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Smart Health Monitoring System Using Internet of Things

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ABSTRACT

This paper proposes a low cost, wearable and portable smart health monitoring system in real time. Smart Health Monitoring System is IoT based system which makes use of sensors and cloud storage. Data obtained from sensors is stored on cloud, where individual records are separated and Naïve Bayes Algorithm is applied to detect the disease. This system monitors health of normal people rather than only focusing on the patients and allows people to be mobile in their working environment. Person's health is continuously monitored using wireless sensor networks and the obtained data is transmitted to microcontroller unit which is then sent to cloud storage. Proposed system consists of pulse rate sensor, body temperature sensor and blood pressure sensor. Using these parameters and by applying Naïve Bayes algorithm any sudden change in person's health will be notified to doctor through SMS using GSM connection.

Keywords: Body temperature, Cloud storage, GSM, Heart rate, IoT, Naïve Bayes algorithm, Sensors.

I.INTRODUCTION

The electronic technology has entered in all aspects of day to day life. Medical field is not an exception, so the need for well-equipped hospitals and diagnostic centers is increasing day by day as the people are becoming more aware and conscious about their health problems. Parameters like heart rate, pulse rate, blood oxygen saturation level, body temperature, blood pressure etc. are checked by the doctor, to know about health condition. As these parameters give doctor fair idea about the person's health, hence these parameters are vital. However, if these parameters are transmitted directly to the doctor's location, it saves time and imparts comfort to both the doctor and the patient.

Wireless communication technology is considered the best way to overcome the problem of visiting doctor for regular checkup.

Using computers and wireless technology, in healthcare monitoring will achieve many goals such as decrease in diagnosis time, improvement in accuracy, treating more number of patients, reduced paper work and many other. Thus, this system proves to be useful one, which not only deals with monitoring person's condition but also tries to predict the disease. This system also informs the doctor indicating the emergency level for treatment.

Data mining[6] is the core step, which results in the discovery of hidden and predictive information from large databases. Data mining technology provides a user-oriented approach to the novel and hidden patterns in the data. The discovered knowledge can be used by the healthcare administrators. This system makes use of sensors to obtain data, wireless transmission for transmitting data and Naïve Bayes algorithm for predicting diseases. After analysis, obtained results will be sent to the doctor through SMS using GSM connection.

Thus, this paper provides low cost system which makes health monitoring easy by providing quick and fast access to data for doctors, and tries to predict disease using Naïve Bayes algorithm.

II.EXISTING SYSTEM

In existing systems[1], the patient's health status is looked up and taken care by some person who has to sit near the patient itself. It is difficult to keep each person or expert for each patient.

Figure 2.1 shows overall structure of system where health of only patients is monitored within hospital premises.

2.1 Block Diagram

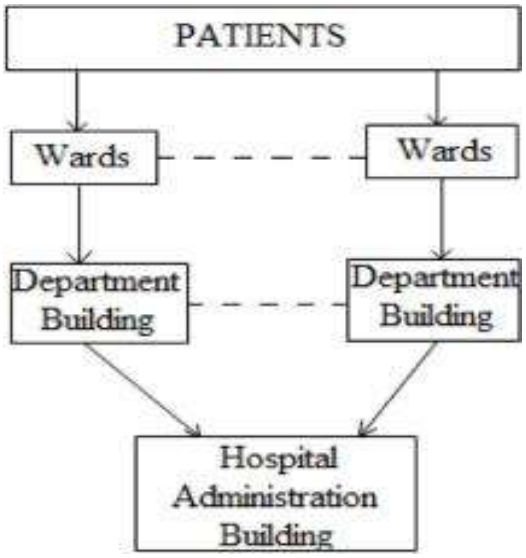

Fig. 2.1 Monitoring of patient health in hospital[1]

This, system mainly focuses on patient and does not provide freedom to move them comfortably. However, most systems have problem of range or monitoring and need more attention to handle patients, and makes it mandatory to monitor health of patient even if there are no any drastic changes, which leads to time wastage and work labor.

2.2 Network Communication

This system mainly focuses only on patients. Patient's data is acquired by sensors which is transmitted to the microcontroller using Wi-Fi module. A centralized data center of Healthcare Organization(HCO) is used for storing data to which, only doctors and higher authorities have access.

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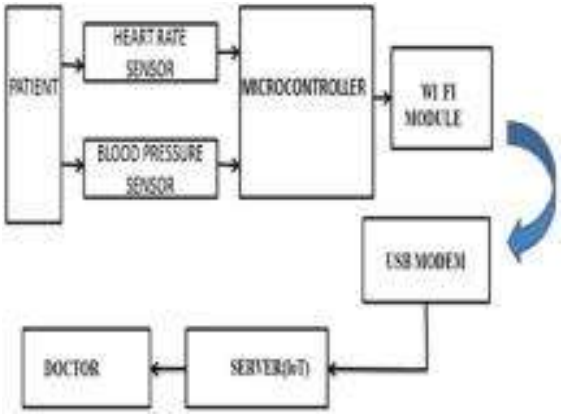

Fig. 2.2 Network Communication in hospital premises[7]

III. PROPOSED SYSTEM

Proposed Smart Health Monitoring System is a real-time system, which responds to the changes very quickly. This IoT based system has sensors to collect data, microcontroller to convert analog data to digital data, Bluetooth module to provide communication between microcontroller and mobile application, and cloud database to store data[4]. Cloud database maintains and analyses using Naïve Bayes algorithm and tries to predict the disease. Result of analyzed data is then sent to doctor if any abnormality occurs, through GSM connection, using mobile app.

3.1 Block Diagram

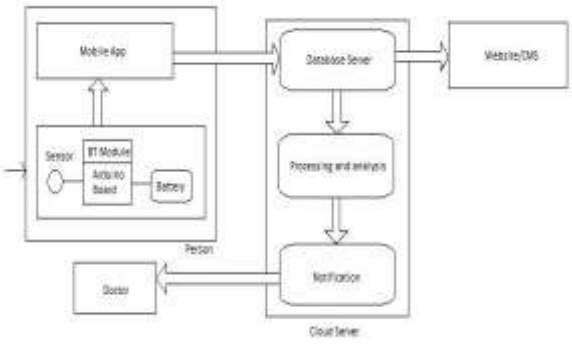

Fig. 3.1 Architecture of proposed system

Figure 3.1 shows the overall flow of the system starting from sensors connected to person until the data is sent to the doctor via SMS.

3.2 Sensors

In the proposed system, sensors[6] such as body temperature, heart rate and blood pressure are used, which detect these parameters and send them to microcontroller. Transmitted data is in analog form and needs to be converted into digital format. Sensors used are small in size and can be integrated into a single chip, making it

wearable device. Wearable device will continuously monitor the person's health allowing him/her to freely roam in their working environment. For continuously acquiring data sensors need power for which small battery is used which will last for 8-10 hours.

Transmission of data from sensors to mobile application is secured and does not broadcast to any other devices.

3.3 Networking

Data obtained from various sensors is in analog form which is converted into digital using microcontroller and sent to mobile app using Bluetooth module. Thus, data from mobile will be sent using Wi-Fi or data connection to store in cloud storage, where the database is maintained to separate and store data and to perform computation of predicting the disease. Secure communication should take place between cloud storage and the mobile app.

3.4 Data management

Proposed Smart Health Monitoring System makes use of structured database[12] for storing and analyzing the data. Data obtained is serial and needs to be handled efficiently as it has to be further used for computation. Each record has to be maintained separately, so to differentiate individual's data. Data is stored in table format instead of putting all the data in a big storeroom, this management of large database is somewhat easier in MySQL or any other database which follows table structure to store data. MySQL software provides client Server architecture. where server is handling multiple clients simultaneously. Different queries are used to interface with database. Database also maintains personal information like name, age, department, birthdate, etc. Interval has been defined for storing data, because sensors transmit data at very high speed and certain threshold value has to be defined for each parameter, when sensors values exceeds that threshold value then only the data will get stored in database. This will avoid storing of unnecessary data in database.

3.5 Data Analyzing

Data stored in database should be analyzed to predict the disease. Naïve Bayes algorithm is implemented to predict the disease. Bayesian classifier known as the Naïve Bayesian classifier to be comparable in performance with decision tree and selected neural network classifiers. Bayesian classifiers have also exhibited high accuracy and speed when applied to large databases.

Hence, Naïve Bayes proves to be more useful algorithm compared to other.

Bayes' theorem is

$$P(H|\boldsymbol{X}) = P(\boldsymbol{X}|H)P(H)\,/P(\boldsymbol{X}) \qquad (1)$$

Where,

$P(\boldsymbol{X}|H)$ is the posterior probability of $\boldsymbol{X}$ conditioned on H.

$P(\boldsymbol{X})$ is the prior probability of $\boldsymbol{X}$.

$P(H)$ is the prior probability.

Naïve Bayesian classifiers[7] assume that the effect of an attribute value on a given class is independent of the values of the other attributes. This assumption is called class conditional independence. It is made to simplify the computations involved and, in this sense, is considered "naïve." Bayesian belief networks are

graphical models, which unlike naïve Bayesian classifiers, allow the representation of dependencies among subsets of attributes. Bayesian belief networks can also be used for classification.

3.6 Data Flow Diagram

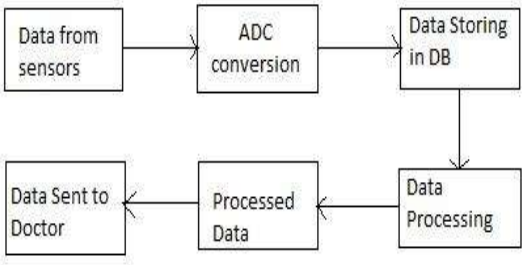

Fig 3.2 Data Flow Diagram

Figure 3.2 shows, how data flows in system. Firstly, data is captured by sensors. This data is in analog form and is sent to microcontroller for converting it into digital form. Then, this digital data is stored in database, where data processing takes place with the help of Naïve Bayes algorithm and then 'processed data' which is any dynamic change that has occurred in person's body. Then this data is sent to doctor if needed.

IV. TECHNOLOGY USED

4.1 GSM Technology

GSM[1] (Global System for Mobile communications) is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 80% of the global mobile market uses the standard. GSM is used by over 3 billion people across more than 212 countries and territories. GSM differs from its predecessors in that both signaling and speech channels are digital, and thus is considered a second generation (2G) mobile phone system.

4.2 Bluetooth

Bluetooth[5] is a wireless technology standard for exchanging data over short distances (using short wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Here, Bluetooth is used provide the connection between sensors and mobile app.

4.3 Wi-Fi

Wi-Fi[2] stands for wireless fidelity. It is a technology for wireless local networking for devices based on IEEE 802.11 standards. Devices which can use Wi-Fi technology include mobile, PDA's, laptops, etc. In the proposed system, Wi-Fi is used to send the data from mobile app to the cloud storage. Wi-Fi support faster data transfer rate with proper bandwidth utilization.

V. CONCLUSION AND FUTURE SCOPE

This paper emphasizes on IoT based smart health monitoring system for continuously monitoring a person's health and for detecting the disease at earlier stage.as soon as possible. We have proposed a system in which all the health-related information of a person can be safely transferred to doctor. With the help of this system a network of devices whose motive is to collect health related data automatically and immediately inform the doctor if any major change takes place in person's body by sending the SMS directly to doctor. With the help of this system, need of visiting doctor every time for routine check-up can be avoided as data will be directly available to doctor.

This IoT based system deals with problems of healthcare delivery cost, information sharing and shortage of healthcare professional better and enhances services for the patients.

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