Conceptual Model for Healthcare Information Systems based on IOT & Cloud Services

Satinder Kaur
Assistant Professor, Department of Computer Science and Engineering, Guru Nanak Dev University, Regional Campus, Sathiala, India.

Simmi Bagga
Assistant Professor, Sant Hira Dass Kanya MahaVidyalaya, Kala Sanghian, Distt Kpt. India.

Abstract – Today, information technology industry is working on two hot areas i.e. cloud computing & Internet of things. These areas have also a wide application fields. Application fields now rely more on virtualization rather than permanent infrastructure. But these areas have limited application in medical field. This paper discusses how cloud computing in combination with internet of things can provide services to patients to diagnose their health problems. A model is prepared at conceptual level for providing healthcare information system at remote sites. Physical as well as logical view of model is presented with some challenges for its implementation.

Index Terms – Information technology, Internet of Things, Cloud Computing, Virtualization.

1. INTRODUCTION

Nowadays, information technology is dealing with a major problem of managing a huge amount of data which is generated at very large pace, in large varieties. So, the term big data emerge [1]. Secondly, the concept of cloud architecture provides a super infrastructure to deal with problem of big data as it has excellent scalability, low price, more security, platform independence & large computing power [2]. Also, IOT provides sensors & RFID in large scale [3]. Many enterprises are providing cloud services successfully [4] but their usage is limited in modern medical areas [5]. The main need is better service and fast speed at lower expense. Researchers believe that IOT will solve each problem of modern society and major contribution in research in near future [6].

As health care services are for national welfare and the people's livelihood, so they need strong information and resource sharing which can be better implemented using cloud and IOT in medical field. Due to the power of virtualization, public cloud can be constructed in hospitals which promote resource sharing among patients. With the facility of RFID and photo acoustic electromagnetic sensors, IOT can provide high quality medical monitoring and management systems [7]. IOT can also be used to monitor and track patient's management. So, these new and rapidly developing disciplines of IT can provide new platforms for its better functioning and management [8].

This paper discusses the model to monitor & manage cloud platform of healthcare information for remote sites (MMCPHIR). The next section discusses the role of cloud and IOT in health care systems. Section 3 discusses its physical and logical architecture. At the end, some challenges for researchers are discussed.

2. MEDICAL APPLICATIONS

(a) Cloud information service for medical system: Due to maximal efficiency, low costs and better service availability, cloud computing can help in medical field in two ways:

- High speed medical information system can be built for patients and hospital by combining cloud architecture with internet service mode.
- A platform for to enable information sharing can be built in hospitals which has other added features like data sharing, remote data storage, interaction with doctors, medical experts' consultation, etc.

An effective cloud can be build through various cloud service providers through the network, which solves the basic problems where as to add new features these service portals can be enhanced. It can provide public or private cloud but patient's control can't be implemented from any type of them. It needs a hybrid of two.

The main hub is data centre that stores the whole data related to patient queries and their control. An effective expert system with implementation of data mining algorithms can be build instead of a doctor than handle queries. The main role of cloud is to provide virtual resources both in means of hardware i.e. servers and software i.e. various new techniques with their implementation from all over the world. To store the huge amount of data and handle patient's control this cloud infrastructure function very effectively. Patients can take advices and suggestions by posting queries to data

miners which perform significant analysis on huge amount of data which has been scattered all over the world through virtualization.

So, a cloud infrastructure is very essential part of MMCPHIR model. The key to the cloud is virtualization. Rather than depending on physical resources, a scalable system of multiple independent virtual computing devices can be made and used. This is also cost effective and speedy as it can utilize the power of idle systems for computing. The automation also reduces human errors and virtualization provides resources on demand basis.

(b)Role of IOT: IOT can provide various types of sensors which can collect human body medical information. This information can be stored in cloud infrastructure which can be extracted via data encryption, analysed and processed by expert systems. Today, the most common cardiovascular disease is hypertension. More than 160 million people is suffering from it and day by day incidents are increasing [9]. It is all due to accelerated pace of life. Early detection and prevention can help a lot. Cloud platform can provide remote monitoring which can further provide services for managing these diseases. Other diseases which can be included are stroke, heart disease, kidney disease, chronic lung disease, heart palpitations, chest tightness, disorders of consciousness, etc. the platform is not only able to manage and monitor the medical health information but behavioural state is also analysed.

- For early detection, user post queries when their body seems to be abnormal, which in response are informed to take particular treatment?
- But in emergency or hazardous state, it can inform the emergent agencies to improve the medical aids.
- National health records are also established to detect regional disease by comparing and analyzing health care information.

3. REMOTE MONITORING HEALTHCARE ARCHITECTURE

The architecture comprises of two parts, one is physical components and another is software and logical modules.

Architecture from physical point of view: It comprises of body sensors, sensor network, home gateway, cloud servers, medical staff, and users and so on. All these physical parts can be categorized as sensors and WSN, cloud computing centre or users as shown in fig 1

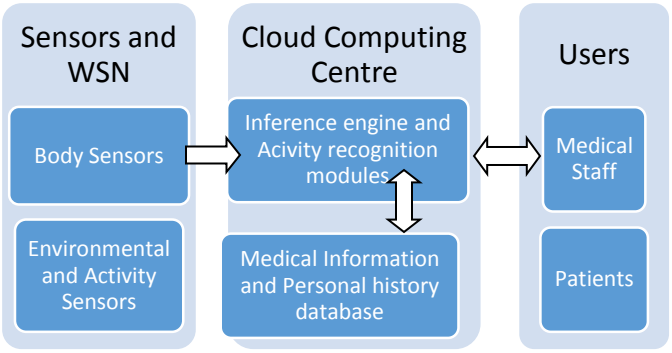

Fig 1 Physical architecture of MMCPHIR

Body sensors can register as well as delete medical body area network. Furthermore, they can be wearable or implant sensor but wearable sensor is easy to use but it has restricted applications. Sensors must be portable, consume low power, mobile, small and minimally invasive to human body. Sensors can be used for measuring blood pressure, body temperature and position and so on.

The main processing engine is the cloud computing centre which is an application of IOT. Body sensor transmits medical information to cloud via communication centre which is passed to data storage and processing centre. Inference engine process the queries of patients with the help of database and communication centre.

Sensors provide medical information which is increasing rapidly both in terms of variety and volume. This information should be available to different medical aid centres in proper form via network resource sharing means and information extraction module.

Architecture from Logical point of View: The physical components are worked via logical modules. Actually, it is logical architecture which can drive and use physical components better. First of all, the input is provided by sensors. These sensors actually monitor the patients. The body sensors are already discussed in above section. One can also use sensors on wall which store the information regarding patient activities and provide that information in terms of images and videos which is non-biased. User's flexibility can be improved by using activity-based access control mechanisms.

First of all, modules are needed which can properly pass the sensor information to communication centre. All sensors form a wireless sensor network (WSN) whose functionality is quite different from traditional ad hoc network (TAN) as shown in table 1.So, modules of ad hoc networks cannot be directly used for WSN. Due to criticality of IOT applications, real time support systems are required for many communication and computation tasks. Hierarchical communication technique with reconfigurable mapping and pipeline methodology can

be adopted to efficiently improve the monitoring of patients. Modules for routing and medium access scheduling are also required.

Logical view can be represented as layered architecture as shown in fig 2. The main operating layer is cloud computing layer which provide services to client as well as server layer. Client layer are provided services like social network of doctors for monitoring their health, environmental sensors and different types of platforms to interact with systems.

Characteristic	WSN	TAN
Scale	Large	Small to large
Density	Higher	Medium
Limited power supply	Mandatory	Not mandatory
Lifetime	Long	Ad hoc
Real time support	Mandatory	Not mandatory
Environment interactions	Tighter	Medium

Table 1 Comparison of WSN & TAN

Cloud also provides resources to server layer so that it can perform real time tasks. It also provides the software and algorithms required for its intended purposes. Moreover, security means are also provided by this layer to the whole model.

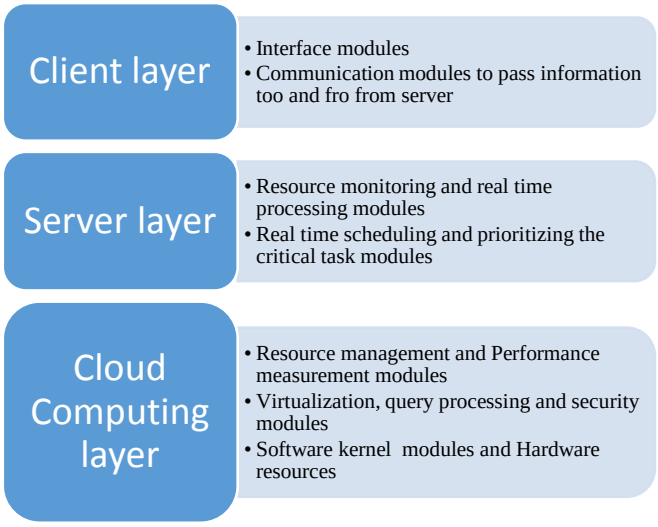

Fig 2 Logical architecture of MMCPHIR

4. CHALLENGES FOR MMCPHIR

For researchers it is a big challenge to design and implement real time scheduling and processing algorithms which can be implemented via cloud computing on remote sites. First of all, communication modules should be so much efficient to pass data to these algorithms from remote sites. Second issue is related with scalability for cloud services. This model is always evolving as new sensors for new diseases can be added on at any time. So, new information and facts are needed to be added and processed in database.

5. CONCLUSION

This paper shows that model can be easily implemented by using body and environmental sensors, cloud computing, IOT and effective expert systems. But WSN is quite different from traditional ad hoc network so it needs new modules to implement. It also shows how virtualization enhanced the healthcare information systems. But, real time scheduling and processing by taking data from remote site is a big challenge yet.

REFERENCES

[1] Howarth LC, Cronin C, and Slawek AT, "From personal information system to collective information system: Realities and mirages of information sharing at the firm", 30th Annual Conference of the Canadian-Association-for-Information-Science, TORONTO, CANADA, 2002.
[2] Wang Jian, Zhao Yan, and LeJiajin, "A New Privacy Preserving Approach used in Cloud Computing", International Conference on Advanced Measurement and Test (AMT 2010), Sanya, CHINA, 2010.
[3] Zseby T, Savola R, and Pistore M, "On Using Home Networks and Cloud Computing for a Future Internet of Things", 2nd Future Internet Symposium (FIS 2009), Berlin, GERMANY, 2009.
[4] Mejia J. D. , Salgado N. , and Orrego C. E., "Effect of blends of Diesel and Palm-Castor biodiesels on viscosity, cloud point and flash point", INDUSTRIAL CROPS AND PRODUCTS, vol.43,no.1, pp.791-797, 2013.
[5] Castellani Angelo P. , Dissegna Moreno, and Bui Nicola, "WebIoT: A Web Application Framework for the Internet of Things", IEEE Wireless Communications and NetworkingConference (WCNC), Paris, FRANCE, 2012.
[6] Liekenbrock Dirk, "Scientific Workshop 4: The Internet of Things State-of-the-Art and Perspectives for Future Research", 2nd European Conference on Ambient Intelligence, Nuremberg, GERMANY, 2009.
[7] Kostas Psannis, Marios Hadjinicolaou, and Anargyros Krikelis, "MPEG-2 Streaming Of Full Interactive Content", IEEE Transactions on Circuits and Systems for Video Technology, vol.16, no. 2, pp.280-285, 2006.
[8] Chang Kai-Di et. al., "Internet of Things and Cloud Computing for Future Internet", 2nd International Conference on the Emerging Areas of Security-Enriched Urban Computing and Smart Grids, Hualien, TAIWAN, 2011.
[9] Baraona Fernando Gurvitz Michelle, and LandzbergMichael J, "Hospitalizations and mortality in the United States for adults with down syndrome and congenital heart disease", The American Journal of cardiology, vol.111, no. 7, pp.1046-1051, 2013.