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SIMULATION OF CLOUD-BASED CRM MODEL

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ABSTRACT

Cloud based CRM is an approach to CRM that relies on cloud computing platforms and services to deliver a business with more flexible business process revolution. Cloud based CRM systems are nowadays seen as an influential IT solution for organizations. What inform the research is the fact that business environment, face aggressive competition and increasingly short product development

Introduction

Increase in the capacity of Internet as well as the outgrowing number of new computing and mobile technologies have significantly altered our lives at individual and at corporate level. The fast growing usage of portable and handheld devices which are communication gadgets that transmit information in a matter of seconds has even changed the way we used to do our daily activities. As technology increases in ubiquity and pervasion, so also the rate at which organizations and individuals are integrating it in their daily tasks. One of the new trends in ICT application is Cloud computing.

Cloud computing provides IT services such as applications, software and storage for individuals and businesses over the Internet (Yeboah-Boateng & Essandoh, 2013). It meets essential computing needs of individuals and organizations

by providing on-demand, elastic and d ynamically scalable resources as a service to government corporations, private organizations and individuals. Cloud computing solutions offer both time and cost savings, and thus perfectly suit Small and Medium-sized Enterprises (SMEs) (Budrienė & Zalieckaitė, 2012). Cloud computing as a new paradigm shift in computing has the potential to bring significant benefits to the SMEs by reducing the costs of investment in ICT infrastructure since Cloud computing allows users to make use of services such as computation, software, data access, and storage to end-users without the need to know the physical location and configuration of the system that delivers the services.
In the same vein, customers are the most integral part of any business (Ramasamy & Singh, 2017). Customers are the prime target of any business and for that business to compete favorably in a market place amiable relationship has to maintain. There is, therefore the need for any organization -small, medium or large scale- to maintain good relationship with its customers. In view of that, understanding and predicting customer demand as well as enhancing customer satisfaction can be seen as a critical aspect of

cycles. As such, they are required to provide high-quality products and fast services. Therefore, there is need to have a system that is scalable and has the ability to handle a growing volume of work in a capable manner. The objective of this research, therefore, is to propose a Cloud-based Customer Relationship Management (CRM) Model that will be scalable to accommodate the ever-increasing computing demand without affecting the computing time. The study adopted experimental methodology using simulation technique to conduct the experiment with CloudSim simulation tool 3.0. The result revealed that in the cloud based CRM is faster than the traditional system in handling growing volume of workloads. The key contribution of this research is the incorporation of cloud scalability to the work of El Fazziki et al as well as simulating the model.

Keywords: Cloud-Based, Innovation, Capability, Simulation, Model

Customer Relationship Management (CRM). CRM is perceived as an imperative strategy to improve a firm's innovation capability and to enhance a firm's competitive advantage (Lin, Chen, & Chiu, 2010). A study by Ku, Wei & Hsiao (2012) revealed that the use of social networks is continuously increasing, especially among young people. These facts encourage companies to use social networks to draw attention to their products, services and brands with the aim of building up customer relationship and increase demand (El Fazziki, Ennaj, Sadiq, Benslimane, & Sadgal, 2017).

In the 21st-century business environment, companies face aggressive competition and increasingly short product development cycles. Moreover, they are required to provide high-quality products and fast services at low prices (Lee & Wang, 2018). As such, there is need to have a system that is scalable and has the ability to handle a growing volume of work in a capable manner. The aim of this research, therefore, is to propose a Cloud-based Customer Relationship Management (CRM) Model that will be scalable to accommodate the ever-increasing computing demand without affecting the computing time.

Literature Review

Cloud Computing

There are different views concerning the definition of Cloud Computing. These divergent views are apparently visible in the literature. According to Voas and Zhang (2009), Cloud computing has recently attracted significant momentum and attention in both academia and industry, but no common definition exists yet. The main idea behind Cloud computing is not a new one. John McCarthy in the 1960s already envisioned that computing facilities will be provided to the general public like a utility (Zhang et al., 2010). He added that the term "Cloud" has also been used in various contexts such as describing large Automated Teller Machine (ATM) networks in the1990s. However, it was after Google's Chief Executive Officer (CEO) Eric Schmidt used the word to describe the business model of providing services across the Internet in 2006, that the term really started to gain popularity. (Zhang et al., 2010).

However, this does not discourage some authors in trying to to define the term.

Cloud computing can be defined as a technique for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction (Gupta & Bhatia, 2017).

This definition is almost similar to the one provided by Mell and Grance, (2011) which defined Cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This definition is widely used by so many authors. It is a bit more elaborate than the one provided by Gupta and Bhatia, (2017) even though they, too, adopted their definition from that of Mell and Grance, (2011) provided in a special publication of National Institute of Standard and Technology (NIST). The only difference is that the former viewed it as a technique while the latter viewed it as a model.

In another attempt by Saini, Saini, Yousif, and Khandage, (2011), they viewed Cloud computing as a new paradigm in which computing resources such as processing, memory, and storage are not physically present at the user's location. Instead, a service provider owns and manages these resources, and users access them via the Internet. This definition is almost similar to the previous ones but with different wordings.

According to Budrienė and Zalieckaitė, (2012), Cloud computing is the way in which the totality of the heterogeneous technologies provides computing resources services to the client via the Internet.The customer is dissociated from details of these measures, services, support, and the resources are paid for in so far as they have been used. In other words, this is outsourcing of IT services, where a part or all of the non-core business services are purchased from external suppliers (Budrienė & Zalieckaitė, 2012). The main idea here is that the services are outsourced from another vendor and the user pays for the service when used.

The main reason for the existence of different perceptions of Cloud computing is that Cloud computing, unlike other technical terms, is not a new technology, but rather a new operation model that brings together a set of existing technologies to run business in a different way (Zhang et al., 2010). They added that, indeed, most of the technologies used by Cloud computing, such as virtualization and utility-based pricing, are not new. Instead, Cloud computing leverages these existing technologies to meet the technological and economic requirements of today's demand for information technology (Zhang et al., 2010).

According to Mell and Grance (2011), Cloud computing model is composed of five essential characteristics, three service models and four deployment models. This was adopted and reported by many authors like Zhang et al. (2010) and Budrienė & Zalieckaitė (2012) etc.

Figure 1 Cloud computing layered Architecture

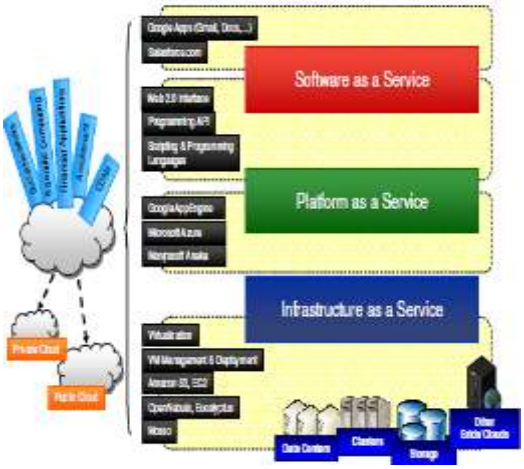

Figure 2 Cloud computing offerings by services

Source: (Vecchiola, Pandey, & Buyya, 2009)

Customer Relationship Management (CRM)

Customer Relationship Management (CRM) has attracted the expanded attention of practitioners and scholars (Parvatiyar & Sheth, 2001). In a similar view, Payne and Frow, (2005) stated that over the past decade, there has been an explosion of interest in Customer Relationship Management (CRM) by both academics and executives. They added that despite an increasing amount of published material, most of which is practitioner oriented, there remains a lack of agreement about what

CRM is and how CRM strategy should be developed (Payne & Frow, 2005).

CRM means different things to different people. For some, CRM means direct e-mails. For others, it is mass customization or developing products that fit individual customer's needs. For IT consultants, CRM translates into complicated technical jargon related to terms such as OLAP (on-line analytical processing) and CICs (customer interaction centers) (Richards & Jones, 2006). This definition looks at CRM from simple application like e-mail to a more customer oriented one. In another definition by Sin et al. (2005), CRM refers to utilizing extensive strategies and engineering to find, obtain, and cultivate advantaged customers, and hence maintain long-term partnerships. Aggarwal, (1997) and Claycomb, et al, (1999) cited in Lin, Chen, and Chiu, (2010) defined CRM as activities that manufacturers practice for understanding customer demands and improving customer satisfaction.

Another narrow, yet relevant, viewpoint is to consider CRM only as seeking customer retention by using a variety of after marketing tactics that lead to customer bonding or staying in touch with the customer after a sale is made (Vavra, 1992) cited in (Parvatiyar & Sheth, 2001). Another almost similar meaning is given by Faed, Wu, and Chang, (2010) which defined CRM as a disciplined business strategy to create and sustain long-term, profitable customer relationships. To this aim, it must concentrate on customer.

In some organizations, CRM is simply a technology solution that extends separate databases and sales force automation tools to bridge sales and marketing functions in order to improve targeting efforts (Chen & Popovich, 2003).

A more popular approach with the recent application of information technology is to focus on individual or one-to-one relationships with customers that integrate database knowledge with a longterm customer retention and growth strategy (Peppers & Rogers, 1993) in (Parvatiyar & Sheth, 2001).

An important aspect of the CRM definition that we wanted to examine is its association with technology. This is important because CRM technology is often incorrectly equated with CRM and a key reason for

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CRM failure is viewing CRM as a technology initiative Reinartz, Krafft, and Hoyer (2004) and Kale (2004) cited in (Payne & Frow, 2005).

The definitions and descriptions of CRM that different authors and authorities use vary considerably, signifying a variety of CRM viewpoint (Payne & Frow, 2005).

From the above literature it can be deduced that virtually there is no any universally acceptable definition of CRM. Each author gives his definition looking at it from his/her viewpoint.

Related Work

There has been a spur of research activity in assessing the performance of virtualized resources, in cloud computing environments. Lee, and Wang (2018) proposed an approach in combination with the elastic Model-View-Controller (MVC) framework for hosting an enterprise cloud that has successfully assisted enterprises and increased the value of web services. In this work, they looked at the performance of cloud based Enterprise Resource Planning (ERP) in handling critical business needs. CRM is one of the key components of ERP. The research paid less attention effect of scalability on computation time. Also, Vecchiola, Pandey, and Buyya (2009) conducted an experiment and concluded that large high performance applications can benefit from on-demand access and scalability of computer and storage resources provided by public Clouds. Hence, it has significant effect on the application execution time by making use of abundance of Cloud resources, which can be provisioned on demand. However, this paper looked at cloud based application in relation to scientific computing. It is in line with our work since it looked at the execution time of such applications. In contrast to these studies, ours targets the computation time of cloud based CRM

Close to our work is the study of performance and cost of executing the Montage workflow on clouds by Deelman, *et al.*, (2008). This study aimed at measuring the performance of Montage heavy workflow execution using cloud resources.

Methodology

This section describes the methodology used in this research to experiment a cloud based customer relationship management (CRM) model that will accommodate the ever-increasing computing demand without affecting the computing time. It includes experiment overview,

experimental methodology design and set up, dataset definition choice of experiment approach, assumptions, result analysis, choice of parameters, delimitations and model validation

Experiment Overview

This section gives general overview of the experiment. The major aim of this experiment is to test a cloud based framework for customer relationship management that can accommodate the ever-increasing computing demand without affecting the computing time. This will be conducted by using the researcher's local machine which will double as both the client and the server and will perform the read/write operations. CloudSim toolkit is going to be used as a simulation tool in this research. CloudSim is a leading technology in simulating cloud computing infrastructure. CloudSim allows us to carry out discrete event simulation (DES) of cloud computing infrastructure. CloudSim can model large scale Cloud computing data centers on a single physical node. It can also model different virtualized infrastructures: cloud based data centers, virtualized clusters, public clouds, private clouds and hybrid clouds. With its functionality for virtualized infrastructures simulation can be used to model smaller virtualization clusters. CloudSim exposes functionalities for complex workload profiling and application performance studies. Testing and profiling application on models can be done while cluster is used by other users. It has good support for modeling virtualization enabled resources. It supports Virtual Machine (VM) provisioning in two layers: at host level and at the VM level. At host level amount of processing power of each core assigned to the VM can be configured. At the VM level amount of processing power can be assigned to individual application services.

Result and Discussion

Model Presentation

In this proposed model, social media is used as input data sets. It collects the data from the comments and posts of customers about a product offered by SME.

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At the data integration and analysis layer there are three components, namely, data extraction agent, data analysis agent and manager agent. The Data Extraction Agent (DEA) handles data gathering from social media. As such, it has two main capacities namely:

i. Data extraction from social media, and

ii. Real time detection of users' activities that contain the chosen key words.

The Data Analysis Agent (DAA) analyses extracted data and updates stored results. This agent is responsible for knowledge analysis and authority analysis by evaluating the knowledge and Authority scores of users. Knowledge analysis includes the quality and the significance assessment according to the author's expertise level. This score means how many times a user has published a post about this topic and its value. In addition to the number of reviews a user has written, this system evaluates the quality of each post by calculating its rate score. The knowledge score (KS) of a user u is the number of times that the keyword and are repeated. The authority analysis process is based on the influence score and the rate review. If these scores fulfill the condition, then the agent can perform the sentiment analysis stage. Sentiment Analysis identifies the sentiment expressed in a text then analyses it. To do so, sentences are classifies into three groups: negative, positive and neutral opinion.

The Manager Agent (MA) is responsible for the reliability of the whole system and manages the operation of the individual agents. It sends a request for the data extraction agent which search and send the requested information to the data analysis agent. The Manager agent prepares the analysis results for the data management agent which loads them into the appropriate target.

At the data management layer, the Data management Agent (DMA) is responsible for storage synchronization. Every time that an entry is evaluated, DMA intervenes to refresh the results stored in the database. The database stores two categories of data – corporate and social media data. This agent must ensure enough performance to minimize the offline time during updates operations. The CRM component of this layer gets analyzed data about customers' responses from the corporate and

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databases which is to be used by managers in decision making. The framework provides a mechanism for feedback to customers.

This model is hosted in a cloud data center which handles the management of application execution, and monitoring the scalability of the system. Cloud applications are directly available to end-users. End-users are the active entities that utilize the SaaS applications over the Internet. These applications are supplied by the Cloud provider (SaaS providers) and accessed by end-users on a pay-per-use basis.

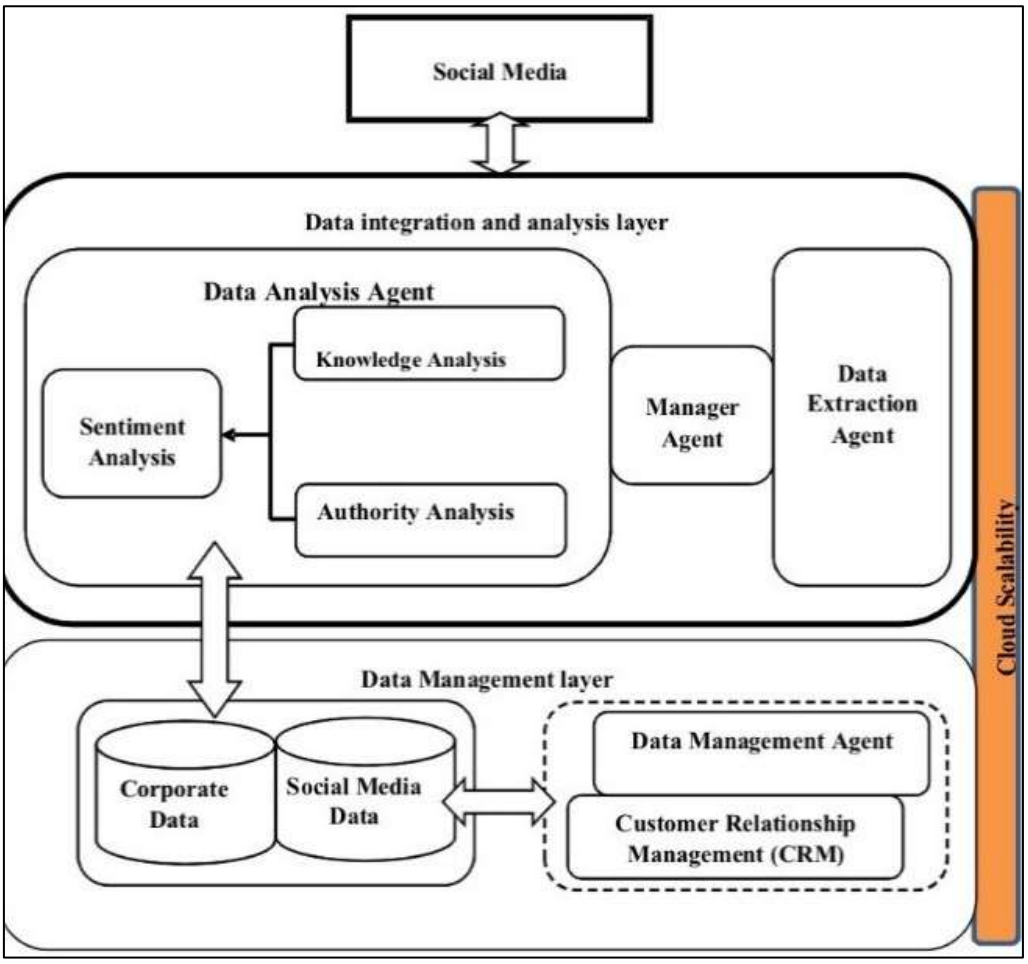

Figure 3 the CRM Model

Result and Discussion

As stated in the methodology, this research is an experiment using CloudSim tool kit to experiment a cloud based CRM model based on cloud scalability in order to assertain the computation time.

In order to accomplish this task in CloudSim, two data centers were created namely Datacenter_0 and Datacenter_1. Each data Center has virtual machines (VMs). So, two Source: El Fazziki *et al.*, (2017) resources are available and were handed to the Cloud Broker. The Broker made Virtual Machines available (VMs) and allocated them to clients (SMEs). The user at the other end sent Cloudlets to broker for processing. Once Cloudlets are received, the hosts and their Virtual Machines are started and the Broker matched users' requests (Cloudlets) to Virtual Machines for processing. After accomplishing the task, the VMs and hosts are shut down and output (result) displayed together with the associated costs accrued to user at each data center.

Each of the objects mentioned above (Datacenter, VM, and Cloudlet) has its parameters. Datacenter has Id, name and other properties. VM has Id, VM name, mips, pesNumber, ram, bw, size amd CloudletScheduler. Cloudlet has Id, length, pesNumber, fileSize, outputSize and utilizationModel.

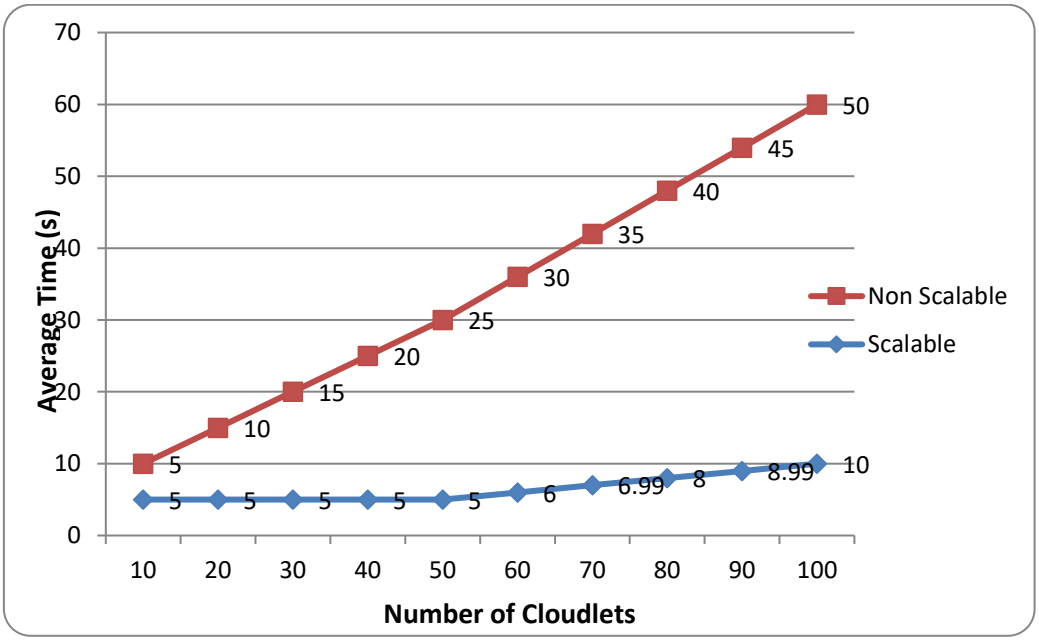

Figure 4 The computation time of scalable and non-scalable CRM

In figure 4, the y-axis represents the average time in seconds to process the users' workloads (cloudlets) while the x-axis represents the number of cloudlets. The figure showed that the computation time of cloud

based system is more efficient than the non-cloud based. In the scalable system, an average time of 5 seconds was maintained to handle ten to fifty cloudlets. The highest time it took was 10 seconds for handling one hundred cloudlets. That is to say, an average of 5 to 10 seconds was maintained in processing any number of cloudlets between one and one hundred.

On the other hand, in the non-cloud based system, the computation time continued to increase as the number of job increased. It took an average time of 5 seconds to handle ten cloudlets. When the demand increased to twenty, the time rouse up to 10 second and it continued like that up to 50 seconds for handling one hundred cloudlets. This clearly showed that that the non-scalable system is slower than the scalable system. This is because in scalable system, the resource increased as the demand increased but in the non-scalable system the resource provisioning is fixed and did not cater for increase in demand. As such, the higher the request, the slower the system.

Conclusion

In this research, an experiment was conducted to model a cloud based CRM with cloud scalability. The results revealed that CRM that is deployed in the Cloud performs better in terms of computation time. It is fast even when the volume of job is high because the system scales up or down to meet up with the volume of the job. As such, the system is able to maintain the average computation time despite the increase in the demand. On the other hand, the computation time of traditional system is higher as the demand increases. This makes the system very slow during higher demand. Therefore, it is recognized that cloud computing will be supportive in enhancing the performance and the throughputs of applications to meet the ever rising market demands for computing.

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