Healthcare Monitoring System Using IoT

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Abstract— **Health-related issues have been regarded as one of the main problems which directly impact quality of life of a person and development of the nation. Avoidance of healthcare monitoring negatively results in many aspects. Among the extensive applications enabled by the Internet of Things (IoT), digital health care is a mainly essential one. Internet of Things (IoT) provides a new life to the healthcare field. One of the better ways is where the doctors are able to certainly and quickly use the relevant patient information through the help of internet of things to take suitable actions. This tremendously improves the quality of information and the patient care in the Medical field. So, Internet of Things offers a concrete platform to connect all the resources and improve the quality of life. The proposed system presents a personal healthcare system that is both flexible and scalable. Making use of embedded wearable sensors, the system monitors the health parameters dynamically. The acquired data is transmitted to the Raspberry pi i.e. the processor which will process and analyze the data. This analyzed data is stored on cloud for scalability and flexibility purpose. Results of the analysis are then automatically sent to the doctor when a critical condition occurs.**

Keywords—raspberry pi; monitoring system; sensor; internet of things; cloud.

I. INTRODUCTION

Internet of things (IoT) can be described as embedded devices (things) with Internet connectivity that interacts with each other, services and people on a comprehensive scale [1-4]. Internet of Things utilizes the "Smart" objects which use various sensors and actuators for performing various actions [5]. The advancement in the new innovative technology and Internet of Things (IoT) has had a substantial influence in the healthcare system. Health care is the preservation and betterment of health via identification, diagnosis, treatment and prevention of diseases, sickness, wound and other physical and mental damage in humans. Health care can add to major part of a country's economy. But the fragmented nature of the healthcare system, which is further worsened by the lack of tools for communication between the specialists, stimulates the need of functional interoperability to ameliorate this coordination. Currently, information technology is considered a necessity rather than a supporting tool.

A major aspect in the healthcare system is the monitoring of the patient's vital signs such as temperature, blood pressure and heart rate. Many monitoring devices that display the patient's vital signs are commonly present in the critical care units in operating rooms. But there could be instances where the doctor cannot be alerted in time when there is an emergency, despite of 24 hours of monitoring. Also the data cannot be shared remotely with the other doctors who are specialists in that field and the family members. Technology that enables all these activities are available but aren't accessible and affordable by many people in developing nations. Hence, the problem can be overcome by using Internet of things. In healthcare IT enables elements with the sensor data system to become intelligent by embedding them into a system which process the sensed data and produce results effectively. Medical sensors are a grouping of transducers for sensing electrical, thermal, genetic and other kind of signals with physiological origin to signify a person's health status. Sensors further than those that directly evaluate health state have also found use in the practice of medicine.

The paper is organized as follows, the section 1 includes introduction. In section 2 IoT in healthcare is discussed. In section 3 the proposed system is described with the help of block diagram, design methodology and system architecture finally, section 4 is conclusion.

II. IoT IN HEALTHCARE

IoT in the field of health care observing comprises of custom-assembled sensors, patient worn bits that sample, and send the information through a wireless system. Patients in the clinic whose health status should be ceaseless checked can without much of a stretch be observed utilizing IoT-driven, noninvasive observing. This type of IoT empowered arrangement utilize sensors that get physiological data from the patient's body and utilizing gateways and the cloud to analyze and store data this information is sent wirelessly to the specialists(doctors) for propel examination and survey [6-8]. It replaces the act of having a health expert to check the health status at normal interims of the patient. IoT enormously enhances the nature of health care through consistent consideration and fewer mistakes and furthermore brings down the cost of care by wiping out the requirement for a parental figure. The main challenge here is to give reasonable correspondence (prepared) when there is an emergency situation of the patient paying little heed to the area and time for picking up treatment from specialist. Physical checking of the patient is required if there is a basic condition. In this way, manual process can be screwing up slanted and less effective.

There are many individuals everywhere throughout the world who endure health issues since they don't have prepared access to powerful health checking. Be that as it may, with the assistance of Raspberry Pi which is a smaller than expected PC comprising of processor, graphics card, and memory in a solitary bundle, capable wireless solution associated with internet it is feasible for checking the health of an individual adequately and proficiently [9], [10]. These arrangements can be utilized to safely catch, exchange the patients health information from a grouping of sensors to processors and apply complex computations to analyze the data and after that impart it through remote network to medicinal specialists who can make proper health proposals.

III. PROPOSED SYSTEM

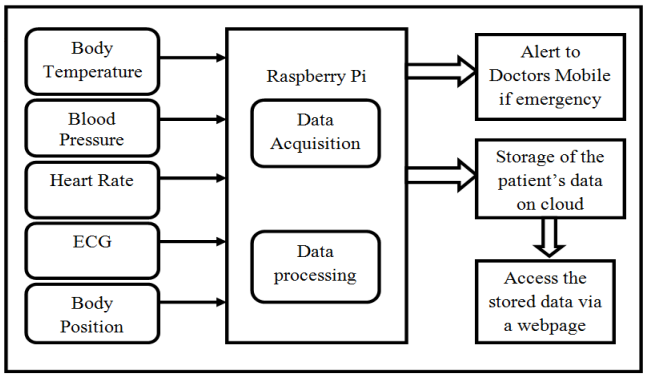

Fig. 1 Block Diagram

Block diagram is shown in figure 1. The diagram is divided into two parts: Transmitter and receiver. In the transmitter section all the sensors are connected to the raspberry pi processor which does acquisition and processing and stores the processed data in the database which is on cloud. In the receiver section a web page is built and data collected is displayed on the web page by an authorized person. Also, the doctor is alerted in case of emergency.

A. Design Methodology

The design of the system is divided into two parts: hardware components and software components.

Hardware components

1) Temperature sensor (LM35): It is a sensor used to measure temperature. The LM35 series are accuracy coordinated integrated circuit temperature sensors, whose output voltage is directly related to the Celsius (Centigrade) temperature. It measures temperature more precisely than thermostats. It is fixed and does not experience oxidation. It does not require output voltage to be amplified [11].

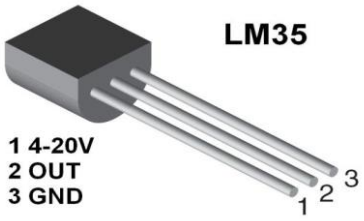

Fig. 2 Temperature sensor (LM 35)

2) *ECG sensor:* ECG electrode sticks to the chest to pickup ECG signals. At that point wires are associated with AD8232. This sensor is a financially savvy board used to measure the electrical activity of the heart. ECGs can be boisterous, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals effortlessly [12].

Fig. 3 ECG sensor

3) *Heart Rate sensor:* The sensor gives the digital output of heart beat when a finger is placed on it. When the sensor starts, the LED flashes in unison with the beat. The output generated is in Beats per Minute (BPM) rate [13].

Fig. 4 Heart rate sensor

4) *Blood Pressure sensor:* The Blood Pressure sensor is fully automatic, easy to operate, intelligent device which shows systolic, diastolic and pulse readings. Its compact design fits over the wrist like a watch. Easy to use wrist style eliminates pumping. It gives serial output data for external circuit processing or displays [14].

Fig. 5 Blood Pressure sensor

5) *Accelerometer:* The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration [15].

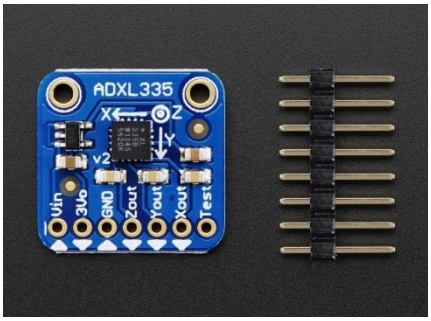

Fig. 6 Accelerometer (ADXL 335)

6) *Raspberry Pi*: The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor and uses a standard keyboard and mouse. The Raspberry Pi Model B+ has dual core ARM11 processor with 512MB SDRAM and powers through Micro USB socket of 5V [16].

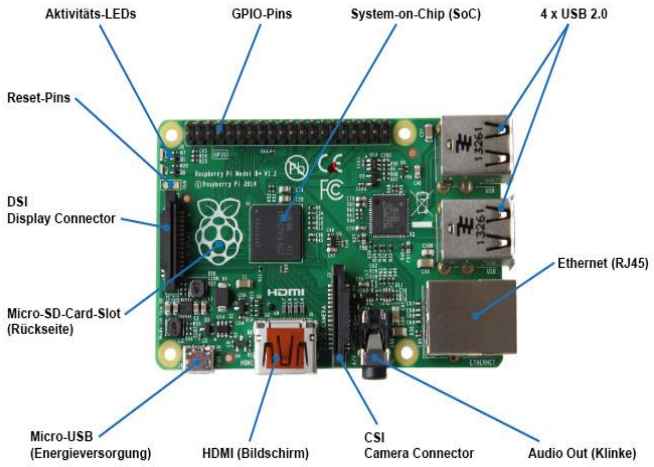

Fig. 7 Raspberry Pi B+

Software components

1) *Server* - The data send by Raspberry pi is stored on a server. The detailed information of patients and doctor is registered through website and stored on server. The website can be accessible from anywhere.

B. System Architecture

The proposed system is described with the help of system architecture as shown below in figure 8.

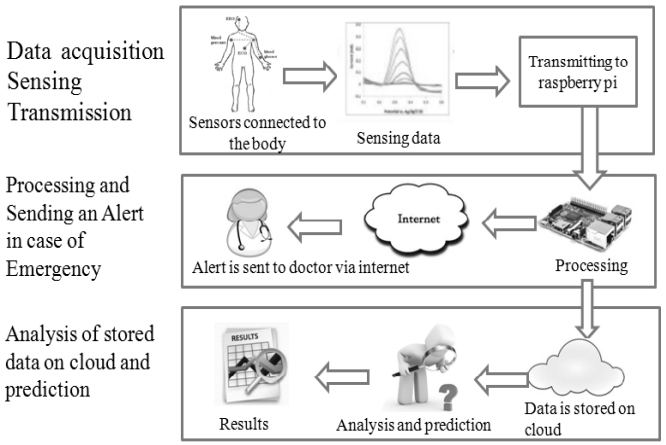

Fig. 8 System Architecture

The interconnection between various components is explained using the system architecture. Once the system is turned ON, the procedure begins. The sensors are connected to the body of the patient. The sensors gather the information of the patient i.e. its heart rate, body temperature, weight, ECG, body position. This is the data acquisition step. After the data is gathered the information is transformed to be fed as a input to the raspberry pi. The transformation step converts the analogue data to digital form. This information is given to the raspberry pi for processing. The processing step checks for every one of the parameters whether they are in the specified range. On the off chance that the information is inside the defined range it creates a report for storage purpose. If the data is not in determined range that demonstrates that the patient is in a critical/abnormal state thus it sends an alert to the doctor. In view of the caution the specialist will analyze the patient's treatment. Successful examination and forecast can be performed utilizing decision tree algorithm to foresee the illness before its event. The doctors alongside their login accreditation can login and see the patient's information. Doctors can see every single past record of a patient and recommend drugs and changes in medicine. Likewise patients are given one of a kind client id and password to see their records. The proposed system which uses sensors for sensing multiple factors such as patient's body temperature, heart rate, ECG (Electrocardiography), blood pressure, body position all together.

At its core our proposed prototype contains:

1) Capturing information from sensors.

2) Sending the detected information to raspberry pi.

3) If the patient record is not in the therapeutic scope of finding, raspberry pi will send a caution to the specialist (doctor) through SMS.

4) Doctor then peruses the patient current information for finding and treatment.

5) The therapeutic records of the patients are stored on the cloud for simple access by the patient and the specialist (doctor). Based on the stored data, analysis and thus prediction of the problem (disease) is performed by the system prior to its occurrence

6) The proposed model would include adaptability as far as time, cash and treatment so that a great part of the season of patient and specialist would be spared.

Every one of the sensors is promptly accessible in the market to trial and sense real time information through physical objects. We are utilizing raspberry pi show B+ processor for processing the information detected by these sensors. Every one of the sensors is connected with the processor. The coding is done utilizing python programming language on raspberry pi. The information stored on cloud is then utilized for prediction purposes. Decision tree algorithm is used to predict and avoid different kind of problem (diseases) that can happen in future.

IV. CONCLUSION

As health care administrations are essential piece of our society, computerizing these services reduces the weight on people and facilitates the measuring procedure. Additionally the easy of access of this system helps patients to rely on it. The goal of creating such a system is to decrease health mind costs by diminishing doctor office visits, hospitalizations, and demonstrative testing method. Many further upgrades can be made in the proposed system to improve it and make it effortlessly versatile, for example, including more propelled sensors. The system is expected to track and sense the ongoing (real time) information with the assistance of various sensors and help to enhance the nature of healthcare.

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