Cloud Service Oriented Architecture (CSoA) for Agriculture through Internet of Things (IoT) and Big Data

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Abstract—**In the present backdrop of agriculture scenario the fruits of farming are not being enjoyed by the producer due to various obstacles that come up in the process. Hence in order to get rid off these obstacles and to see that farming becomes smart and friendly, by using the technological advancements, the present work proposed has been prepared. The proposed work which makes use of various technologies like Big Data, Internet of Things (IoT), Cloud Computing, etc is going to be a big boon to the farmer who otherwise is made to undergo a tough time in view of lack of the technology that he/she should have been adapted by this time. The proposed one will provide a number of services to the farmers that include crop management, marketing, finance management, e-commerce, web services through cloud etc. which also will reduce the unemployment problem in the youth. It also makes agriculture not only a profession for living but also a profitable sector in the globe which further enhances the GDP**

Keywords—Cloud Computing, Big Data, Internet of Things, Agriculture, Smart Farming, Cloud Services

I. INTRODUCTION

As of now the total population of the world is presumed to be approximately 7 billion, and is projected to increase by 2.0 billion in just 40 years, reaching 9.0 billion by 2050. Amidst this explosive global population growth, the problem of food shortages is about to become a world-scale issue. While the globe is witnessing enormous increase in the population on one hand, there is lot more demand for production of food on the other hand. However with various changes that have come up in every walk of life, production of food materials is getting hampered and in such a situation one wonders whether one will be able to meet the food demand that matches with the population growing day by day. An integrated survey of farming and food production sectors indicate that they are not able to cater to the needs of the population, since they are complex processes that require a good number of technical advancements such as smart farming with Intenet of things (IoT), Big Data, cloud service oriented architecture with Internet etc.

The present scenario of agriculture is undergoing turmoil in view of various issues that include limited availability of farming land, climate change, lack of fresh water, increase in the price and decrease in the availability of power etc[3].

In addition to this the farming activity is very much affected due to the urbanization which in turn lead to shortage of human resources mainly the supply of labor. Another burning problem is that the youth of the country are trying to seek employment elsewhere and there by leaving only middle-aged and old people with the activity. All these factors have contributed to the present situation where in the production of food is in the declining trend in spite of the fact that it should have been the other way round.

Traditional farming and smart farming differ from each other in many ways. Traditional farming adheres to the traditional methods of agriculture. On the other hand, smart farming experiments with the implementation of advanced technology in the field of agriculture[1]. In our proposed work the cloud and IoT is implementedfor implementing smart farming[2]. With this technology the farming becomes easy, economical, minimizes the labor and improves the crop yielding.

II. INTERNET OF THINGS TO FARMING

A. Crop Management

In view of the present back drop of agriculture food production, it is time that we switched over to various agricultural technologies so that the problems can be addressed and hence the present work is one such agricultural, technological advancement that can offer solution to various issues that are under discussion. On the whole the agriculture Internet of Things (IoT) proposed is a combination of several components which are connected by a wireless sensor network using sensors.

The sensors get the data related to crop monitoring and send to the server. The server will implement action such watering the plants if the soil moisture below the threshold values. Such actions are done by the server automatically without manual intervention. The important of them being pesticides used to control the pest by drones, and modern machines for conventional works, soil and water management as illustrated in the following figure 1.

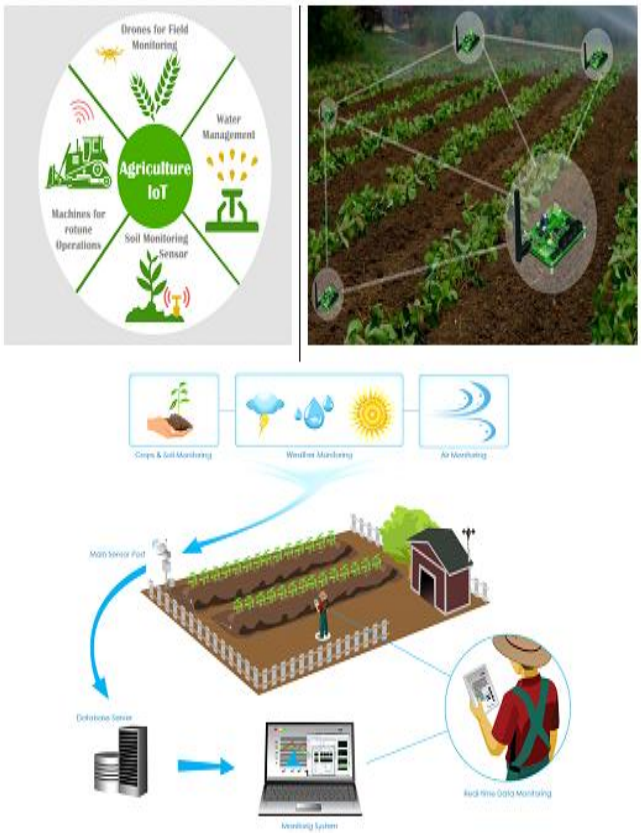

Fig. 1. Field monitoring using Internet of Things (IoT)

III CLOUD SERVICE ORIENTED ARCHITECTURE TO THE AGRICULTURE

Here we are proposing a cloud service oriented architecture for the agriculture which is shown in the figure 2. This architecture includes various services for the farming and farmers to such as farming monitoring, market oriented service, warehousing information, fostering agri-business development service, farmers training on usage of the information services, etc,. which will minimize the expenditure for farming, minimizes the labor, saves the time and improves the crop yielding, provides the marketing information, banking and finance information, exchange of information among the farmers, scientists advises regarding the pest control, suitability of crop for a particular soil, The system has the following feature.

- Crop and filed data is collected automatically
- Water pump/valve control automatically,
- Disease and pest models and controls
- Soil moisture, temperature and other field reading
- Manage data simply and efficiently and easy to use data views
- In-field and remote user support
- Authorized advisors are allowed to access the data and fully automated data collection
- No grower setup required
- Remoter crop monitoring
- Predictive analytics for crop yielding
- Sensor-based field monitoring
- Smart logistics and warehousing
- Data is fully backed-up and secure
- Data is shareable with stakeholders

A. Cloud architecture

The architecture for cloud services is shown in the figure which contains various services for farmers and farming[4, 5, 6]. In the center the server is located and connected to various modules each one will implement a particular service.

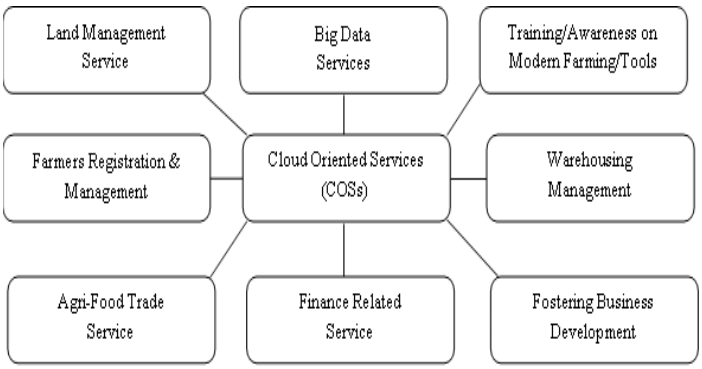

Fig 2. Cloud Service oriented Architecture for Agriculture

B. Farmers registration and accessing the information

The farmers can register to obtain the information provided by this cloud services system by providing farmer information such as name, phone number, address, aadhar number (India) for security reasons, his land details, location, etc. Once he registers, that he can access the information from anywhere, any time. This scenario is illustrated in the figure 2.

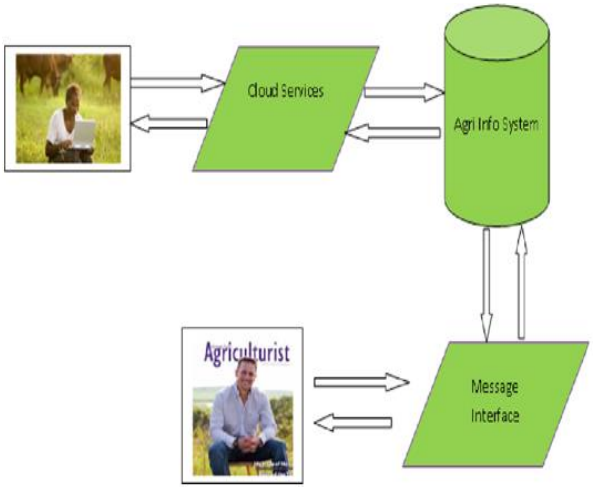

Fig. 3. Scientist helping the farmers through information system

C. Cloud Services

i. Web Portal Service:

It facilitates a single window solution to the farmers and its community. With the popularization and application of Internet Technologies in agriculture, it is useful and fast information dissemination channel. India witnesses a few agricultural websites that have come up in the last decade. The establishment of Web Portals promotes the sharing and utilization of information minimizes overall investment, operational costs and increase in the service coverage.

ii. Voice Based Service:

It is the transmission of voice conversations over Internet. It is based on the Voice over Internet Protocol (VoIP). IT Services uses Cisco IP phones, and we consequently use the term IP Phones interchangeably with VoIP. The farmers can access the information services from anywhere and anytime with the mobile phones. At present, India's rural mobile/telephone penetration rate is on a very high level. So the voice service is currently a key channel to get connected with the farmers. The farmers can use this service and get information and guidance on technology, modern farming methods, business marketing, or other relevant information.

iii. Text (SMS) based Service:

This is simple, easy and cheaper service for the farmer's community to avail the services from out system. SMS stands for Short Message Service. Mobile phones have become cheaper and an important communication media for farmers in managing agricultural activities in daily life for communicating with the outside world. It is useful service for sending short messages which works over wireless mobile network. Now in India most of the farmers have the mobile phones. The farmers can send the messages and can get advises or help from concerned experts. With the increasing number of farmers that own mobile phones, the information dissemination through SMS has become a key service model.

iv. Farming Community online chatting service:

Farmers and other stakeholders can form a community to help each other. In this community, the mail stakeholder is the farmers. The members linked to farmers are bankers, government agriculture field officers, crop insurance agents, revenue officers, agriculture scientists, researchers, etc. Therefore, online communities provide a platform for farmers and relevant parties to share information. Using this service, they can chat online using their computers or mobile phones.

v. Interactive Video Conferencing Service:

The most notable features of this model lie in a visual and face to face interaction. Farmers can obtain this service remotely. This is very useful service for the farmers. They can watch the videos which are recorded related agriculture such as how to use modern agriculture machinery and can use this for their practice. For example use of fertilizers during dripping the water to the crop or equipment used during pest control. Farmers and agricultural experts can have an online one-to-one interaction.

vi. Mobile Internet-based Service:

Due to the low penetration rate of computers in rural households and high usage of mobile phones in India this model is developed by taking the advantages of mobile Internet technologies. Mobile users can connectto our proposed systemfrom anywhere at any time. Agricultural information is accessible to the farmers on the move or located in any agriculture field. The mobile information service is ubiquitous, portable, and geographical identifiable. This service model is expected to dominate the future information dissemination models. As per the Internet Development Statistics Report in India the 4G internet coverage in rural areas will reach 80%.

vii. Unified Multi-Channel Service model:

An integrated service model has been designed and developed to facilitate information transfer using multiple communication channels. The success of this cloud servicemodel requires a two-way flow of information. This

unified multi-channel service model incorporates both one way information transfer (e.g. portal, text message) and two way (e.g. audio and video communications, online community, and mobile Internet service facilitated two way communications). Currently, each state is exploring the best way to carry out agricultural information dissemination by coordinating different service approaches and models, to maximize the service effectiveness and efficiency.

Conclusion and recommendations

In this paper a cloud service-oriented architecture for agriculture was designed. This architecture uses various advanced and emerging technologies such as Internet of Things, Cloud Computing, Big data collection and management methods and techniques through Internet. We did not much literature in implementing these technologies to the agriculture. The proposed one has many advantages than traditional farming methods. Farmers, Government and other stakeholders farm a networking and can share agri-information. The major challenge is to familiarize this modern smart agriculture to the farmers and implementation by the farmers. If this system implemented by the farmers, then the economy of the people and country will be improved.

References

[1] Dr. Pamidi Srinivasulu, Dr. M Sarath Babu and R Venkat, "Automated Services for Agro-farms using Internet of Things (IoT)", International journal of computer applications(IJCA), Vol. 154, No. 11, pp. 17-21, November 2016.

[2] Y Zhang, "Agriculture information dissemination using ICTs : A review and analysis of information dissemination models in China", International Journal of Information Processing in Agriculture, Vol 3, Issue 1, pp. 17-29, March 2016.

[3] Allen DW and Ochs MA, "Building pathways out of rural poverty through investments in agricultural information systems", WorldAgroInfo Design Team Final Report, Link: www.worldaginfo.org/files/WorldAgInfo%20Final%20Report%20Web.pdf, 2008.

[4] "China Internet Development Statistics Report Network", China Internet Network Information Center, 2014.

[5] Dang H., "A study on agricultural information service models in shaanxi [MSc thesis]", Northwest Agriculture and Forestry University; 2009.

[6] Jiao JL., "Towards the integration of information technologies and modern agriculture (in Chinese)", China Economic Daily, China Economic Network. www.ce.cn, Oct, 2014.