Context-Awareness in Mobile Cloud Computing: Healthcare

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ABSTRACT

Rapid changes in mobile cloud computing tremendously affect the telecommunication, education and healthcare industries and also business perspectives. Nowadays, advanced information and communication technology enhanced healthcare sector to improved medical services at reduced cost. However, issues related to security, privacy, quality of services and mobility and viability need to be solved before mobile cloud computing can be adopted in the healthcare industry. Mobile healthcare (m-Healthcare) is one of the latest technologies in the healthcare industry which enable the industry players to collaborate each other’s especially in sharing the patient’s medical reports and histories. M-Healthcare offer real-time monitoring and provide rapid diagnosis of health condition. User’s context such as location, identities and etc which are collected by active sensor is important element in M-Healthcare. This paper conducts a study pertaining to mobile cloud healthcare, mobile healthcare and comparisons between the variety of applications and architecture developed/proposed by researchers.

KEYWORKS

Mobile cloud, healthcare, context-awareness, mobile healthcare architecture, mobile healthcare applications.

1 INTRODUCTION

Cloud computing change the way IT resources are utilized and consumed and give a lot of benefits to public sectors and government entities. Cloud computing can be defined on-demand resources when ever needed, released when no longer required and billed only when used. NIST defined Cloud Computing as follows [1]:

"Model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

Latest advances in mobile communication networks and increasing penetration of Smartphone are transform the mobile internet and users with rich mobile experience. However, the limitation of memory storage, unable to process heavy algorithm, battery life and bandwidth are the biggest problems[2]. 4G and long-term evolution (LTE) wireless networks provide mobile devices with access to integrated communication standards and low transmission cost with rich multimedia support[3]. According to[4], mobile computing has four constraints:

- Mobile elements are resources-poor relative to static elements
- Mobility is inherently hazardous
- Mobile connectivity is highly variable in performance and reliability
- Mobile elements rely on finite energy resources.

Currently each hospitals developed their in house system to manage their daily operations. The systems do not link each other’s resulting the patients need to re-register their personal detail each time they visit to deference hospitals. In Malaysia, some hospitals still using manual healthcare system (paper-based) even though they have invested in the healthcare technology. Doctors record treatment detail and drug manually, making it difficult to access a patient’s history and determine the appropriate treatment.
How context-awareness relevant to mobile cloud computing? User’s mobility will create the situation where user’s context such as the location, people and objects around her is more dynamic. Mobile cloud gives users facilities that they can access information services anytime and wherever they are and able to overcome the limitation of mobile devices such as processing power and battery consumption.

2 BACKGROUND

2.1 Mobile Cloud Computing

According to Wikipedia[5], Mobile Cloud Computing (MCC) is distributed computing paradigm comprises of three heterogeneous domains of mobile computing, cloud computing, and wireless networks.

In MCC, there are four types of cloud-based resources, namely distant immobile clouds, proximate immobile computing entities, proximate mobile computing entities, and hybrid (combination of the other three model) Giant clouds such as Amazon EC2 are in the distant immobile groups whereas cloudlet or surrogates are member of proximate immobile computing entities. Smart phones, tablets, handheld devices, and wearable computing devices are part of the third group of cloud-based resources which is proximate mobile computing entities.

Applications are run on a remote server and then sent to the user. Because of the advanced improvement in mobile browsers thanks to Apple, Google, Microsoft and Research in Motion, nearly every mobile should have a suitable browser. This means developers will have a much wider market and they can bypass the restrictions created by mobile operating systems.

Mobile cloud computing gives new company chances for mobile network providers. Several operators such as Vodafone, Orange and Verizon have started to offer cloud computing services for companies.

2.2 Context-Awareness

Many scholars define the context-awareness based on their perspectives. Schilit et al. mentioned that context-awareness initially referred to as location, identities of nearby people, objects to these objects[6]. Dey[7] has same understanding where context is any information considered relevant to interaction between a user and an application, including the user and the application themselves. These parameters may be dynamic and may change during the execution[8]. Besides that, context-awareness also be defined as a set of environment states and settings that either determines an application’s behaviour or in which application event occur and is interesting to the user and as an intrinsic characteristic of intelligent environment[9][10].

Context-aware computing was first discussed by Olivette Active Badge work in 1992[11] and followed by Schilit and Theimer[6] in 1994 that context-awareness computing is “adapt according to its location of use, the collection of nearby people and objects as well as changes to those objects over time”.

The use of context in mobile devices is get considerable attention in various fields of research including mobile computing, wearable computing, augmented reality and the collection of ubiquitous computing.
3 RELATED WORKS

Applications in mobile cloud healthcare have been discussed and presented in the following.

3.1 Cloud Healthcare Application & Mobile Cloud Healthcare Application

All the application is based on the semi-auto system. As shown in Figure 2, staff member collect and record all the information using paper based. Information treatment and drug prescription key-in in the healthcare system periodically. Problems raised due to manual process and prone to human errors and delay in availability of patients data.

Figure 2. Healthcare Semi-Auto System. [4]

Proposed to attach a sensor to medical equipments to automate the process and make the patient’s information available in the cloud. Figure 3 show the sensor attached to the medical equipment to collect and transmit patient’s information thro wireless network. Eliminate the manual process and data in the cloud allow medical staff access information real-time and reduced cost.

According to [13], they proposed integration network module with existing system that connected within the hospitals. The proposed based on cloud computing so the information sharing and high-end processing is available in the "cloud".

The integration module via virtual private network (VPN) and public internet access. Therefore, they reduce the risk of security and privacy. There are problems with traditional Hospital Information System (HIS):

1. Lack of uniform standards for data-sharing
2. High cost for independent construction
3. Difficult to Management, Upgrades and Maintenance

Doang and Liefeng [14] proposed a Mobile Cloud for Assistive Healthcare (MoCAsH) that deploys intelligent mobile agents, context-awareness middleware and collaborative protocol in their architecture.

Figure 3. Cloud Healthcare solution for patient’s data collection [5]

Data collected by the sensor are analyzed, processed by the intelligent context-aware...
middleware. For examples, body temperature, pulse, motion and time. This model addressed in security and privacy issues also quality of service and energy consumption.

According to [15], they proposed the architecture that others architecture fails to provide. Figure 5 show the enhancement which prevented from running the complex and massive algorithms.

The advantages of the proposed architecture are preventing others component affected if one component failed. This is due to loose coupling connected among the components.

[3]developed a prototype of the SparkMed framework to evaluate a radiological workflow simulation. The framework integrates techniques from multimedia streaming, rich internet application (RIA) and remote procedure call (RPC). Techniques include RPC framework such as CORBA, semantic Ontology, software agents and others form of wrapper generation.

This architecture still has limitation in term of format acceptability, Quality of Service (QoS), and data synchronization.

Our proposed model is scenario based act based on the following conditions:

1. Intelligent Cloud Computing: user’s behavior information collected periodically and it forecasts and prepares contents by analyzed the collection of information. Information contents can be collected from patient’s Smartphone and wearable devices and get the feedback and personalized services made by server based on patient’s status and need.
2. All the analyzed data can be transferred, viewed to the respective clinicians using ubiquitous devices (Smartphone, laptop and other portable devices). Observation, consultations and treatment can be done anytime, anywhere without barriers of connectivity, availability and accesses ability to the patient’s information.

3. Intelligent Hospital Information System (IHIS) has a centralized information system stored and accessible by all departments in the hospital. Intelligent sensor attached with health equipments. Patient

Apart from that, there are several challenges facing by researches in cloud healthcare, mobile cloud healthcare and mobile healthcare. The challenges are as following:

1. Information system fragmented and incompatible with others departments
2. Low propensity to adopt ICT among healthcare professional.
3. Rural-urban discrepancies.
4. High cost for independent construction.
5. Lack of a centralized repository or common standard for most healthcare data.
6. The limited scope of access to data in proprietary hospital infrastructure systems
7. Security and privacy issues
8. Interoperability & availability heterogenous resources.
9. Healthcare cost increase due to aging societies.
10. Data quality.

4. CONCLUSION

Mobile cloud computing technology opened up enomorous opportunities to improve healthcare sector and change the community lifestyle. Our model fulfills the requirements of professional healthcare. In future, we will focus more detail in technical aspects of this model and develop prototype to test the intelligence, effectively and accuracy of the system. Hopefully this model can benefit to the healthcare sector, government, society and others fields related to data sharing of critical information.

5. REFERENCES


[5] “Mobile cloud computing - Wikipedia, the free encyclopedia.”.


