a revolutionary concept as it tries to mend or repair traditional operations in agriculture. Slowly the cultivation operations in this sector are ultra-modernized with the idea of automation. It is a farm managing concept using modern technology to upgrade the quality and quantity of agricultural proceeds and products. The idea of lab to land crowns the concept of smart agriculture. Farmers in this century have access to irrigation technologies, smart ploughing systems, GPS (Global Positioning System), soil scanning, data managing, and many more modern farming processes [1]. The goal of smart agriculture research is to provide an intelligent decision-making support system for farm management. Smart agriculture deems it necessary to address the issues of population growth, climatic changes, and manual labor that have gained a lot of technological consideration, from ploughing to harvesting. In IoT-based smart agriculture a system which is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.), automating the irrigation system and many more self-operating systems in the agricultural processes. The combination of traditional methods and IoT based wireless sensors can lead to a modern and a highly helpful technique in monitoring the field. Wireless sensors can be used to collect information from the field [2]. IoT in agriculture helps crop producers in many ways to save time, cost and reduce laborious works. Agriculture in India is dependent on monsoons. If Nature smiles there will be a bounteous harvest but if it frowns there will famine and poverty.

2. LITERATURE SURVEY

The research done by Rolf A. Kjellby *et al* [3], presents the prototype of designing and testing long-range, self-powered IoT devices. Long-range communication powering of the devices are very difficult in an agricultural farm. The researches with an ultra-low-powered (ULP) wireless application with Bluetooth 5 have supported long-ranges. To extend the network range furthermore and to allow full coverage of large fields, Multi-Hop Topologies are used. They are powered using a solar panel. They can even operate in an anywhere as they use low - powered microcontrollers.

Automation in Agricultural using IoT for a large-scale agricultural system reduces the maintenance and supervision. The analysis by Sharmila *et al* [4], exhibited to automate the Maintenance, Control of Insecticides, pesticides, Water Management and Crop Monitoring process. Automation helps to rectify errors at any node in a process. This extends the workflow and help standalone systems to perform without human intervention. The paper had implemented workflows that would increase the level of automation in the field.

The paper by Gabriela Carrio´n *et al* [5] had presented the usage of Internet of Things using a set of sensors and actuators to monitor climatic changes and irrigation technologies. The sensors helps to measure parameters like humidity, temperature, soil moisture, soil temperature, CO_2 levels, luminosity and crop presence; using a microcontroller that takes decisions. This information is received by a server is stored in the cloud and is then sent to the client's computer or device, which will be available for the client to access his data.

An E-Agricultural Application which is based on the framework of a KM-Knowledge base was proposed by Mohanraj *et al* [6]. The Knowledge base is structured with various details of the crop that aids to give us information about various inputs like market availability, geospatial statistics and weather prediction. Monitoring system observes modules such as plant growth at several stages, irrigation planning and crop profit. The evapotranspiration is calculated with the devised algorithm. The current system takes in various aspects into account like the knowledge base, monitoring modules, efficiency and its reliability.

The proposal of a prototype for precision farming using a wireless sensor network with the help of IoT cloud was put forward by Foughali Karim *et al* [7]. This uses a decision-support system. The real-time supervision of microclimatic conditions is a way of knowing the need for irrigation to cultivate. It supervises with the help of web services. The IoT cloud reveals the platforms and allows the manipulation of web services to fit the objects integrated.

A mobile app that provides services which would be beneficial for farmers was presented by Agraj Aher *et al* [8]. The proposed work collects the data from various other nearby farms. These data can then be accessed by a mobile application (mobile app). The application provides graphical information by the use of a remote monitoring system. This is a user friendly application for the agricultural industry. They aim to collect the information (readings) from multiple nodes and help the farmers to handle various operations wirelessly and simultaneously providing a smart agricultural practice for farmers.

A smart irrigation monitoring system using Arduino whose objective is to automate and control the water pumped by the motor, was put forward by Rajkumar *et al* [9]. The developed system helps the farmer to know about his field from a place where the IoT server is placed. It gives detailed particulars on the parameters like temperature, soil moisture and humidity. These can even be monitored by our mobile phones remotely. Arduino acts as the main control of the whole system. This automatic irrigation system provides a user friendly interface, reduces labour, increases the efficiency and saves a lot of time. It is designed in such a way that it is cheap and will be easily available in the market.

3. IoT IN AGRICULTURE

a) Soil Analysis and its preparation

Few inches of the top soil are the most prolific and the whole mankind depends on this to maintain their civilisation needs. Soil Analysis is an important step to obtain the nutrient status, soil quality and water holding capacity of the soil being used. There are various sensors and testing tool kits that can assist farmers to track soil properties like its texture, density, salinity, and pollutants available without any laboratory testing. These factors help to give information about the chemical, physical and the biological statuses of a soil.

Drought is one of the major factors affecting agriculture. To deal with it, Remote sensing technology [10] plays a vital role which helps to analyse agricultural drought in the field. Water level, stage, or flow can be measured with many types of sensors and actuators.

SMOS [11] launched a satellite to provide soil moisture maps and many robots were introduced to minimize the field activities like ploughing, sowing seeds, and covering with soil which comprises the local map with the help of the Global Positioning System to work effectively.

b) Sowing

Preparation of seed-bed and sowing the right seeds in the right soil has been helped by IoT. Sowing at the right time is essential for growing an edible and a healthy crop, but there are different constraints on sowing time in various parts of the world. Sowing depends on the type of crop being grown (rabi or kharif). In order to stimulate germination and for the seedlings to emerge, the seeds must be sowed at the right depth. As sowing density determines the effect of photosynthesis [12] which is the process by which the plants generate energy for their own. We can also save our time and energy by use of automation (i.e.) seeding robots [13] which is a recent trend in the field of agriculture. The robotic vehicle is capable of levelling, digging, sowing, and covering the seeds with mud and is cost-effective as it saves a lot of labour cost. If the robot uses Bluetooth/RF with Arduino, then it helps in providing a more efficient and a desired output.

c) Irrigation

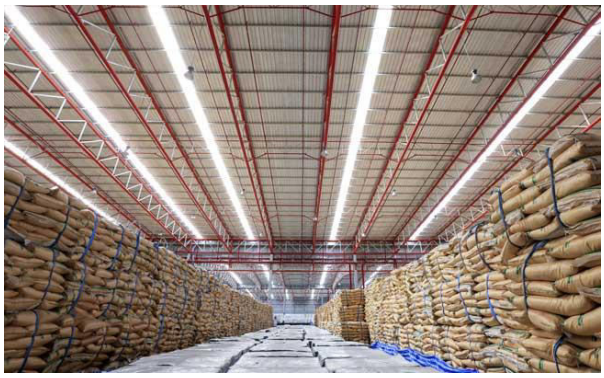
The water management is the most important as water has become a rare commodity. Preservation of this liquid gold for future generation has become an obligation on the present mankind. Smart irrigation using IoT is one of the best ways to combat water scarcity and to increase productivity with a limited usage of water. Crop damage can be avoided by preventing over or under irrigation. Rainfall, Pressure and Temperature are the three major important factors that are supervised using sensors. These sensors must be kept in the correct location which would provide accurate information of the overall condition of the soil [14]. Furthermore this data is transferred to the processing centre which is then collected in a PC or monitored online through a website (remotely).

Depending on the moisture content and level of resources available, automatic sprinkler system can be triggered so that the humidity would remain constant [15]. This can also be made to operate the system in a regular timeframe. The notification system notifies the farmer about any technical issues such as leakage in tanks and monitors the irrigation flow. Ultimately, by enabling smarter water management systems, farmers are profited by producing the large quantity and fine quality of crops. This IoT provides real-time updates and is not difficult to implement. This system saves time, manpower and reduces cost of producing the crops.

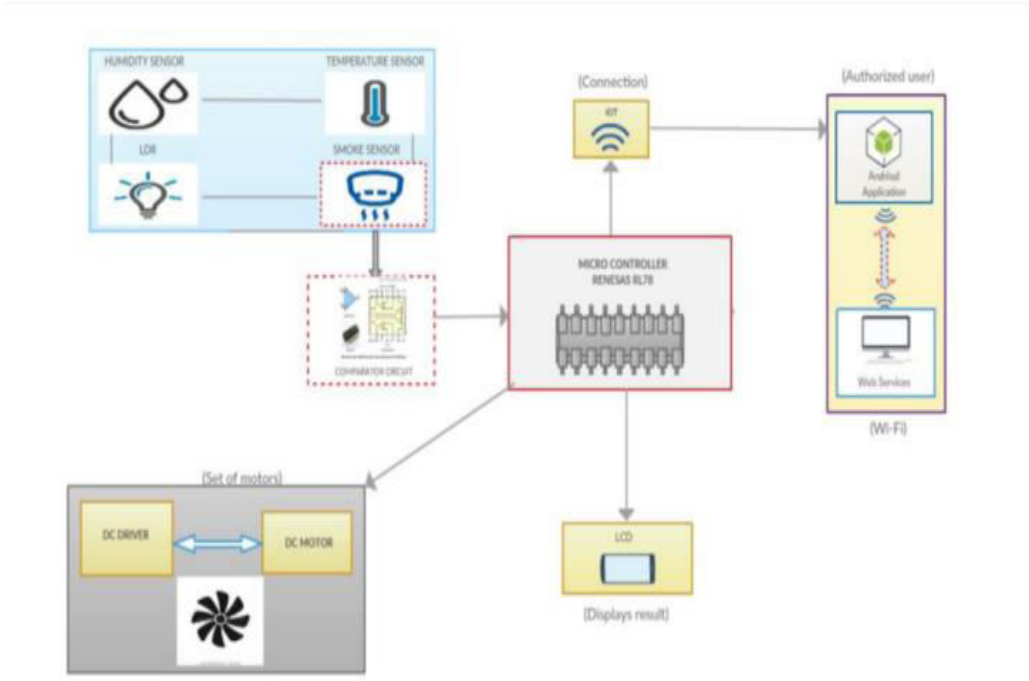
d) Harvesting

Harvesting is the method of collecting a ripe crop from the fields. Cheaper machines have become necessary to reduce the cost. We can use robots for harvesting and threshing. It is carried out as soon as the plant attains average maturity concerning the useful requirement of seeds, rhizomes, bulbs, tubers, stems, leaves. Harvester machine with yield monitor installed in it is linked with a mobile application (Kisan Suvidha, IFFCO Kisan Agriculture, RML Farmer- Krishi Mitr) which show the live harvest data and uploads it automatically to the Farmer's web-based platform. This application generates high-quality yield map and shares these maps with an agronomist and the farmer for analyzation of the matured crop. The measurement of fruit's growth can be highly beneficial to estimate the production precisely and the yield's quality. Satellite images can be a good option to monitor the yield of crops in vast areas[16]. Since fruit size plays a critical role to estimate its maturing, making decisions regarding harvesting and targeting the right market. For this (RGB) depth images are used to track the different fruit conditions in the farms. Similarly, multiple optical sensors are used to monitor the shrinking of fruits during dry conditions.

e) Storing



The erratic monsoons, global warming have become beyond the control of mankind. Storing agricultural products as they are live organisms for lean years has become essential for sustenance of human beings. IoT helps in this regard. A Cold storage warehouse being sensitive to the temperature containing eatable and non-eatable products requires a monitoring system to prevent spoilage. The smart sensor-based warehouse is essential to slow down the spoilage of food products. By the application of IoT based temperature sensors become wireless and has smart location gateways. An IoT monitoring system improves the food safety and quality of many restaurants. IoT Devices are linked inside the chambers. The mobile application is built to share the details with the owner/farmer, about the product inside the cold storage. When there is a change conditions are detected, an alert is sent to the farmer/owner through the mobile application. Power consumption of the device can be recorded and analysed to minimize wastage. This technology helps the user to control the band and monitor the light intensity. Due to this, it increases worker and asset safety, real-time monitoring, efficient tracking, stock management, and reduces third-party intervention. Using IoT for cold storage monitoring can improve the efficient usage of resources.



4. Conclusion

IoT enabled farming has helped to put technological answers to time-examined knowledge. This has helped to bridge the gap between manufacturing, high satisfaction and agricultural yield. Internet of Things (IoT) plays a vital role and significant impact in battling the challenges like bad weather conditions and unpleasant climate changes. Under recent researches in the field of agriculture, the implementation of IoT devices will scale up the

annual growth rate up to 20% [17]. It might be an impending obstacle to implement IoT in rural areas due to the absence of reliable network infrastructure. This can be mitigated by the utilization of sensors. Sensors help farmers to monitor the water level which makes the irrigation process more efficient when connected to the satellite. This integration of IoT with the sensors might be rightly called the "Second Wave Of Green Revolution".

5. References

[1] Ms.Pradnya.A Hukeri1, P.B.Ghewari, "Review Paper On Iot Based Technology", *International Research Journal of Engineering and Technology,* Vol. 04, Pg. 1580-1582 (2017)

[2] Bakhtawar Parvez, Raza Abbas Haidri and Jitendra Kumar Verma, "IoT in Agriculture", *International Conference on Computational Performance Evaluation* Pg. 844 – 847 (2020)

[3] Rolf A. Kjellby, Linga R. Cenkeramaddi, Anders Frøytlog and Baltasar B. Lozano , "Long-range & Self-powered IoT Devices for Agriculture & Aquaponics Based on Multi-hop Topology", *IEEE 5th World Forum on Internet of Things* (2019)

[4] Xiaohui Wang and Nannan Liu, "The application of internet of things in agricultural means of production supply chain management", *Journal of Chemical and Pharmaceutical Research,* (2014) Vol.6 No.7 pp.2304-2310

[5] Gabriela Carrio´n, Mo´nica Huerta and Boris Barzallo, "Monitoring and irrigation of an urban garden using IoT",

[6] Mohanraj, Kirthika Ashokumarb, Naren Jc, "Field Monitoring and Automation using IOT in Agriculture Domain*",* *Emerging Trends in Expert Applications and Security* (2019) (pp.425-432)

[7] Foughali Karim ,Fathalah Karim and Ali frihida, "Monitoring system using web of things in precision agriculture", *Procedia Computer Science*, Vol. 110, Pg. 402-409 (2017)

[8] Agraj Aher, Janhavi Kasar, Palasha Ahuja and Varsha Jadhav, "Smart Agriculture using Clustering and IOT", *International Journal of Engineering and Technical Research* , Vol.9, Pg. 110-114 (2020)

[9] Rajkumar, M. Newlin, Abinaya, S., Kumar and V. Venkatesa, "Intelligent Irrigation System – An Iot Based Approach", *International Conference on Innovations in Green Energy and Healthcare Technologies (IGEHT)*, (2017)

[10]Anil. K, Bhargava, Tor Vagen and Anja Gassner, "Breaking Ground: Unearthing the Potential of High-resolution, Remote-sensing Soil Data in Understanding Agricultural Profits and Technology Use in Sub-Saharan Africa", *World Development,* Vol. 105, Pg. 352-366, (2018)

[11] Manuela Girotto, Matthew Rodell, Qing Liu, Sarith Mahanama and Gabriëlle J.M.De Lannoy, "Multi-sensor assimilation of SMOS brightness temperature and GRACE terrestrial water storage observations for soil moisture and shallow groundwater estimation", *Remote Sensing of Environment,* Vol. 227*,* Pg 12-27, (2019)

[12] Jesus Roberto Millan-Almaraza, Irineo Torres Pacheco, Carlos Duarte-Galvan, Ramon Gerardo Guevara-Gonzalez, Luis Miguel Contreras-Medina, Rene de Jesus Romero-Troncoso, Jesus Rooney, Rivera-Guillen, "Computers and Electronics in Agriculture", Vol. 95, Pg 58-69, (2013)

[13] Pankaj Kumar and G. Ashok, "Design and fabrication of smart seed sowing robot", *Materials Today: Proceedings,* Vol. 39, Pg. 354-358 (2021)

[14] Seong KwangAn, Hyo BeomLee, JongyunKim and Ki SunKim, "Soil moisture sensor-based automated irrigation of Cymbidium under various substrate conditions", *Scientia Horticulturae,* Vol.286, (2021)

[15] M.V.B.T.Santhi, S.Hrushikesava Raju, P. Seetha Rama Krishna and Ashok Koujalagi, "Full smart sprinklers: Monitoring of sprinkler watering using IoT", *Materials Today: Proceedings,* Online (2021)

[16] Thanh TamNguyen, Thanh DatHoang, Minh TamPham, Tuyet TrinhVu, Thanh HungNguyen, Quyet-ThangHuynh and JunJo, "Monitoring agriculture areas with satellite images and deep learning", *Applied Soft Computing,* Vol. 95, Online (2020)

17] Ankit Maroli, Vaibhav S.Narwane and Bhaskar B. Gardas, "Applications of IoT for achieving sustainability in agricultural sector: A comprehensive review", *Journal of Environmental Management,* Vol. 298, (2021)