International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 4 ǁ 2021 ǁ PP. 74-76

"Developing A Human-Centric Agricultural Model In The Iot Environment"

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ABSTRACT
The prevalent state of agriculture, especially in developing countries, is not efficient and organized enough to address the growing demand for food, a direct result of the increasing human population. Internet of things and cloud computing together have provided a promising opportunity to resolve the challenges posed by this increasing demand worldwide. By employing IoT and cloud services, and through precision farming tactics, the efficiency and quality of agricultural production, storage and transportation can be tremendously improved. In this paper, we present the architecture of a multilayered enabling platform for incorporating IoT technologies in the agricultural sector. This work makes important contributions by proposing a feasible human centric IoT model for agriculture with special emphasis on developing nations.
Internet of Things is the newly emerging horizon in the field of IT and communications. Through IoT, digitization of the physical world is being brought about on a massive scale. In the ideal IoT vision, each and every object is embedded with sensing, computing and networking capabilities. The common facet of all these connected objects (be it a home appliance, a thermostat, a light or a wearable accessory) is that they collect data that is produced by or about people to offer value-added services. In the agricultural sector, the development and deployment of IoT has been slow, especially in developing nations. The growing demand for food worldwide calls for efficient and effective farming strategies. Such strategies cannot be realized without the active involvement of IoT and cloud computing. A pressing need is thus felt for developing a human-centric IoT platform and cloud services, keeping in mind the fact that the literacy rates and education levels of farmers in developing nations are generally poor. A similar work targeting the Indian agricultural sector has been undertaken recently in which a bottom-up approach has been proposed [2]. However, a strictly bottom-up approach is not feasible to implement in the agricultural scenario of a country like India, due to the lack of self-sufficiency in farmers. Such an approach would be beneficial once self-sufficiency in educational, infrastructural and monetary terms has been established. A model is thus needed which empowers the farming community while reducing the manual burden at the same time. Keeping these important factors in mind, we have proposed a model for incorporating IoT and cloud computing into the agricultural domain specifically targeting developing countries. The root of agricultural problems is inefficiency and lack of management. We have attempted to provide a solution to this problem with the ubiquitous involvement of IoT and cloud computing

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Date of Submission: 26-03-2021 Date of acceptance: 09-04-2021

I. INTRODUCTION

Agriculture (including forestry and fishing) is one of the largest sectors of Indian Economy. While employment share in the sector declined from 64.8% in 1993-94 to 48.9% in 2011-12, almost half of the Indian workforce remains dependent on agriculture. The Government of India (GOI) has taken many initiatives for upliftment of this sector, and the country has seen improved food production in last few decades. GOI is already disseminating the information and knowledge in the area to the stakeholders through various means, e.g. television, websites, radio, print media, call centres, etc. Under GOI, the Ministry of Agriculture and Farmers Welfare (formerly Ministry of Agriculture) is the apex body working in this area. Under the ministry, the Department of Agricultural Research and Education (DARE) coordinates and promotes agricultural research and education. The Indian Council of Agricultural Research (ICAR) is an autonomous organization under the DARE, which is engaged in scientific and technological areas with approximately 100 of its institutes spread across the country.

Internet of Things is the newly emerging horizon in the field of IT and communications. Through IoT, digitization of the physical world is being brought about on a massive scale. In the ideal IoT vision, every object is embedded with sensing, computing and networking capabilities. The common facet of all these connected objects (be it a home appliance, a thermostat, a light or a wearable accessory) is that they collect data that is produced by or about people to offer value-added services. In the agricultural sector, the development and deployment of IoT has been slow, especially in developing nations. The growing demand for food worldwide calls for efficient and effective farming strategies. Such strategies cannot be realized without the active involvement of IoT and cloud computing. A pressing need is thus felt for developing a human-centric IoT platform and cloud services, keeping in mind the fact that the literacy rates and education levels of farmers in developing nations are generally poor. A similar work targeting the Indian agricultural sector has been undertaken recently in which a bottom-up approach has been proposed. However, a strictly bottom-up approach is not feasible to implement in the agricultural scenario of a country like India, due to the lack of

self-sufficiency in farmers. Such an approach would be beneficial once self-sufficiency in educational, infrastructural and monetary terms has been established.

A model is thus needed which empowers the farming community while reducing the manual burden at the same time. In a significant research work, Wark, T., et. al. have developed a large-scale, outdoor pervasive computing system that uses static and animal-borne nodes to measure the state of a complex system comprising climate, soil, pasture and animals. While it makes good use of animal mobility for farm hold monitoring, a drawback of this system is the dependency on farm animal movement for obtaining spatially variable data. Deploying this system in a farm dedicated to crop growth would thus be disadvantageous. A proposal for the utilization of CCTV for image monitoring of agricultural hold and GPS monitoring of the components therein has been made in another research work. Such an approach, although increases awareness and controllability of the farm land, is of little consequence. Moreover, it increases the bandwidth requirements drastically which is not a wise decision for the use case of developing nations like India. Keeping these important factors in mind, we have proposed a model for incorporating IoT and cloud computing into the agricultural domain specifically targeting developing countries. The root of agricultural problems is inefficiency and lack of management. We have attempted to provide a solution to this problem with the ubiquitous involvement of IoT and cloud computing.

II. METHODOLOGY

Sensors provide the desired data accurately and constantly. Through wireless sensor networking, factors which the farmer initially monitored personally, can be visualized in an organized manner by use of data analytics, thus leading to minimal workload for the farmer. Remote actuation can be employed for various use cases such as running a tube well, actuating an emergency mechanism, and for spraying pesticides/insecticides in an affected area. Through remote actuation of various farming tools, farmers can further reduce their workloads and focus on constructive learning processes to further enhance their knowledge and skills.

In accordance with our minimal cost approach, we have utilized only the most widely used technologies for communication purposes. The sensor nodes communicate with the farm node through Wi-Fi, while the farm node, which also acts as a local server, organizing and classifying raw sensor data, relays its information to a cellular gateway in the vicinity of the agricultural hold through 3G cellular networking. Owing to the high costs of 4G networks, we have employed 3Gcellular data networks in our architecture. An important case arises when the size of an agricultural hold increases beyond the range of one Wi-Fi access point. In this scenario, the farm is divided into multiple 'zones' with each zone having one Wi-Fi access point for the sensors lying within it. Each Wi-Fi access point also acts as a station which relays sensor data to the farm node. In this manner, the model addresses the issue of scalability

The architecture presented in this work provides farm owners with two broad classes of services, viz. elementary data analytics and cloud services. Elementary data analytics are a direct result of the data generated by sensors.

III. ADAVANTAGES

1) Increased Production: It allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc.
2) High Quality Crops: Using IoT in agriculture, it improves the quality of the seeds and crops.
3) Utilization of Solar Energy: This project uses the Solar powered sensor nodes
4) Use of technology in Agriculture: Fusion of technology in the agriculture sector is a need of the hour. With unseasonal changes and undetermined rains, it is needed to do the farming efficiently. This project uses the latest technology to improve and maximize the agricultural crop production

IV. RESULT

This project is focused on use of IoT in agriculture and expected result is to use the IoT enabled agriculture to help implement modern technological solutions to time tested knowledge. This will help bridge the gap between production and quality and quality yield. Data Ingested by obtaining and importing information from the multiple sensors for real time use or storage in a database ensures swift action and less damage to the crops. With seamless end to end intelligent operations and improved business process execution, produce to get processed faster and reaches supermarkets in fastest time possible.

By classifying the research and deployment literature on IoT in protected agriculture, three important application fields were given: plant management, animal farming and agri-food supply chain traceability. Finally, a detailed analysis of IoT research challenges and prospects were outlined.

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