IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 6, June 2022

An Analysis of Internet of Things (IoT) Based Smart Agriculture for Long-Term Food Safety

Manish Joshi, Assistant Professor,
College of Computing Sciences and Information Technology, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- gothroughmanish@gmail.com

ABSTRACT: From farm to fork, the communication and information technology industry is being improved to aid farmers, croppers, and other consumers of intelligent services. The technological advance incorporates the creation of smart gadgets and Internet of Things (IoT) services. To feed the continuously expanding global population, the agricultural sector must be expanded. The IoT paves the way for intelligent farming solutions to boost agriculture productivity. IoT technologies provide farmers with historical and real-time data for forecasting the quality of the soil, weather patterns, and crop growth as a service. Smart agriculture offers expanded opportunities for process automation, assessment, and reducing waste. As a consequence, these characteristics significantly improve the quality and quantity of food items while decreasing their manufacturing costs. There has been highlighted the key IoT ecosystem components in this study. In addition to this, there is identified current study obstacles and discussed future research areas for agricultural IoTs.

KEYWORDS: Internet of Things (IoT), Information, Communications Technology, Smart Agriculture, Sensors.

1. INTRODUCTION

The Internet of Things (IoT) is a networking architecture of the future that will link widely dispersed logical and physical resources. There are four main parts to an IoT environment: the Internet, a Gateway node, mobile devices, or "back end" devices, and the objects themselves. Things can be anything from sensors and devices to RFID tags and wireless mobile gadgets and even whole smart homes. Users in distant locations may connect to wearable sensors in an unsupervised setting and get access to the associated equipment and smart applications [1]. Water shortages, outdated farming methods, and a lack of farmer education are all contributing factors to Pakistan's agricultural decline. Even though the fact that genetically modified organism (GMO) crops have proven to be advantageous as staple crops for Pakistan, trying to produce 95 percent of production as Bt-cotton and hybrid maize is detrimental to biodiversity. Unfortunately, Pakistan follows downward in agricultural production, specifically focusing on chemical pesticides and fertilizers, and GMO seeds. Several programs are being implemented by Pakistan to ensure food safety [2].

Modern conveniences for farmers are a direct result of technical progress in the agriculture sector. The Internet of Things is the engine that is powering more efficient and cost-effective agricultural production. By combining wireless monitoring devices with a cloud-based platform, smart farming technology can remotely assess factors including soil health, climate, crop development, and damages [3]. The data or information needed for intensive computing is delivered on demand via gateway nodes. Smart buildings and cities are next for the Internet of Things infrastructure. Important factors to think about while securing a system include access control, identity management, and legal, and technological concerns. One of the biggest problems in today's linked society is figuring out how to implement security in the Internet of Things[4].

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 6, June 2022

Agriculture has been a fundamental endeavor that has been essential to the continued existence of humankind for roughly many thousands of years. This connection has led to the development of agricultural practices, which were at first carried out using the labor-intensive procedures of conventional farming. The worldwide project known as "smart agriculture" aims to keep agriculture sustainable while also preserving the earth's resources. Recent years have seen an increase in the use of the Internet of Things (IoT) by academics, with a series of studies focusing on the acceptance and deployment of IoT in agricultural settings, farming operations, and irrigation systems [5]. These abilities are allowing for the exploration of whole new territories in the realm of agriculture. This study provides a concise overview of the use of the Internet of Things in sustainable farming for ensuring the long-term sustainability of food supplies.

2. DISCUSSION

There is a pressing need for efficient water usage in light of the modern reality of declining groundwater tables, the drying up of streams and reservoirs, and an uncertain climate. Use temperature and moisture sensors in strategic places to keep up with this for agricultural applications. In smart farming, a microcontroller-based gateway is used to regulate water distribution depending on predetermined conditions such as temperature and moisture thresholds. Solar panels provide energy, and a cellular Internet interface enables two-way communications for data examination and irrigation management through a graphical interface [6].

2.1.Climate, Soil, And Plant Conditions Monitored:

Both the development of plants and the quantity of food produced by farms are adversely affected by sudden shifts in the environment and by natural catastrophes. Many sensors can capture a wide range of environmental variables, which may then be stored as integrative and heterogeneous information and relayed through the Internet of Things. Sensors capture data in the form of measurements of soils and micronutrients, as well as moisture, temperature, and electrical properties. This information is then stored in integrated databases. The amount of fertilizer to be administered is going to be established based on the soil profile[7].

The Internet of Things plays a critical part in the process of monitoring plants to locate and detect pests and illnesses that are stunting the plants' development. Through the use of sensors, alarms and warnings may be created to advise the farmers to take action if the degree of pest control exceeds the authorized range. The optimum times for planting crops, harvesting, and managing plant diseases and pests may all be communicated to farmers and agriculturists via the use of cloud databases. This allows for more efficiency.

2.2.Irrigation Of Water And Waste Reductions:

By monitoring tank levels and setting irrigation times remotely, the Internet of Things enables precise water management for maximum plant development. Keeping an eye on unauthorized seepages is also essential. All of these features may be accessed through business cloud-hosted web and mobile apps. Internet of Things technology aids farmers and agriculturists in cutting down on waste while increasing output. It's a technique that improves the precision and control of agricultural cultivation. After harvesting, grains are stored in silos and farm fields, which need constant monitoring of factors such as temperature, pressure, moisture, and light [8].

2.3.Sensor Components/Technology for IoT:

ISSN PRINT 2319 1775 Online 2320 7876
Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 6, June 2022

Smart agriculture is impossible without sensor technologies. Sensors that collect and monitor various environmental parameters and variables that may impact crop output. Precision agriculture's performance is dependent on precise sensor data collecting for crop- and soil-specific control. Almost all of the vehicles and equipment (including the tractors, harvester, unmanned aerial, and sensors) are outfitted with remote sensor devices such as Geographic Information System (GIS) and Global Positioning System (GPS) for accurate and autonomously site-specific operations. A large variety of IoT sensors for monitoring applications may be divided into two groups. The first is intelligent multifunctional imaging sensors, which might have been installed in unmanned aerial vehicles (UAVs), railroads, and fixed position elements and entail sensing [9].

2.3.1. Unmanned Aerial Vehicles (UAVs):

UAVs are not just part of the Internet of Things (IoT) ecosystem, but also a distinct and independently developing field of technology that draws from a wide variety of related fields, including robotics, onboard computers, AI, ICT, IoT, and batteries. The limitations of remote sensing imagery via satellite (such as weather and cloud penetration) and on-the-ground robot limitations (such as uneven terrain, obstructions, and speed) contribute to UAVs' rising popularity. Unmanned Aerial Vehicles (UAVs) use hyperspectral, multispectral, and Red Green Blue (RGB) sensors to capture images with exceptional detail. Costs are reduced while more precise information about the field is provided [10]. UAVs may be used successfully in both the monitoring and the action stages of the application. Following are examples of how UAVs are often used throughout the first and second stages of precision farming. Soil and crop mapping and sample, yield prediction, weed identification, diseases, pests' detection, and stress evaluation are all examples of monitoring's usefulness. Sowing seed, spraying herbicides, and insecticides, and applying fertilizer are all part of the second, action phase [11].

2.3.2. Communication Technologies:

Information and Communications Technology (ICT) is essential to the practice of smart agriculture. Smart agriculture relies on the ability to store and transfer data to a remote location for analysis and computation. Distance, data rate, bandwidth, energy consumption, authorized vs spectrum resources, available bandwidth, and subscription costs are only a few of the factors that divide the wide world of communications technology into several categories. Different communication technologies excel in different application contexts, with the relative importance of many factors dictating the relative success of each. Some applications are better than others depending on the specifics of the situation. For instance, greenhouse agricultural surveillance is a better fit for Zigbee communications technologies, whereas field precision agriculture is better suited for Narrowband Internet of Things (NB-IoT) and long-range (LoRa) technologies[11].

2.4.Agriculture IoT Applications:

When it comes to modern farming, practically everything is determined by data collected in real-time through the Internet of Things (IoT) sensors placed strategically around the farm. Some of the smart farming applications that are impossible to implement without the Internet of Things include geospatial and temporal mapping and sample selection, smart drip and sprinkler irrigation, pest and disease tracking and management, output evaluation, and accuracy fertilizer application, and environmental maintenance [12].

2.4.1. Sampling and Geospatial and Temporal Mapping:

ISSN PRINT 2319 1775 Online 2320 7876

 UGC CARE Listed (Group -I) Journal Volume 11, Iss 6, June 2022

Assessment and mapping of agricultural fields may benefit from the simple but critical use of precision agriculture. Weed control systems, water stress evaluations, and vegetation indices are all examples of applications that rely on geographic and temporal sampling. GIS may also be used to evaluate geographical variability. Remote sensing, aerial surveys, and unmanned aerial vehicle (UAV) remote images are all tools that may be used in the geospatial field. Before improvements were made, the process was costly and inefficient. Cloud distortion from satellites and also the reduced cost and increased efficiency of UAVs mean that they might be the initial step towards widespread use of precision agriculture.

2.4.2. Method for Controlling Pests and Weeds:

A crop's yield may be drastically lowered by pests, weeds, and pathogens—up to 30% by weeds alone, in certain cases. However, pesticides and herbicides decrease earnings and lower product quality, both of which worry consumers. Internet of Things (IoT) and smart systems may detect early signs of disease, pest, and weed in a crop and tell the farmer; they can also eradicate pests and diseases by precision targeted with pesticides and herbicides, smart vehicles could also be used for this reason.

2.4.3. Precision Fertilization:

The Internet of Things (IoT) has some vital uses in agriculture, the most notable of which is the ability to reduce costs while protecting natural resources. Inadequate fertilization may have far-reaching consequences, including plant death, decreased yields, higher production costs, and even contributing to global warming via evaporation. This is because plants have varying nutritional needs, and occasionally they need fewer minerals than usual. But if the plant needed more nutrients but received fewer, it would likewise experience stunting of development and output. Moreover, the ratio of water to fertilizer components including nitrogen (N), potassium (K), and phosphorus (P) is crucial for crop productivity; this ratio varies with plant and soil type as well as climate. Another factor is variability, which can be managed only via meticulous mapping and monitoring of land and crop. By using the Internet of Things, farmers may save money on labor and inputs while getting a more accurate estimate of their nutritional needs.

2.5.Challenges in Smart Farming:

The greatest obstacle to the widespread adoption of agricultural technologies is the relatively small size of most farms, which limits room for sustained gains in production. Although 48% of our seeded area is dry fields, all of our technology, such as high-yielding seeds, are designed for irrigated soils. Many significant advances have been made in the study of hardware and software components of the Internet of Things (IoT) for application in smart agriculture. Many Internet of Things technologies has been used on expansive farms and fields. There are, however, several obstacles to the full-scale use of IoT in agriculture. One of the most crucial features of agricultural economics is the low rate of return of an investment proposal, because of the many hazards posed by environmental factors. The advantage of new technology-seeking seeking deployment in agriculture must be carefully analyzed to guarantee a trade-off between both the expense of system integration and the potential profits. It is not often farmers but rather major agribusinesses that are the ones to make use of smart technology. Farm-loan firms utilize some of these methods for risk management since they face challenges including decreasing water supplies, scarce land, and high yet expensive fertility. And the current methods are insufficient to deal with the difficulties. Security solutions for the world of tiny embedded devices need to be cheap and simple to roll out [13].

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 6, June 2022

3. CONCLUSION

Integrating all of a farmer's or agriculturalist's gadgets onto a virtual level in as many different ways as possible is one way that the Internet of Things may improve upon the lifestyles they now lead. Internet technology, social networks, securely integrated databases, and data that is available on demand would all help to promote intelligent agriculture and global food production. The significance of IoT and its useful uses in agriculture are addressed, along with the difficulties that have arisen and how they have been overcome. The author also discusses the advantages and disadvantages of using UAVs in agriculture, as well as the IoT ecosystem and the numerous kinds of UAVs, modulation schemes, and agricultural applications. Implementation of cutting-edge forms of computing and information theory, such as AI, which are often lacking in home-grown initiatives. Therefore, Pakistan and other developing nations should pay for the research and development in the area of inter-agriculture and information technology; this would enable them, in the long run, to achieve long-term food security despite changes in the environment.

REFERENCES:

[1] M. Bhatia and S. K. Sood, “A comprehensive health assessment framework to facilitate IoT-assisted smart workouts: A predictive healthcare perspective,” *Comput. Ind.*, 2017, doi: 10.1016/j.compind.2017.06.009.

[2] V. C. Patil, K. A. Al-Gaadi, D. P. Biradar, and M. Rangaswamy, “Internet of Things (Iot) and Cloud Computing for Agriculture: an Overview,” *Agro-Informatics Precis. Agric.*, 2012.

[3] R. Shahzadi, J. Ferzund, M. Tausif, and M. Asif, “Internet of Things based Expert System for Smart Agriculture,” *Int. J. Adv. Comput. Sci. Appl.*, 2016, doi: 10.14569/ijacsa.2016.070947.

[4] S. K. M. K. N. S. I. Dilson, “Internet Of Things (IoT) Refrence Models Dalam membangun Smart Agriculture di indonesia,” *Isbn -978-979-98691-9-7*, 2016.

[5] L. Taiz, “Agriculture, plant physiology, and human population growth: past, present, and future,” *Theor. Exp. Plant Physiol.*, 2013, doi: 10.1590/s2197-00252013000300001.

[6] A. Rojas, “Smart Agriculture IoT with Cloud Computing,” *Rev. Hist. América*, 2015.

[7] F. J. Ferrández-Pastor, J. M. García-Chamizo, M. Nieto-Hidalgo, J. Mora-Pascual, and J. Mora-Martínez, “Developing ubiquitous sensor network platform using internet of things: Application in precision agriculture,” *Sensors (Switzerland)*, 2016, doi: 10.3390/s16071141.

[8] C.-J. Chae and H.-J. Cho, “Smart Fusion Agriculture based on Internet of Thing,” *J. Korea Converg. Soc.*, 2016, doi: 10.15207/jkcs.2016.7.6.049.

[9] R. Nukala, K. Panduru, A. Shields, D. Riordan, P. Doody, and J. Walsh, “Internet of Things: A review from ‘Farm to Fork,’” 2016. doi: 10.1109/ISSC.2016.7528456.

[10] B. Hazim Younus Alsalam, K. Morton, D. Campbell, and F. Gonzalez, “Autonomous UAV with Vision Based On-board Decision Making for Remote Sensing and Precision Agriculture 2-Australian Research Centre for Aerospace Automation (ARCAA),” *IEEE Aerosp. Conf.*, 2017.

[11] B. S. Faiçal *et al.*, “An adaptive approach for UAV-based pesticide spraying in dynamic environments,” *Comput. Electron. Agric.*, 2017, doi: 10.1016/j.compag.2017.04.011.

[12] J. Torres-Sánchez, J. M. Peña, A. I. de Castro, and F. López-Granados, “Multi-temporal mapping of the vegetation fraction in early-season wheat fields using images from UAV,” *Comput. Electron. Agric.*, 2014, doi: 10.1016/j.compag.2014.02.009.

[13] O. Vermesan and P. Friess, *Digitising the industry internet of things connecting the physical, digital and virtual worlds*. 2016. doi: 10.13052/rp-9788793379824.