



Role of Internet of Things (IoT) Technology in the Agriculture Sector

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ABSTRACT

Agriculture is a very specific sector and multifarious people are working in this sector since ancient times as it is the main source of foodstuff for a large population across the globe. Nowadays, technologies are playing a key role in this sector to efficiently monitor the crops for maximum production with minimal resources. In today's world, technology is playing a very critical role and various instruments or strategies are accessible in the agricultural field. There is an essential requirement to move towards digital technologies known as the Internet of Things (IoT) to increase production, competitiveness, and international economy, as well as reduce human interference, time, and expense. The IoT is a network of computers that transmit data without any need for human intervention. As a result, to achieve high output, IoT collaborates with cultivation to achieve precision agriculture. The involvement of IoT in cultivation, which contributes to smart framing, is the subject of this article.

KEYWORDS: Agriculture, Crop, Farming, IoT, Technology, Modern Technology, Cultivation.

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INTRODUCTION

Agriculture is becoming common and important as a result of rapid technological advancements. For the production of cultivation, various methods and technologies are accessible. As per the United Nations (UN) Foodstuff and Cultivation Agency, the globe will have to generate 70% additional food in 2050 than what it had in 2006 to supply the increasing population. Landowners and agriculture firms are looking towards IoT technology for monitoring and greater computational capability to satisfy people's needs [1][2],[3]. IoT can maximize production, gain access to a broad international economy, and provide insight into current crop patterns. The Internet of Things (IoT) is a system of connected computers that can easily transmit data without the need for external intervention[2],[4].

Some farming industries are turning towards IoT technologies for agricultural development to improve production, profitability, and domestic production, as well as other aspects like minimal human interaction, energy, and expense, among others [5],[6]. Sensors are becoming thinner, more advanced, and much more cost-effective as technological advancements. The systems are also readily available from anywhere in the world, allowing for maximum commitment to crop monitoring [7],[8]. Concentrating on promoting creativity in the agricultural sector, smart cultivation is the solution to the threats that industries are currently facing. This could be accomplished by utilizing mobile devices as well as intelligent systems [9],[10]. A peasant may access any type of data or knowledge he requires, and also track the agricultural fields more efficiently [11],[12].

The IoT has been recognized as one of the successful as well as an essential technology to resolve various existing issues such as efficient crop monitoring and many more. IoT is made up of a variety of modules, including sensors, applications, networking devices, as well as other communications components. This also improves the efficiency of data. IoT enables data to be exchanged over a channel without the need for user intercession. We should reflect objects in the IoT devices conventionally, much as a real human

being, such as a detector, a motorist, and so on. The device has been given an IP address, allowing it to communicate wirelessly[13], [14]. Figure 1 shows how the Internet of Things (IoT) benefits the modern farming sector nowadays.

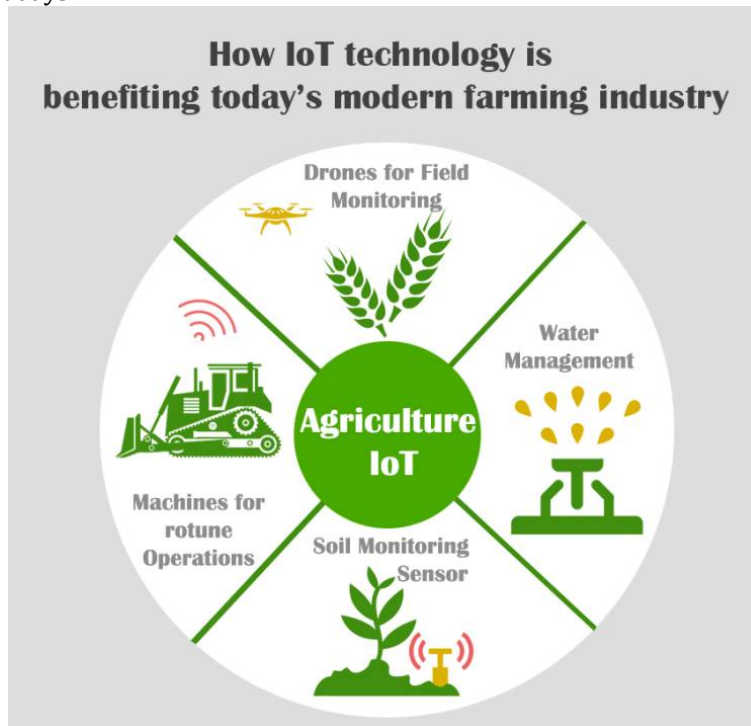


Figure 1: Illustrates how the Internet of Things (IoT) benefits the modern farming sector [Data Flair/Blogs]

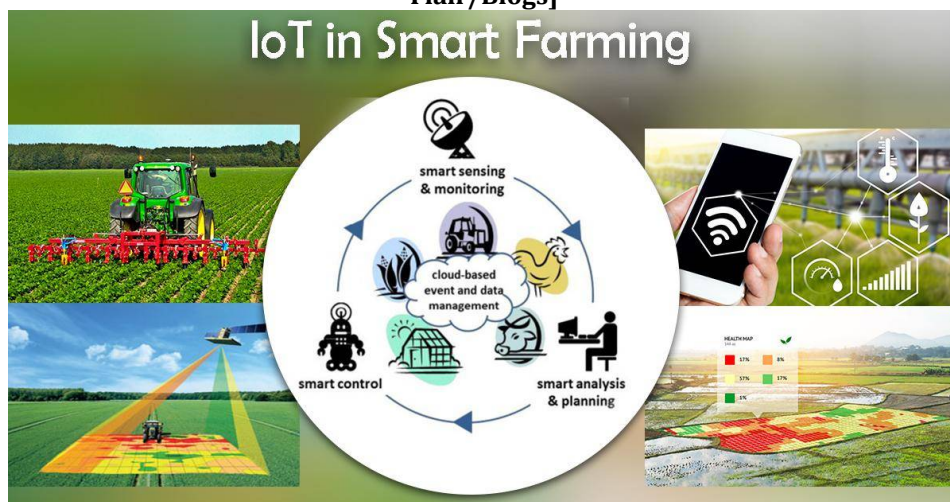


Figure 2: Illustrates the Internet of Things (IoT) applications in smart farming [Data Flair/Blogs]

By 2050, the planet's population will have grown to about 9.60 billion inhabitants. As a result, the agricultural sector must accept IoT to survive this massive population [13],[15]. The increased cost of food must be met while still facing problems like increasing global warming, adverse weather, as well as the ecological consequences of industrial agricultural activities [16],[17]. Landowners would be able to minimize pollution and increase production by using IoT technology in organic agriculture[18],[19]. This may be attributed to the amount of fertilizer added or the no. of visits the field automobiles have taken. Thus, sustainable agriculture is simply a high-tech method for providing clean, long-lasting feed for the population. This is simply an implementation of new Information and Communication Technologies (ICT) into cultivation and also their implementation[5],[20]. Figure 2 shows the IoT applications in smart farming. Figure 3 shows IoT-based smart farming. Smart farming is becoming more popular nowadays across the globe. Figure 4 shows the IoT utilization case in the cultivation/monitoring of climate conditions. Figure 5 shows the IoT-based monitoring of the farm with the help of a drone [21],[22].

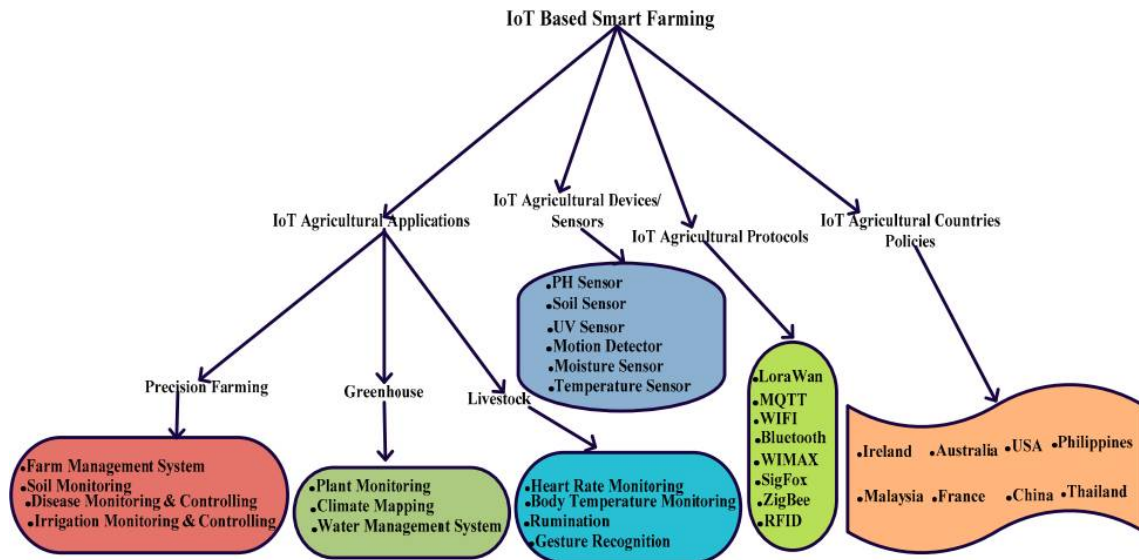


Figure 3: Illustrates the Internet of things based on smart farming. Smart farming is becoming more popular across the globe[23]

Weather stations, which combine different crop cultivation detectors, are perhaps the most common precision agricultural devices. They gather data from the atmosphere but submit it to the cloud from locations all over the world [24],[25]. The information given could be utilized for mapping climate conditions, selecting suitable plants, as well as take the necessary steps to increase harvest capability (for instance, precision farming)[23].The most successful horticulture innovation is the effective utilization of farmland drones in crop monitoring. Often classified as unmanned aerial vehicles (UAVs), these drones are becoming better suited than airplanes or satellites to gather farmlands data [26],[27]. The drones may perform a wide range of functions that previously required skilled workers, such as fertile soil, combating insects as well as diseases, crop spraying, harvest monitoring, etc. The web's frequent deployment over the past two decades has brought untold advantages to organizations and people all over the world. The opportunity to generate or receive resources in actual timing was a significant advantage of this breakthrough. Lately, the IoT has promised to offer similar benefits through innovative technologies, allowing people to improve their views and capacity by altering their workplace environment[28].



Figure 4: Illustrates the Internet of Things (IoT) utilization case in cultivation/monitoring of the climate conditions [Easter Peak/Blog]



Figure 5: Illustrates the Internet of Things (IoT) based monitoring of the farm with the help of a drone [Easter Peak/Blog]



Figure 6: Illustrates crop management by using the Internet of Things (IoT) technology [Easter Peak/Blog]

Agricultural control apparatus is a separate classification of the IoT products in agriculture and a component of smart agriculture. These must be put throughout the fields, much like meteorological stations, to gather data unique to growing crops, namely temperature and rainfall, as well as soil moisture capacity and improved plant health. As a result, you'll be able to keep track of your crop successfully and any irregularities to efficiently avoid pests or pests that might damage your production. Figure 6 shows crop management by using the Internet of Things (IoT) technology.

Technology Used in the Farming Sector

Farming is the mainstay of any country's economic growth. Global warming is the most serious obstacle which traditional cultivation faces. Strong drought, most violent storms, extreme weather reduced rainfall, and other atmospheric transition consequences are only a few. Profitability suffers as a result of these factors. Climate change has ramifications for the climate, namely seasonal variations in crop life cycles. To improve production and eliminate obstacles in the agricultural sector, advanced technology known as IoT must be used. The IoT is now changing the agriculture sector, helping peasants to succeed during immense challenges. IoT provides peasants with a plethora of data and awareness regarding emerging developments and technologies. Figure 7 shows the major roles of IoT technology in the farming sector.

Since IoT apparatus may be utilized to measure the soil water content, heat, as well as other factors, they could be extremely useful in boosting agricultural quality and productivity. Sustainable farming can also aid in the tracking of livestock production or welfare. IoT sensors which can provide peasants with information about agricultural productivity, irrigation, pest infestations, and soil health are highly useful in cultivation as well as provide accurate data which could be utilized to enhance agricultural practices over a period. In its actual, reliable, and mutual features, the IoT can turn the farming supply chain to offer a vital platform for maintaining a seamless flow of agriculture logistics. Figure 8 shows that the globe has been added 1.5 billion masses since the International Conference on Population and Development (ICPD) and continuously growing.

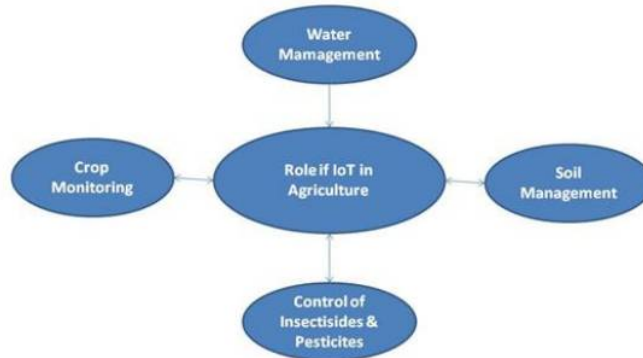


Figure 7: Illustrates the major roles of the Internet of Things (IoT) technology in the farming sector[13]

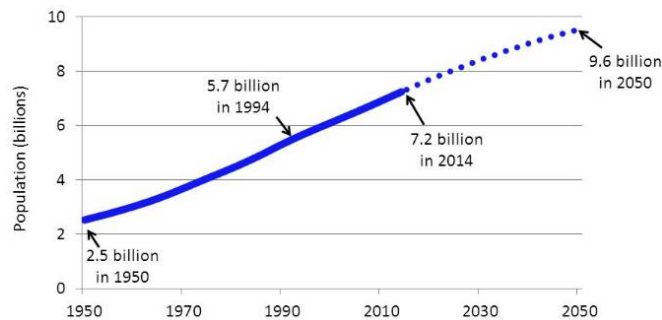


Figure 8: The globe has added 1.5 billion masses since the International Conference on Population and Development (ICPD) and continuously growing [Digiteum/IoT-agriculture]

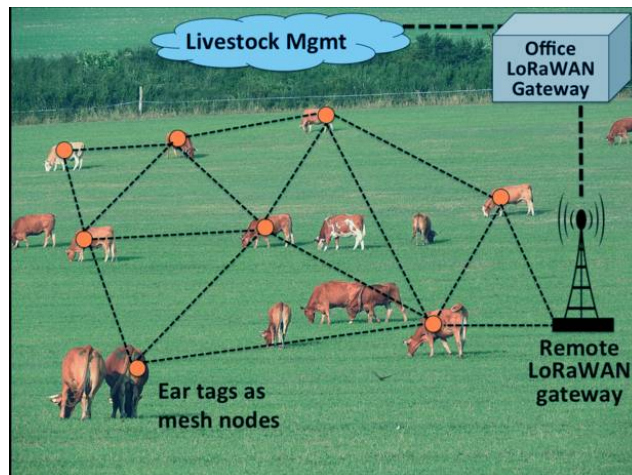


Figure 9: Illustrates the Internet of Things (IoT) applications in livestock monitoring [Data Flair/Blogs]

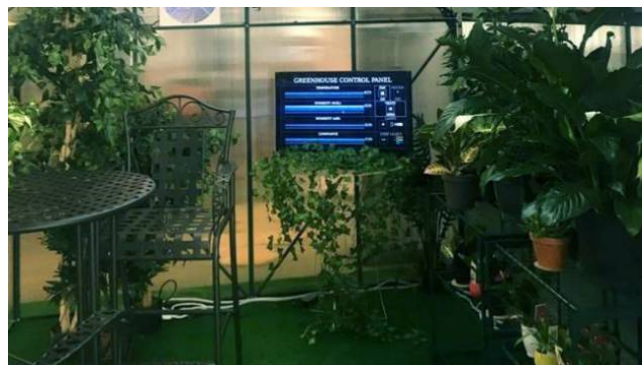


Figure 10: Illustrates the Internet of Things (IoT) applications in the smart greenhouses[Data Flair/Blogs]

Figure 9, shows IoT applications in livestock monitoring. Figure 10 shows IoT applications in smart greenhouses. Farm owners may use IoT apps to obtain information about the cattle's place, and well-being, including fitness. This data aids farmers in determining the health of the animals. For eg, identifying infected cattle so that they're being isolated from either the herd, stopping the illness from spreading to the whole herd. Rural households' ability to identify cattle using IoT-based detectors tends to reduce labor costs significantly. Greenhouse cultivation is a method of growing grain, flower, and vegetable yields. Greenhouses monitor climatic factors in one of two directions: manually or using a reciprocal method of control. Manual interference, on the other hand, has pitfalls namely productivity loss, power losses, or labor cost, making these approaches less efficient. By using IoT-embedded devices, smart cultivation not only watches and also regulates the environment. As a result, no requirement for human involvement [29], [30].

CONCLUSION AND IMPLICATION

In the coming years, agriculture would play a critical role in the economy of countries across the globe. As a result, smart cultivation is required and is in high demand. IoT is used in various aspects of farming nowadays to increase early prevention, water treatment, soil sampling, cover crops, fungicides as well as pest prevention, and so on. This also reduces human workers, simplifies agricultural methods, and aids in precision agriculture. With such features, smart cultivation could assist farmers in growing their market with such a quick flick with minimal work. This paper provides a detailed overview of IoT technology and how it provides additional facilities to farmers to monitor the crops efficiently for maximum production with minimal investment. Moreover, this paper provides a comprehensive review of smart farming with the help of IoT technology and how it benefits farmers efficiently. Although there have been done numerous research in this field still there is a huge scope for more research to resolve the existing issues related to farming.

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CONFLICT OF INTEREST

The authors have no conflict of interest

AUTHOR CONTRIBUTIONS

Dr. Suman conducted the research, analyzed the data, proposed the methodology, and wrote the initial draft; Dr. AnuNaruka modified and supervised the initial draft; Dr. Rajeev Kumar, Dr. Ashok Kumar has supervised the research and written the final version of the manuscript. All authors had approved the final version.

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