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Challenges of Practical Implementation of Internet of Things in Agriculture

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Abstract
The present study considered the internet of things major work in agriculture grassland. The initiation of Internet brought a new viewpoint to all the businesses. The conventional models were refurbished and enhanced for large-scale adoption. Advancements in technology lead to the Internet of things, which is an extension of the network of computers to the network of smart devices.In this study the awareness of Internet of Things (IoT) in the field of agriculture. IoT is a revolutionary technology that represents the future of computing and communications. It provides a complete review of its framework, considerations and implications in implementation. The paper intends to brief the reader about the IoT technology and its operational requirements in agricultural practices.The major need of IOT in agriculture is that the world population is set to touch 9.6 billion by 2050. So, to feed this much population, the farming industry must embrace IoT. Against the challenges such as extreme weather conditions and rising climate change, and environmental impact resulting from intensive farming practices, the demand for more food has to be met.The working of Agriculture IoT is discussed along with some real-world examples. The use of IoT in the fields and orchards will help the farmers reap the benefits of its various technologies.The major scope of our research is IOT in agriculture is highly recommended and is very effective when looking into the long term benefits like good production and automation. When agriculture is integrated with IOT the data collected in the process will be highly efficient in making more progress towards the improvement of this field which can save many from financial troubles.
Keywords: Internet of Things (IoT), Agriculture IoT, Information and Communication Technology (ICT), Smart Agriculture, Implementation, Cloud Computing, Big Data, FarmBot
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I.INTRODUCTION

Smart farming represents the application of modern information and communication technologies (ICT) into agriculture to increase the amount of production and economic returns, often also with the goal to reduce the impact on the environment. Similar terms are used for the same purpose such as precision agriculture, site-specific farming, site-specific crop management, prescription farming, and satellite farming [2].

Initiative germinates from the smartness concept given by technologies like Internet of Things, Big Data and Cloud computing etc [3]. Agriculture IoT can be seen as a network of sensors, cameras and devices which will work towards a common goal of helping a farmer do his job in an intelligent manner [1][2]. These devices will be autonomous in a way that they will not need human interfering to communicate with each other. In other words, the devices are equipped with the intelligence of knowing the time and reasons for interacting with other devices in the system [3].

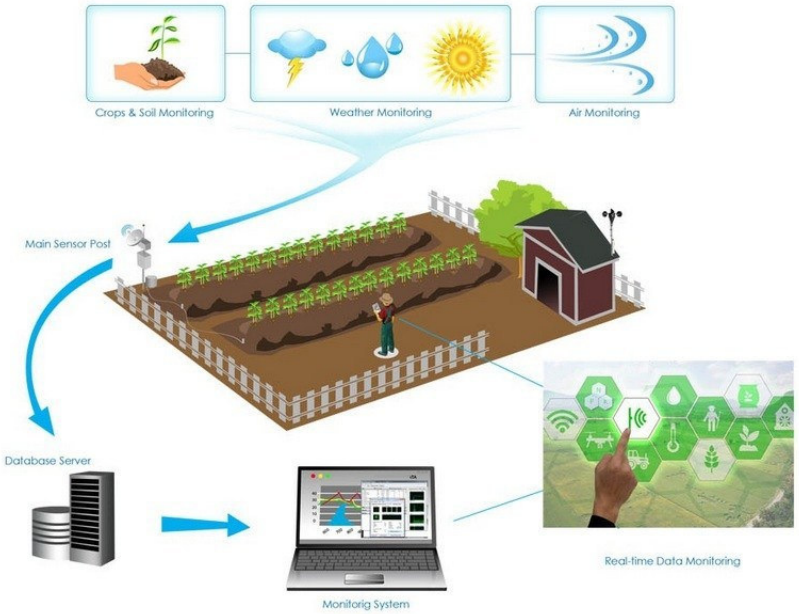

Fig 1. The idea of Agriculture IoT

IoT can help you with your situation in agriculture. There are a lot of use cases in the agriculture industry that IoT can help you to solve. But for each use case, the final solution will be slightly different, even if the general system architecture is based on the same principles [4][5].

Fig 2. SemiosBIO Company's sensor connected through cellular network and used on trees for pest control

The sensors and cameras are mainly used to collect data about the weather conditions, soil's moisture and nutrient contents, images of crops to detect pest attacks and the onset of diseases, controlling the greenhouse environments, animal husbandry supervision and control, food transportation and marketing etc[6]. Companies like SemiosBIO and John Deere (Figure 2, Figure 3) have introduced their products in the market. These are sensors which are used for monitoring orchards and fields through data collected by them. This data is used for effective pest control and field management.

Fig 3. John Deere's Field Connect system used to collect soil, moisture and other data

The major ideas are summarized below:

- Monitoring the fields in a more scientific way by collecting data through sensors and devices.
- Facilitate in smart management of fields and greenhouses with respect to watering needs, pest control etc.
- Better disaster control through prior information and alerts.
- Assist to achieve higher yields of crops along with enhancing their quality.
- Effective supervision of animal husbandry.
- Help improvise the whole supply chain from farmers to the market.

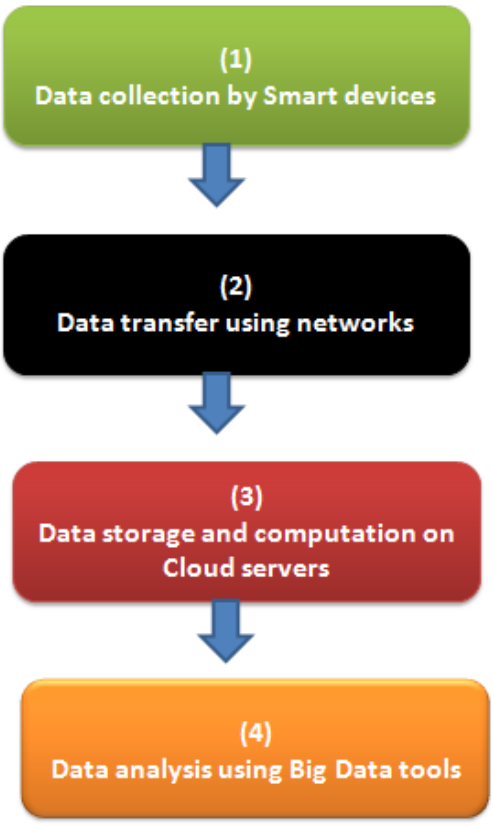

Figure 4. Working of Agriculture IoT

WORKING OF AGRICULTURE IoT:

In this study, IoT use cases in agriculture and examine their benefits. So, if you are considering investing into smart farming, or are planning to build an IoT solution for agriculture, dive right in [3][4]

The whole process revolves around the collection of data for use by the farmers and other stakeholders. This is the most crucial part of its working [5]. The devices used range from sensors to cameras and satellite images. The second part consists of the network which will help transfer the data generated by the devices as mentioned earlier. Different types of network technologies like GSM, LTE, WiFi, 3G etc. may be used depending upon the availability and requirements. The third part consists of data collection and computing technology like the Cloud services. The cloud servers can be made available independent of the locations and hence most suitable for IoT type of systems [5][6].

The data can be stored and computed upon on such servers. The cloud services can be taken on a pay-per-use policy as they are becoming popular for this reason [6]. The last part of the system will be the Big Data analytics tools which can work on the vast amount of data generated and stored on the cloud servers, to excavate important patters and trends in the data. For example, weather predictions and market analysis can be done using such tools [7][8].

The different parts can be summarized in Fig 4 below.

IoT INNOVATIONS & CONSIDERATIONS IN THE FILED OF AGRICULTURE:

The use of IoT in various fields like Agriculture to benefit the farmers, traders and other stakeholders is a novel idea. Many countries like China, Taiwan, European countries like Czech Republic etc. have already taken initiatives in this area [6][7]. Smart agriculture or Precision agriculture is the new buzzword in such countries. Taiwan government's i236 Project (Smart Living Technology Application Project) lays focus on various key areas including farming. Projects like Farmbot (Figure 5) have created intelligent machines for precision farming [8][9]. The challenge is to meet the needs of the future along with the efficient use of available resources.

Fig 4. Farm Bot [5]

There are a number of considerations in adoption of Agriculture IoT. The popularity of any technology depends on the ease of its adoption and implementation. The devices and platforms need to be standardized and protocols need to be established. The compatibility between different devices used in such a system is a major consideration as well. Though many commercial organizations are bringing solutions in the market but the lack of participation of local governments is a critical aspect. Popularizing a solution that will meet the future needs of a sector and the country as a whole is the responsibility of its government.[9]

The selection of an appropriate network technology and infrastructure is also an important issue. The network which provides good speed, lesser energy requirements and supports more number of devices per access point will be the apt choice [10]. Infrastructural requirements in terms of access points, smart devices, network facility, participation of local government and imparting education and awareness among the users has to be considered by the government. Its futuristic policies and vision can help in the implementation of Agriculture IoT as has happened in countries like China, Australia, and Taiwan etc [10][13].

IMPLICATIONS OF IMPLEMENTATION OF AGRICULTURE IOT (Internet of Things):

The large-scale implementation of Agriculture IoT is possible only with the support of the government. It can facilitate the adoption by introducing user-friendly schemes and policies [9]. It can provide the devices and

infrastructure at subsidized rates which can't be afforded by the farmers otherwise.[12] The gaps in agriculture supply chain need to be managed. The role of middleman needs to be reconsidered and dealt with in order to provide maximum benefits to the farmers and the consumers. These gaps may hinder the wide-scale adoption of such technology. The lack of awareness and required skills in the farming community shall be taken very seriously. The farmers need to be made aware of the benefits of IoT in their works. Training programs can help the farmers in understanding the use of new technology and get rid of their fears. They need to come out of the traditional methods of farming in order to survive the dynamics of the world [12][13].

The various implications have been listed below:

- Lack of government investment and policies
- Huge cost of communications.
- Gaps in the agriculture Supply Chain
- Lack of knowledge and skill
- Lack of awareness and social farming
- Agriculture IoT is in the experimental phase

CONCLUSION

The use of latest technology in every field is the way of functioning of the modern world. No such field can progress and yield maximum potential, which is not incorporating the use of advanced techniques and innovations. Agriculture is a field which has relied on traditional methods and experiences till now. But the changing times have exhibited their impact on agricultural practices and they have started to adapt to the dynamics of change. The use of Internet of Things (IoT) in agriculture will not only improve the yields but also effectively manage all the farm activities. Many companies have launched their products in the market which will cater to the needs of farmers who wish to adopt smart farming. The implementation may have certain implications like cost factor and lack of knowledge but it can nevertheless be worked upon to reap the benefits to the most. There is a dire need to bring about changes in agriculture as a majority of population depends on it for their living.

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