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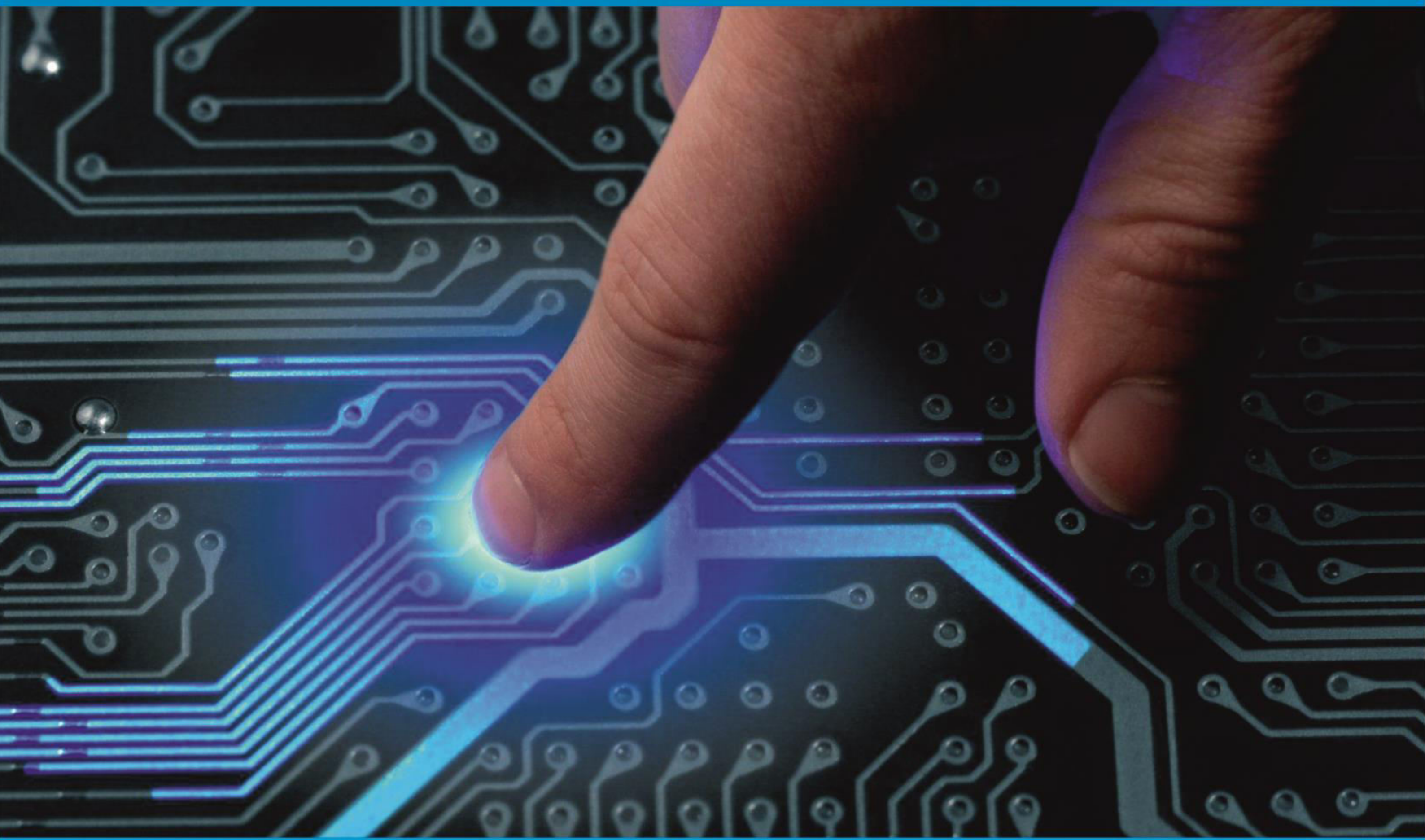

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Developing a Human-Centric Agricultural Model in the IOT Environment

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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

II. 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.

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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 farmland, 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.

III. RELATED WORK

The size of an agricultural holding varies from owner to owner. In India and China, the average size of a farm is around 1 hectare, while in the US, this figure rises sharply to about 170 hectares. Within the farm holdings in India, the sizes range from below a hectare to tens and hundreds of hectares for larger plantations. The size of an agricultural holding dictates the type of wireless communication technology and protocol to be followed. For instance, a typical Indian farm holding would require a single Wi-Fi access point for the entire land, with which the various sensors can communicate easily. However, in the case of plantations spread out over large areas, a single Wi-Fi or ZigBee access point will not be enough to cover the entirety of the installed sensors. Thus, a need is felt for scaling IoT solutions in accordance with the farm size. In our approach, we have addressed this scalability issue by deploying multiple access points in a zone-wise architecture, communicating with a single localized farm node in a star or mesh topology. Multi-hop routing scheme can also be implemented to this end. This decision offers maximum efficiency with minimal room for error.

In developing nations, the literacy rates of those involved in agricultural practices is significantly low. Therefore, data provided through sensors, data analytics, and cloud services is not fit for direct presentation before farmers lacking in literacy. In this context, a human-centric approach to agricultural automation is called for. The authors of this paper, keeping this data incoherence in mind, have developed a SoA which renders this information accessible and understandable by farmers. We have accomplished this by incorporating a language translation service and a data simplification service above the local server layer. This provides the farm owner PDA with real time data in preferred language format. The data simplification service works in synchronization with data analytics and cloud services to simplify the incoming information before sending it to the PDA. The language and education profile of a farmer is configured on the basis of language preference and education level provided by the farm owner at the time of registration.

Pervasive ICT infrastructure plays a dominant role in adopting IoT in any sector, more so in the agricultural sector because of the complexities involved. However, as is widely accepted, the ICT scenario of developing nations lags behind in this regard. Implementing IoT in the agricultural sector requires a highly competent ICT platform which, if missing, leads to the following undesirable factors.

- Low level of familiarity with computing and communication technologies
- High cost of ICT equipment
- Connectivity constraints in rural areas
- High cost of cellular data services

To overcome the limitations caused by an incompetent ICT platform, we have taken the following design decisions:

- Minimized front end hardware and software infrastructure by extensively exploiting cloud-based back end services through a SoA

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- Self-sustaining architecture which allows for minimal additional resources and interference, both technological and human
- Developing a learning environment by capitalizing on cloud-based e-learning services and e-platforms for interaction with academicians and researchers
- Use of conventional wireless technologies such as Wi-Fi, ZigBee and 3G instead of the newly emerging technologies such as 6LoWPAN and 4G

IV. 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.

V. FUTURE SCOPE

The work presented in this project recognizes only to human centric approach using IoT in agriculture. It can be extended, IoT technology is being applied to many fields of society, economy and life at an unprecedented speed, making human society step into a new era of high intelligence. IoT technology is evolving and mature, and many novel deployments and applications are constantly being built in protected agriculture. Based on the above analysis and discussion of the key technologies and applications of IoT in the protection of agriculture, we will present its future development prospects and key research and development directions in the following aspects. In the perception layer, the development of sensors should focus on new sensitive materials, mechanisms, processes and methodologies as well as low power consumption and low cost. Besides, we must accelerate the development of sensors and rapid detection devices soil, animal and plant life. At the network layer, we should focus on high-capacity data real-time broadband communication standards and technologies for complex agricultural application environments, high-reliability, adaptive, low-power network deployment and management strategies and algorithms. With wide coverage, high capacity, low power consumption and low cost, LPWAN is ideal for some agricultural scenarios where text-based, video and voice service support is not required and coverage, power consumption and cost are critical. Future research and deployment should focus on IoT solutions based on LPWAN. In the application layer, governments and organizations should develop unified standards for the sensors and identification interface devices, data transmission communication protocols, multi-source data fusion analysis processing and application services in protected agriculture through international cooperation or negotiation. Software developers should develop large open source databases and signal processing algorithm libraries for different areas of facility agriculture. For universities and research institutes, cloud-based agricultural intelligent decision-making models, multi-source data-based information fusion algorithms, agricultural Big Data mining technologies, distributed intelligent processing systems and lightweight IoT authentication, encryption and authorization mechanisms will be the key research directions for the future. With an increased presence of IoT technology in protected agriculture, its potential for the refined management of crop, livestock and aquatic animals will be recognized. Besides, as a technical means to monitor the production, processing, circulation and consumption of agricultural products, IoT will play an increasingly important role in food safety. We

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can use a closed system for image acquisition, with a high definition camera i.e. CCD, this might help to avoid the grain shadow observed in the database acquired and will also give uniformity in the intensity of background color.

The future prospects of IoT in protected agriculture are expectant, but the challenges mentioned above must handle. In order to cope with its complex and changing agricultural environment, the hardware devices must be fully upgraded to further enhance their universality, reliability, expansibility, endurance and intelligence level, while reducing costs and operative difficulty. Secondly, the local network must be protected from interference from other networks. In addition, the interoperability, filtering and semantic annotation of data generated by the various devices of IoT must be realized to a certain extent. Only in this way can we optimize the Big Data decision support model by using a large amount of heterogeneous data. Finally, the impact of IoT on the agroecological environment and social economy should be considered in the application of protected agriculture, to realize the sustainable development of agricultural environment as quick as possible.

VI. CONCLUSION

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.

REFERENCES

1. U. G. Acer, et al., “Sensing Wi-Fi Network for Personal IoT Analytics, “Bell Laboratories, 2015.
2. B. N. Kumar, V. Suma, U. S. Poornima, “A Localized Bottom-Up Approach for Indian Agricultural Scenario Using Information Technology,” in Proc. IEEE International Conference on Electronics and Communication Systems, pp 1-5, Feb 2014.
3. T. Wark, et. al., “Transforming Agriculture through Pervasive Wireless Sensor Networks,” IEEE Trans. Pervasive Computing, vol. 6, pp. 50-57, April 2017.
4. J. Huang, C. Shin, H Yoe, “Study on an Agricultural Environment Monitoring Server System using Wireless Sensor Networks,” Sensors, vol. 10, no. 12, pp.11189-11211, Dec. 2015.
5. “World Bank Featured Data Indicators” [online] Available: data.worldbank.com
6. Institution of Mechanical Engineers, unpublished.
7. Mahindra Dev, “Small Farmers in India: Challenges and Opportunities,” Indira Gandhi Institute of Development Research, WP-2012-14.
8. J. S. Lee, Y. W. Su, C. C. Shen, “A Comparative Study of Wireless Protocols: Bluetooth, UWB, ZigBee, and Wi-Fi,” in Proc. 33rd Annual Conference of the IEEE Industrial Electronics Society