Pervasive Monitoring of M-Health Care Using Android

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Abstract: *'Pervasive Healthcare Monitoring System (PHMS)'* is one of the important pervasive computing applications aimed at providing healthcare services to all the people through mobile communication devices. Pervasive computing devices are resource constrained devices such as battery power, memory, processing power and bandwidth. In pervasive environment data privacy is a key issue. In this application a secured frame work is developed for receiving the patient's medical data periodically, updates automatically in Patient Record Database and generates a Check up Reminder. Challenge response onetime password mechanism is applied for authentication process. With the pervasiveness of smart phones and the advance of wireless body sensor networks (BSNs), mobile Healthcare (m-Healthcare), which extends the operation of Healthcare provider 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. We propose a pervasive monitoring of m-health care using android for m-Healthcare emergency. With Pervasive Monitoring, Smart Phone Resources Including Computing Power and energy can be opportunistically gathered to process the computing intensive personal health information (PHI) during m-Healthcare emergency with minimal privacy disclosure.

Keywords: BSNS, PHI, Smart phone, PHMS, m-Healthcare

1. Introduction

Pervasive computing is the concept that incorporates computation in our working and living environment in such a way so that the interaction between human and computational devices such as mobile devices or computers becomes extremely natural and the user can get multiple types of data in a totally transparent manner [1]. Handhelds, phones and manifold embedded systems make information access easily available for everyone from anywhere at any time. We termed the integration of mobile computing to pervasive health care as mobile health care. The goal of mobile health care is to provide health care services to anyone at anytime, overcoming the constraints of place, time and character. Mobile health care takes steps to design, develop and evaluate mobile technologies that help citizens participate more closely in their own health care. Obesity, high blood pressure, irregular heartbeat, or diabetes is examples of such common health problems. In these cases, people are usually advised to periodically visit their doctors for routine medical checkups. But if we can provide them with a smarter and more personalized means through which they can get medical feedback, it will save their valuable time, satisfy their desire for personal control over their own health, and lower the cost of long term medical care.
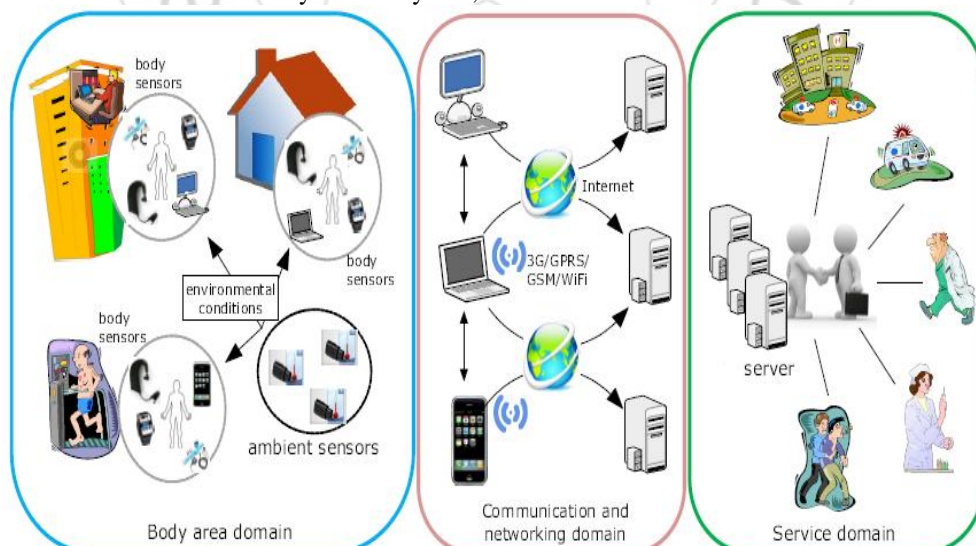

Figure 1: Pervasive Health Monitoring Process [5].

The pervasiveness of smart phones and the advance of wireless body sensor networks (BSNs), mobile Healthcare (m-Healthcare), which extends the operation of Healthcare provider into a pervasive environment for better health monitoring. We propose a secure and privacy-preserving opportunistic computing framework, called Pervasive Monitoring for m-Healthcare. With Pervasive Monitoring, smart phone resources including computing power and energy can be opportunistically gathered to process the computing intensive personal health information (PHI)

during m-Healthcare emergency with minimal privacy disclosure. In specific, to leverage the PHI privacy disclosure and the high reliability of PHI process and transmission in m-Healthcare emergency, we introduce an efficient user-centric privacy access control in Pervasive Monitoring framework.Body sensor network systems can help people by providing healthcare services such as medical monitoring, memory enhancement, medical data access, and communication with the healthcare provider in emergency situations through the SMS or GPRS [1,2]. Continuous health monitoring with wearable [3] or clothing-embedded transducers [4] and implantable body sensor networks [5] will increase detection of emergency conditions in at risk patients. Not only the patient, but also their families will benefit from these. Also, these systems provide useful methods to remotely acquire and monitor the physiological signals without the need of interruption of the patient's normal life, thus improving life quality [6,7].

2. Review of Literature

Enabling secure service discovery in mobile healthcare enterprise networks, a less and ratoninelli, rebeccamontanari, and antoniocorradi

Advances in wireless networks, sensors, and portable devices offer unique chances to deliver novel anytime anywhere medical services and information, thus enabling a wide range of healthcare applications, from mobile telemedicine to remote patient monitoring, from location-based medical services to emergency response. Mobile e-health has great potential to extend enterprise hospital services beyond traditional boundaries, but faces many organizational and technological challenges. In pervasive healthcare environments, characterized by user/service mobility, device heterogeneity, and wide deployment scale, a crucial issue is to discover available healthcare services taking into account the dynamic operational and environmental context of patient-healthcare operator interactions. In particular, novel discovery solutions should support interoperability in healthcare service descriptions and ensure security during the discovery process by making services discoverable by authorized users only. This article proposes a semantic-based secure discovery framework for mobile healthcare enterprise networks that exploits semantic metadata (profiles and policies) to allow flexible and secure service search/retrieval [1].

Mobile Patient Monitoring

The Mobile Health System, Aart Van Halteren, Richard Bults, KatarzynaWac:-The forthcoming wide availability of high bandwidth public wireless networks will give rise to new mobile healthcare services. To this end, the MobiHealth project has developed and trailed a highly customisable vital signs monitoring system based on a body area network (BAN) and a mobile-health (m-health) service platform utilising next generation public wireless networks. The developed system allows the incorporation of diverse medical sensors via wireless connections, and the live transmission of the measured vital signs over public wireless

networks to healthcare providers. Nine trials with different healthcare scenarios and patient groups in four different European countries have been conducted. These have been performed to test the service and the network infrastructure including its suitability for mobile healthcare applications. Preliminarily results have documented the feasibility of using the system, but also demonstrated logistical problems with use of the BANs and the infrastructure for transmitting mobile healthcare data [2].

Opportunistic computing for wireless sensor networks, Marco Avvenuti, Paolo Corsini, Paolo Masci and AlessioVecchio

Wireless sensor networks are moving from academia to real world scenarios. This will involve, in the near future, the design and production of hardware platforms characterized by low-cost and small form factor. As a consequence, the amount of resources available on a single node, i.e. computing power, storage, and energy, will be even more constrained than today. This paper faces the problem of storing and executing an application that exceeds the memory resources available on a single node. The proposed solution is based on the idea of partitioning the application code into a number of opportunistically cooperating modules. Each node contributes to the execution of the original application by running a subset of the application tasks and providing service to the neighbouring nodes. Wireless sensor networks (WSNs) are massively distributed networks that do not require any external infrastructure and are typically used to monitor a physical phenomenon. Sensor network applications can play a key role in many different areas, such as intrusion detection and Surveillance, wildlife monitoring, precision agriculture and building monitoring [3].

Wireless Body Sensor Network Using Medical Implant Band , Mehmet R. Yuce & Steven W. P. Ng &Naung L. Myo&Jamil Y. Khan &Wentai Liu

A wireless body sensor network hardware has been designed and implemented based on MICS (Medical Implant Communication Service) band. The sensor node can transmit data over the air to a remote central control unit (CCU) for further processing, monitoring and storage. The developed system offers medical staff to obtain patient's physiological data on demand basis via the Internet. Some preliminary performance data is presented in the paper. According to a New York Times report, 5% of people admitted to hospitals, or about 1.8 million people per year, in the United States pick up an infection while staying there. Such infections are induced by physicians, hospitals, drugs, and medical procedures. They are directly responsible for the 20,000 deaths among hospital patients in the U.S. each year, and they have effect on an additional 70,000deaths, according to the federal Centres for Disease Control (CDC). The dollar cost of such infections estimated by the CDC is $4.5 billion. In most hospitals, the number of medical staff is not sufficient. With the advancement of wireless technologies, high performance and fault tolerant wireless devices can be employed to eliminate medical errors, to reduce workload, to improve the efficiency of hospital staff as well as to improve the comfort of patients. Thus, over the past decade, there has

been increased interest among researchers in developing wireless recording and monitoring for real-time physiological parameters (e.g. ECG, EEG, EOG, EMG, Neural, Blood Flow, Blood Pressure etc.) from a patient body in medical environments [4].

Xiaohui Liang , Xu Liy, Mrinmoy Barua , Le Chen , Rongxing Lu , Xuemin (Sherman) Shen , and Henry Y. Luoz have introduced a novel Remote Health Monitoring (RHM) system to enable high-quality pervasive healthcare services to users with low delivery delay and reduced costs. They define the RHM architecture and summarize the design considerations. They have presented a promising commercialized solution, ViiCare, with system infrastructures and supporting techniques. They have also discussed regarding future research challenges for implementing RHM systems[5].

Secure Handshake with Symptoms-matching: TheEssential to the Success of mHealthcare Social Network, Rongxing Lu†, Xiaodong Lin‡, Xiaohui Liang†, and Xuemin (Sherman) Shen†- In our aging society, mHealthcare social network (MHSN) built upon wireless body sensor network (WBSN) and mobile communications provides a promising platform for the seniors who have the same symptom to exchange their experiences, give mutual support and inspiration to each other, and help forwarding their health information wirelessly to a related eHealthcenter. However, there exist many challenging security issues in MHSN such as how to securely identify a senior who has the same symptom, how to prevent others who don't have the symptom from knowing someone's symptom? In this paper, to tackle these challenging security issues, we propose a secure same-symptom-based handshake (SSH) scheme, and apply the provable security technique to demonstrate its security in the random oracle model[6].

SAGE: A Strong Privacy-Preserving SchemeAgainst Global Eavesdropping for eHealth Systems, Xiaodong Lin, *Member, IEEE,* **Rongxing Lu, Xuemin (Sherman) Shen,** *Fellow, IEEE,* **Yoshiaki Nemoto,** *Senior Member, IEEE,* **and Nei Kato,** *Senior Member, IEEE***:–**The eHealth system is envisioned as a promising approach to improving health care through information technology, where security and privacy are crucial for its success and large scale deployment. In this paper, we propose a strong privacy preserving Scheme Against Global Eavesdropping, named SAGE, for e-Health systems. The proposed SAGE can achieve not only the content oriented privacy but also the contextual privacy against a strong global adversary. Extensive analysis demonstrates the effectiveness and practicability of the proposed scheme is crucial when dealing with acute diseases, such as heart disease and stroke. By statistics, in the United States alone stroke kills 150,000 people each year. The patients 'lives could be saved if they are transported quickly to a hospital and receive immediate treatment and expeditious care. Over the last twenty years, the miraculous evolution of wireless technology has imposed a major impact on the revolution of human's lifestyle by providing the best ever convenience and flexibility in accessing the Internet services and various types of personal communication applications. Recently, Body Area Networks

(BANs) (or Body Sensor Networks (BSNs)) are emerging and envisioned to be a promising approach for helping improve health care by effectively monitoring patient health and disease progression[7].

Cross-Domain Data Sharing in Distributed Electronic Health Record Systems, Jinyuan Sun, Student Member, IEEE, and Yuguang Fang, Fellow, IEEE:-Cross-organization or cross-domain cooperation takes place from time to time in Electronic Health Record (EHR) systemfor necessary and high-quality patient treatment. Cautious design of delegation mechanism must be in place as a building block of cross-domain cooperation, since the cooperation inevitably involves exchanging and sharing relevant patient data that are considered highly private and confidential. The delegation mechanism grants permission to and restricts access rights of a cooperating partner. Patients are unwilling to accept the EHR system unless their health data are guaranteed proper use and disclosure, which cannot be easily achieved without cross-domain authentication and fine-grained access control. In addition, revocation of the delegated rights should be possible at any time during the cooperation. In this paper, we propose a secure EHR system, based on cryptographic constructions, to enable secure sharing of sensitive patient data during cooperation and preserve patient data privacy. Our HER system further incorporates advanced mechanisms for fine-grained access control, and on-demand revocation, as enhancements to the basic access control offered by the delegation mechanism, and the basic revocation mechanism, respectively. The proposed HER system is demonstrated to fulfill objectives specific to the cross-domain delegation scenario of interest[8].

Data security and privacy in wireless body area networks , mingli and wenjinglou:-The wireless body area network has emerged as a new technology for e-healthcare that allows the data of a patient's vital body parameters and movements to be collected by small wearable or Implantable sensors and communicated using short-range wireless communication techniques. The security and privacy protection of the data collected from a WBAN, either while stored inside the WBAN or during their transmission outside of the WBAN, is a major unsolved concern, with challenges coming from stringent resource constraints of WBAN devices, and the high demand for both security/privacy and practicality/usability. In this article we look into two important data security issues: secure and dependable distributed data storage, and fine-grained distributed data access control for sensitive and private patient medical data. Relevant solutions with the rapid development in wearable medical sensors and wireless communication, wireless body area networks (WBANs) have emerged as a promising technique that will revolutionize the way of seeking healthcare [1–3], which is often termed *e-healthcare*. Instead of being measured face-to-face, with WBANs patients' health-related parameters can be monitored remotely, continuously, and in real time, and then processed and transferred to medical databases. This medical information is shared among and accessed by various users such as healthcare staff, researchers, government agencies, and insurance companies[9].

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Performance Evaluation of Service Execution inOpportunistic Computing, Andrea Passarella, Marco Conti,Elonora Borgia, Mohan Kumar:-Opportunistic computing has emerged as a new paradigm incomputing, leveraging the advances in pervasive computing and opportunistic networking. Nodes in an opportunistinetwork avail of each others' connectivity and mobility to overcome network partitions. In opportunistic computing, cthis concept is generalised, as nodes avail of any resource available in the environment[10].

An Overview of Android Operating System and Its Security Features, Rajinder Singh

Department of Computer Science and Applications DCSA Punjab:-Android operating system is one of the most widely used mobile Operating System these days. Android mobile operating system is based on the Linux kernel and is developed by Google. Android operating system is primarily designed for smartphones and tablets. Since Android is an open source it has become the fastest growing mobile operating system. Due to its open nature it has become favorite for many consumers and developers. Moreover software developers can easily modify and add enhanced feature in it to meet the latest requirements of the mobile technology. Android users download more than 1.5 billion applications and games from Google Play each month. Due to Its Powerful development framework users as well software developers are able to create their own applications for wide range of devices. Some of the key features of Android operating system are: Application Frame work, Dalvik virtual machine, Integrated browser, Optimized Graphics, SQLite, Media Support, GSM Technology, Bluetooth, Edge, 3G, Wi-Fi, Camera and GPS etc. To help the developers for better software development Android provides Android Software development kit (SDK). It provides Java programming Language for application development. The Android software development kit includes a debugger, libraries, a handset emulator based on QEMU (Quick Emulator), documentation, sample code, and tutorials.

3. Existing System

The agents for variation detection in a health parameters are placed in every sensor node of the base network. These agents detect any anomaly in the body by using local audit traces and also communicate with agents of neighboring nodes to detect any variation in health parameters. In [9], Most nodes are assumed to be mobile and communication is assumed to be wireless. The mobility of nodes in a network means that the network are highly dynamic. Pervasive computing entered health care in almost every setting, making it difficult to develop an idea of its typical implementation and maintain an overview of recent developments. We address this difficulty by providing a systematic overview and analysis of systems developments and implementations of pervasive computing in health care and highlighting experiences in deployment.The goal of our paper is to monitor the remote patient's health status and provide a secure healthcare system. The biomedical data, collected by wearable sensors will be transmitted using cell phones towards the corresponding Health Monitoring Centers via various wireless networks.

4. Proposed System

In our proposed Pervasive Monitoring framework aims at the security and privacy issues, and develops a user-centric privacy access control of opportunistic computing in m-Healthcare emergency. In this paper, we propose a new secure and privacy preserving opportunistic computing framework, called Pervasive Monitoring, to address this challenge. With the proposed Pervasive Monitoring 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. Specifically, the main contributions of this paper are Firstly, we propose Pervasive Monitoring, a secure and privacy-preserving opportunistic computing framework for m-Healthcare emergency. With pervasive monitoring, 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. Since the PHI will be disclosed during the process in opportunistic computing, to minimize the PHI privacy disclosure, Pervasive Monitoring introduces a user-centric two-phase privacy access control to only allow those medical users who have similar symptoms to participate in opportunistic computing. In this application a secured frame work is developed for receiving the patient's medical data periodically, updates automatically in Patient Record Database and generates a Check up Reminder. In the present work a light weight asymmetric algorithm is used for encrypting the data to ensure data confidentiality for its users.
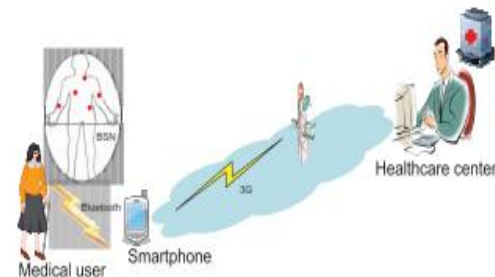

Figure 2: Frame Work of pervasive health monitoring.

In this module, 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 via Bluetooth. Finally, they are further transmitted to the remote healthcare centre via 3G networks. Based on these collected PHI data, medical professionals at healthcare centre 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.

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4.1 Advantages of Proposed System:

1. Shift from a clinic-oriented, centralized healthcare system to a patient oriented, distributed healthcare system
2. Reduce healthcare expenses through more efficient use of clinical resources and earlier detection of medical condition
3. It mainly solves the security issues.

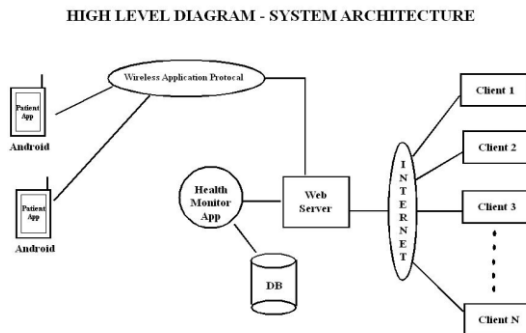## 4.2 Architecture of Pervasive Health Monitoring

Figure 3: System Architecture

The system architecture shows the high level working of the pervasive health monitoring system, as shown in the fig-3 the user initially registers to the android part with the help of cell phone and logs into the pplication through the wireless application protocol, the details of the registered user is updated into the web server at the admin side and all the health parameters of the patients data are stored in database and with the help of internet the details can be accessed by respective clients to provide service to the patients during emergency by sending location details to the ambulance driver, also the details of the ambulance are sent to the patients smart phone so as to get the service at the emergency point of time.

A brief explanation of the main modules follows.

a) **Setup**: Initial signal setup interface checks for the reception of wireless signals, network setup and resolves various difficulties that may arise. Additionally, this module makes sure that the BAN and wireless networks are alive and handshake properly.
b) **Registration**: Patient's information is fed in this module and stored in the server. This module includes a graphical user interface (GUI) that simplifies data entry and retrieval. Additionally, the module keeps track of patient's biosensor data and records all information needed. If any critical situation occurs, the system behaves based on the patient's pre-defined data and requests (e.g. notifying the relatives) and the severity of the situation (e.g. notifying a hospital).
c) **Monitoring & Reasoning**: It keeps track of the patient's health status and depending on his health status, a decision regarding the patient's treatment is made. This is by far the most important module of system as making decisions through logical reasoning using limited number of biosensors (e.g. ECG, bloodpressure /Oxygen / Glucose) is quite challenging. In general, this is done by building adynamic model (historical profile) for each individual and

use learning/reasoning algorithms to evaluate and grade the severity of each and every significant changes. More importantly, this module will be responsible to set off the alarm while achieving almost-zero false positive and false negative.

d) **Value Added Services**: This module provides extra information such as geographical location of patients and close hospitals, availability of doctors in region, weather, etc. Such services may be desirable for certain group of patients with special needs or requests. **Report**: It is responsible for communicating (exchange messages) with the outside components, e.g. producing/ sending an alarm or a report to a health-care provider.

4.3 Physiological Parameters

The physiological parameters that are monitored are Electrocardiogram (ECG), heart rate derived from ECG signals by determining the R-R intervals, blood pressure, body temperature, Galvanic Skin Response (GSR), Oxygen saturation in blood (SaO2), respiratory rate, Electromyogram (EMG), Electroencephalogram (EEG) and three axis movement of the subject measured using an accelerometer. Table 1 illustrates the specifications of the physiological signals being monitored.

Table 1: Specifications of physiological parameter

Physiological Parameter	Specifications
Electrocardiogram (ECG)	Frequency: 0.5Hz – 100 Hz Amplitude: 0.25 – 1mV
Electromyogram (EMG)	Frequency: 10Hz - 3KHz Amplitude: 50μV – 1mV
Electroencephalogram (EEG)	Frequency: 0.5Hz - 100Hz Amplitude: 1μV – 100μV
Blood Pressure (BP)	Systolic: 60 - 200mmHg Diastolic: 50 – 110mmHg
Body Temperature	32°C – 40°C
Galvanic Skin Response (GSR)	0 – 100 KΩ
Respiratory Rate (RR)	2 – 50 breaths/min Frequency 0.1 – 10Hz
Oxygen Saturation in Blood (SaO2)	0-100%
Heart Rate (HR)	40 – 220 Beats per minute

5. Testing Stages of the Project

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that he Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

Types of Tests

Unit Testing: Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Integration Testing: Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfied, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Functional Testing: Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centred on the following items:
- Valid Input: identified classes of valid input must be accepted.
- Invalid Input: identified classes of invalid input must be rejected.
- Functions: identified functions must be exercised.
- Output: identified classes of application outputs must be exercised.
- Systems/Procedures: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing [9]. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

System Testing: System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

White Box Testing: White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

Black Box Testing: Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot "se" into it. The test provides inputs and responds to outputs without considering how the software works.

Unit Testing: Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

Test strategy and approach: Field testing will be performed manually and functional tests will be written in detail.
Test objectives
a) All field entries must work properly.
b) Pages must be activated from the identified link.
c) The entry screen, messages and responses must not be delayed.

Features to be tested
- Verify that the entries are of the correct format.
- No duplicate entries should be allowed.
- All links should take the user to the correct page.

Integration Testing: Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects. The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing: User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that he system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.Results

Test cases for home page

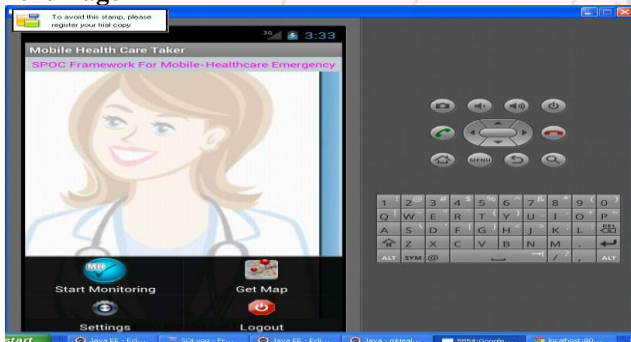| Test Case	Test Input	Test Results	Remarks
Verify login functionality with correct credentials	Navigate to enter URL here. Enter username, Enter password. Click on submit	User navigates to login page, User can enter user name, User can enter password, Menu page opens.	PASS

Home Page

Whenever user clicks on m-health care app the home page is displayed.

Login Page

The user enters the login details such as user name and password.

Menu Page

After authentication the menu page is displayed.

Test cases for start monitor

Test Case	Test Input	Test Result	Remarks
Checking the patient's health condition.	Navigate to start monitor. Click on start to read the parameter readings. Click on stop to know the condition.	Mobile health care taker starts to monitor. The patient's health normal or critical condition is displayed.	PASS

Start Monitor

When the user clicks on start monitor the values of health parameters are displayed so that the patients critical or normal condition is known.

Test cases for patients readings

| Test Case	Test Input	Test result	Remarks
To view the patient's health parameter values.	In the server screen, click on view readings. Select the required patients name & click on go.	In the server screen, it displays all the readings monitored by the android app. Displays the readings of the specified patient at the admin side.	PASS

View Reading

Whenever user clicks on view readings, all the readings of the patients are displayed which is been traced by the start monitor process.
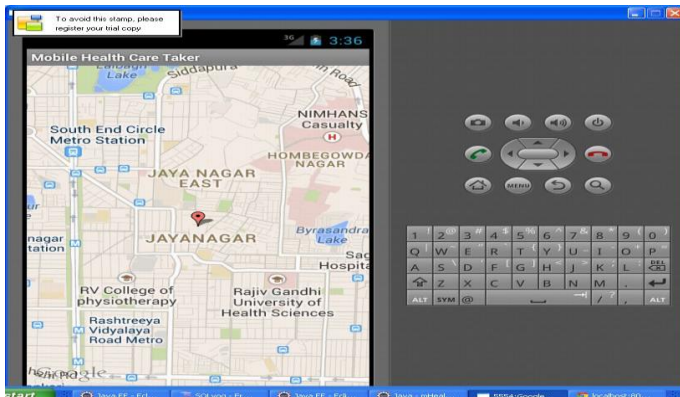
Test cases for map

Test Case	Test Input	Test Result	Remarks
To track the patient's location details.	In the server screen, click on get map.	In the server screen, all the details of the patient's location are displayed at server side.	PASS

Get Map
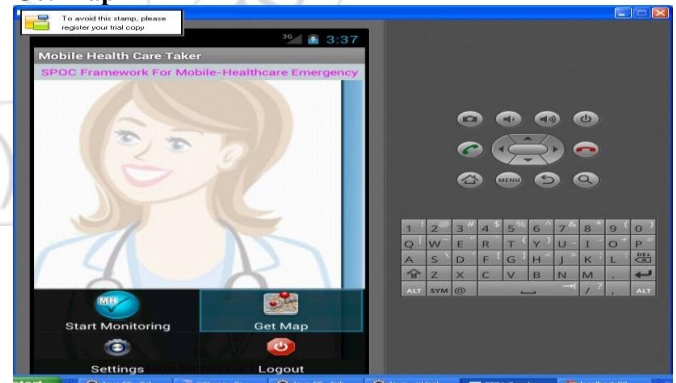
In any variation of patients health parameters, the location of the patient is traced by clicking on get map.

Map Displayed

The patient's exact location is displayed in the map to provide service in emergency.

Test case for ambulance

Test Case ID	Test Input	Expected Result	Remarks
To verify sending message to ambulance driver.	In the server screen, click on view readings. Click on send message. Enter the mobile number and location details. Click on send.	Driver receives the location details and receives the patient.	PASS

Send Message to Ambulance Driver

After tracing the map location, the details of patients location is sent to the ambulance driver.

7. Conclusions and Future Enhancements

The paper concludes that pervasive healthcare will enable a paradigm shift from the established centralized healthcare model to a pervasive, user-centered and preventive overall lifestyle health management. In order to provide these new opportunities everywhere, anytime and to anyone, future research in the fields of pervasive sensing, pervasive prevention and evaluation of pervasive technology is inevitably needed. Pervasive healthcare offers both, healthcare professionals and patients, new opportunities. On one side, medical doctors and other healthcare professionals will benefit from diagnostic and therapeutic opportunities far beyond what is possible with today's occasional examinations. They will have access to long-term recordings of physiological data measured in natural environment including patient's activity and the situations to which he has been exposed to. On the other side, patients are empowered

to take a more active role in their personal health management and prevention. For example, user feedback or even personal coaching might help a patient to adjust his lifestyle to the requirement of his health.

References

[1] A. Toninelli, R. Montanari, and A. Corradi, "Enabling secure service discovery in mobile healthcare enterprise networks," *IEEE WirelessCommunications*, vol. 16, pp. 24–32, 2009.

[2] Y. Ren, R. W. N. Pazzi, and A. Boukerche, "Monitoring patients via a secure and mobile healthcare system," *IEEE Wireless Communications*, vol. 17, pp. 59–65, 2010.

[3] M. Conti and M. Kumar, "Opportunities in opportunistic computing," IEEE Computer, vol. 43, no. 1, pp. 42–50, 2010.

[4] M. R. Yuce, S. W. P. Ng, N. L. Myo, J. Y. Khan, and W. Liu, "Wireless body sensor network using medical implant band," Journal of Medical Systems, vol. 31, no. 6, pp. 467–474, 2007.

[5] Enable Pervasive Healthcare through Continuous Remote Health Monitoring Xiaohui Liang , Xu Liy, Mrinmoy Barua , Le Chen , Rongxing Lu , Xuemin (Sherman) Shen , and Henry Y. Luoz

[6] R. Lu, X. Lin, X. Liang, and X. Shen, "Secure handshake with symptoms-matching: The essential to the success of mhealthcare social network," in *Proc. BodyNets'10*, Corfu Island, Greece, 2010.

[7] SAGE: A Strong Privacy-Preserving SchemeAgainst Global Eavesdropping for eHealth Systems, Xiaodong Lin, *Member, IEEE,* Rongxing Lu, Xuemin (Sherman) Shen, *Fellow, IEEE,* Yoshiaki Nemoto, *Senior Member, IEEE,* and Nei Kato, *Senior Member, IEEE.*

[8] Cross-Domain Data Sharing in Distributed Electronic Health Record Systems, Jinyuan Sun, Student Member, IEEE, and Yuguang Fang, Fellow, IEEE. Thais Webber, César Marcon, Leonardo A. Amaral, Rubem D. R. Fagundes, Letícia B. Poehls, Pervasive Computing Integration on Healthcare Environments

[9] Data security and privacy in wireless body area networks , mingli and wenjinglou. R. Lu, X. Lin, X. Liang, and X. Shen, "A secure handshake scheme with symptoms-matching for mhealthcare social network," *MONET*, vol. 16, no. 6, pp. 683–694, 2011.

[10] Secured privacy preserving opportunistic frame work for Mobile Healthcare Emergency G.Yogeshwaran* and C.Gunaseelan

[11] An Overview of Android Operating System and Its Security Features, Rajinder Singh Department of Computer Science and Applications DCSA Punjab.