Chapter 69
IoT Based Agriculture as a Cloud and Big Data Service:
The Beginning of Digital India

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ABSTRACT

Cloud computing has transpired as a new model for managing and delivering applications as services efficiently. Convergence of cloud computing with technologies such as wireless sensor networking, Internet of Things (IoT) and Big Data analytics offers new applications' of cloud services. This paper proposes a cloud-based autonomic information system for delivering Agriculture-as-a-Service (AaaS) through the use of cloud and big data technologies. The proposed system gathers information from various users through preconfigured devices and IoT sensors and processes it in cloud using big data analytics and provides the required information to users automatically. The performance of the proposed system has been evaluated in Cloud environment and experimental results show that the proposed system offers better service and the Quality of Service (QoS) is also better in terms of QoS parameters.

1. INTRODUCTION

Emergence of ICT (Information and Communication Technologies) plays an important role in the agriculture sector by providing services through computer-based agriculture systems (Singh and Chana, 2015). But these agriculture systems are not able to fulfill the needs of today's generation due to processing of large amount of data, lack of important requirements like processing speed, data storage space, reliability, availability, scalability etc. and even resources used in computer-based agriculture systems are not utilized

DOI: 10.4018/978-1-5225-9866-4.ch069

efficiently. Agriculture-as-a-Service (AaaS) applications exhibit Big data characteristics. For example, the volume of agriculture dataset captured by environments such as Open Government Data Platform India (data.gov.in, 2015), India Agriculture and Climate Data Set (Sanghi et al.), and regional land and climate modelling in China (Shangguan et al., 2012) can be in order of 1000000 records with size of 3.5 GB. The data is coming in large data variety and volume from both users in the form of images like damaged crop images due to weather, insects etc. and devices through Internet of Things (IoT) sensors and satellites (GPS systems) that send weather related images. As a result of regular capturing and collection of datasets, they grow with the velocity of 80.72 KB/minute or more (data.gov.in, 2015). To solve the problem of existing agriculture systems, there is a need to develop a cloud-based service that can easily manage different types of agriculture related-data based on different domains (crop, weather, soil, pest, fertilizer, productivity, irrigation, cattle, and equipment) through these steps: i) gather data from various sensors through preconfigured devices, ii) classify the gathered data (heterogeneous, high volume of big data) into various classes through analysis, iii) store the classified information in cloud repository for future use, and iv) automatic diagnosis of the agriculture status. As large number of users are using agriculture systems operating on large datasets simultaneously, there is a need of highly scalable and elastic distributed computing environment such as cloud computing. In addition, cloud-based autonomic information system should be able to identify the QoS (Quality of Service) requirements of user request and resources should be allocated efficiently to execute the user request based on these requirements.

The main aim of this paper is to design architecture of Agriculture-as-a-Service (AaaS) that manages various types of agriculture-related data based on different domains. This is realized through the following objectives: i) propose an autonomic resource management technique which is used to a) gather the information from various users through preconfigured devices, IoT sensors, GPS (Global Positioning System), etc. b) extract the attributes, c) analyze the information by creating various classes based on the information received, d) store the classified information in cloud repository for future use and e) diagnose the agriculture status automatically and ii) perform resource allocation automatically at infrastructure level after identification of QoS requirements of user request.

The rest of the paper is organized as follows. Section 2 presents related work of existing agricultures systems. Proposed architecture is presented in Section 3. Section 4 presents Autonomic Resource Management. Sections 5 describe the experimental setup and present the results of evaluation. Section 6 presents conclusions and future scope.

2. RELATED WORK

Existing research reported that few agriculture systems have been developed with limited functionality. Related work of existing agriculture systems has been presented in this section.

2.1. Existing Agriculture Systems

Ranya et al. (2013) presented ALSE (Agriculture Land Suitability Evaluator) to study various types of land to find the appropriate land for different types of crops by analyzing geo-environmental factors. ALSE used GIS (Global Information System) capabilities to evaluate land using local environment conditions through digital map and based on this information decisions can be made. Raimo et al. (2010) proposed FMIS (Farm Management Information System) used to find the precision agriculture requirements for

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