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Smart Agriculture and Smart Farming using IoT Technology

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Abstract. It has become easier to access agriculture data in recent years as a result of a decline in digital breaches between agricultural producers and IoT technologies. These future technologies can be used to boost productivity by cultivating food more sustainably while also preserving the environment, thanks to improved water use and input and treatment optimization. The Internet of Things (IoT) enables the production of agricultural process-supporting systems. Referred to as remote monitoring systems, decision support tools, automated irrigation systems, frost protection systems, and fertilisation systems, respectively. Farmers and researchers must be provided with a detailed understanding of IoT applications in agriculture as a result of the knowledge described above. This study is about using Internet of Things (IoT) technologies and techniques to enhance agriculture. This article is meant to serve as an introduction to IoT-based applications in agriculture by identifying need for such tools and explaining how they support agriculture.
Keywords: Internet of Things (IoT), Internet of Lighting, Fertilization, Agriculture, Remote, Communication.

1. Introduction

The advancement of science and technology, the global GDP has risen consistently. As a result, the presence of this reality has encouraged the development of smart farming, which use sensors and irrigation systems to manage crops as they grow. With sensor-based computer applications, more accurate information about the crop, soil, and environment may be gathered. It promotes high-quality process and raw materials throughout the entire product process. This is because utilising the Internet of Things in smarter agriculture makes it more competitive than traditional methods. Combined with IoT-based smart agriculture technologies, organic agricultural agriculture and family farming may see a benefit. It is the case that between agricultural producers and IoT technology, a digital breach has occurred, thus farmers are not vulnerable to IoT assaults. Sustainable use of water and input and treatment optimization will allow farmers to produce more food while also preserving the environment. To include agriculture in smart use of natural resources, usage of technologies such as remote control, decision support tools, automated irrigation systems, frost avoidance, and fertilisation

is required. These activities are supplied by IoT technologies, which provide devices like as hardware, intelligent apps, integration platforms, control procedures, operating systems, and cloud computing. The benefits of IoT and the Internet may be gained through the Cloud of Things, which combines IoT with cloud computing. Another requirement for the IoT is for it to provide society with information transparency. This work summarizes the current IoT-based agricultural tools and applications, which are broken down into distinct areas [1,2]. The aim of this paper is to describe all these topics in detail, as well as discuss the advantages of using IoT-based technologies in agriculture.

The yields obtained with less capital and labor have improved over time, with significant innovations having been made in human history. However, as long as the population rate is high, the demand and supply cannot balance, regardless of the periods. The numbers that have been estimated say that in 2050, the world population will be around 25 percent larger than it is now. In the vast majority of the growth predicted for the developed countries, it is expected that much of it will occur. Urbanization is expected to increase even more rapidly in the future, and about 70 percent of the world's population will be urban by 2050 (currently 49 percent). A further factor contributing to food demand is that income levels will be multiple times what they are now, which will lead to further increases in food demand particularly in developing countries [3,4].

Consequently, dietary preferences will change from wheat and grains to legumes and then to meat. To meet the increased demand for food due to an increasingly urbanized and wealthy population, food production must increase by a factor of two by the year 2050. This prediction is particularly important because of the current prediction of approximately 2.1 billion tons of annual cereal production and the prediction of a rise in meat production of over 200 million tons to meet the predicted demand of 470 million tons. Crop processing is playing an increasingly important role in industrial economies as well. On top of that, the bio energy demand began to increase in the food crops-based bio energy market. From the start of the twentieth century until now, only the manufacture of ethanol has used 110 million tons of coarse grains (approximately 10 percent of the world production). Food protection is in danger due to the rise in industrial and other uses of food crops for bio-fuel production. the scarcity of agricultural capital is making the demands even more onerous.

2. Literature Survey

The deployment of IoT in agriculture has the potential to affect our society and the rest of the world. Nowadays, we see weather, soil, and water drying up as land that's critical to agriculture declines, making it harder and harder to produce food. Agriculturalists will benefit from using Internet of Things (IoT) technology, which will help them cut down on generated wastelands while also improving production. This figure could stem from the number of missions the farmhouse automobiles have performed, or from the amount of compost used in the composting process. A smart agriculture system may be defined as a food system that utilizes emerging nutrition that is uncontaminated and is accessible to a wide number of people. With the expansion of the entire Farming system with the addition of the Smooth Agricultural IoT platform, the Internet of Things (IoT) plays a larger role in agriculture. Although the Internet of Things (IoT) is utilized in Farming, it has saved not only the time of agriculturalists but also massive quantities of liquid and power, thanks to the interconnectedness of devices and services. It is able to preserve frequently encountered topographies including moisture, high temperature, soil, etc. and offers real-time surveillance through the crystal-clear map. In agriculture, embracing Internet of Things (IoT) will yield various benefits. For example, the farmhouse automobiles have accomplished numerous missions. Smart agriculture is thus basically an integrated, uncontaminated method of emerging nutrition that supports crowds. The smooth agricultural system extends the farming system by not only watching the soil, but also physically monitoring it [5,6]. Even though individual devices and networking aren't directly saving the agriculturalists' time, the Internet of Things (IoT) is negatively affecting wasteful spending on assets such as Liquid and Power. The overall goal of this model is to preserve frequent topographical features like moisture, temperature, soil, and other information, and provide a real-time crystal-clear

surveillance. In addition to the advantages described above, agriculture will benefit from implementing Internet of Things (IoT).

Tunable Fields: Precision agriculture is a way or practice that makes the farming process more correct and managed to raise live stocks and grow crops. The use of IT and objects such as sensors, self-supporting cars, computer hardware, control systems, robotics and many others. The main additives are in this technique. Precision farming using IoT is presented in figure.1. Precision agriculture has become one of the most well-known agricultural IoT initiatives in recent years and this technique has begun to be used by a large number of organisations.

Figure 1. Precision farming using IoT [1]

Data Analytics: The predictable database system now has not enough parking space to store the facts from the IoT sensors. In the clever agriculture machine the cloud based mainly facts garage and a stop-stop IoT platform plays an important part. These structures are expected to play a vital role in finishing higher sports. In the IoT universe, sensors are the main source of massive facts. The numbers are analyzed and the use of analytical equipment converted into meaningful facts. The analytics of records helps to evaluate temperature, farm animal conditions and crop situations. The statistics collected use the technical advances and make better decisions for this purpose. You can understand the plants' real-time reputation using IoT devices, by collecting the facts from sensors[7,8]. You will gain a perception using predictive analytics to make better decisions on harvesting. The fashion analysis allows farmers to understand future climatic conditions and vegetation harvesting. IoT enabled farmers to maintain the quality of the vegetation and the fertility of the land in the agricultural industry, thus improving and improving the amount of products exceptional.

Climate Conditions: Climate plays a vital role for agriculture. And mistaken climate know-how deteriorates the quantity and the first class of crop production considerably. But IoT answers allow you to know the weather situation in real time. Within and outside the agricultural fields, sensors are mounted. They collect environmental statistics that are used to select the right plants that can grow and sustain in precise climatic situations. The entire IoT atmosphere consists of sensors that can locate conditions such as humidity, precipitation, temperature and more accurately in real time. There are various sensors that have to be hit on each of these parameters and configured to fit your clever agricultural needs. These sensors reveal the situation and climatic conditions of the crops around them. If any troubling climatic conditions are established, the ship is an alert. The lack of physical presence in troubling climatic conditions, which eventually increases productivity and helps farmers to gain higher agricultural authorisations, is eliminated[9,10].

Smart Greenhouse: Greenhouse agriculture is a technique complementing crop yields, greens, end results etc. Greenhouses handle environmental parameters in two ways, either manually or by a proportional control mechanism. However, these approaches are much less successful because

manual intervention has risks, including production loss, energy loss and labor prices. A smart, IoT-based greenhouse now does not simply track but regulates the environment. There is a need for human action. Various sensors that are in line with plant requirements are used to monitor the environment in an intelligent greenhouse. A cloud server then creates a computer for remote access when associating IoT usage. The cloud server confidentially enables records to be processed and manages the flow. This design offers farmers the best and most effective solutions with minimum and almost no manual intervention.

Agricultural Drones: Scientific advances have almost revolutionized agricultural operations and there is trend disturbance with the advent of agricultural drones. Ground and aerial drones are used for the fitness assessment, crop inspection, planting, spraying of crops and field assessment. With the right approach and preparation based on real reality, the drone generation has given the agriculture industry a strong push and overhaul. Drones with thermal or multi-spectral sensors select areas where irrigation changes are necessary. When plants begin to grow, sensors indicate their health and measure the index of their plants. Clever drones have eventually reduced the environmental impact. The technology based Smart farming using Drones is presented in figure.2. The consequences were such that there was a great reduction in the chemical effects of groundwater and Livestock Internet monitoring correspondences allow farmers to obtain materials about their livestock's neighborhood, proper life and welfare [11,12]. This calculation allows them to recognize their livestock's position. Such as identifying animals that are uncomfortable in order to divide the herd, preventing the disease from developing for the whole animal. The feasibility of farmers with Internet of Things (IoT)-based sensors to locate their farm animals helps them to transportation of depressed hard work charges by a significant amount.
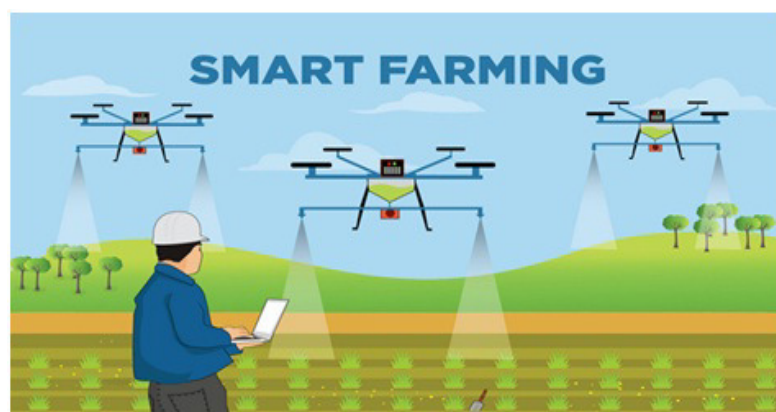

Figure 2. Smart farming using Drones [2]

3. IoT Irrigation System

Figure 3 illustrates a typical IoT Irrigation system. Crop docking and air temperature measurement sensors are connected to the network gateway by means of a Wireless Sensor Network (WSN). ZigBee is a popular choice with many different applications since it is simple to implement and personalise. The connection to the Internet will be at a lower cost since this software only requires a limited quantity of data capacity. 4G LTE mobile communications are being used to connect to the Internet wirelessly. Mobile network data is sent to the cloud-based web services that are subscribed to, and the data is made available to other cloud-based web services[13,14]. Software that has the ability to integrate all kinds of data and combine it with CWSI models to create irrigation index values is able to analyse agricultural land data and, based on this information, can apply CWSI models to assess water need. Weather service and satellite imagery are other relevant sources of information, and the results are irrigation index values for each area. The data provided to the network gateway is sent to a

controller for irrigation management, after which it is forwarded back to the gateway. Both data and results, as well as making changes to terminals, may be seen via specialised web applications, and farmers may also use these web apps to provide other farmers and professionals access to their data and outcomes.
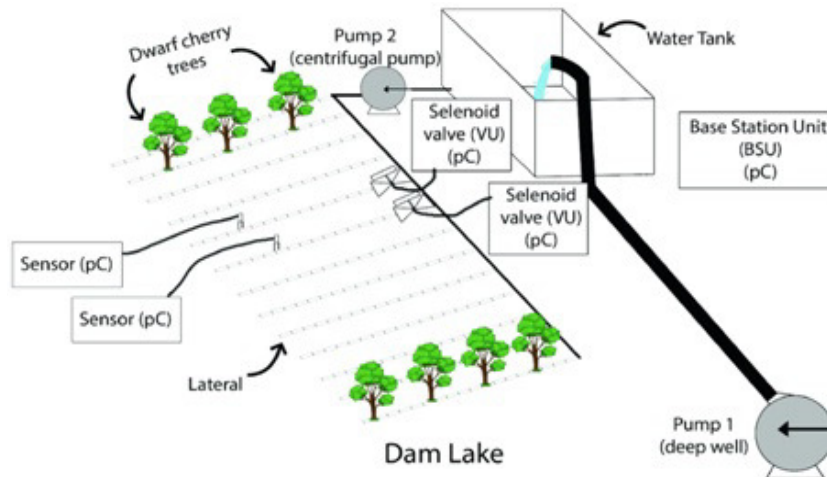

Figure 3. IoT Irrigation System [3]

4. Smart Cow Farm

In addition to cattle farming, IoT technology is also used in livestock farming. With the use of IoT sensors on the cows and the use of smartphones or tablets, farmers can easily find cows and detect significant animal welfare issues like rumination and lameness. As farmers use Internet of Things (IoT) technology to convert their animals into the so-called Internet of Cows, connected cows, or intelligent cows, their animals will come to be known as Internet of Things cows. As far as cattle farming and/or ranching is concerned, the Internet of Things paradigm may help by improving water, power, nutrition, and other resource production while also preserving animal welfare. Additionally, it gives farmers the ability to organise information, create reports, categorise cows, and track the life cycle of each animal [15,16]. IoT has given farmers tough issues like identifying cow estrus, which has long been a challenge for the dairy industry. When it comes to cows, the farmer will spend anywhere from 20 to 30 minutes four to five times a day in the stables to check whether the cow is in heat, which is a symptom of estrus. In figure.4. Presented an technology base IoT Smart Cow Farm system. The majority of instances occur at night while the farmer is asleep. There are a number of additional examples, such the animal disease "cattle lameness" which has a major impact on cows' productivity in terms of output, fertility, and lifespan. The importance of these problems has diminished because of the use of IoT technology. Cows equipped with IoT sensor tags are connected to their ears, necks, or legs to track their daily labour and overall well-being every 24 hours. After gathering data, the results are analysed using complex statistical and empirical models to determine whether a cow is in heat. As a consequence, the IoT solution detection rate may reach up to 95%, whereas conventional methods achieve detection rates in the range of 55 to 70%. Fully integrated IoT health monitoring systems are designed to provide accurate and dynamic diagnostics of lameness. In the smart cow farm, both animal sensors and other nearby sensors will be used to collect varied data. Data is used for automated equipment control, as well as animal status monitoring and user decision recommendations. Diversified sensors are miniaturising, reducing prices, and increasing performance, which will lead to more specialised IoT solutions to assist cow farmers.
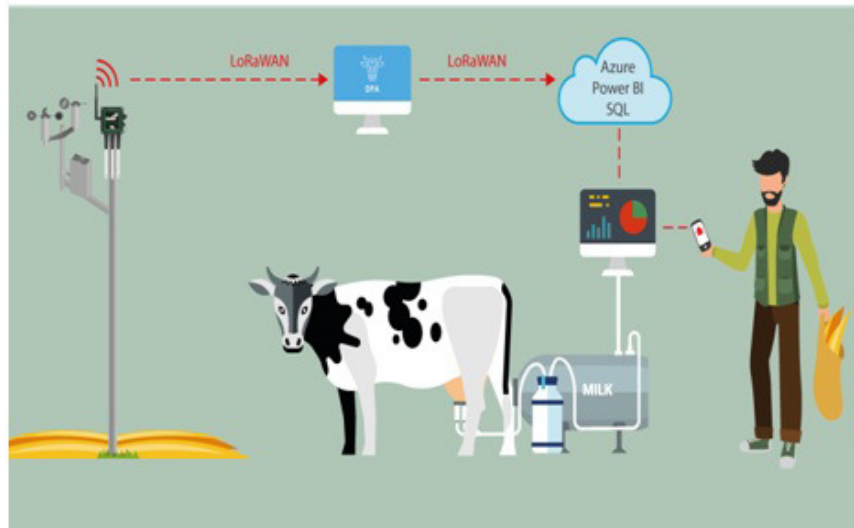
Figure 4. IoT Smart Cow Farm [4]

5. IoT Can Improve Agriculture

The Internet of Things (IoT) is used by farmers to implement certain IoT methods for enhancing their agricultural. Concentrated penalties for these practises may persuade farmers to abandon them. 1. D ata; loads of information such as weather, good soil, crop development, or animal health gathered by smart agricultural sensors These data may be utilised to help your business enhance the smartness of its country and its workers' overall performance, productivity, and efficiency. 2. Reduced production risks due to improved switching over internal techniques. If you are able to anticipate the outcome of your manufacturing, you can plan ahead and be better prepared to deliver your goods on time. If exactly how much undergrowth you are going to cultivate, you might persuade your products that their sale is increasing. 3. Increased business efficiency by process mechanization. You will master various technologies through the building period, e.g. drainage, composting or pest control by applying smooth strategies. 4. Budget organization and unused decrease awareness of the manufacturer by the increased controller. If you are smart to see irregularities or control fitness in harvest, you can moderate the dangers behind your products. 5. Improved dominance and capacity growth. Improved regulator completed construction development and established principles of production excellence and increasing mechanization completed with volume[17].

6. Challenges of IoT for Agriculture

The is a All smart farming responses must start with data analysis. If you can't make sense of the information you've gathered, it'll be of no use. As a result, you'll need strong data analytics, predictive algorithms, and devices to analyze the data and derive operational insights [18,19]. the equipment is made of of Selecting the sensors for your instrument is critical for internet of things agriculture (or create a custom one). The manner in which you look for information and how you make decisions all influence your choice. Whatever the situation may be, it is possible to discern the efficacy of your product based on the quality and consistency of the data you gather. Keeping up with Hardware maintenance is an important project in agriculture Internet of Things products, since sensors are commonly used in the topic and can be easily destroyed. As a result, you must make certain that your hardware is both reliable and simple to maintain. Then you'll have to update your sensors more often than you'd like. The revolution is underway, In figure .5. shows the various Smart farming tools. In order to be used in the field, intelligent agricultural applications must be adapted [20,21]. To access the information on the website, a company owner or farm administrator must be able to use a mobile phone or a personal computer anywhere in the globe. Furthermore, each linked tool must be self-

contained and have sufficient wireless diversity to connect to other devices and transmit data to the central server. The services available You'll need a robust internal infrastructure to ensure that your smart farming application runs smoothly (and that the load of records can handle it). Furthermore, the internal systems must be pleasant to use. Failure to make our system more user-friendly only increases the appeal of someone who interrupts, steals your information, or even uses your self-satisfying tractors.
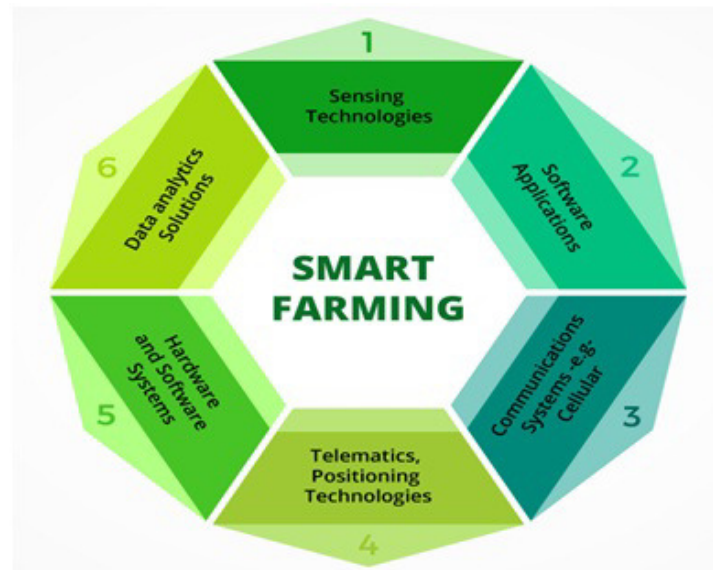

Figure 5. Smart farming Tools [5]

Smart Farming is a cultured understanding of management using current devices to improve the quantity and excellence of sophisticated properties. In the 21st period farmers have access to GPS, ground browsing, data management and the internet of machinery for stuff. By measuring difference within a field with confidence and familiarizing the method, farmers can significantly increase the efficiency and more selective use of pesticides and stimulants. Smart farming is a virtual global call for these days [22,23]. Intelligent farming offers many possibilities including nice water, healthy plants. Smart agriculture is an idea for managing agriculture, with a view to controlling advanced know-how which includes extensive knowledge, the cloud and Internet of Things (IoT) to follow, look, mechanize and compare approaches.

7. Conclusion

Agriculture facilitated by the Internet of Things has helped implement current technical responses to time explored understanding. This allowed the distance between production and pleasant production and quantity to be combined. Statistics The fact that more than one instrument are obtained and measured for real time use or garage are placed in a database guarantees rapid intervention and significantly less harm for vegetation. With smooth cease-fire and better execution of business processes, production becomes quicker and affects supermarkets in the wildest period. IoT farming applications are production of expressive statistics that farmers and farmers can possibly collect. Large owners of land and smallholder farmers need to appreciate the potential IoT demand for agriculture by linking intelligent know-how to increasing their manufacturing attractiveness and sustainability. In this paper we research the IoT application for agriculture and how farmers can expand by using the

Internet of Agriculture Stuff. This article examines the job opportunities of the Internet of Things (IoT).

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