A Review on Smart Agriculture using Internet of Things (IOT) and Cloud Computing Techniques

Dr. C.Lalitha, Assistant Professor, C.T.T.E College for Women, Chennai-11, Tamil Nadu, INdia.
lalithabarathi78@gmail.com
Dr. S.Arulselvarani, Assistant Professor, STET Women's College, Trichy, Tamil Nadu, India.
arul2catchme@gmail.com

ABSTRACT-Farmers are the backbone of the country and agriculture is the basic revenue of each and every country. But the climatic condition and the insufficient techniques affect the production of the agricultural system. Based on the major features of cloud computing and key techniques of internet of things, visualization and SOA technologies can build massive data involved in agricultural production. The usages of geomatics or GIS or GPS in agriculture are adding to a smart agriculture and greater environmental stewardship. This paper deals and reviews the implementation of revolutionary technologies such as IOT and cloud computing in agriculture.

Keywords: ***Cloud Computing, ,geomatics, Internet of Things, Smart Agriculture, SOA, WSN***

I. INTRODUCTION

Recently Cloud computing and Internet of Things (IOT) has been emerged into everyone's modern life. They are the hard-core of information technology industry of the new generation [1]. In order to ensure global food security, Agriculture sector will have to be much more efficient and resilient. Indian farmers are at great disadvantage in terms of size of farms, technology, trade, government policies, etc. Information and Communication Technology (ICT) can mitigate some of the problems of farmers. After the World Wide Web and the Mobile Internet, "Internet of Things" (IOT) has started to exhibit everyday's life. It occupies diverse areas including agriculture, healthcare, retail, transport, environment, supply chain management, infrastructure monitoring etc. Applications in agriculture include soil and plant monitoring, greenhouse environs monitoring and control systems, monitoring of food supply chain, monitoring of animals, etc. Precision farming equipment with wireless links to data collected from remote satellites and ground sensors can take into account crop conditions and adjust the way each individual part of a field is farmed. Agriculture, rural area and farmers are of particular importance when it comes to socialist modernization reform.

II. LITERATURE SURVEY

Fan Tong Ke[1] Issues concerning agriculture, countryside and farmers have been always hindering China's development. The only solution to these three problems is agricultural modernization. However, China's agriculture is far from modernized. A perfect combination of them can promote fast development of agricultural modernization, realize smart agriculture and effectively solve the issues concerning agriculture, countryside and farmers.

V.C. Patil et. al.[2] explores the future of computing and communications. The development of wisdom based systems for the farming sector has to be focused on Internet of Things. RFID technology and Agri-business organizations are increasingly becoming active in the social media. Despite the advances made in the technologies, application of IOT for agriculture still remains a formidable task, since integration of diverse domains for online monitoring of agricultural supply chain and management of complex agro ecosystems require concerted and collaborative efforts in a structured manner.

Harjit Singh Lamba [8] determines that the cloud computing paradigm for delivering computing services. This computing approach relies on a number of existing technologies. This paper provides a framework, Education Cloud for the e-management of NGO's. This paper also presents the case study of Kalgidhar trust, Baru Sahib, Himachal Pradesh, NGO which is using the education as the tool to solve the social issues.

YupingXing and Yong zhao Zhan [10] explain that with the use of virtualization, cloud computing brings about not only convenience and efficiency benefits, but also great challenges in the field of data security and privacy protection. For example, it may be binds different tenants' virtual resources to the same physical resource, then the user data will be accessed by other users. To solve this problem, the paper analyses and discusses several ways to improve the safety of cloud computing.

III. CLOUD COMPUTING

Today the buzzword in the IT world is Cloud computing. The integration of IOT and cloud computing is of great significance. Cloud computing has several functions such

 DOI : 10.18231/2454-9150.2018.0768

as powerful storage, processing and service ability, combined with the IOT's ability of information collection, composes a real network between people and items and the items themselves. Three layers are available in clouding such as Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). Data is one of the most important components of this stack and providing data as service has a huge potential, especially to the geospatial world. Cloud computing management platform is the "brain" of cloud computing and relevant data. It involves management of accession of cloud computing customization application. Ubiquitous network includes 3G, LTE, GSM, WLAN, WPAN, WiMax, RFID, Zigbee, NFC, blue tooth and other wireless communication protocol technology [2]. It also includes optical cable and other wire communication protocol and technology. The principle of cloud computing for IOT is shown in **Figure 1.**

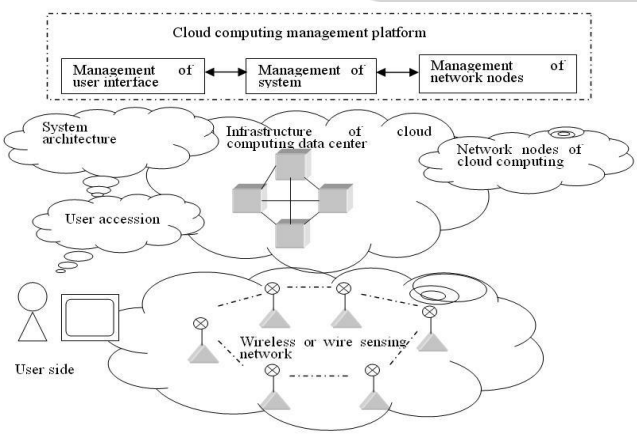

Figure 1: Principle of IOT and cloud computing

IV. INTERNET OF THINGS

The Internet of Things (IOT) is a worldwide network of intercommunicating devices. It integrates the ubiquitous communications, pervasive computing, and ambient intelligence. IOT is a vision where "things", especially everyday objects are readable, recognizable, locatable, addressable and controllable via the Internet. This will provide the basis for many new applications, such as energy monitoring, transport safety systems or building security. Innovative use of technologies such as RFID, NFC, ZigBee and Bluetooth, are contributing to create a value proposition for stakeholders of IOT. This will connect the world's objects in both a sensory and intelligent manner through combining technological developments in item identification, sensors and wireless sensor networks, embedded systems and nanotechnology.

Based on the internet and improvement in the production and life, the central computer can realize concentrated management and control of machine .This is useful for integration and harmony between human society and the physical world and is regarded as the third wave of information industry development following computer and internet [3]. Major IOT technologies include radio frequency identification technology, sensor technology, sensor network technology and internetwork communication have been involved in the four links of IOT like industrial chain, namely, identification, sensing, processing and information delivery[4].

IOT is an intelligent technology in which life and even intelligence of life itself can also be regarded as part of IOT technology. It is used in pattern identification fields like measurement and computing as well as computer and communication fields like sensing, communication, information collection and processing [5]-[8].

V. FUNCTIONS OF IOT IN AGRICULTURE

Datang Mobile introduced Wisdom Agriculture system solution of Internet of Things for Agriculture. The system has three layers, namely, sensor layer, transport layer, application layer. Their functions are as follows:

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

VI. APPLICATIONS OF IOT

There are several applications of IOT in agriculture, healthcare, retail, transport, environment, supply chain management, infrastructure monitoring, etc. Some of them are listed below:

- *Agriculture:* Agricultural IOT will completely subvert the traditional assertions from "physical world" and "ICT world". In agricultural IOT, farmland, agricultural machineries, and fresh agricultural products are integrated with the chips, broadband network and database systems. Thus it forms a completely new "agricultural infrastructure". IOT applications in agriculture include food traceability (RFID), soil and plant monitoring, precision agriculture, greenhouse environment monitoring and control systems, monitoring of food supply chain, monitoring of animals, etc.
- *Retail Management:* Retailing has many application areas of business interest. It includes monitoring customer behavior and preferences, shelf stock tracking, context based advertising and product promotions, vending machines, automated checkout, and theft control.

 DOI : 10.18231/2454-9150.2018.0768

- *Healthcare:* A major application in healthcare area is the identification of spurious drugs. Other application areas are personal health monitoring, telemedicine, assisted living, etc.
- *Security:* Detection of counterfeit goods, access control, restricted materials, banknotes, passports.
- Government and public sector: Disaster management, forest monitoring, tourism support, homeland security, pollution monitoring.
- Home: Home security, smart home (lighting, entertainment, energy management, assistance).
- *Sports:* Sports equipment, user performance monitoring, safety, etc.

VII. BENEFITS OF IOT IN AGRICULTURE

The following are the benefits of IOT applications in agriculture:

1. Improvement in the use efficiency of inputs (Soil, Water, Fertilizers, Pesticides, etc.)
2. Reduced cost of production
3. Increased profitability
4. Sustainability
5. Food safety
6. Protection of the environment.

VIII. SMART AGRICULTURE

1. Agricultural informationization

While world agriculture is undergoing industrialization, it is important to develop agricultural informationization at the same time. Agricultural informationization has become the trend of development for world agriculture. As far as China's agricultural development is concerned, agricultural informationization is a major force promoting agricultural development and transformation and a corner stone for maintaining sound and sustaining economic development. After years of hard efforts, remarkable results have been seen in agricultural infrastructure development. These infrastructure provided foundation for agricultural information service. However, problems still exist in China's agricultural information. To change this situation and promote fast development of agricultural informationization, it is necessary to use cloud computing and visualization technology to construct "agricultural information cloud" [9] which combines IOT technology and RFID technology.

2. Architecture of agricultural information cloud:

The architecture of a agricultural information cloud technology consists of four layers: physical resource layer, resource pool layer, management of middleware layer and SOA[10] construction layer. The physical resource layer include various kinds of resource servers, memories, internet facilities, database and software in relation to agricultural information; the resource pool layer builds a large amount of resources of the same kind into isomorphic or approximate isomorphic resource pools, like computing resource pool and data resource pool. The construction of resource pool can be regarded as integration and management of physical resource, the main purpose of which is to integrate isomeric agricultural information resources into resource pools of the same kind, so as to create a basis for synergy. Management of middleware layer is the core for agricultural information cloud. It is responsible for management of cloud computing resources and dispatching of various kinds of tasks. The SOA construction layers encapsulates cloud computing capacity into standard Web Services and incorporate them into SOA system for management. The management of middleware layer and resource pool are key parts of cloud computing technology. The function of SOA construction layer, to a large extent, relies on external facilities [7].

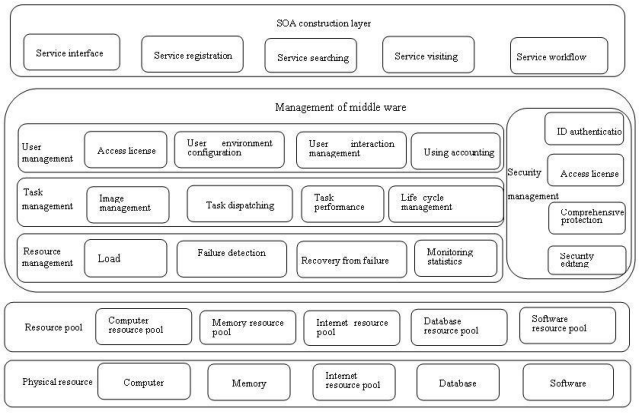

Figure. 2 Architecture of agricultural information cloud

3. Plant factory based on IOT

IOT technology in terms of modern farm production mainly consists of soilless culture and culture solution control technology, artificial photosynthesis technology, growing environment control technology, intelligent irrigation technology, etc. IOT technology and method is used with the integration of farm production and plant factory technology.

Plant factory is a highly efficient agricultural system that achieves continuous production of crops around the year through highly accurate control to environment within the facility. It uses computer to automatically control temperature, humidity, carbon dioxide concentration and culture solution of crops, so as to achieve labor-saving production of crops which are subject to no or little natural condition limitation. In the production of plant factory, IOT serves the plant factory through "comprehensive sensing, reliable delivery and intelligent handling" [10].

4. Cloud Computing in Microsoft Cloud Services

It is the central component which enables crowd sourcing the problem to agriculturists, researchers, and others interested in enhancing the value, while addressing

 DOI : 10.18231/2454-9150.2018.0768

performance and scalability. Agriculturists may use home computers, mobile devices or village kiosks/computers to access the system, either independently or with help of a village coordinator. Agricultural researchers may depend both on Azure hosted cloud services for analysis, as well as use the interfaces to download information to local systems for information analysis and reloading the results back to the system. Third-party service providers can advertise their services, which helps in revenue generation for sustaining the system. They can also bind their services to the cloud solution. Besides, Web Services exposed over the cloud allows for seamless integration between on-premise and cloud services. In addition, using the Microsoft .NET support, the services may also be provided in regional languages.

5. IOT Agriculture in China

Internet of things attracts much greater attention in China than that in the United States, the European Union and other countries. The first Chinese agriculture IOT application service platform has been built by scale, which connects the first group of the 64 IOT bases involved in the production, processing and distribution in China. They can make analysis and decisions with information feedback from the sensing and incorporated with the agricultural knowledge. They are now used in agricultural production on the fruit (orange) farms on the precise husbandry farms, as well as in the process of the storage, transportation and tracing of agricultural products, etc.

6. Cloud Computing in Rural India

In rural areas, it is not economically viable for farmers to deal with service providers on an individual basis. They need comprehensive and cost effective service providers with multiple services. It was first introduced in 2005 by Rama Krishna in one such venture to meet the rural market demand. It began as a super *bazaar* based out of Eluru, Andhra Pradesh. It enables the consumers to have day-to-day transaction with the company. It is an example of how a corporate can contribute to the development of stores by building sustainable business models consumers as well as in maintaining extensive rural consumer databases with micro information about the rural consumers to provide customized services. Such centers would be very convenient and provide the much needed respect/dignity and freedom to the rural consumers.

IX. CONCLUSION

Thus IOT works powerful computing tools with the integration of cloud computing and cloud computing finds the best practicing channel based on IOT. Agricultural information cloud is constructed based on cloud computing and smart agriculture is constructed with combination of IOT and RFID. Large amount of data obtained by using radio frequency identification, wireless communication, automatic control, information sensing techniques of IOT are handled with agricultural information cloud, truly realizing smart agriculture. With the Internet of Things, single farmers may be able to deliver the crops directly to the consumers in direct marketing or shops. This will change the whole supply chain which is mainly in the hand of large companies with the shorter chain between producers and consumers. Cloud Computing would enable corporate sector to provide all the necessary services at affordable cost to farmers in rural areas.

REFERENCES

[1]. Fan Tong Ke . “Smart Agriculture Based on Cloud Computing and IOT” Journal of Convergence Information Technology(JCIT) Volume 8, Number 2, Jan 2013 doi : 10.4156/jcit.vol8.issue2.26.

[2]. V.C. Patil , K.A. Al-Gaadi , D.P. Biradar and M. Rangaswamy. “Internet Of Things (Iot) and Cloud Computing for Agriculture: An Overview “ Agriculture 2012 (AIPA 2012).

[3]. Cao Qinglin. “Present research on IOT. Software Guide, Vol. 59, pp. 6~7, 2010.

[4]. Li Hong. “IOT and cloud computing: Advance Strategic New Industry” [M].Beijing, Posts & Telecom Press, China, 2011.

[5]. Ken Cai.” Internet of Things Technology Applied in Field Information Monitoring”, Advances in information Sciences and Service Sciences AISS, Vol.4, No.12, pp.405-414, 2012.

[6]. Zhao Xing, Liao Guiping, Shi Xiaohui, Chen Cheng and Li Wen. “Construction of agricultural service mode in IOT and cloud computing environment” [J]. Journal of Agricultural Mechanization Research, Vol.4 pp.142-147, 2012.

[7]. Liu Hai, He Chaobo, Tang Yong, Huang ShiPing. ” Research and Application of Service-Oriented Scholar Cloud Platform”, Journal of Convergence Information Technology JCIT,Vol.7, No.5, pp.333-339, 2012.

[8]. Harjit Singh Lamba,Gurdev Singh, "Cloud Computing-future Framework for e-management of NGO’s", International Journal of Advancements in Technology,Vol.2, No. 3, pp.400-407,2011.

[9]. Zhao Xing, Liao Guiping, Shi Xiaohui, Chen Cheng and Li Wen. “Construction of agricultural service mode in IOT and cloud computing environment” [J]. Journal of Agricultural Mechanization Research, Vol.4 pp.142-147, 2012.

[10]. Yuping Xing and Yong zhao Zhan “Virtualization and Cloud Computing Group”. “Virtualization and Cloud Computing” [M]. Beijing: Publishing House of Electronics Industry, China, 2009.

 DOI : 10.18231/2454-9150.2018.0768