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IoT in Agriculture : Smart Farming

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ABSTRACT

From farm to fork, information and communication technology sector is being enhanced to facilitate the farmers, croppers and related users of intelligent services. Technological revolution integrates the development of smart devices and IoT services. To feed the ever growing global population, the agriculture industry needs to be extended. Internet of Things opens the door wide for smart farming solution to increase the agricultural production. IoT technologies helps the farmers as a service by providing historical and real time data for predicting soil quality, weather conditions and crop's health. Smart farming provides the enhanced facility for process automation and evaluation and waste reduction. As a result, all these factors drastically increase the quality and quantity of the food products and decrease the production cost. This paper outlines the promising solutions applied in the sphere of agriculture.

Keywords : Smart Farming, Internet of Things, Green House, IoT agriculture.

I. INTRODUCTION

Internet of Things is a dynamic global information network, supports several applications for users such as healthcare organizations, security, smart transports, traffic management, E-payment, smart farming etc[1]. Researchers estimate that IoT will consist of 50 billion objects by 2020[2]. Most of the organizations can be monitored and controlled by smart IoT devices and applications.

IoT is a future networking paradigm which interconnects physically distributed physical and logical resources. IoT environment consists of four primary components such as things, mobile devices or back end devices, Gateway node and Internet. The things are the devices which may be sensors, actuators, RFID, mobile devices and smart appliances. Remote users can access these devices and smart applications by connecting with sensing devices in an unattended environment [3]. Once connected with network, user can access information from these devices.

Gateway nodes provide on-demand delivery of data or information for high computational processing. The application areas of IoT infrastructure will be extended from smart devices to smart homes and smart city development [4]. Access control, identity management, legal and technical issues are key considerations for ensuring security. Deploying security in IoT is one of the greatest challenges in this interconnected world.

In agricultural industry, technological advancements lead the comfortable pathway for the farmers. Internet of Things is the driving force behind agricultural production at a lower cost in smarter way. Smart farming technologies can remotely detect soil quality, weather conditions, crop growth, and crop damage using wireless monitoring sensors with cloud based platform.

In this article, section II describes the review of existing technologies. Section III enumerates the IoT applications in agriculture. Section IV is regretted for challenges in smart farming by farmers. Section V is concluded with future work and it is followed by the list of references reviewed for designing this article.

II. LITERATURE REVIEW

The newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. To cope up with this use of temperature and moisture sensor at suitable locations for monitoring of crops [5]. In smart farming, threshold values of temperature and soil moisture can be programmed into a microcontroller-based gateway to control water quantity. The system is powered by photovoltaic panels and can have a duplex communication link based on a cellular Internet interface that allows data inspection and irrigation scheduling to be programmed through a web page [6].

The technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture [7]. Researchers found that the yield of agriculture is decreasing day by day. However, use of technology in the field of agriculture plays important role in increasing the production as well as in reducing the extra man power efforts. Some of the research attempts are done for betterment of farmers which provides the systems that use technologies helpful for increasing the agricultural yield. Wireless Sensor Networks is said to be mature technology and lot of work has been done for agriculture domain [8, 9]. Use of cloud computing for agriculture sector for storing details of agriculture information has been explained in [10].

III. IOT APPLICATIONS IN AGRICULTURE

Smart farming practices provides the solutions to overcome the challenges such as rising climate changes, weather conditions, soil conditions, waste reduction and green housing. The Internet of things are various sensors, autonomous vehicles, control systems and robotics. At below, these are various stages of prediction in agriculture from farm to fork.

A. Monitoring climate conditions, soil and plants

Dramatic changes in the climate and natural disasters seriously affect the plant growth and agricultural production.. Variety of environmental conditions can also be collected by many sensors and stored in integrated and heterogeneous information and reported by internet of Things.

Sensing soil and nutrients, measurement of moisture, temperature and electrical conductivity are collected through sensors and stored in integrated databases. Based on soil profile, fertilizer level to be determined and applied.

Farmers and agriculturalists needs to install mobile applications and register with cloud through MobileApp. Cloud storage consists of all the details of weather conditions, soil conditions irrigation levels, plant growth and damage. It also stores details about farmer, marketing agent details, and agro vendors and service providers and government schemes for agriculture sector including bank loans for farmers and concessions given on seed and/or fertilizers. Periodical data is collected from soil and environment sampling through sensors, will be updated and is used for controlling the smart farms.

Internet of Things plays a vital role for monitoring the plants for identifying diseases and insects which are affecting the growth. If the level of pest control exceeds prescribed range, through sensors alarm and alerts can be generated to warn the farmers to take

actions. Optimal time for planting crops, controlling the pests and plant diseases and harvesting can also be intimated through and cloud database to the farmers and agriculturists.

B. Water Irrigation and Waste Reduction

Controlling water usage for optimal plant growth is enabled by an Internet of Things to monitor tank leveling and schedule irrigation timings. It is also necessary to monitor the unwanted leakages. All these are accessible through the web and mobile applications hosted on enterprise cloud.

IoT technologies help the agriculturists and farmers to reduce generated wastes and enhance productivity. It is a practice that makes the farming procedure more controlled and accurate for the growing of crops. After harvesting, for agriculture storage, silos and grain elevators are to be monitored for sensing temperature, pressure, humidity and light levels of the grains.

C. Livestock monitoring

Farmers and agriculturalists collect information about the location, health conditions of their cattle and feeding schedule. IoT based sensors are also used for finding the sick animal in the herd before it contaminates the rest of the animals, It will drastically reduce livestock losses and reduce costs by monitoring them continually and recover the others in the large group.

D. Smart Greenhouses

Modern affordable and healthy green houses are to be built by using Iot sensors which are solar powered. The sensors are used for providing information about temperature, pressure, humidity and light levels. These environmental parameters are monitored by sensors and controlled either by control systems or by manual intervention. Smart sprinklers are also used for water irrigation. All these are connected using IoT cloud server accesses the data and provide cost effective solutions to the farmers.

IV. CHALLENGES IN SMART FARMING

The main challenge in technology diffusion in agriculture is that land holdings are so small, hurting long-term productivity growth. All our technologies, like high yielding seeds, are for irrigated lands, although 48% of our sown area is dry lands.

According to the Agricultural Census 2016, 80% of land ownership is of less than 2 hectares and total cropped area is only 45%. Nearly 90% of farmers are small and marginal. The average size of a farm is now just 1.15 hectares. Only 5% farmers operate on land bigger than 4 hectares. Farmers, who have been able to pool in their lands to increase their farm size to at least 100-200 acres have been the early beneficiaries. By contrast, only 5% of farmers operate on land parcels larger than 4 hectares.

Often, those exploiting smart technologies aren't farmers but large agri-businesses. Some of these tools are used by farm-loan companies for risk management,The industry must overcome increasing water shortages, limited availability of lands, and fertility of lands difficult to manage cost. Moreover, existing strategies are not enough to overcome the challenges. Security challenges in the environment of small embedded devices must be easy to implement and cost effective.

V. CONCLUSION AND FUTURE WORK

IoT technology enhances the existing life style of agriculturalists and farmers by integrating all the devices to a digital level in the extensive directions. Internet technologies, social networks, secured integrated databases and on demand availability of information will facilitate the smart farming and

global food production. The purpose of Smart Farming is to increase the quality and quantity of agricultural production by using sensing technology to make farmers more intelligent and more connected. New innovative IoT applications will address these issues and help in increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. IoT can be leveraged to allow the farmers to evaluate the soil conditions, moisture level, livestock feed levels density and level of pest control. The model development and implementation will be focused in future.

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