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Emergency Patient Health Monitoring System Using IoT Sensors

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Abstract: **The IOT based wireless body sensors 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. WBSN has shown great potential in improving healthcare quality, and thus has found a wide range of applications from ubiquitous health monitoring and computer assisted rehabilitation to emergency medical response systems. Internet of Things (IoT) enable humans to get higher level of automate by developing system using sensors, interconnected devices and Internet. Monitoring of critical Patient health is most important activity small delay in decision related to patient's treatment may cause permanent disability or even death. Most of critical Patient are equipped with IOT sensors to measure health parameters, We are proposing IOT based system which can help to monitor the patient health & transfer patients health related Readings through fast communication and identifying emergency and initiate communication with healthcare staff and also helps to initiate proactive and quick treatment. This health care system reduces possibility of human errors, delay in communication and helps doctor to spare more time in decision with accurate observations.**

Index Terms **– IOT (Internet of Things), BP(Blood Pressure), Critical Patient etc.**

I. Introduction

In our aging society, mobile Healthcare (m-Healthcare) system has been envisioned as an important application of pervasive computing to improve health care quality and save lives, where miniaturized wearable and implantable body sensor nodes and Smartphone's are utilized to provide remote healthcare monitoring to people who have chronic medical conditions such as diabetes and heart disease & Critical patient. 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 (BSN) formed by body sensor nodes, medical users can walk outside and receive the high quality healthcare monitoring from medical professionals anytime and anywhere. For example, 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 center via 3G/4G 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.

II. LITERATURE SURVEY

In 2015, N. Powers et al [1], presented a mobile-cloudlet-cloud architecture to perform real-time face recognition by executing this application in three distinct steps: Face Detection (FD), Projection (PJ) and Searching (S).We observed that, due to their separability, these three steps can be executed in different hardware components: Mobile device (M), Cloudlet (CL), and Cloud (C).

In 2014, A.F. Hani, I. V. Paputungan, M. [2], presented a private cloud storage design and prototype development within an organization to solve such issues. Leveraging on the ability of cloud computing is shown meet to the system requirements. The prototype is implemented on Own Cloud storage framework. The complete functionality of Own Cloud made it an ideal platform to develop and deploy this kind of cloud-based system. Own Cloud can keep images in different file formats and share such images to other.

In 2014, S. X. et al [3] described experimental and theoretical approaches for using ideas in soft micro fluidics, structured adhesive surfaces, and controlled mechanical buckling to achieve ultralow modulus, highly stretchable systems that incorporate assemblies of high-modulus, rigid, state-of-the-art functional elements. The outcome is a thin, conformable device technology that can softly laminate onto the surface of the skin to enable advanced, multifunctional operation for physiological monitoring in a wireless mode.

In 2014, A. Page et al [4], proposed a system that couples health monitoring techniques with analytic methods to permit the extraction of relevant information from patient data without compromising privacy. The proposal is based on the concept of fully homomorphic encryption (FHE). Since the technique is known to be resource-heavy, the papers develop a proof-of-concept to assess its practicality. Results are presented from proposed prototype system, which mimics live QT monitoring and detection of drug induced QT prolongation.

In 2014, A.Benharref and M. A. Serhani [5], proposed a framework to collect patients' data in real time, perform appropriate non-intrusive monitoring, and propose medical and/or life style engagements whenever needed and appropriate. The framework, which relies on Service Oriented Architecture (SOA) and the Cloud, allows a seamless integration of different technologies, applications, and services. It also integrates mobile technologies to smoothly collect and communicate vital data from a patient's wearable Biosensors while considering the mobile devices' limited capabilities and power drainage in addition to intermittent network disconnections. Then data is stored in the Cloud and made available via SOA to allow easy access by physicians, paramedics or any other authorized entity.

In 2014, N. Cao et al [6], defined and solved the challenging problem of privacy-preserving multi-keyword ranked search over encrypted data in cloud computing (MRSE). The proposed papers establish a set of strict privacy requirements for such a secure cloud data utilization system. Among various multi-keyword semantics, the paper choose the efficient similarity measure of "coordinate matching," i.e., as many matches as possible, to capture the relevance of data documents to the search query. In further use "inner product similarity" to quantitatively evaluate such similarity measure. paper first propose a basic idea for the MRSE based on secure inner product computation, and then give two significantly improved MRSE schemes to achieve various stringent privacy requirements in two different threat models.

In 2013, S. Babu et al [7], Proposed Open Geo-Spatial Consortium (OGC) standard based remote health monitoring system that allows integration of sensor and web using standard web based interface. The aim is to provide the data in an open & interoperable manner, and reduce data redundancy. Fixed specification is used for exchange of sensor data globally for all sensor networks. OGC SWE is applicable to different sensor systems including medical sensor networks. A standard format is used to document sensor descriptions and encapsulate data. Sensor data is ported on to cloud which provides scalability, centralized user access, persistent data storage and no infrastructure maintenance cost for heavy volumes of sensitive health data. Decision tree pruning algorithm with high confidence factor is proposed for automatic decision making.

In 2013, C. O. Rolim et al [8], proposed a solution to automate this process by using "sensors" attached to existing medical equipment that are inter-connected to exchange service. The proposal is based on the concepts of utility computing and wireless sensor networks. The information becomes available in the "cloud" from where it can be processed by expert systems and/or distributed to medical staff. The proof-of-concept design applies commodity computing integrated to legacy medical devices, ensuring cost effectiveness and simple integration.

In 2012, D. Kim et al [9], Advances in materials, mechanics, and manufacturing now allow construction of high-quality electronics and optoelectronics in forms that can readily integrate with the soft, curvilinear, and time-dynamic surfaces of the human body. The resulting capabilities create new opportunities for studying disease states, improving surgical procedures, monitoring health/wellness, establishing human-machine interfaces, and performing other functions. Above review summarizes these technologies and illustrates their use in forms integrated with the brain, the heart, and the skin.

III. METHODOLOGY

Existing system

In the Traditional Method the Medical professionals play the major role. They have to visit the patient's ward for necessary diagnosis and advising Treatment. In this approach there are two basic problems associated with it.

Firstly, the Medical professionals must be present on site of the patient all the time and secondly, the patient has to remain admitted in a hospital, bedside biomedical instruments for a period of time.

1. In order to solve these two problems, the patients are given knowledge and information about diseases diagnosis and prevention.

2. Secondly reliable and readily available patient monitoring system (PMS) is required.
3. Privacy & Security of Data is not available in wireless Sensor Technology.

Proposed System

Mobile Healthcare system framework aims at design and development of portable primarily based Healthcare system. We also provide the security and privacy issues, and develop a user-centric privacy access control of opportunistic computing in Mobile Healthcare emergency situation. This project mainly consists of 2 modules i.e. one module will be integrated in patient android mobile, which is associated with many sensors like heartbeat measurement and sugar level management etc. This module frequently activates sensors via android mobile and measures various parameters of individual patient such as blood sugar level, body temperature, heartbeat, blood pressure and sends these details to hospital server, where the second module gets installed. This module receives data and suggests patients accordingly through Trusted

Authority over text or voice call via mobile. And in case of emergency it activates ambulance call to its nearest hospital. Thus, using android platform we increase the hospital service level being provided to patients.

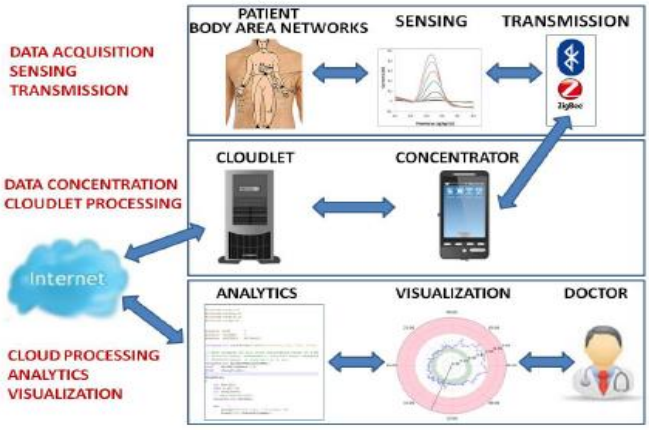
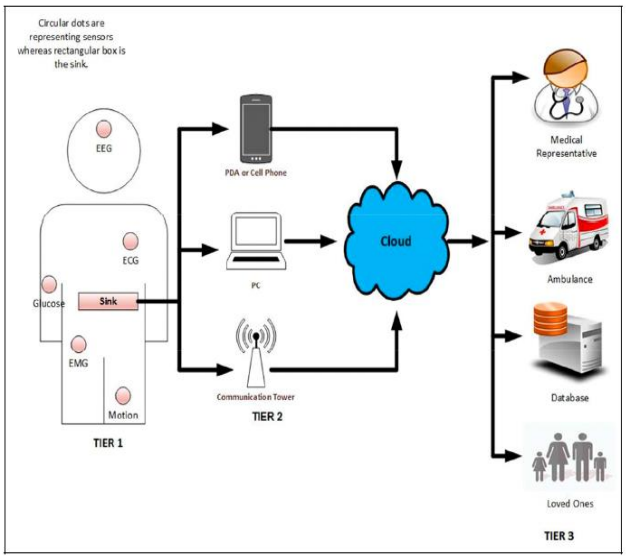


Fig. 1. Components of a remote patient monitoring system that is based on an IoT-Cloud architecture.



WBASN communication architecture.

Fig 2.ARCHITECTURE OF PATIENT HEALTH MONITORING

Architecture diagram for mobile healthcare system gives the flow of communication between patients and the trusted Authority as shown in fig 2.The following are the steps involved:

Patient login: Raw input data is read from the various body sensors networks present in the patient's android
Mobile and converted to fuzzy values. These values are then aggregated via Bluetooth. Body sensor measures
Various parameters like blood pressure, heartbeat, body temperature.

Web Interface: The data collected from the patients mobile are sent to the hospital server via 3G/4G network.
The information is read by the authorized professionals and provides necessary suggestion and prescriptions
based on the patient's data.

Patients Data: Data collected by the various sensors are kept in the hospital database for trusted user and
Diagnose patient. The data is kept in two sections one is the normal readings and the other is critical readings.

Trusted Authority or Service Provider: The individual health information is processed in hospital server and related diagnoses are
made by the particular medical professionals based on the readings. Services provided are in the form of text or
voice. Patient's health information is stored in database and information is kept secure.

Data Privacy

Regardless of the type of encryption scheme, communicating parties must agree on key(s) to encrypt/decrypt messages. In the public-key cryptography, sender uses the public key of the receiver to encrypt messages and the receiver uses his/her private key to decrypt encrypted messages. Every user in the system has a dedicated public and

private key pair generated by a Public-Key Infrastructure (PKI) [6]. PKI is a trusted third party such as a certificate authority that authenticates the key pairs by binding them to the identity of users.

For symmetric key cryptography, both sender and receiver must share the same secret key to encrypt/decrypt messages. Both parties perform a key-exchange protocol, such as Diffie- Hellman key exchange, to generate the secret key. Once both parties share the same key, they can use symmetric key cryptography to securely transfer the data.

AES(ADVANCED ENCRYPTION STANDARD) ALGORITHM

AES is one of the most widely used symmetric key encryption algorithms and is accepted as an industry and a government applications standard. AES is optimized for speed, low memory footprint and energy efficiency. Its low resource intensity allows AES to run on a wide range of hardware platforms ranging from 8-bit microcontrollers to high-end desktops and servers.

ALGORITHM:

input : Plaintext Block $ptxt_b$, Secret Key sk
output: AES state $state$
$state = InitState(ptxt_b, sk)$
$AddKey(state, sk_0)$
for $i = 1$ **to** $n_r - 1$ **do**
  $SubBytes(state)$
  $ShiftRows(state)$
  $MixColumns(state)$
  $AddKey(state, key_i)$
$SubBytes(state)$
$ShiftRows(state)$
$AddKey(state, key_{n_r-1})$

DECRYPTION CAN BE ACHIEVED BY REVERSING THE OPERATIONS.

PSEUDO CODE FOR AES

```
public String encrypt(String plainText)throws Exception {
byte[] plainTextByte = plainText.getBytes();
cipher = Cipher.getInstance("AES");
keysecretKey = generateKey(template);
cipher.init(Cipher.ENCRYPT_MODE, secretKey);
byte [] encryptedByte = cipher.doFinal (plainTextByte);
Base64.Encoder encoder = Base64.getEncoder ();
String encryptedText = encoder.encodeToString
(encryptedByte);
returnencryptedText;
}
```

```
public String decrypt (String encryptedText)
throws Exception {
Base64.Decoder decoder = Base64.getDecoder();
byte[] encryptedTextByte =
decoder.decode(encryptedText);
cipher = Cipher.getInstance("AES");
keysecretKey = generateKey(template);
cipher.init(Cipher.DECRYPT_MODE, secretKey);
byte[] decryptedByte =
cipher.doFinal(encryptedTextByte);
String decryptedText = new String(decryptedByte);
returndecryptedText;
}
```

Human Beings Body Parameters

1 Blood Pressure

Age Group	Gender	**Min/Max (mmHg)**
<18	Male	80/120
18 to 20	Male	80/125
21 to 40	Male	85/135
40 and above	Male	85/135
<20	Female	80/123
21 to 40	Female	85/133
40 and above	Female	85/133

Table 1: Blood Pressure Values

2 Pulse Rate Range

Status	BPM
Rest / Normal	60-100
Sleeping	40-50
Tachycardia	>100

Table 2: Pulse Rate Range

3 Body Temperature Range

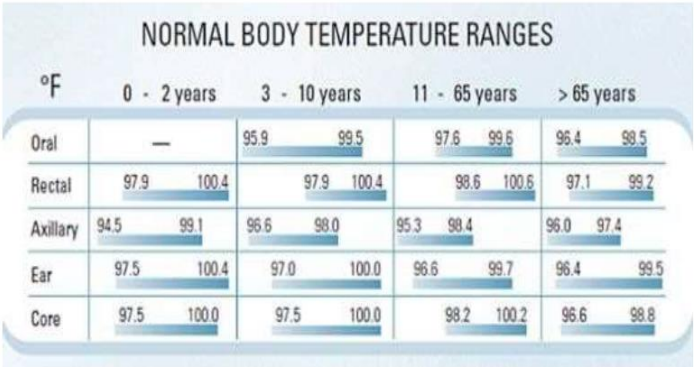


Table 3: Body Temperature Range

IV. RESULTS AND DISCUSSION

After successful implementation, testing and deployment of the project the project's working in the user environment is recorded as the screen captures which gives the clear interpretation of results. The personal health information of the patient which includes pulse rate, blood sugar, temperature and blood pressure. Diagnoses are made based on these readings. The deployed system consists of two main parts System and Android app part. The System part has two separate login for admin and a trusted login. Admin is responsible for over-all management. Doctors and hospital officials can register through the trusted

login. Admin will assign a key id and credentials for all the hospital officials been registered through the portal. The patients can register themselves through the android application been installed in there smart phone. The deployed system collects the various parameters of patients such as blood pressure, sugar level and heartbeat from the sensors that are integrated with the smart phone. These data are then forwarded to the server, where the data is been analyzed and responds the patient status such as critical, Normal etc and also provides emergency service by forwarding the condition of patient to the concerned doctor or hospital official responsible for the patient. It also provides the provision for intimating the near by ambulance in case of emergency. The objective of the system is to provide the emergency service for the patient in critical conditions by getting the various factors of patients through sensors deployed via smart-phone. The system is tested against various patients and doctors. The system achieved an efficiency of delivering a message to doctor about patient details is quiet satisfactory .These kinds of systems can be used by hospitals or government health sectors where they can monitor each individual patient condition periodically. The database of each patient is handled separately by the server, which then can allows the hospital officials to predict the condition of patient and then allows taking necessary precautions accordingly.

V. CONCLUSION

In this paper, we have proposed a mobile phone based healthcare system to monitor the patients remotely and help them in case of emergency. Authorized users monitor patients continuously by reading the data of the patients every now and then. Patient locality and health details are only visible to authorized users. If the patient/client doesn't want to be monitored by the other person then they can disable the system. If the patient is in critical health condition or the patient feels abnormal then the authorized users can give them first aid by sending the SMS to nearby hospital to dispatch ambulance. In our future work, we will exploit the security issues with internal attackers, where the internal attackers will not strictly follow the protocol.

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