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IOT in AGRICULTURE – A SURVEY

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Abstract – *Increase in food consumption, demand for quality food, environmental impacts of agriculture has lead to use information technology in the agriculture sector, which comes under the heading of precision agriculture. Internet of things (IOT) is a well known technology now a days that is growing rapidly in recent years and brings numerous benefits with it for agriculture. Because of the heterogeneous and enormous amount of data collected by IoT devices, future of internet of things (IoT) agricultural applications depend on cloud computing. At the same time, microcontrollers will add new power to the internet of things (IoT). In this survey, the research trend, the concepts, fundamental components of IOT, the challenges, and IOT applications in agriculture are examined. Firstly, the numbers of published papers in this field reviewed. Secondly, IOT definition and IOT architecture together with its layers are introduced. Thirdly, some involved technologies in the IOT are compared; finally, the main challenges in IOT and precision agriculture (PA) are considered.*

Key Words: Internet of Things, Machine to Machine, Precision Agriculture, Artificial Neural Network, Ecological Monitoring , Environmental Monitoring and Control, IoT Sensors

Motivation: Internet of Things in Agriculture is the biggest thing in upcoming era. Smart farming is a capital intensive and hi-tech system for growing food cleanly and sustainably for everyone. In IoT smart farming a system is built for monitoring crops using various devices which in turn will help to increase food production by reducing any future harm for crops. Use of AI will bring a great change in upcoming future of farming. It has tendency to revolutionize entire farming culture from reducing production cost to increased food supply to feed each and every person.

1. INTRODUCTION

The Internet of things, IOT, is a new application domain that joins different technologies (software) and devices (hardware) such as wireless telecommunications technology, sensors, Radio-Frequency Identification (RFID) tags, actuators, mobile phones, etc. Kevin Ashton invented the word 'Internet of Things' in 1999. The first interesting characteristic of IOT originated from the name that describes it. It is a set of physical interconnected objects or "Things". Physical entities can be an animal, humans, cars, environments, appliance etc. Furthermore, the "Internet" refers to the fact that "Things" are connected to the internet. Additionally, each "Thing" has an identifier in order to be identifiable..

Before Modern agriculture especially precision agriculture (PA) has a key role in helping to enhance crop yields. PA promises to make agriculture extremely effectiveness to make sure high productivity levels and reduce the environmental impact of farming. Additionally, PA positive approaches have a marked effect on greenhouse gas emissions. Precision agriculture thanks to advanced technologies such as WSN, sensors, RFID, actuators, etc. is able to cut the amount of fertilizers and pesticides, as it optimizes the needs of the fields and indoor agriculture. In recent years, there have been advances in low-cost and low-power sensors. These sensors measure soil moisture, temperature, humidity and other parameters such as water content, outdoor temperature, wind speed etc. Data collected from the sensors analyze by data analysis methods which helping to extract more information from the data, decision making support systems and create more accurate prediction models

Uses of IoT technologies in different fields have a significant growth, some of which are: healthcare, smart cities, industries, agriculture, traffic management, military, smart grid and others[6], so we carry out a wide-ranging review of related work in three renowned scientific databases (IEE, Springer, and Science Direct) to investigate the recent trend in IOT related publication. Fig. 1 describes the number of publications indexed in the three major scientific databases over an eight years period between 2010 and 2017. Meanwhile, in recent years there has been a sharp rise in the trend of submitted research articles related to applications of the internet of things in agriculture in the scientific databases (see Fig. 2). In this paper, we use the Google Scholar search engine for compare the number of publications between 2010 and 2017. The results obtain by browsing the keywords 'IOT and agriculture', 'IOT and precision agriculture', 'IOT and farming', 'IOT and smart agriculture'. This dramatic increase drives us to study to investigate the latest scientific research on applications of IoT in agriculture.

The IOT sensing technology is a network established by a number of sensors to sense analog data such as light, pressure, temperature, wind speed, and etc. Collected data might involve in aggregation and preprocess techniques in order to reduce the data traffic and increase the sensor node lifetime. Various forms of communication technologies have been used by IOT such as WiFi, ZigBee, Bluetooth, IEEE 802.15.4, LTE, and 5G. The IOT requires a

standard way to connects IOT devices to each other and to the internet.

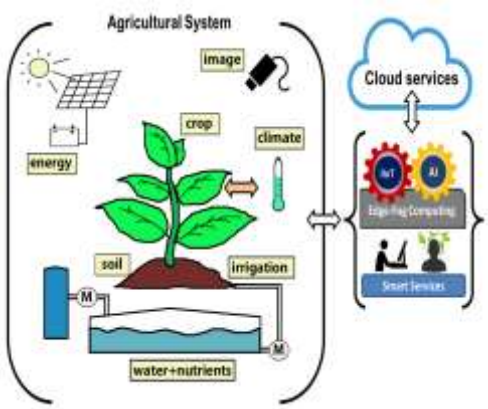

Fig:-1 Experimental Implementation of IoT devices.

2. Literature Survey

In the year 2007 Kushalnagar N. Produced a research paper citing the importance of 6LoWPAN's in IoT while used in agriculture.

PatilK. Aet al. (2016)[6], proposes a wise agricultural model in integration with ICT. ICT has always mattered in the Agriculture domain. Over the period, weather patterns and soil conditions and epidemics of pests and diseases changed, received updated information allows the farmers to cope with and even benefit from these changes. It is a really challenging task that needs to provide such knowledge because of the highly localized nature of agriculture information specifically distinct conditions. The complete real-time and historical environment information helps to achieve efficient management and utilization of resources. The issue is that the technique can achieve a convenient wireless connection within a short distance.

Joaquín Gutiérrez et al. (2014)[3], The paper aims at optimizing water use for agricultural crops. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The issue is that the investment in electric power supply would be expensive.

ShakthipriyaNet al. (2014) [7], As mentioned it reviews the state of art wireless sensor technology in agriculture. Based on the value of soil moisture sensor the water sprinkler works during the period of water scarcity. Once the field is sprinkled with adequate water, the water sprinkler is switched off. Hereby water can be conserved. Also, the value of the soil pH sensor is sent to the farmer via SMS using GSM modem. The issue is that it provides only precision values that are not accurate and does not cost-efficient.

BezaNegashGetuet al. (2015) [1], investigate the design and simulation of an electronic system for automatic controlling of water pumps that are used for agricultural fields or plant watering based on the level of soil moisture sensing. The speed of the motor is varied according to the level of the soil moisture content; the motor is OFF during maximum wet and is running with HIGH speed during dry soil conditions respectively. The duration of water pumping is controlled by a timer circuit. The system is tested using NI MULTISM simulation software. DIAC and TRIAC techniques are used. The issue is that it does not support several water levels and uses old techniques.

G.MeenaKumari et al. (2014)[4], The approach proposes technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture. In the Field bus concept, the data transfer is mainly controlled by hybrid system(wired and wireless) to automate the system performance and throughput. ZigBee protocols based on IEEE 802.15.4 for the wireless systems are used. The atmospheric conditions are monitored and controlled online by using Ethernet IEEE 802.3. Partial Root Zone Drying Process is implemented to save water. Also, Controller Area Network (CAN) and Hybrid networks are used. It uses a traditional communication system is used. The future research can be focused on Optical communication System with wavelength routing networks and can also be implemented using advanced ARM Controllers and core processors and also in energy saving, data fusion, and other directions.

Nikhil Agrawal et al. (2015) [5],It proposes a design for home automation system using ready-to-use, cost effective and energy efficient devices including raspberry pi,arduino microcontrollers, xbee modules and relay boards. Use of these components results in overall cost effective, scalable and robust implementation of system. Use of these components results in overall cost effective, scalable and robust implementation of system. Drip irrigation system makes the efficient use of water and fertilizer. Freeduino flavor of arduino is used in this design. To start the drip irrigation system an email is sent to a defined account. The issue is that the failure of any particular part or device is not informed and has to be tested manually. Not efficient for large agricultural fields.

HemlataChanne1et al. (2015)[2], it reviews the use of modernized techniques such as Internet-of-Things (IoT), Sensors, Cloud-Computing, Mobile Computing, Big-Data analysis in agricultural sector. Soil and environment properties are sensed and periodically sent to Agro Cloud through IoT (Beagle Black Bone). Big data analysis on Agro Cloud data is done for fertilizer requirements, best crop sequences analysis, total production, and current stock and market requirements. It is beneficial for increase in agricultural production and for cost control of Agro-

products. The system does not include different soil nutrient sensors and does not produce accurate data

3. CONCLUSIONS

Integration of IOT into agriculture can lead the quality improvement of crops and increasing productivity. In this way, microcontrollers and cloud computing are key actors in IOT based solutions. So, we surveyed six types of microcontrollers based on the different parameters. Moreover, according to the extensive activities major cloud companies in the cloud IOT and big data issues, this paper compared the main cloud IOT provides in the world to help researchers and stakeholders on the choice the best option. Precision farming is one of the Applications which makes agricultural activities more precise and controlled.

There are various applications which are used to monitor Climate conditions.

To make our greenhouses smart, IoT has enabled weather stations to automatically adjust the climate conditions according to a particular set of instructions.

Cloud based data storage and an end-to-end IoT Platform plays an important role in the smart agriculture system.

The Ground and Aerial drones are used for assessment of crop health, crop monitoring, planting, crop spraying, and field analysis.

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