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Internet of Things (IoT) For Smart Agriculture: Innovative Practices and the Path for Future Farming

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Abstract

The Internet of Things has gained a lot of attention in the fields of business and education in recent years. IoT systems are now being utilized in many industries, transforming lives in many areas such as artificial streaming, interconnected communities, intelligent networking, autonomous vehicles and digital network. Like other industries, both farmers and farming companies are shifting towards an emerging technology that have accurate, time intensive, cost-effective and less humane intervention to satisfy this requirement and achieve high profitability. One of such methods is called Internet of Things (IOT) and it aims to accomplish intelligent agriculture. The continuous development of Internet of Things based techniques remodeled farming sector to Intelligent Farming that shifted the sector from quantitative to qualitative approaches. This study discusses deployment of IoT and sensor networks which are intended to move and alleviate the consequences of land and environmental issues in agriculture.

Keyword:- Internet of Things, Smart Agriculture, Water management, Soil Management, Crop Monitoring, Disease Management, Pest Control, Intelligent Farming

I INTRODUCTION

As per the statistics of Food and Agriculture Organization, nearly 15 to 25% of crops are destroyed due to rodents, pests and diseases [1]. In addition to increasing production of food grains, the nation needs to ensure food safety and security for its increasing needs in terms of consumption. According to the report of Department of Horticulture and Plantation crops, Government of Tamilnadu, for adults, the standard per capita consumption is 300 g/day. But as per the existing production level of the state only 130 g/day can be supplied [2]. However, nearly 53 % of yields is destroyed as a consequence of pathogens named bacteriosis. This can be controlled and reduced through proper tracking and regulating environmental variables in crops.

In developing nations like India, several rural areas tend to pursue conventional agriculture without taking into consideration of new technical methods because of insufficient access to knowledge and technology. The 21st century is the era of information and communication technology. In this sector, technological advances have to be enforced to create better living standard for the people involved in these activities and consumers[3] [4].

IoT allows for automatic monitoring of variables like temperature, moisture etc through sensors [5] [6]. The crop growth can be tracked by farmer from anywhere. Compared to traditional agriculture, this IoT driven intelligent farming is extremely efficient. The implementation of IoT in agriculture is not only increasing crop productivity, but it can also be used to provide various agriculture related information to farmers via their mobile phone. IoT based intelligent farming practices offers various benefits to the farmers. In short, IoT can act as an effective development technology collaborator to the farming sector and reduces the human involvement.

II IoT IN WATER MANAGEMENT AND IRRIGATION

Water is an essential resource for daily existence and monitoring the proper usage of water is now a major challenge. Water management information and communication infrastructure face interoperability problems due to the non-availability of uniform reporting and testing equipment's assistance. The intelligent IoT farming integrates Cloud Map Software (CMS) and the Sensor Observation Tool (SOT) with the knowledge of water requirements in order to prevent water wastage. In dry weather, water management can be easily handled by smart sensors, which can report the humidity level in the ground and irrigate water to the field at the time of necessity. The remote sensing is used to prevent wastage of water in the field. Based on irrigation requirements and water supply stage, the meter can be automatically turned on or off [7]. The water saving methods are practiced with integrated control systems which indirectly increase the production in agriculture with less water consumption [8]. Wetting Front Detector (WFT) technology in IoT offers knowledge about soil wetting and moisture content more accurately and effectively in real time. This device is versatile equipment because its price is affordable and good efficiency [9]. The web interface by WSN and Linux allows farmers to automatically monitor farm irrigation. This program is controlled using the ZigBee Wireless Networking Protocol to capture, track and evaluate moisture content of soil with the help of mobile browser. This technique significantly decreases the use of water and encourages consistent water delivery across the whole field [10]. The health of the crops is one of the

important factors for increasing profitability in farming sector. An integrated system designed by Martin et. Al analyzes temperature and moisture data with the help of a software defined controller and only irrigates the controlled water volume at correct times as per the requirements. This information and procedure is shared among the farmers and allows them to control and track water irrigation [11].

III IoT IN CROP MONITORING AND CROP MANAGEMENT

The growth of crops need to be tracked during their lifecycle from planting to harvesting. All the information are gathered from the field by using wireless sensor [12]. Farming drones are used to track plant growth and improves farming. The most significant aids for the deployment of drones and improve crop productivity are drone fitness, optimized GIS imaging, easy to use and time efficiency. Drone technology offers technical advantage for agriculture through tactics and strategy focuses on real time data capture and analysis. Through the use of such IoT Technology, weather and soil information can be collected and used by farmers through mobile devices [13]. Researches indicate that agriculture by using these automated system is 92% productive than traditional farming practice [14]

IV DISEASE MANAGEMENT AND PEST CONTROL USING IoT

Pest control is an essential activity in farming. Integrated Pest Management (IPM) is a means of preventing insect threats for long term by utilizing successful approaches. The usage of IoT is inevitable for advanced pesticide control as specific biological, chemical, mechanical and cultural instruments are used. With IoT in farming, mobile phones, portable cameras, RFID chips and drones are used to track and identify many diseases in agricultural crops. Such IoT devices would relay details to the consumer devices and farmers would be equipped with protection steps for controlling bacterial and insect problems by means of spraying [12]. This method will help to manage pesticide dosage and disease issues in earlier stage of infections. Simultaneously, metrics such as humidity, temperature and climate variables may help to get a better understanding of farm issues by agri-experts for seeding [15]. IoT is used to obtain data on pests and disease infection by using wireless sensor networks while concurrently monitoring and disseminating information on application of pesticides in agriculture fields. This might ultimately help to minimize cost involved in production of crops and improves output development by rising crop quality, revenue and productivity [16,17]. In the organic pest management process, the Integrated Pest Management encourages healthy crop production. The farmer may access the necessary

details, develop a personal and self-protection strategy for crops in changing weather conditions and collect information regarding treatments utilizing IoT middleware that allows mobile and centralized dynamic solutions [18]. For the identification of plant diseases and insect destruction, there is a specific framework for controlling environmental variables by data collection, knowledge aggregation and appropriate algorithm [19]. Recent implementation of IoT in integrated pest management is the development of IPM ontology which act as a web ontology language document. It helps to protect plants from pests through automated ontology [20]. The implementation of IoT in agriculture reduces the usage of insecticides and fungicides in farms. This coincides with forecast details from weather stations and pest. This helps farmers to frame regulated steps to defend their crops with diseases and pest knowledge [16]

V SOIL MONITORING WITH IoT

Soil Management is necessary in farming before cultivation. Soil pH, moisture, nutrition content and humidity variables of soil can be monitored by using IoT. All these metrics are traditionally taken by farmers manually and these observations are tracked at periodic intervals. IoT enabled systems will reduce human interventions in soil management and monitoring. In this system nodes are used to submit data to the central server which stores, examines, shows and transmits the data on the cell phone as well. The ambient temperature and moisture are controlled by the microcontroller which eventually increase or decrease energy consumption, reduces human errors and possibilities of errors [21]. ZigBee technology, artificial intelligence and decision support system are used to monitor humidity content of the soil. This device allows farmers to grow their agricultural crops more reliably and systematically. This aims to reduce labour prices and pollution [22]. For pH, humidity and temperature tracking, a device with less expensive sensor launchpad with cloud storage is developed [23]. A smart irrigation device with ‘Arduino’ has also been built to regulate soil humidity and temperature [24].

VI CONCLUSION

In order to meet growing demand for food and in view of rapidly diminishing farming land, there is a need to concentrate on more clever, cheaper and efficient farming methods. The IoT and its derivative broad variety of technologies enable farmers to be more competitive in creating and remodeling the agricultural sector in order to meet the new threats that will emerge. This technology supports agriculture and enhances it by making it more competitive through easy finding of knowledge on successful parameters. IoT assists farming and farmers by lining their

field worldwide without time bound. The development of IoT empowers and encourages farmers to plan for preventive action to align themselves for the current circumstances of their farms. Over conventional cultivation, IoT technology optimizes smart agriculture with improved efficiency and low cost input. IoT benefits agriculture and farming not only by reducing resources and less time consuming planning, but also applies to a range of agriculture parameters including water control, control of diseases and pests, tracking of green house, livestock management, land management and crop monitoring.

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