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Applications of IoT Based Technology in Smart Agriculture and Farming

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Abstract: Smart agriculture and farming is a big input field for economic development. The most population of country like India depends on agriculture and smart farming. In this paper, it is proposed to develop a smart agriculture and farming system that uses technologies such as wireless sensor network, Internet of Things (IoT) to help farmers. Sensors are used to get information about the field help farmers to take appropriate decisions on insights and recommendations based on the collected data. Internet of Things (IoT) in agriculture is designed to assist farmers monitor vital information like humidity, temperature, and quality of soil using remote sensors, and to improve yields, plan more efficient irrigation, and make harvest forecasts.

Keywords: Internet of Things (IOT), Smart Agriculture, Smart Farming, IoT based agriculture applications.

I. INTRODUCTION

Agriculture is the main backbone of many country economical growths. The major barrier that arises in traditional farming is climate change. There are many factors to change climate like heavy rainfall , most intense storm , and heatwaves, less rainfall etc. due to these the productivity of crop decrease. The change in climate is the seasonal change in the lifecycle of the plant. To raise the productivity and reduce the barrier in agriculture there is need to apply innovative technology and technique that is Internet of things. The most important issues of smart farming are measurement of environment, and management of water. The reason is that the environmental and water management affect the growth of plant [6].

The more accurate information about the crop, soil, and environment may be gathered using sensor-based computer applications. It increases high-quality process and raw materials through and through the entire product process. This is because utilizing the IoT in smarter agriculture makes it more emulative than traditionary methods. Combined with IoT-based smart agriculture technologies, organic agricultural agriculture and family farming may see advantages. It is the case that between agricultural producers and Internet of Things 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 comprise agriculture in smart use of natural resources, and technologies such as remote control, decision support tools, automated irrigation systems, frost avoidance, and fertilization 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 advantages of IoT and the Internet may be gained through the Cloud of Things, which connects IoT with cloud computing. Another need for the IoT is for it to give society with information transparency. This work summarizes the current IoT-based agricultural tools and applications, which are broken down into distinct areas [11, 12]. The aim of this paper is to describe these entire contexts in detail, as well as discuss the advantages of IoT-based technologies in agriculture field. And finally the Solicitation to farmer for smart agriculture and farming.

II. LITERATURE REVIEW

The continuous decreasing water levels, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. To survive with this use of temperature and moisture sensors at suitable locations for monitoring of crops is implemented in [8]. An algorithm developed with threshold values of temperature and soil moisture can be programmed into microcontroller based gateway to control water quantity. The system can be powered by Photo voltaic panels and can have duplex communication link based on cellular–Internet interface that allow data in section and irrigation scheduling to be programmed through web page.[9].The technological development in open source software and hardware make it very easy to develop the device which can make better monitoring and wireless sensor network made it possible to use in monitoring and control of greenhouse parameter in precision agriculture [7].

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The IoT deployment in agriculture has the great potential to affect our society and the rest of the world. Currently, we see weather, soil, and water drying up as land that's critical to agriculture declines, making it harder and harder to produce food. IoT plays a greater role in agriculture, 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 advancement of the entire Farming system with the addition of the Smooth Agricultural IoT platform, the Internet of Things (IoT) plays a greater role in agriculture. Despite the fact that, the Internet of Things (IoT) is utilized in Farming, it has saved not only the time of agriculturalists but also large number in quantities of liquid and power, special thanks to the interconnectedness of devices and services. It is able to preserve frequently encountered topographies including moisture, high temperature, soil, etc. and gives real-time surveillance through the crystal-clear map. In agriculture field, hold Internet of Things (IoT) will yield various benefits. For example, the farmhouse automobiles have accomplished numerous missions. Smart agriculture is basically an integrated, uncontaminated, technologically fulfilled 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 [13,14]. After all individual devices and networking aren't directly saving the agriculturalists' time; the Internet of Things (IoT) is negatively affecting uneconomical 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. Additionally, the advantages described above, agriculture will benefit from implementing Internet of Things (IoT). Tunable Fields: Precision agriculture is a way that makes the farming process more correct and managed to increase 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. Fig 1 represented the precision agriculture. Precision agriculture has become one of the most well-known agricultural IoT programme in recent years and this technique has begun to be used by a large number of organisations.

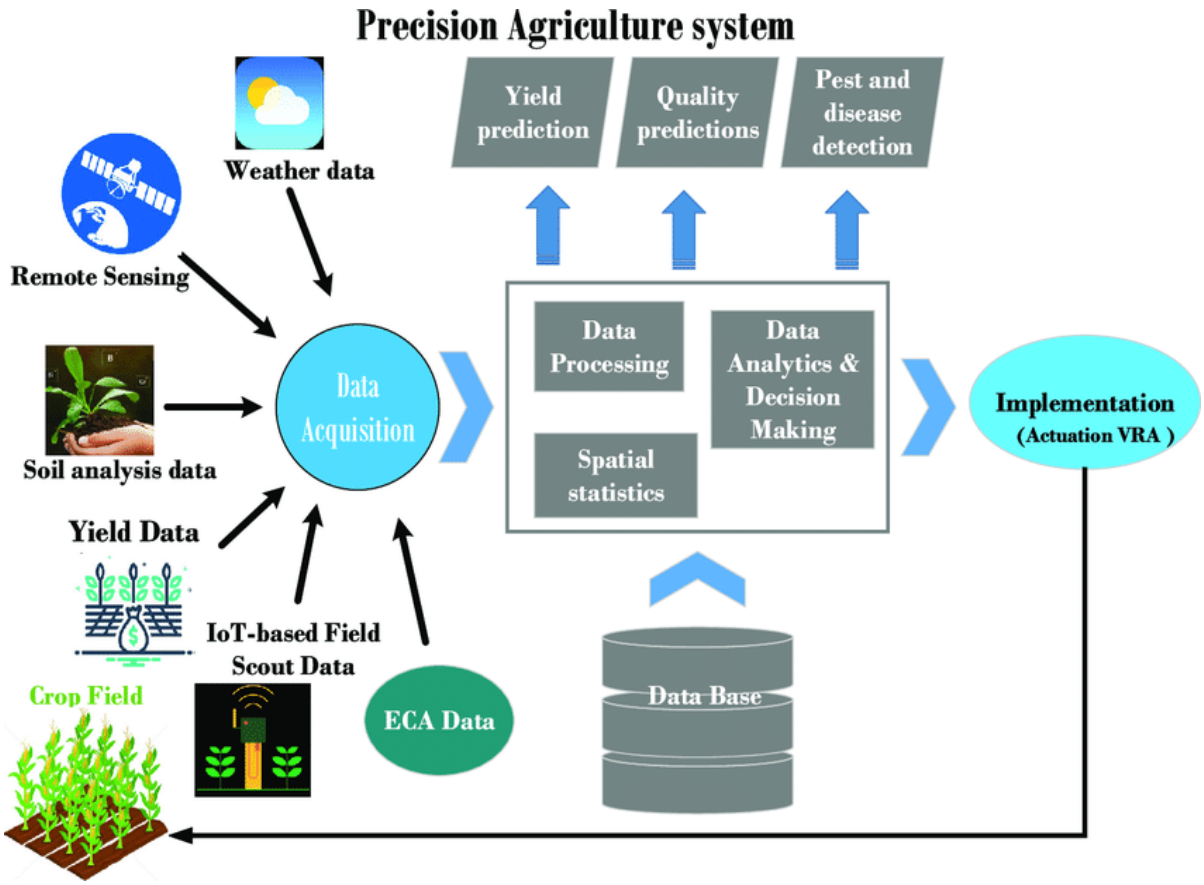

Figure 1. Precision farming using IoT [15]

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Data Analytics: The predictable database system now has not enough parking spaces to store the facts from the IoT sensors. In the smart agriculture machine the cloud based mainly facts garage and end to end IoT platform plays an important part. These structures are expected to play a vital role in finishing higher sports. The numbers are analyzed and the use of analytical apparatus converted into meaningful facts. The analytics of records helps to estimate temperature, farm animal conditions and various crop situations. The collected statistics use the technical advances and make better decisions for any purpose. You can understand the plants' real-time reputation using IoT devices, by collecting the facts from sensors [16,17]. You will gain an insight using prognostic analytics to make better decisions on harvesting. These analyses allow farmers to understand future climatic conditions and vegetation harvesting. IoT accredited farmers to manage the quality of the vegetation and the fertility of the land in the agricultural field, thus improving the amount of products.

Climate Conditions: Climate plays a very important role for agriculture. And mistaken climate knowhow deteriorates the quantity and the first class of crop production considerably. But IoT allow you to know the actual weather situation in real time.They collect environmental statistics that are used to select the right plants that can easily grow and sustain in specific climatic situations. The IoT atmosphere comprise of sensors that can locate conditions such as humidity, precipitation, temperature and more accurately in real time.

There are different sensors that have to be hit on each of these parameters and compose to fit your clever agricultural needs. These sensors disclose the situation and climatic conditions of the crops around them. The lack of physical presence in troubling climatic conditions, which eventually increases productivity and helps farmers to gain higher agricultural authorizations, is eliminated[18,19]. Smart Greenhouse: Greenhouse agriculture is a technique accompanying crop yields, greens, end results etc. Greenhouses handle various environmental parameters in two ways, either manually or by a proportional control mechanism.

Figure 2. Smart farming using Drones [20]

A smart IoT based greenhouse now does not simply path but adjust the environment. There is a need for human activities. Different sensors that are in line with plant concern are used to monitor the environment in an intelligent greenhouse. A cloud server creates a computer for remote accessing when associating IoT usage. The cloud server quietly enables records to be processed and manages the flow. This design gives farmers the better and most effective solutions with minimum and almost no manual interposition.

Agricultural Drones: Scientific advances have almost reorganized agricultural operations and there is way to disturbance with the advent of agricultural drones. Ground and aerial drones these are used for the fitness assessment, crop inspection, planting, spraying of crops and field assessment. With the right approach and composing based on real reality, the drone growth has given the agriculture industry a strong push and overhaul. Drones with thermal or multi-spectral sensors select

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areas where irrigation changes are very needy. When plants begin to grow, sensors indicate their health and measure the growth index of their plants. Clever drones have in due course reduced the environmental impact. The technology based Smart farming using Drones is given in figure.2. The outcomes were such that there was a great reduction in the chemical effects of groundwater and Livestock Internet monitoring resemblance allow farmers to obtain materials about their livestock's neighborhood, proper life and welfare [21,22]. This calculation allows them to identify their livestock's position. Such as identifying different animals that are uncomfortable in order to divide the herd, preventing the disease from developing for the whole animal. The suitability of farmers with Internet of Things (IoT)-based sensors to locate their farm animals helps them to transportation of miserably hard work charges by a significant amount.

III. IOT BASED AGRICULTURE APPLICATIONS

In this part of paper presents the possible agricultural farming and related appliances that is currently being implemented using Internet of Things.

Irrigation system: In present agriculture requires developed irrigation system to govern the water usage in farming and related activities [23,24,25]. There are four important factors used in smart irrigation system such as, real-time weather forecast data, control of farmer's system, enabling WiFi and Ethernet connection, adding contemporize with moisture sensors installed in farmer's yard, and it continuously reducing farmer's monthly bills while helping to conserve limited water resources. IoT is getting expansion in agricultural management related systems around the world.

Control over Pest and disease: The minimum usage of pesticides and fertilizers helps to improve the quality of crop as well as reduce the farming cost. However, for controlling the extra usage of pesticides in the field, we need to monitor the probability and occurrence of pests in crops at every crop cycle. To forecast this, we also need collecting disease and insect pest information using sensor nodes, data processing and mining, etc. with use of IoT infrastructure [26]. A three layered IoT architecture is proposed that may recognize the disease occurred and take important actions to point out the responsible pest which has caused the disease. Farmer can implicit upon the required medicine to save the crop.

Monitoring of cattle: A herd of cattle grazing a field can be monitored using IoT easily without the extra man force. Thus, real-time monitoring of any cattle is also achieved.[27] has exhibit IoT based environmental control system for nursery pig.

Dairy monitoring: IoT based cloud solutions, such as, Connectors are being currently very popular to monitor dairy in smart way. It is able to give multiple behaviour detection and predictions including animal heat & estrus cycles, health analysis and also provide a forward-looking conjecture of the next cycle start dates. Further, individual activity estimation and location aware purpose can be added on top of the services.

Water quality monitoring: Using sensor nodes entitled with wireless communication help in monitoring the water quality. A recent article published which develops a real time monitoring of the water quality using IoT. The system measures various parts like physical and chemical parameters of the water such as, temperature, pH, turbidity, conductivity, dissolved oxygen. The sensor data is viewed on Internet using cloud services at any time [28].

Greenhouse condition monitoring: Greenhouse and agriculture are closely connected to each other. Greenhouse gases are responsible for increasing the climate temperature and thus it create a direct impact on agriculture. Additionally, greenhouse gas emission depends on pH, temperature, CO2, etc. Harvest Geek gives an IoT cloud based services to monitor the greenhouse condition remotely which can further be managed by the user or by automatically.

Soil monitoring: Soil property is very crucial for agricultural domain. On understanding the properties of soil adds an advantage to the production of crops. [29] has incorporated 6LoWPAN technology with IoT to remotely accumulation of the condition of soil while performing various sensor nodes. SNMP is already used to monitor the network in real time.

Precision Agricultural by UAV: Agricultural precision can be obtained by make use of advanced technologies such as, UAV and Drone, for productive effect of the farm. Precision Hawk (www.precisionhawk.com) enterprise leverages UAV, GIS and sensors enabled IoT cloud platform to locate artificial intelligence through inthe-air flight path calculations for detection of weather conditions in the air.

Further, in-flight diagnostics and monitoring their different processes continually monitor its own status while in flight and counts on the operational weather/wind limitations, land mapping, and real time analytics supports.

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Agricultural means production supply chain management: Agricultural products always need to be efficiently managed so that farmer can gain profit, hence the operating efficiency on it. Supply chain management on the agri-products can be easily monitored by IoT and [30] examine the application of IoT in product supply chain business processes, and the operating factor in the acceptance of agricultural products by supply chain effects in IoT. It further gives a reference structure for the node enterprises of the product chain for necessary inferences. Research in traffic categorization, which avoids payload inspection, has hastened over the last five years. It is generally difficult to compare their different approaches, because they differ in the selection of features (some requiring inspection of the packet payload), choice of supervised or unsupervised classification algorithms, and set of classified traffic classes. Additionally complicating comparisons between various studies is the fact that classification performance depends on how the classifier is trained and the test data used to assess accuracy. Unfortunately, a universal set of test traffic data does not available to allow uniform comparisons of various classifiers till now.

IV. CONCLUSION

This paper present the development of the agriculture sector will always be a priority especially given the dynamics of the world today. Therefore, using IoT in agriculture has a big promising future as a driving force of efficiency, sustainability, and scalability in this industry.

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