Significance of Internet of Things in Smart Farming

Mrs.J.Jerlin Adaikala Sundari

Assistant Professor

Department of Computer Science

PSG College of Arts and Science, Civil Aerodrome Post, Avinashi Road, Coimbatore – 641014, India.

Abstract: The Internet of Things has evolved across many sectors including the Farming Sector. The IoT technology has paved a way for Green Revolution by making a vital impact in Farming. The Farming Sector depends profoundly on novel thoughts because of the steadily growing demand for food produced across the world. It is bound to adapt the Internet of Things. It applies the IoT technology to overcome the challenges like varying climatic conditions, inadequate space for farming and other environmental factors. It is obvious that the IoT equipment installation will see a considerable growth rate in the farming industry. And the number of connected gadgets (farming) will also increase drastically in the nearby future. Satellite connectivity and cellular networks are being introduced in the remote areas to provide a continuous and reliable network infrastructure to offer new capabilities not possible before. In this paper we review the components of smart farming method, the applications of IoT in farming, the benefits of IoT technology in the modern farming ,and the future scope of IoT in the farming Sector.

Index Terms: Internet of Things, Network infrastructure, Sensors, Smart farming.

I. INTRODUCTION

The Internet of Things (IoT) is ruling various sectors nowadays. It has stepped into houses and business with various applications. It is not an exception that IoT has also entered into the farming sector. IoT and has offered an enormous level of benefits in smart agriculture by introducing connected devices. Farming involves various operations between tilling and yielding crops. It involves watering the fields at adequate intervals, measuring the weather parameters, checking the soil moisture etc. All of these operations are automated with the help of sensors to measure the different parameters precisely. The farmers can observe the field conditions from anyplace. It is highly efficient compared to the traditional approach. IoT in smart farming enables reduction of waste and increase productivity.

II. COMPONENTS OF SMART FARM SYSTEM

The Smart farm system contains various components. The components are Management Information System - MIS/Control Centers, Remote Sensing Systems/ Sensors, Geographic Information Systems- GIS, Spatial Decision Support Systems- SDSS and Grain Yield Mapping Monitor.
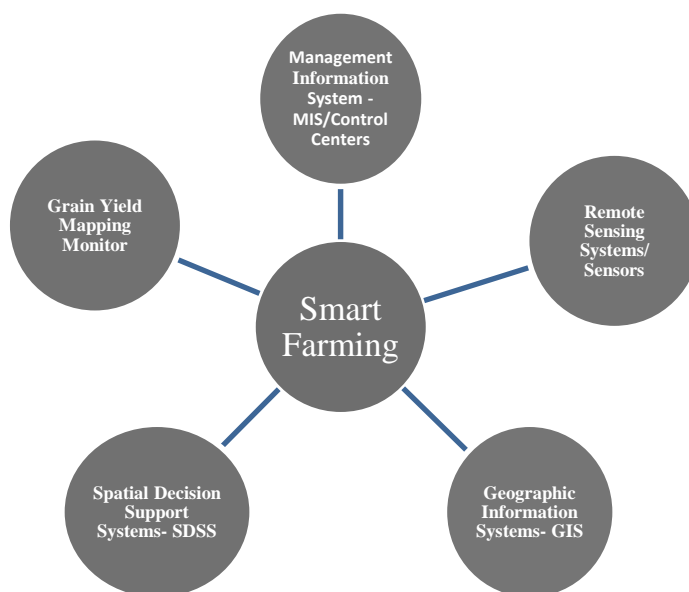
Components of Smart Farm System

2.1. Management Information System –MIS/Control Centers

The Management Information System does the job of collection, dispensation, storage and disseminating data. It plays a vital role in smart farming. It helps the farmers to make best decisions in various stages of cultivation starting from tilling to yielding. The collected data is processed real-time. The advancements in the Microcontroller manufacturing has made smart farming possible.

2.2. Remote Sensing Systems/Sensors

Remote sensing has discovered a tremendous potential in providing a wide grade of crop condition and production possibilities. The crop status at each stage and its development progress can be obtained by remote sensing. The sensors are placed in the fields to measure the moisture level, temperature and humidity. The sensors send the data to the MIS.

2.3. Geographic Information Systems-GIS

The Geographical Information Systems (GIS) consist of a set of tools for capturing, mapping, analyzing and displaying data related to positions on the surface of the Earth. Most of the GIS systems benefit from the Unmanned Aerial Vehicle (UAV) technology.GIS is used to analyze the data captured from the soil to find out the suitable crops for planting.GIS also predicts the environmental factors and can map the geological and geographic features. They enable the farmers to develop efficient farming strategies
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2.4. Spatial Decision Support Systems-SDSS

Spatial decision support systems help to store the spatial problems. It allows the decision makers to create spatial and process based relationships, combine many data layers into synthetic information. With the help of the recognition algorithms and video algorithm technology decision makers can monitor, envisage and make decisions on the farming operations.

2.5. Grain Yield mapping Monitor

The Grain yield mapping is a tool which makes use of the GPS data to calculate the grain yield. It consists of grain flow sensor, grain moisture sensor, and speed sensor to accept the signals from the satellite, yield monitor and travel speed sensor.

III. APPLICATIONS OF IoT IN SMART FARMING

IoT enabled smart farming improves the whole farming structure by monitoring the farm in real time. It is in the phase of bringing enormous benefits like well-organized and efficient use of the available resources, optimization of inputs thus making revolutions in farming. Following are some of the applications of IoT in smart farming.

3.1. Precision Farming

Precision farming is one of the important applications of IoT in farming. It helps making the entire farming practice precise and predictable. It helps to analyze the data generated from the sensors and respond immediately to the results in an intellectual manner. It can sense the real time operational conditions of the associated devices. Every parameter can be analyzed perfectly through precision farming. Accurate results can be obtained from precision farming. It can detect the real time working conditions of the linked devices.

3.2. Smart Greenhouse

Greenhouses protect crops from climate variability, which affects the yield of the plants. They help certain crops to be cultivated all through the year irrespective of the changing weather. IoT enables the weather stations to automatically regulate the climatic conditions according to a given set of instruction. Application of IoT in Green houses has wiped out human interference, thus making the entire practice cost efficient and escalating the precision.

3.3. Predictive Analysis

The predictive analysis tools help the farmers and decision makers to analyze the risks of infestations, pestilence and other diseases making it more manageable, controllable, and predictive and hence increasing the productivity.

IV. BENEFITS OF IoT IN SMART FARMING

The advancement of IoT technology created an ongoing shift in the Agricultural sector as steps involved in the farming process are becoming more modified. It has also move toward as a second beckon of green revolution. The IoT technology enables efficiency, cut back of resource and cost, and automation. It helps the farmers to increase the production and improve decision making. Some of the benefits through which the farming sector gain from IoT are:

4.1. Smarter Process

IoT based systems help the farmers to decrease the usage of water and energy. It appreciably scales down the usage of insecticides and fertilizers. The yield finally becomes more natural when compared to the conventional farming methods. So it makes farming a smarter process

4.2. Swiftness

With real-time inspection and forecast systems, the farmers can rapidly react to any considerable change in weather conditions, moisture, and air and soil quality. Swiftness is an essence of IoT in farming in facing the volatile weather patterns.

4.3. Improved Yield Quality

Data-driven farming helps to increase the quality and quantity of the yield. With remote sensing systems, geographic information systems and yield mapping monitor, the farmers can better understand and create the finest conditions and amplify the dietetic value of the produce.

4.4. Expansion

Most of the populations in the world live in urban areas. IoT enabled greenhouses and hydroponic systems facilitate diminutive food supply chains and should be able to provide food to the people. Smart farming systems allow growing food basically everywhere in superstores, on walls and roof tops of tall buildings, in shipping containers and, of course, in the ease of everyone's home.

V. CHALLENGES OF IoT IN SMART FARMING

There arise several challenges when IoT technology is applied in farming. The tools placed at the farms have to be exposed directly to high solar rays, extreme weather, and other threats capable of damaging the electronic equipments. The devices have to be active for long hours with the limited batter power. The server infrastructure must be able to handle the high volume of data extracted from the sensors. Some of the important challenges faced in applying IoT in farming are

5.1. Networking

The environment not only enforces challenges to the physical components, but also to the network layer. Wireless communication is the most general in farming deployments, owed to the lack of wiring costs. Environment is known to be one of the major factors which lead to low wireless link quality which may be affected by temperature, moisture, human intervention and other factors within the area in which a wireless node tries to communicate. Hence records have to be transmitted using robust and trustworthy technologies, according to the necessities and challenges of the rustic environment.

5.2. Security

The key challenges in ensuring security are access control, confidentiality, integrity and availability. Data attacks, data leakage and malware injection becomes challenging in maintaining security. Additional security measures have to be taken to avoid hackers stealing the data.

5.3. High Hardware Cost

The devices required to implement smart farming using IoT is quite expensive. The Automated equipments cost more than the manually operated equipments. The cost of farm management along with software, hardware and cloud storage is quite expensive. But to maximize profits, the farmers have to invest initially to set up IoT technology in their farms. They can rely on the banks for the initial investment instead of falling into the prey of unauthorized money lenders.

5.4. Design and Durability

The IoT devices should be able to manage the conditions when placed outdoors. The moveable sensors, drones and the weather observation stations should have a certain level of robustness to withstand the changing weather conditions. It needs skillful designers and developers to implement it.

VI. CONCLUSION

As IoT has entered into the world of farming, it is likely to set a huge impact in this industry. The farming sector can gain more and work towards closing the supply demand map. It is advantageous that these specialized IoT equipments help farmers to foresee the output. Farmers started realizing that the IoT is a driving force for increasing production of the crops in an effective manner. It is obvious that the IoT is in its way to restructure the farming sector.

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