



ADAPTIVE AND FAULT – TOLERANT DATA PROCESSING IN HEALTHCARE IOT

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Abstract

The interconnection of the devices using network technologies form Internet of Things (IOT). IOT is the advanced technology useful for the medical health sector in many ways. In this system, the proposed design is to find out the reading of the human pulse sensor and alert the system, if the heartbeat of the victim is abnormal through a buzzer and also send the messages to the emergency contacts through Global system for Mobile (GSM) system. This system will also be connected to the Thing speak Cloud for the data processing with the help of Wi-Fi based microcontroller. The entire system can be used for easy evaluation of the doctor regarding the victim past medical heart beats. The data will be continuously active and stored in the cloud. The proposed system experimental values are reliable, user friendly and economical to use regularly.

Introduction

Health is always a major concern in every growth the human race is advancing in terms of technology. Like the recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. In such areas where the epidemic is spread, it is always a better idea to monitor these patients using remote health monitoring technology. So, Internet of Things (IoT) based health monitoring system is the current solution for it. Remote Patient Monitoring arrangement empowers observation of patients outside of customary clinical settings (e.g., at home), which expands access to human Services offices at bring down expenses. The core objective of this system is the design and implementation of a smart patient health tracking system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues.

The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure. Each of our bodies utilizes temperature and also pulse acknowledging to perceive understanding wellbeing. The sensors are linked to a microcontroller to track the status which is thus interfaced to an LCD screen and additionally remote association with have the capacity to exchange alarms. If framework finds any sudden changes in understanding heart beat or body temperature, the framework consequently alarms the client about the patient's status over IOT and furthermore indicates subtle elements of pulse and temperature of patient live in the web. In this manner IOT set up tolerant wellbeing following framework viably utilizes web to screen quiet wellbeing measurements and spare persist time. There is a significant capability between Inmost of the rural areas, the medical facility would not be in a hand reach distance for the natives. So normally the people neglect any kind of minor health issues which is shown in early stages by variation of vital elements like body temperature, heartbeat rate etc.

Once the health issue has been increased to a critical stage and the life of the person is endangered, then they take medical assistance, which can cause an unnecessary waste of their earnings. This also comes into account especially when certain epidemic is spread in an area where the reach of doctors is impossible. So, to avoid the spread of disease, if a smart sensor is given to patients, who can be monitored from a distance would be a practical solution to save many lives.

The Internet of Things is the inter connection of the 'things' with the network connectivity that process the data from the sensor node to the end point. In the Health monitoring system, the constant care of observing the heart beat parameter is very important for the patients and can be a better solution with the technology use of Internet of Things (IOT) to maintain the patient previous medical history of the pulse rate. The 24 hours' medical observation can help the patient for the better treatment also. This technology that provides better enhancement feature is hardly difficult to use in India due to its accessibility and affordability.

LITERATURE SURVEY

1. Development and Clinical Evaluation of a Home Healthcare System Measuring in Toilet, Bathtub and Bed without Attachment of Any Biological Sensors:

Daily monitoring of health condition at home is important for a scheme for early diagnosis, treatment, and prevention of lifestyle-related diseases such as adiposity, diabetes and cardiovascular diseases. While many commercially available devices for home health care monitoring are widely used, those are cumbersome in terms of self-attachment of biological sensors and self-operation of them. From this viewpoint, we have been developing a non-conscious physiological monitoring system without attachment of any sensors to the human body as well as any operations for the measurement. We developed some devices installed in a toilet, a bath,

and a bed and showed their high Measurement precision by comparison with simultaneous recordings of ordinary biological sensors directly attached to the body. To investigate that applicability to the health condition monitoring, we developed a monitoring system in combination with all the monitoring devices at hospital rooms and previously carried out the measurements of patients' health condition. Further, in this study, the health conditions were measured in 10 patients with cardiovascular disease or sleep disorder. From these results, the patients' health conditions such as the body and excretion weight in the toilet, the ECG during taking the bath and the pulse and respiration rate during sleeping were successfully monitored in the hospital room, demonstrating its usefulness for monitoring the health condition of the subjects with cardiovascular disease or sleep disorder.

2. Intelligent wireless mobile patient monitoring system

Nowadays, Heart-related diseases are on the rise. Cardiac arrest is quoted as the major contributor to the sudden and unexpected death rate in the modern stress filled lifestyle around the globe. A system that warns the person about the onset of the disease earlier automatically will be a boon to the society. This is achievable by deploying advances in wireless technology to the existing patient monitoring system. This system proposes the development of a module that provides mobility to the doctor and the patient, by adopting a simple and popular technique, detecting the abnormalities in the bio signal of the patient in advance and sending an SMS alert to the doctor through Global System for Mobile (GSM) thereby taking suitable precautionary measures thus reducing the critical level of the patient. Worldwide surveys conducted by World Health Organization (WHO) have confirmed that the heart-related diseases are on the rise. Many of the cardiac-related problems are attributed to the modern lifestyles, food habits, obesity, smoking, tobacco chewing and lack of physical exercises etc. The post-operative patients can develop complications once they are discharged from the hospital. In some patients, the cardiac problems may reoccur, when they start doing their routine work. Hence the ECG of such patients needs to be monitored for some time after their treatment. This helps in diagnosing the improper functioning of the heart and take precautions. Some of these lives can often be saved if acute care and cardiac surgery is provided within the so-called golden hour. So, the need for advice on first-hand medical attention and promotion of good health by patient monitoring and follow-up becomes inevitable. Hence, patients who are at risk require that their cardiac health to be monitored frequently whether they are indoors or outdoors so that emergency treatment is possible. Telemedicine is widely considered to be part of the inevitable future of the modern practice of medicine.

3 The real-time monitoring system for in-patient based on Zig Bee

The system is made up of two sub-systems: patient physical states data acquisition and communication system based on Zig Bee technology, and hospital monitoring and control center. The patient physical states data acquisition and communication system monitors the main physical parameters and movement status continuously. The information from data acquisition system is sent to hospital monitoring center by Zig Bee wireless communication module. The monitoring center receives the information from each patient and save them to the database, and then judges the states of the patient by fuzzy reasoning. The data from the patient can be displayed as a graph or numeric on the monitor if it is necessary, and then the doctor can diagnose the patient according to the recorded continuous data. Wireless sensor network is made up of a lot of wireless sensors based on Zig Bee technology. The Zig Bee technology provides a resolution for transmitting sensors' data by wireless communication. Zig Bee technology can transmit data with a rate of 250kbps, and then it is enough for the physical parameters of the patient. The communication distance of Zig Bee node can be over 200 meters and can be spread by add route node, and then Zig Bee technology is suited to a short distance wireless sensors network. Zig Bee technology owns many virtues, such as low power consumption, low cost, small size, free frequency, etc. To know the physical states of in-patient, the physical parameters need to be monitored Real-time. The traditional medical test instrument is a large size and connected by wire often, and the patient is required to be quiet during the test. In most of the hospital, the medical instruments need to be read by doctor or nurse, and the physical parameters are tested and recorded one or two times each day, the real-time monitoring is expensive for most of the patients, and can be only acquirable for ICU by a nurse. For this reason, the worsening of patient can't be found in time, and then the patient can't be helped in time. For most of the patients can be monitored real-time in hospital, we should find a new method. Consider that the movement of the patient is limited in hospital, we adopted the Zig Bee and wireless sensors network to acquire the physical parameters of the patient.

SYSTEM ARCHITECTURE

SYSTEM IMPLEMENTATION

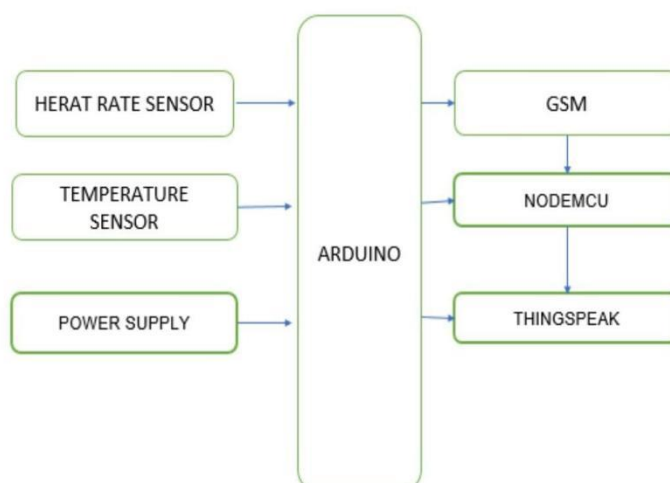


Fig 1:system design

The Heartbeat sensor is fixed to the patient's finger. This contains an IR sensor in it. Every pumping we get pulse from that sensor. This sensor output is given to the arduino via Signal conditioning unit for amplification. The heart rate is measured using a pair of LED and LDR and a microcontroller and it works on the fundamentals of optoelectronics. The infrared radiation is emitted by IR led and the infrared light is reflected by the surface.

The intensity of radiation generated electron-hole pair which in turn produces leakage current. This current thus generated is sent through a resistor to obtain the proportional voltage. Thus, the greater is the intensity of the incident ray, the larger value of voltage flowing across resistor will be obtained. The heart rate is measured by placing the tip of forefinger upon the sensor. Once the circuit senses the pulse, an LED will start blinking along with your pulse.

The output is sent to a circuit or a micro-controller to measure the heart beat rate in BPM. NTC type thermistor is used as a temperature sensor. This temperature sensor output varies based on the temperature, this output is also given to arduino. For measuring the temperature DHT 11 sensor has been used which is a sensor used to measure the temperature with the help of the analog output proportional to the temperature. The IC temperature sensor with an output voltage which is proportional to the Celsius temperature.

The Temperature sensor is better than linear temperature sensors which have calibration in Kelvin, because one doesn't need to remove a large constant voltage from the output value to obtain the Celsius reading. We design the system for monitoring the pulse rate of the patient body. The advancement of the system is to store the parameter of pulse rate into the cloud and also helps to alert the patient's family, when the abnormality in the pulse rate is observed with the GSM and the Buzzer. In the stage 1, the sensor is connected to the Microcontroller which acts as a source of the data. In the stage 2, the data is ready to measure and thus the data acquisition collect the data from the sensor node via Microcontroller. In the data pro-processing the data model obtained from the data acquisition are identified as a label and used to send the information to the cloud/database for the further purpose of utilized in data analysis and data mining. In the stage 3, the data is stored which is collected from the pre-processing stage and used to observe the parameters for the future observation, predictions etc. The ESP8266 Wi-Fi module is a self-contained SOC with incorporated TCP/IP protocol stack that can offer any controller access to Wi-Fi network. It uses 802.11 b/g/n protocols. Standby power consumption is less than 0.1mW.

PERFORMANCE ANALYSIS

The developed system was tested with various subjects of different ages in different conditions. In the test cases, for heartbeat, body temperature, and room temperature sensors, we manually calculated the actual value and observed value from the developed system. Here, the room temperature sensor is used to measure the humidity only. From the data, we measured error rate to show the effectiveness of the system. The actual and observed data with error rate for heartbeat, body temperature, and room temperature sensors are demonstrated in

Table 1

Heart rate data collected by analog machine (actual) and developed system (observed)

Subjects	Actual data (bpm)	Observed data (bpm)	Error (%)
S ₁	67	68	1.49
S ₂	70	73	4.28
S ₃	74	77	4.05
S ₄	75	73	2.66
S ₅	73	72	1.36
S ₆	80	83	3.75

Table 2

Body temperature data collected by analog machine (actual) and developed system (observed)

Subjects	Actual data (°F)	Observed data (°F)	Error (%)
S ₁	97.3	97.8	0.51
S ₂	98.4	97.7	0.71
S ₃	98.1	98.6	0.50
S ₄	96.9	97.5	0.62
S ₅	97.5	97.1	0.41
S ₆	98.2	97.0	0.81

To analyze the deviation of data obtained by the developed system from actual data, Fig. 4 is depicted here. From Fig. 4, it is shown that there is some deviation between the actual and observed data. Figure 4a represents the data for heart rate which are collected using six different subjects of different ages in hospital environment. The deviation is occurred due to motion artifact which is caused by the movement of patients during treatment. Sometimes, the sensor is displaced that leads to inaccurate data. Moreover,

scattering of light from other sources causes deviation. The deviation of body temperature is found due to the miss-positioning of the system and environmental effect that is shown in Fig. 4b.

CONCLUSION

In this project, the prototypes provide the real time solution of observing the patient heart pulse rate with reliability. This system can be adopted in the general wards of the hospital to help the patients understand its performance and utilization. The processes of storing the data can be further used in many ways such as predicting the diseases, analyzing etc. using this system can reduce the adverse emergency for a patient to occur with the heart disease.

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