**I J C T A**, 9(9), 2016, pp. 3651-3657


# A Smart E-Health Care System with Health Sensors and Cloud

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**ABSTRACT**

E-health care system is considered as one of the most important systems all around the world. It connects the patient with their doctor in order to check the patient situation. The main aim to develop this system where the patient can be monitored in their respective places due to this it increase the bed capacity in hospital, delay in medical information is reduced. This system is mainly developed for patients suffering from heart diseases, chronic diseases, accident people etc. The architecture consists of health sensors which are placed on patients' body. It transfers the values to the server. It provides data gathering, reduces manual data entering, huge number of patients' can be monitored.

***Keywords:*** *E*-healthcare system, cloud computing and health sensors.

## 1. INTRODUCTION

E-health care system provides routine medical check and other service from hospital to home environment. Wireless sensor network plays a major role in this system. It provides various aspect of sensing and it is used in many applications. It faces challenge such as power level, memory level, and data transmission level. These challenges are overcomes by the Iot or cloud technology and improves the sensor efficiency.

Cloud computing is a technological service providing through an internet [1]. It provides online network access for numerous computers like networks, applications and services. The advantages of this system are low cost, highly automated, flexibility, fast and large storage availability. It builds their application on remote servers using various infrastructures. There are three types of service one is software as a services (SaaS) provides remote access and function to their applications. Second one is platform as a service (PaaS) it provides application framework and to minimize the design effort. Third one is infrastructure as a service (IaaS) offers cloud resources, like servers, networking and a huge storage ware house.Amazon web server and Amazon elastic compute cloud (EC2) are used as cloud resources.

The basic idea of the system is to link the sensors with the cloud network. From the patients' body sensor data's are gathered and transferred to the cloud network. The cloud is capable of receiving, storing, processing and distributing. E-health care system is fully automated from collecting patients' data to immediate action under critical condition.A prototype of the E-health care system is implemented with respective sensors and cloud framework on raspberry-pi. Data mining technique is implemented on the cloud feature.

## 2. RELATED WORK

Alexandros Pantelopoulos et al. [2] give a brief lecture on wearable biosensors for health monitoring and diagnosis. A survey on biosensors is briefly described and the different types of transmission medium are described on this paper.

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Purnima Puneet Singh [3] offers a novel design on health monitoring system with the help of Zigbee and GSM technology. Using this technique wireless health monitoring system is developed.

Lei Clifton, David Clifton et al. [4] offers a Gaussian process for health monitoring system. The authors had proposed the project on large clinical study using a Gaussian process framework. It Produce an interference using the noise that is suited for the physiological patients' data.

Sang Joong Jang [5] described about the machine to machine communication. The authors combine mobile and IPv6 technique in the wearable sensors for monitoring patients' data and they provide wide range and convenient healthcare services.

Mir Hojjat Seyedi [6] and his teams in IEEE members provide us a survey on intra body communications (IBC) for body sensor network applications. IBC is a new emerged short range non RF-wireless technology in IEEE 802.15.6 using human body as IBC transmission medium. The survey proposed two IBC coupling methods. But it has many demerits such as transmission medium, quality, data rates need to be increased.

Fortino et al. [7] proposed a theory of integration of cloud computing and sensor networks. It improves the power and transmission efficiency by integrating and hence they proved the theory.

Hwang et al. [8] developed an algorithm to provide a secure data transfer to the cloud. The technique is called as encryption and decryption algorithm.

## 3. PROPOSED SOLUTION

This section describes about the health care system and all the requirements both software and hardware is described briefly in this section. It consists of three parts. First one is patient side data gathering through

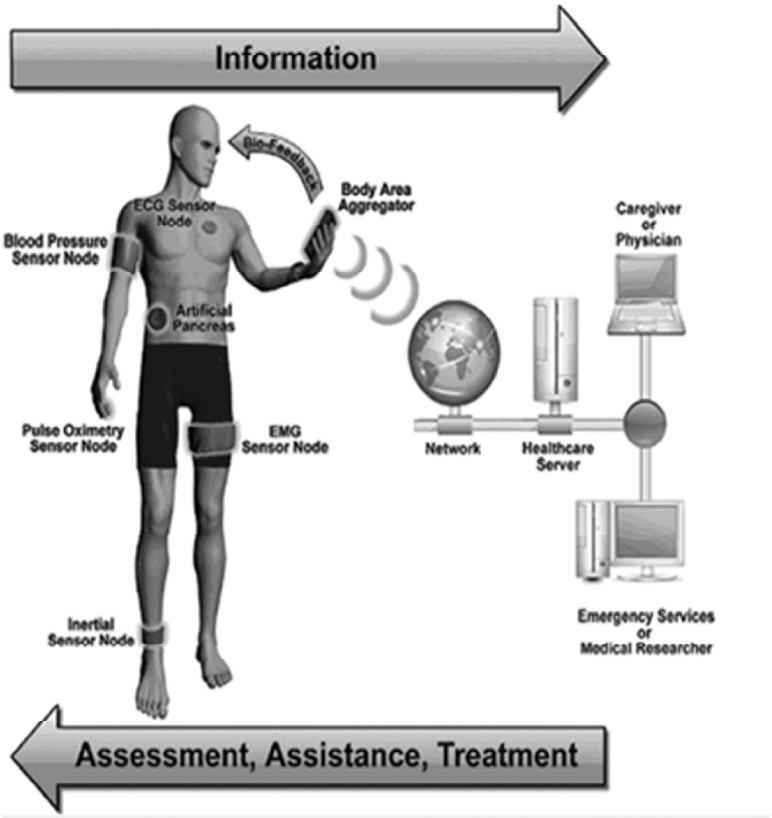


**Figure 1: Proposed System Architecture**

sensors. Second one is server and database where the details are stored. Third one is health care side where the monitoring section takes place. The proposed solution block diagram is shown below:

### 3.1. Architecture of patient side system

As shown in figure 1 the prototype is designed. Raspberry pi is used as a medium to access the data from the sensors. It provides real time data gathering. The sensors are attached on the patients' body and it captures vital data from the body and shift over to the raspberry pi then using the LAN cable or modem data is stored in the database. This is mainly for people suffering from long term fever, accident, major operation etc. Data transferred to web server should be authorized. SSL (Socket Secure Layer) provide an encrypted channel for data transfer from raspberry pi to server.

### 3.2. Web Server and Database

The main heart of the proposed system is cloud features to be in touch with the database and web server. Server must be able to access the database and respond the user with an immediate action. Accessed data are encrypted and stored. Advanced Encryption Standard (AES) algorithm is used for security purpose. All the data will be stored in the database. Database is used to store, manage and retrieve data. Data models are used to show the various ways of representing the database.

Decision making in cloud service plays a major role in health care system. Data mining is responsible for this process. It is normally of two type's normal, abnormal. When the data is normal it will continuously stored in the database. Suppose a rare condition when the value goes below abnormal for a patient. It checks the history of the database where similar patient condition is there or not. If there means it takes the prescription or action or response send for an approval to the health care. It intimates the doctor via alarm, message, mail etc. Doctor will check the condition and gives approval. If not there means doctor will prescribe new action.

This new action is stored in the database and if the same conditions exist it takes the same action and send for the response to approval. The database entities are patient information, staff information, monitoring data, queue data, contact us data.

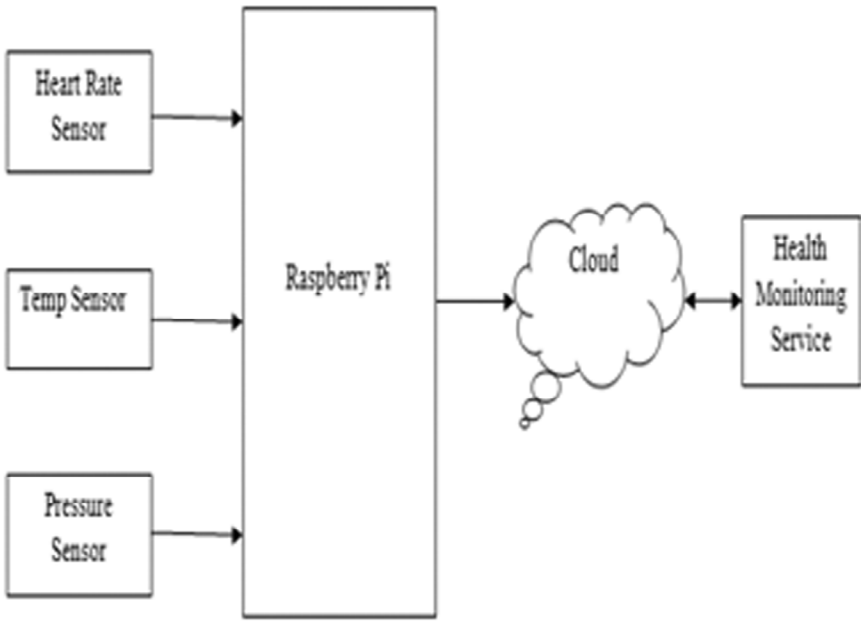


**Figure 2: Block Diagram of Proposed System**

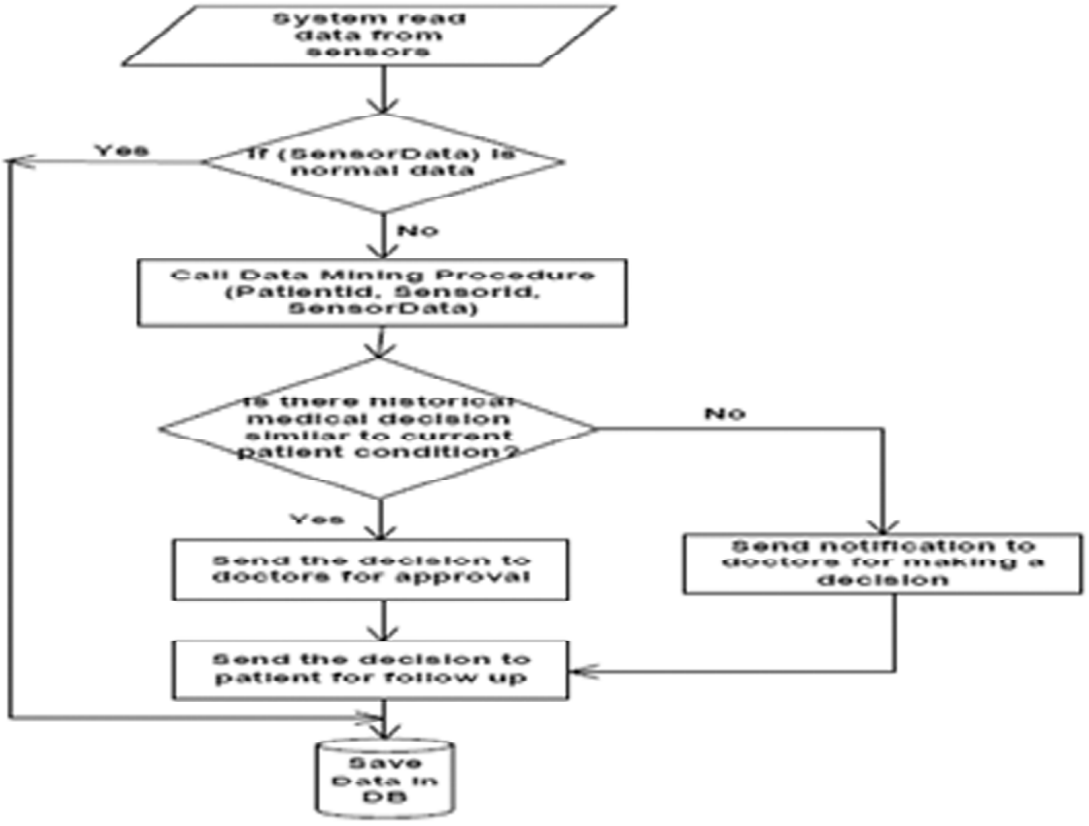


**Figure 3: Decision making process**

### 3.3. Health Care Side System

The third step in health care system. In case of an abnormal condition intimation given to doctors via alarm to a mobile device, message etc. Health care monitoring room is designed and deployed. We can accommodate staffs to monitor the patients from the health carecentric to home centric. A website is created and we stored all the data related to the patient. Using particular patient ID the doctor can check the condition from all over the world. It gives an alarm sound if there is an abnormal condition.

## 4. PROTOTYPE

Health sensors are used for measuring the vital data from the patients' body. Raspberry pi model B2 is used in this prototype.

Raspberry pi is used as a linux based microcomputer. Raspbian OS is used. It consists of 4 USB ports, Ethernet LAN cable, HDMI port, 40 GPIO pins, and Memory card support. It acts as mini CPU.Heart rate sensor is used (TCRT 1000), pressure sensor, temperature sensor (LM35), etc. These sensors are used in my project. The above items are all hardware requirements.Software requirements are described below python language is preferred for raspberry pi processor. It has processing speed 900MHz, 1GB RAM, ARM V7 Quad core processor are used. JSON (Java Script Object Notation) language is used for transferring data to the cloud. SQL server 2008 studio is used for developing the database. Php language is used to create the website design.Cloud features are amazon web server is used as a web server. Amazon elastic cloud (EC2) is used as a cloud services. Amazon EC2 service provides flexible features and easier web scale computing for the users. Microsoft SQL server is used as a database for health monitoring. It is responsible for storing, viewing, updating and retrieving the data from the database.

## 5. IMPLEMENTATION

We had tested our prototype with three sensors heart rate, pressure sensor and temperature sensor because thinking in mind about the cost factor. The test report are shown below we had taken reading from different persons in raspberry pi terminal window.

These data will be transferred to the cloud server and we can take the data from anywhere at any place. In the hospital it will be continuously monitoring the patient in their respective places. These two figures show the result of the data collecting from the patients. Two figures are in normal range it reduces the manual data collecting from the patients and increase the efficiency. We had used a delay technique for all the sensors because to get accurate results it takes one minute for the best result. Data mining technique is used for decision approval. If the historical data is available in the database it provides the same description and asks for doctor's approval. If there is no data it directly intimate the doctor and they prescribed the description on to the patient mobile. These data will be stored in the Database and whenever it is needed they can access at any time and at any place using patient ID.

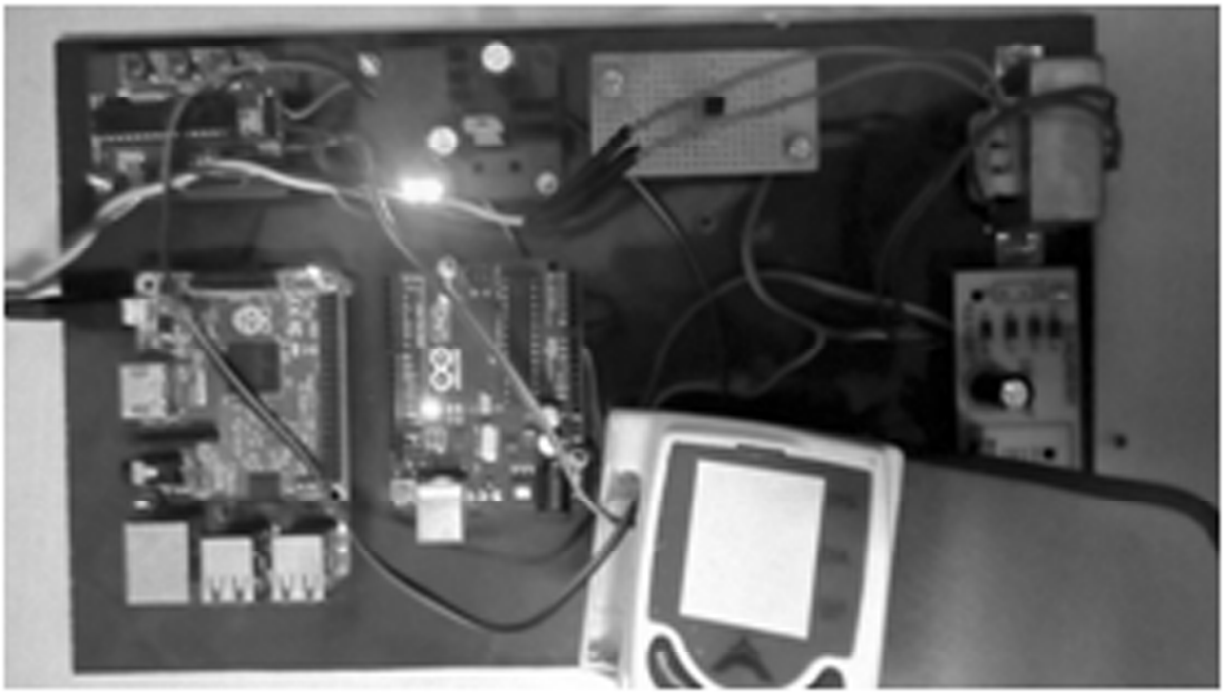

**Figure 4: Raspberry pi model B2**

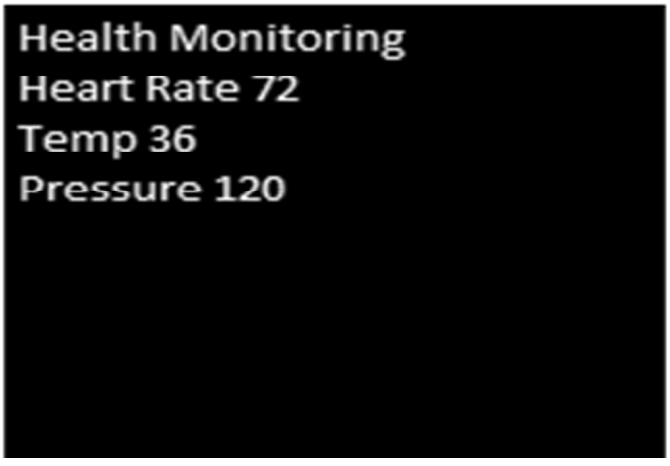


**Figure 5: Data Reading From One Patient**

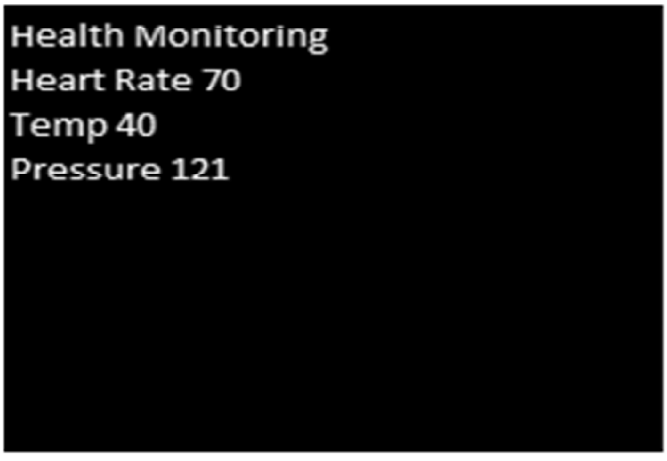


**Figure 6: Data Reading From another Patient**

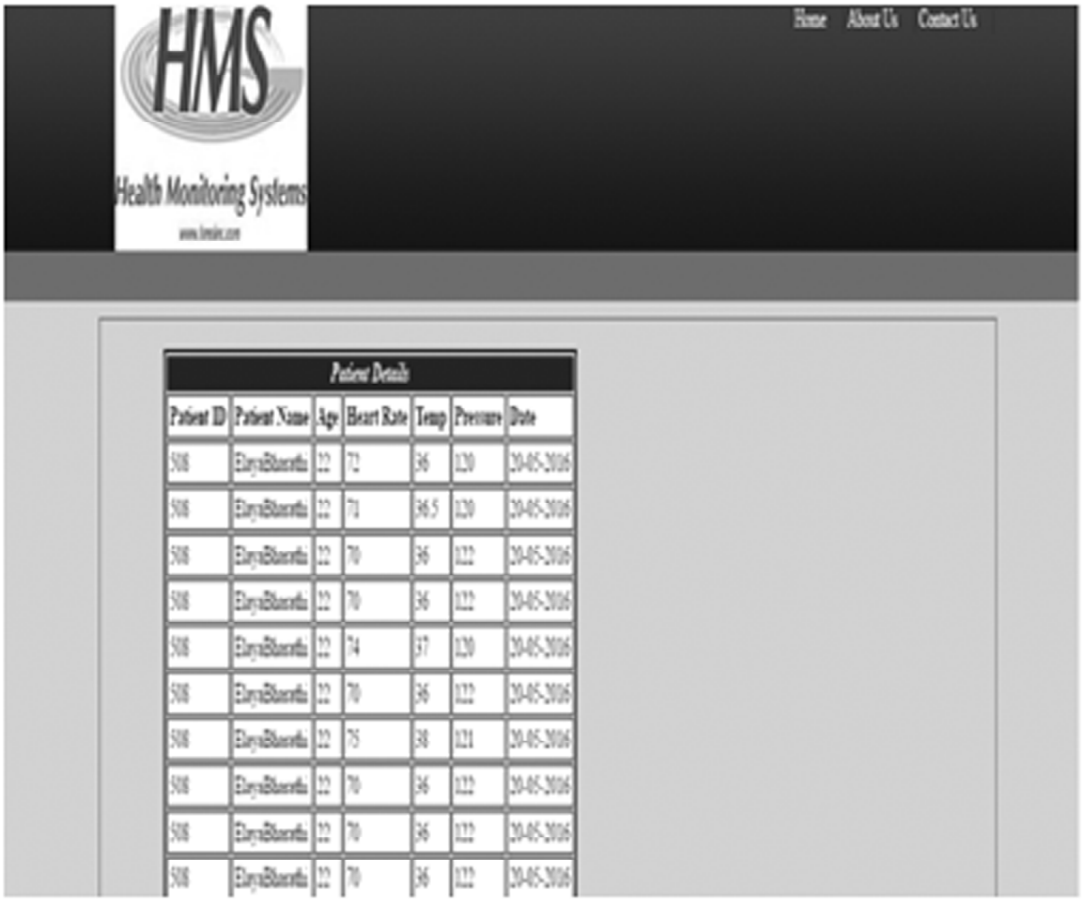


**Figure 7: Data Reading from cloud server**

## 6. CONCLUSION AND FUTURE WORK

In internet of things concept the integration of sensor networks and cloud generates a new technology health monitoring. It is useful that we can monitor the patient in their respective homes. In future we can connect large number of patients with more sensors connecting. In advancement in IOT we planned in future to design a bio patch based mems product to fix it in human body with all sensors and then decided to develop a medbox containing all medicine and prescribes it to the respective patients.

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