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Cloud-based cyber–physical localization Framework for healthcare monitoring system

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***Abstract*- The prospects of cloud-based cyber–physical systems (CCPSs) has drawn a great deal of interest from academia and industry. CCPSs facilitate the continuous integration of devices in the physical world with cyberspace. This enables a range of emerging applications or systems such as patient or health monitoring, which require patient locations to be tracked. CCPSs for patient monitoring by using smart phones to obtain voice and electroencephalogram signals in a real-time and efficient manner.**

Keywords: CCPSs, Cyberspace , Electroencephalogram, Patient.

I. INTRODUCTION

The revolutionary development on Mobile Internet, cloud computing ,sensor technology has become mobile health a prominent topic in academia and medical. Cloud computing is an emerging technology which provides a way to share resources, data and applications. There are usually three types of service which are offered by service providers which includes

- Software as a Service(SaaS)
- Infrastructure as a Service(IaaS)
- Platform as a Service(PaaS)

There are three main cloud architectures developed over time

- Private Cloud

In this model, the cloud provider provides cloud infrastructure to a single organization that handles many consumers. This infrastructure is to be used exclusively for their use and need. This private cloud could be on premises or off premises.

- Public Cloud

This model provides open access for the public;.In this model, a public cloud can be provisioned for public to use it to satisfy their needs.

- Hybrid Cloud

This model comprises private, community, or public. The cloud infrastructure can be combination of those models. Data center within an organization, private cloud, and public cloud can be integrated in order to get services and data from both.

Organizations now are trying to avoid focusing on IT infrastructure. They need to focus on their business process to increase profitability. Therefore, the importance of cloud computing is increasing, becoming a huge market and receiving much attention from the academic and industrial communities.

The smart phones are used in many aspects of our life, shopping on the Internet, and creating and distributing many types of files. But these devices have many limitations including: short battery life time and limited storage and processing. Mobile Cloud Computing technology can help to overcome these limitations. Offloading technique reduces the power consumption and saves the mobile storage by executing the huge tasks at the cloud. The mobile devices are connecting to cloud service providers using 3G or LTE technologies, which introduces some challenges including, limited bandwidth, cost, and latency.

An emerging computing paradigm, CCPSs combine computation and communication capabilities with the physical space . With the increasing popularity of smart mobile devices, networks and localization technologies, CCPSs provide countless opportunities for healthcare monitoring systems. The inherent potential of smartphones integrated with CCPSs will enable patient locations to be determined during monitoring. This is because of the promising capability of smartphones in terms of computational resources, sensory capabilities (e.g., cameras, GPS chips, speakers, and microphones), and localization mechanisms. [1].

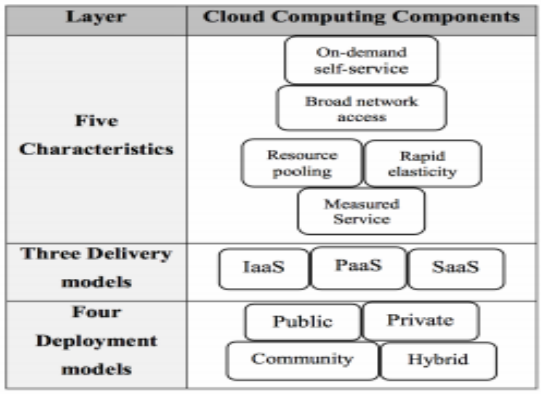

Fig 1:Cloud Computing Architecture

We make use of cyber–physical cloud computing (CPCC)technologies to improve stability, reliability, and scalability with regard to accurate localization for quality patient care. The signal is acquired through the mobile phone. Once the signal has been acquired, the framework sends the signal together with the current location in the form of a GPS reading or WLAN RSSI. GPS positioning can be used for outdoor monitoring, and RSSI can be used for indoor monitoring.

An example scenario is depicted where participating cyber–physical users (e.g., patients, doctors, and others)access a CCPLS at anytime from anywhere via the Internet using their smartphones.

CCPLS continuously manages a number of resources such as sensors, actuators, computation, and cloud storage services. In this scenario, a patient suffering a heart attack would require continuous monitoring by the proposed cloud-assisted CPLS. Once the system detects an deformity ,it examines all the sensed data through mobile CPS using the localization and actuator services of the user's smartphone.

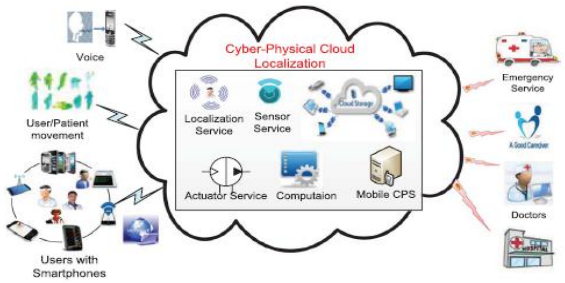

Fig 2:Application scenario of CCPLS for patient monitoring

II. RELATED WORKS

Mobile Cloud Computing technology can help to overcome limitations like short battery life time and limited storage and processing. Cloudlet concept were the mobile devices users can connect directly to cloud resources using cheaper technologies such as Wi-Fi. Once needed, and only if the service is not available in the cloudlet, the user will be connected to the enterprise cloud cloudlet-based model can be used in many applications where security and efficiency is required. It can be used for health applications to save and analyze patients medical records.[2].

An extensive exchange of information takes place among primary and secondary healthcare providers. Without any loss of generality, we distinguish two communication flows: from primary healthcare providers to secondary healthcare providers, and from secondary healthcare providers to primary healthcare providers. In the first communication flow, secondary healthcare providers retrieve patient data to provide the appropriate follow-up examination (such as specialist medical services and examinations). In the second communication flow, primary healthcare providers are notified whenever new information (such as medical records) relating to a given patient is available, thus facilitating a smooth handover.[3].

A cyber-physical system for patient-centric healthcare applications and services ,called Health-CPS, built on cloud and big data analytics technologies. This system consists of a data collection layer with a unified standard, a data management layer for distributed storage and parallel computing, and a data-oriented service layer. a smart health system assisted by

cloud and big data, which includes 1) a unified data collection layer for the integration of public medical resources and personal health devices2) a cloud-enabled and data-driven platform for multisource heterogeneous healthcare data storage and analysis, and 3) a unified API for developers and a unified interface for users. [4].

Cloud computing based remote healthcare service system mainly consists of three parts: Portable medical devices, intelligent terminals (phones, tablets, etc.), cloud services platform. Portable medical acquisition devices transmit physiological signal to the intelligent terminal via wireless way(Bluetooth/WiFi). Monitoring software in smart terminal responses for data display, storage, and push the measurement results to the cloud service platform. Users can view and maintain their health data record anytime and anywhere only need an Internet equipment. Physicians can view their patient's health status through the same way. If necessary, the doctor can also push the diagnosis to patients and their families' smart phone, so related people can get the diagnosis result at the first time. On the smart terminal, a virtual instrument browser is proposed which can dynamically load virtual instrument page programs and can turn them into executable virtual instrument applications[5].

Although many cloud-based RFID authentication protocols have been proposed, some of them only improve the function and performance without considering security and privacy, and most of them are heavyweight. It is not appropriate in the field of healthcare, because improving the trustworthiness of anonymous virtual computing services should be the primary consideration. So lightweight privacy protection authentication scheme which can be applied int he cloud environment, in the scheme, service providers could be anonymous or unknown to the application consumer. Assuming many hospitals build a cloud platform together, the information of patient and his physician will be stored anonymously in the cloud. Patient can go to a doctor in any one hospital with a unique RFID tag. Reader may be fixed or mobile; Readers read tags and upload collected data to the cloud for further processing in real time.[6].

III. METHODOLOGY

The conceptual architecture of CCPLS is shown in Fig. 3,where the patient is being monitored through sensors and actuators embedded in a smartphone. The sensed data are transferred ,along with location information, from the physical space to thecyberspace or a cloud server (public or private).

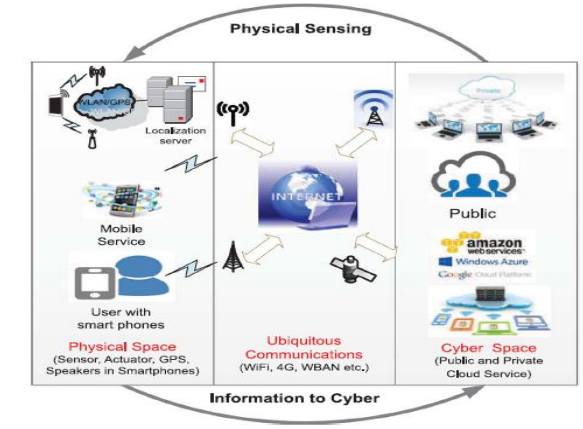

Fig 3:Conceptual architecture for CCPLS for patient monitoring.

The user's smartphone acts as a bridge to communicate with both the world (cyberspace and physical space) via a range of communication technologies (e.g., UWB, RSSI on WLAN,LBS, GPS, Bluetooth, cellular networks, Wi-Fi, and RFID),which are regarded as localization technologies. Smartphone embedded sensors in the physical space are used to capture and collect the patient's vital signs using mobile and localization services, and this information is sent to the cloud server for further computation.
The CCPS framework with localization functions are as follows

After completion of the registration and authentication procedure through an authentication management service, the patient receives the resources via the cloud. After detecting the patient's location and position through the sensing service, location and context information are checked periodically and recorded in the context and DSS server of the cloud for further classification, extraction, and analysis.

In the CCPLS framework, voice signals (or EEGsignals from patients with voice disorders) are recorded through a smartphone. Therefore, the smartphone is used to capture data .Patient tracking

can be conducted both outdoors and indoors. The outdoor environment includes the patient's home, remote rehabilitation center, ambulance, or vehicle carrying the patient. The indoor environment is the same hospital or clinic in which both the patient and the physician are located.

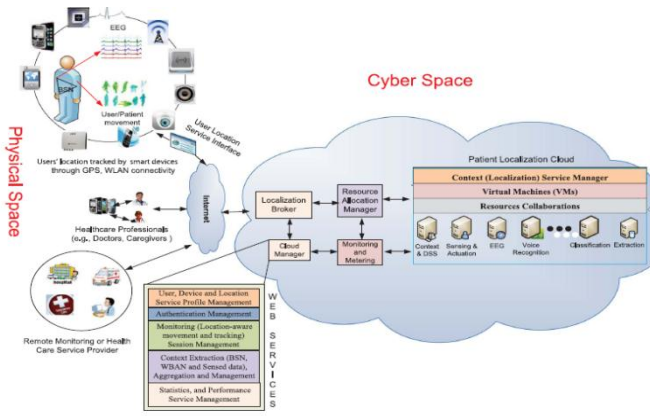

Fig 4: CCPLS architecture with service components

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IV. CHALLENGES

Data security continues to be one of the top concerns for cloud computing, an issue that's been intensified by recent high-profile attacks in healthcare. The encryption solution has to be quick and easy to provision and provides high levels of protection without sacrificing network performance. Cryptography algorithms (homomorphic encryption and RSA) are used for providing security to information based on OpenStack platform[7].

V. CONCLUSION

Healthcare information technology may be slow in changing and transformation , but by using cloud computing technology is in the process of growing and moving ahead continuously.The design and development of cloud based healthcare systems requires access to substantial sensor and user contextual data that are stored in cyberspace. Ensuring reliable and real-time access to such data is sometimes hindered by the high latencies of wide-area networks underlying the CCPLS infrastructure.

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