DESIGN OF FRAMEWORK FOR AGRICULTURE WEB SERVICE

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Abstract— Agriculture is a backbone of India but Information Technology is not used much in agriculture. It is used in various fields like education, business, Medicine, Weather forecasting systems, Communications etc., but not used vastly in Agriculture sector which is main livelihood for majority of people in rural areas and which also drives economy in developing countries like India, China ,Brazil etc., and also over 50% of economy is contributed by Agriculture sector in these countries. Most of the people living in rural areas will depends on agriculture does not have facilities or cost may be very high to technology to Agriculture sector to yield good results. In this paper I proposed a design framework for Agriculture using Internet of things, Cloud computing, Artificial Intelligence and Big data processing which provides assistance to the farmers in analyzing crop diseases, getting required suggestions, every aspect of crop and finding appropriate fertilizers during cultivation at minimum cost from experts in a easily understandable natural language which definitely transform traditional agriculture into modern or smart agriculture.

Keywords— Artificial Intelligence, Cloud Computing, IOT, Big data, Agri-Data capturing layer, Agri-Data Processing Layer, Agri-Data Storage Layer, Hadoop.

I. INTRODUCTION

Agriculture plays major role directly or indirectly in improving economy of developing countries like India, China, Brazil etc., In the current era of liberalization every sector is competitive including agriculture, so as to compete agricultural sector should also use Information technology to achieve maximum benefits. Mostly the rural areas which depend on agriculture are information-poor and lack of facilities to use results of recent technologies. In past the usage of Information technology is only in the hands of some higher sections of society, but in the current world it is in the hands of all at a lower cost and easy to use. Information communication and technology (ICT) plays vital role in bringing latest bulletins regarding weather reports, prices, usage fertilizer, sowing of crops etc., to farmers at rural areas. Now-a-days government is pushing for better technology delivery schemes even to remote rural areas by offering telecom services including internet at cheaper prices which will help farmers to produce quality crops and to compete with markets at international level.

Recent trends show that IOT (Internet of Things) is playing major role in agriculture digitization in countries like Japan, Israel etc. The impact of IOT has given good results and it is extending into latest technologies like cloud and grid computing. The IOT is a network of Internet enabled objects, together with web services that interact with these objects. Underlying the Internet of Things are technologies such as RFID (radio frequency identification), sensors, and smart phones. The basic idea of the IOT is that virtually every physical thing in this world can also become a computer that is connected to the Internet, which can receive and send from its location. [2]

Artificial intelligence (AI) is the branch of computer science which deals with study of intelligent behavior and how it can be applied into machines. So, it has very wide range of applications including Agriculture also. Mainly AI is used to enhance the functionalities like soil-plant atmosphere cycle, grading, drying, internal transport and packaging, storage of crops and plants, heating, cooling, greenhouse maintenance etc. Fuzzy systems, neural networks have applications already in Agriculture sector in Japan and other developed countries. Recent trends show that AI is playing a very vital role in Agriculture sector.

NIST [3] defines Cloud computing whose main design aim is to provide convenient, on-demand, network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services), which can be rapidly provisioned and released with minimal management effort or service provider interactions. Cloud can be deployed in public, private or hybrid models which provide services in various forms like Software as a Service-SaaS, Platform as a Service-PaaS and Infrastructure as Service-IaaS at cheaper cost. Cloud computing has a characteristics of elasticity, scalability etc., it can support different types devices like mobiles, web browsers, Tablets, or any cheaper devices it can be used by consumers of any category from farmers to agriculture experts etc. Cloud computing data centers allows you to store vast historical data securely on which many complex calculations can be done which is required for agricultural scientists for new inventions. In rural areas if the departments of agriculture give timely and accurate agricultural information, stake holders can make the right decisions, planning the development of farm lands. If the Information technology is improved Agri-cultural science and education Personnel can improve the research capacity and level of education by gathering the latest agricultural

information resources and deliver the same to the end users.

As cloud computing data centers allows us to store a very vast amount of data which will be collected from IOTs, experts, farmers, artificial agents, research scientists and government agencies. It is not possible to process and manipulate this huge amount of data (**Big Data**) using traditional database management systems. Big data are high volume, high velocity and high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization. [Gartner 2012]. More predictive analysis is possible with the help of big data. Analysts have not only more data to work with, but also the processing power to handle larger number of records with many attributes. To enable the real time analysis and predictive modeling Hadoop is the best framework for such a type of big data of agricultural sector which gives a powerful assistance to the farmers about every aspect of farming.

So in this paper I proposed a framework of web service using IOT, Cloud computing, Big data and Artificial intelligence which will benefit to the Farmers, Agricultural Experts, and government agencies and it is explained in the later sections of this paper...

II. RELATED WORK

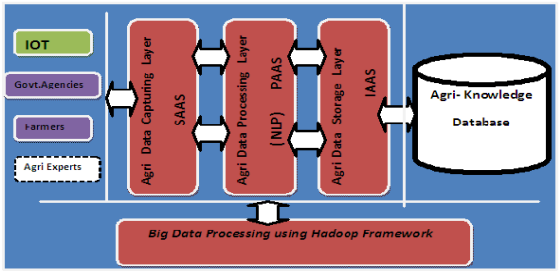
In paper by Janet Kaaya [4] has summarized the importance information in generating and disseminating agriculture technologies, by various types' users to improve agriculture production through information technology. Ji-chu Zhao et.al in there paper [12] has elicited IOT technology (RFID, Mobile, Sensor devices, Internet) and its usage to agriculture field. They have proposed IOT for Agriculture Greenhouse production environment measurement and control system which allows customer to monitor remotely. In his paper [1] Dan Yan-e discussed about characteristics agriculture data and how Agriculture information management system is useful in agriculture field. He has considered IOT to AMIS or information collection, processing and given an idea about Intelligent Agriculture Management information system which facilitates to make decisions regarding crop growth, Fertilization of soil, pricing etc. in more precise manner. In paper regarding Smart cloud computing [5] Qiao Ying,Chen Hao has used IOT along with Cloud computing and proposed Smart Cloud Computing platform which can consume data from various IOT devices. The data can be stored in Cloud data centers and be processed by smart massive servers to make decisions for problems that require. So by considering above facts I have proposed a model for agriculture field which uses IOT, Artificial intelligence, Big data Processing and Cloud computing technology for data acquisition, processing, storing at large quantities in cloud data centers.

In their work by Yifan Bo, Haiyan Wang [6] has analyzed and given idea of how the latest technologies IOT and cloud computing can be used in agriculture and forestry for precise agriculture management. In his paper he pointed problems in cloud computing regarding security, IPV6, data center maintenance etc. In paper Kaas-based intelligent service model in agricultural by Yin Qirui [7] has proposed an agricultural knowledge service model based on Agriculture expert service with a purpose of providing accurate and efficient agricultural knowledge service to users with browser interface. Author has used existing online expert systems to make decisions and restricted only to browser, so in my model I have used Agri-expert service in PaaS which can be used by any type of application interface like Mobiles, PDA, browsers and allows decision making in precise manner which will helpful to stake holders to cultivate farm lands.

Mitsuyoshi Hori et.al [8] in their publication Application of cloud computing to agriculture and prospect to other fields has given details about cloud established by Fujitsu Ltd for agriculture field and how it delivers services to farmers regarding pricing and selling of crops. It is based on the model Plan-Do-Check-Act. But many issues like decision making on fertilizer usage, crop disease finding, queries related to pricing etc.,and security for data in data centers have not been discussed.

III. DESIGN OF FRAMEWORK

This framework consists combination of IOT, Cloud computing, Big data processing and Artificial intelligence and it offers an expertise service to farmers regarding cultivation of crops, pricing, and fertilizers to be used etc. Scientists working at agriculture research center can add their inventions or discoveries, suggestions or advice regarding modern techniques of cultivation, usage of fertilizers, can obtain a cultivation history of specific region etc. This framework will also benefit to Government officials or private organizations by obtaining or inserting the information regarding pricing of crops, farming of lands at various places, benefits to be given to the farmers for various crops like supplying seeds, fertilizers etc.



Working Mechanism of each component of Framework with technical aspects:

A. Sensor/Information through IOT:

The main task of IOT is to achieve automatic and real-time transformation of the physical figures of real-world agricultural production into digital formation or data that can be processed in virtual world through various means. The information categories that Internet of Things for Agriculture collects are:

1. Agricultural sensor information: temperature, humidity, pressure, gas concentrations and vital signs, etc.
2. Agricultural products attribute information: name, model, feature and price, etc.
3. Agricultural working status information: operating parameters of apparatus, equipment, etc.
4. Agricultural location information: location of products, etc.

The main task of Information collection layer is to mark the various kinds of information, and collect the marked information and the physical information in the real world by sensing techniques, and then transform them to digital information for processing. Information collection layer involves these techniques: two-dimension code labels and readers, RFID tags and readers, cameras, GPS sensors, terminals, cable networks, sensor networks and wireless networks. All such information will be given to the cloud layers and hadoop processing and then it will be stored into Agri-Knowledge database.

B. The working of proposed layers of cloud

1) Agri Data Capturing Layer

This layer uses Internet and IOT which provides services to be used by farmers, agriculture experts or government officials to add or query data by using their applications service interfaces either through browsers, Tablet PC's, sensor(RFID) device or mobile devices. This layer is deployed as **SaaS** in Cloud which provides various interface services to be used by different types of consumers with different devices. This layer mainly used for agriculture data acquisition and supply solutions to users. Vast data or historical data used for various purposes is stored in Agri-Knowledge Database.

2) Agri Data Processing Layer

Agri-Data Processing layer is a Data processing layer contains libraries which will accept data in various formats from various devices and converts into uniform format and performs computations on large data sets using hadoop big data processing and reports to consumers of this service. Platform as a service encapsulates a layer of software and provides it as a service that can be used to build higher-level services [9]. This layer is deployed as **PaaS** in Cloud which contains libraries or readymade program modules to be used to build high-level agriculture based applications.

This layer also contains libraries which provide reporting service to customers in formats required by them to various devices after conversion to their respective languages by using natural language processor (NLP). It will convert data into XML format and it can be consumed by applications in SaaS for reporting users in various ways to them.

It also contains libraries which will provide the expert services using soft computing techniques like fuzzy logic and Artificial intelligence to provide solutions in real time etc.

3) Agri Data Storage Layer

This layer supports database infrastructure facilities to store large amounts of data which is required in agriculture sector for results to be accurate which will be accessed and processed by hadoop big data processing framework to produce insights or meaningful results which helps to various users of this service. This layer is deployed at **IaaS** level in cloud which allows data sharing and usage. Agriculture data base contains a data of various categories like the data collected from IOT, data supplied by farmers, data supplied by agriculture experts and scientists, data supplied by Government agencies and other private organizations and market information.

C. Use of Artificial Intelligence

As many types of users like farmers, Experts, Scientists and more important are the IOT such as sensors, cameras etc are going to interact with this service. Each and every input is going to be different so this service must contain Natural Language Processing mechanism of Artificial Intelligence which will provides the services according to the type of users so that they can easily understand it. Also the Agri-knowledge database contains a very vast amount of data and it must be in the form of rules and inferences to make intelligent decisions therefore we must have the very appropriate knowledge representation technique of Artificial Intelligence which will categorizes the Farmers data , Experts data, IOT data like images and sensors data and other Government organizations and private organizations data, market analysis data so that decision making or drawing conclusions from specific type of data becomes easy. Frames, scripts or conceptual dependency like knowledge representation techniques can be used. So, Artificial intelligence plays a vital role in this framework which makes it smart and intelligent.

D. Big data processing using Hadoop

Hadoop is a framework and set of tools for processing very large data sets, was originally designed to work on clusters of physical machines.

That has changed. Now Hadoop can be used for data analytics on cloud. It can be considered as an enterprise data operating system using which we can perform different kinds of data manipulations and analytics operations. As the data generated and captured in proposed service is not structured and it is a Big Data therefore using Hadoop a open source framework which performs processing and analytics very fast and which will decreases the time and service can produce the solutions or decisions in real time. Its main components are MapReduce a distributed analytics framework and hadoop distributed file system. As SQL, MapReduce, In-memory analytics, stream processing, Graph analytics and other types of workloads are able to run on hadoop with adequate performance I have proposed this open source framework in this design so decrease the cost. So the stakeholders of this service will get the expert decisions and support, suggestions, advices, support during the cultivation of crops and after production farmers will get the suggestions regarding the market conditions and other helpful support in real time.

CONCLUSION

In this paper we have proposed Agricultural Service Framework with appropriate technical aspects to provide assistance to farmers during crop cultivation to analyze soil, crop cultivation, and crop diseases and to give pricing solutions during cultivation in a cheaper means through latest technologies like Artificial Intelligence, IOT, cloud computing and Big data processing to Farmers, Agriculture Experts, and Government officials. We hope it will increase the productivity and profit of farmers by getting real time suggestions and support from this service.

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