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An Automated Health Care Computing Model for Continuous Monitoring of Patients for Immediate Medical Care during Emergency

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Abstract— **This paper presents the m-Healthcare system which is envisioned as an important application of pervasive computing to improve health care quality and to save lives. Implantable body sensor nodes and smartphones are utilized to provide remote healthcare monitoring to people who have chronic medical conditions such as diabetes and heart disease. Medical users receive the high-quality healthcare monitoring from medical professionals anytime and anywhere. User's Personal Health information (PHI) such as heart beat, blood sugar level, blood pressure and temperature and others can be first collected by BSN.**

Index Terms—**m-Healthcare system, Implantable body sensor nodes, Smart phone and User's Personal Health information (PHI)**

I. INTRODUCTION

Pervasive computing is a concept in software engineering and computer science where computing is made to appear everywhere and anywhere. It is also called as ubiquitous computing. In contrast to desktop computing, ubiquitous computing can occur using any device, in any location, and in any format. A user interacts with the computer, which can exist in many different forms, including laptop computers, tablets and terminals in everyday objects such as a fridge or a pair of glasses. The underlying technologies to support ubiquitous computing include Internet, advanced middleware, operating system, mobile code, sensors, microprocessors, new I/O and user interfaces, networks, mobile protocols, location and positioning and new materials. Ubiquitous computing touches on a wide range of research topics, including distributed computing, mobile computing, location computing, mobile networking, context-aware computing, sensor networks, human-computer interaction and artificial intelligence.

II. GOALS

To deliver health care services to meet the health needs of target populations. To provide increasing access and decreasing unnecessary variations in proper care. To keep the blood pressure levels in check. To preserve the information of each medical user. To save human lives.

III. OVERVIEW

In our aging society, m-Healthcare system has been envisioned as an important application of pervasive computing to improve health care quality and to save lives, where miniaturized wearable and implantable body sensor nodes and smartphones are utilized to provide remote healthcare monitoring to people who have chronic medical conditions such as diabetes and heart disease. Specifically, in an m- Healthcare system, medical users are no longer needed to be monitored within home or hospital environments. Instead, after being equipped with smartphone and wireless body sensor network formed by body sensor nodes, medical users can walk outside and receive the high-quality healthcare monitoring from medical professionals anytime and anywhere [11].

Each mobile medical user's Personal Health information (PHI) such as heart beat, blood sugar level, blood pressure and temperature and others, can be first collected by BSN, and then aggregated by smartphone jvia Bluetooth. Finally, they are further transmitted to the remote healthcare center via 3G networks. Based on these collected PHI data, medical professionals at healthcare center can continuously monitor medical users' health conditions and as well quickly react to users' life-threatening situations and save their lives by dispatching ambulance and medical personnel to an emergency location in a timely fashion. Although m-Healthcare system can benefit medical users by providing high-quality pervasive healthcare monitoring, the m-Healthcare system still hinges upon how we fully understand and manage the challenges facing in m-Healthcare system, especially during a medical emergency. To clearly illustrate the challenges in m-Healthcare emergency, consider the following scenario [13].

In general, a medical user's PHI should be reported to the healthcare center every 5 minutes for normal remote monitoring. However, when he has an emergency medical condition, for example, heart attack, his BSN becomes busy reading a variety of medical measures, such as heart rate, blood pressure, and as a result, a large amount of PHI data will be generated in a very short period of time, and they further should be reported every 10 seconds for high-intensive monitoring before ambulance and medical personnel's arrival. However, since smartphone is not only used for healthcare monitoring, but also for other applications, the smartphones energy could be insufficient when an emergency takes place. Although this kind of unexpected event may happen with very low probability, i.e., 0.005, for a medical emergency, when we take into more emergency cases into consideration, the average event number will reach 50, which is not negligible and explicitly indicates the reliability of m-Healthcare system is still challenging in emergency [16][17].

Recently, opportunistic computing, as a new pervasive computing paradigm, has received much attention. Essentially, opportunistic computing is characterized by exploiting all available computing resources in an opportunistic environment to provide a platform for the distributed execution of a computing-intensive task.

For example, once the execution of a task exceeds the energy and computing power available on a single node, no other opportunistically contacted nodes can contribute to the execution of the original task by running a subset of task, so that the original task can be reliably performed. Obviously, opportunistic computing paradigm can be applied in m-Healthcare emergency to resolve the challenging reliability issue in PHI process. However, PHI is personal information and very sensitive to medical users, once the raw PHI data are processed in opportunistic computing, the privacy of PHI would be disclosed. Therefore, how to balance the high reliability of PHI process while minimizing the PHI privacy disclosure during the opportunistic computing becomes a challenging issue in m-Healthcare emergency [18][22].

IV.EXISTING WORK

In the existing system, with the pervasiveness of smart phones and the advance of wireless body sensor networks, m-Healthcare, extends the operation of Healthcare systems into a pervasive environment for better health monitoring, has attracted considerable interest recently. However, the flourishing of m-Healthcare still faces many challenges including information security and privacy preservation. Existing system has only two layers namely conceptual layer and the data and communication layers. The conceptual layer deals with data representation and includes the ontology for interpreting the data transferred for the communication of end sources of the architecture. The data and communication layer deals with data management and transmission. Additional tests should be conducted to test the efficiency and effectiveness of the system for monitoring a patient in a real scenario and it takes more time to measure the interaction of the patient-doctor. Since it is a home based monitoring system, the truthfulness of the system cannot be trusted.

Limitations of the Existing System

The limitations of existing system are listed below

i) The m-Healthcare still faces many challenges including information security and privacy preservation.

ii) The Smartphone has various applications running, so its energy could be insufficient when an emergency takes place.

V. PROPOSED WORK

Considering the limitations of the existing system mentioned above, need was felt for proposing a pervasive health care system to provide immediate healthcare for the patients under emergency situation. a new secure and privacy-preserving opportunistic computing framework, called SPOC, is proposed to address this challenge. With the proposed SPOC framework, each medical user in emergency can achieve the user-centric privacy access control to allow only those qualified helpers to participate in the opportunistic computing to balance the high-reliability of PHI process and minimizing PHI privacy disclosure in m-Healthcare emergency. Here an efficient user-centric privacy access control in SPOC framework, which is based on an attribute-based access control is proposed with a new privacy-preserving scalar product computation (PPSPC) technique. It allows a medical user to decide who can participate in the opportunistic computing to assist in processing his overwhelming PHI data. It helps in the analysis, monitoring, planning and execution of Patients health data and report. It helps us to identify the patient's location using the latitude and longitudinal value. Data is sent in high bandwidth so the details reach in time to the end user.

System Architecture Design

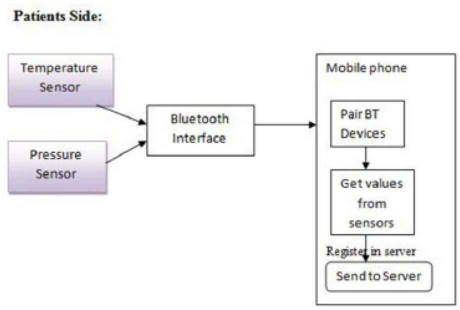

Fig. 1 Patient's Side Architecture Diagram

The architectural diagram clearly explains the m-health care features and functionalities. The architecture diagram has two phases they are i. Patient's side ii. Server side. In the patient's side the Temperature sensor and Pressure sensor are examined, which is connected to the Bluetooth interface and then to the mobile phone. The mobile phone is paired with the Bluetooth to get the values from the sensor and to register the values in the server [20].

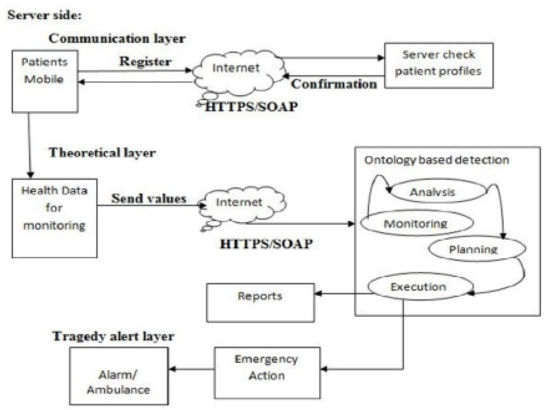

Fig.2 Server Side Architecture Diagram

In the server side architecture there are three layers they are Communication layer, Theoretical layer, Tragedy alert layer. In the Communication layer the mobile phone is registered in Internet using HTTPS/SOAP. It is done to confirm the patient and to check the patient's profile. In the theoretical layer patient's health data is monitored by Ontology based detection. In this detection there are four phases they are Analysis, Monitoring, Planning, Execution and Report generation. In the Tragedy alert layer Emergency action is taken like Alarm and Ambulance service. The main architecture says in detail about the work of the medical user. Here, BSN sensors play a major role in sensing the temperature and body pressure and it links it to the next phase. In the next phase the information is sent through the smartphone to the database. From the database it is then sent to the Health care center through GSM network or through internet as shown in the figure [19][21].

Advantages of the Proposed System

The advantages of the proposed system are

i) SPOC framework allows a medical user to decide who can participate in the opportunistic computing to assist in processing his overwhelming PHI data.

ii) The user-centric privacy access control to allow only those qualified helpers to participate in the opportunistic computing to balance the high-reliability of PHI.

iii) The attributed-based access control can help a medical user in emergency to identify other medical users.

iv) Information of each medical user is preserved.

v) Immediate care is provided to the patients who are under health care monitoring.

Applications of the Proposed System

There are many applications of the proposed system, some of them are listed below

i) It delivers health care services to meet the health needs of target populations.

ii) It provides increasing access, decreasing unnecessary variations in care.

iii) Leads to better patient and public health outcomes, locally, nationally and internationally.

iv) It helps to keep the blood pressure levels in check.

v) It is easy to handle so it can be used by all people irrespective of the age.

VI. IMPLEMENTATION

The different modules of the proposed system are listed below

a) Medical Users Module

b) Body Sensor Network Module

c) Smartphone Communication Module

d) Healthcare Center Module

e) Ontology Based Detection Module

f) GSM/GPRS/3G Module g) Microprocessor Module

h) Graphic LCD Module

a) Medical Users Module

Normally the medical user PHI is mainly invented for monitoring the patients without direct interaction with doctors. In an m-Healthcare system, medical users are no longer needed to be monitored within home or hospital environments. Instead, after being equipped with smart-phone and wireless BSN)formed by body sensor nodes, medical users can walk outside and receive the high-quality healthcare monitoring from medical professionals anytime and anywhere.

b) Body Sensor Network Module

This sensor will be equipped directly in the medical user. This BSN will transmit the user details for every time period that is indicated in this system. For example, each mobile medical user's personal health information (PHI) such as heart beat, blood sugar level, blood pressure and temperature and other details will be captured by the medical users Smartphone.

c) Smartphone Communication Module

For each data transmitted from BSN will be aggregated by the Smartphone that, the medical users having with them using Bluetooth communication. This received medical information or symptom will be transmitted to healthcare center periodically with the help of 3G network.

d) Healthcare Center Module

In health center a secure and privacy-preserving opportunistic computing framework for m-Healthcare emergency is framed. With SPOC, the resources available on other opportunistically contacted medical users' smart-phones can be gathered together to deal with the computing-intensive PHI process in emergency situation. The 3G network receives the network and it sends it to the Health care center. Based on the information the user is given a alert.

e) Ontology Based Detection Module

Ontology learning (ontology extraction, ontology generation, or ontology acquisition) is the automatic or semi-automatic creation of ontologies, including extracting the corresponding domain's terms and the relationships between those concepts from a corpus of natural language text, and encoding them with an ontology language for easy retrieval. As building ontologies manually is extremely labor-intensive and time consuming, there is great motivation to automate the process. Typically, the process starts by extracting terms and concepts or noun phrases from plain text using linguistic processors such as part-of-speech tagging and phrase chunking. Then statistical or symbolic techniques are used to extract relation signatures, often based on pattern-based or definition-based hypernym extraction techniques.

f) GSM/GPRS/3G Module

The wireless modules MC45 and MC46 provide state of the art data transmission technologies, primarily to the consumer segment. The MC45 is the dedicated version for the markets in Europe and Asia, the MC46 is particularly suitable for the North American Market. The new PBCCH signal channel improves transmission capacities in GPRS networks. This means that the resources of wireless network providers can be optimally utilized in data transmission. Consequently, applications that require large data packets to be sent will profit from this in particular, including applications in the areas of mobile phones, mobile computing, mobile telecommunications and security.

g) Microprocessor Module

A microprocessor incorporates the functions of a computer's central processing unit (CPU) on a single integrated circuit(IC), or at most a few integrated circuits. All modern CPUs are microprocessors making the micro- prefix redundant. The microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output. It is an example of sequential digital logic, as it has internal memory. Microprocessors operate on numbers and symbols represented in the binary numeral system.

The integration of a whole CPU onto a single chip or on a few chips greatly reduced the cost of processing power. The integrated circuit processor was produced in large numbers by highly automated processes, so unit cost was low. Single-chip processors increase reliability as there are many fewer electrical connections to fail. As microprocessor designs get faster, the cost of manufacturing a chip (with smaller components built on a semiconductor chip the same size) generally stays the same.

Graphic LCD module

The graphics display resolution describes the width and height dimensions of a display, such as a computer monitor, in pixels. Certain combinations of width and height are standardized and typically given a name and an initialize that is descriptive of its dimensions. A higher display resolution in a display of the same size means that displayed content appears sharper

VII. EXPERIMENTAL RESULTS

The proposed system allows the user to enter the details into the website or any of the android mobile phones where the android application of the proposed system is installed. It provides a secure access to the user data with an update mechanism for the user as well as the owner i.e. doctor. It not only allows the server or the owner of the system to view the patient's details, but it helps to find the patients location using the latitudinal and longitudinal values and to provide emergency care. Moreover, one of the main features of this project is to check the patient's blood pressure and temperature using the sensors and send those details to the server or end system. It allows the database owner to manage and to check the details entered by the patients to provide emergency action.

VIII.CONCLUSION

A new feature is added in the proposed system called the Tragedy alert layer. Based on the ontologies ambulance service is provided to the patients to save their life. One of the features and advantage of the proposed system is that, it can be enhanced to meet the requirements from time to time based on the experience gained while using the system. The proposed automated health care computing model for continuous monitoring of patients immediate medical care during emergency is developed for the patient's betterment. Normally old people and those who are living alone face various health challenges in their life, this health care monitoring system solves those problems faced by the patients. This proposed system automatically senses the temperature and BP of patients and it sends the collected information through android mobile phones, to the nearby hospital for further process. It is cost effective and lifesaving and it creates a better communication between a doctor and a patient. This system has the latitudinal and longitudinal values along with information that is received from the patients mobile; it helps the doctors to find their patients geographical location of the patients.

IX.FUTURE WORK

Mobile health care practice which supported by mobile devices is often hailed as the future of digital services in healthcare. Still the demand for mobile healthcare is not universal. It is therefore not the single critical factor in the future of healthcare digitization.

Of course, there is certainly demand for mobile healthcare applications. The usage of mobile applications in increasing everyday amongst the people. When several applications are running, it is difficult to trigger the execution of the health care system, like the one implemented in this project. Hence, the future work is proposed to provide the highest priority for health care system to give immediate priority for such applications. Since it is related to the life of human beings, every second is considered precious towards the lifesaving activity. Health systems should therefore create mobile solutions that target this audience. For example, apps that focus on prenatal health or those that could be classified as lifestyle apps.

One of the feature and advantage of proposed system is that, its application which is developed in Android platform can be enhanced, so that it can be used in all platforms

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