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Health Care Monitor with Emergency Support

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ABSTRACT

The world of medical science is an emerging area that has accelerated with new technologies and this is the time when the vision of "The internet of things" has turned into reality. People demand more care at reduced clinical costs, remote health monitoring is one of the possible solutions to this demand. Remote health monitoring can be best utilized provided the device is wearable to facilitate continuous self monitoring. In this paper, we propose a system for monitoring of pulse rate, body temperature and oxygen level in blood (vital body parameters) of the person with dedicated sensors along with electrodes using arduino. This system is wearable and also supports remote health monitoring. Remote Health monitoring is attained by storing the collected data to cloud and it can also viewed in an application. In case of any emergency, alert messages are sent to relative's phone numbers. This data can be retrieved by the doctor for analysis anywhere and any aberrancy will be timely detected. Along with remote monitoring and wearability of system, accuracy and cost cannot be ignored.

Keywords: *Sensors, Electrodes, GSM, Arduino*

1. INTRODUCTION :

The "Internet of things" - IOT is a concept and model consisting of sensors, actuators and development boards interacting with each other connected over the internet without any human intervention resulting into a more intelligent system. In simple words, IOT refers to a network of objects all connected to the internet at the same time. The main principle of Internet of things (IOT) is that the objects/things i.e. sensor nodes identify, sense, process and communicate with each other. IoT has a substantial influence in healthcare domain.

Still, there are so many people who do not have access to quality healthcare services, thus remote patient monitoring becomes a need. Presently Healthcare system is shattered with the lack of communication between the patients and the doctors. Thus to address this problem information technologybecomes a need. Healthcare services can be improved a lotwith IoT-enabled healthcare devices. By applying IoT concepts in healthcare, there is a great possibility of virtually saving the lives. E-health solutions based on IoT should provide worth information about health to the patients and the doctors can make better decisions irrespective of their patient's location. IoT has already brought changes in various domains of health care like intelligent healthcare tools and devices, diagnostics and monitoring of patients, data storage, transfer, and collaborations. Thus, a system consisting of wearable temperature, pulse rate sensor, electrodes along with arduino is designed. Once the data is received by the arduino board it will be sent to the cloud, the data stored in the cloud can be retrieved by the doctor and it can also be viewed in an application. Alert messages are sent to relative's phone numbers in case of any emergency. The proposed system will be really helpful in reducing a person's unnecessary visits to a doctor since the person's health monitoring is done on a real-time basis. Apart from this the diseases can be timely detected and treated; errors will be reduced as the data is stored at cloud automatically without human intervention.

2. Literature survey:

2.1: Resting heart rate estimation using PIR sensors

Pyroelectric infrared sensor (PIR) and Photoplethysmogram sensor (PPG) has a major role in estimating the resting heart rate and validation of the ambient sensor at a low cost. The derivative of the discrete – time PIR sensor is used in extracting heart beat signal. The major issue here is - the experimental results shows only 95% of the estimated heart rate values are within 4 beats per minute. Average measurements observed using the PPG sensor is 75.5 beats per minute and using the PIR sensor is 74.7 beats per minute.

2.2: Flexible heartbeat sensor for wearable device

A flexible strain – gauge sensor is majorly used and it is fabricated using a double – sided fabrication method with polymer and metal (polyimide and nickel – chrome). This sensor is compatible with flexible printed circuit board. It helps to detect a bending radius from 5 mm to 100 mm. When compared with the sensitivity of optical Photoplethysmography sensors (PPG) the flexible heart beat sensor is highly sensitive. By using this proposed sensor we can develop wearable smart devices which require heart beat detection and various other applications.

2.3: Spot and continuous monitoring of heart rate by combining time and frequency domain analysis of photoplethysmographic signals at rest conditions

The main target of this system is to develop a wearable device to calculate the Heart Rate at rest conditions. Calculating the heart rate with the help of thePhotoplethysmography sensors (PPG) gives 100% accuracy at the rest positions. This system gives result close to standard Electro Cardio Gram (ECG) device results. This accuracy fails when body movements are encountered in the system and this is one of the major issues.

2.4: Evaluating the accuracy of wearable heart rate monitors

Photoplethysmography sensors (PPG) are popularly used to determine the heart rate even though its accuracy is not 100% when compared with Electro Cardio Gram (ECG). This technology is used in wearable devices to monitor heart rate. When the results of Photoplethysmography sensors (PPG) and Electro Cardio Gram (ECG) are compared, they remain the same at rest conditions while a maximum of 10% variation is observed during body movements.

2.5: Evaluation of the accuracy and reliability for photoplethysmography based heart rate and beat-to-beat detection during daily activities

The study shows the results of using two wrist – worn devices namely PulseOn (PO) and Empatica (E4), by measuring the PPG based heart rate and inter heartbeat intervals. The accuracy and reliability are evaluated with respect to Electro Cardio Gram sensors (ECG) during different daily activities. There is a decrease in accuracy and reliability of the devices due to excessive hand movements. While at rest the percentage of correctly detected heart beat is 89% for PulseOn (PO) and 68% for Empatica (E4). During hand movements it is 76% for PulseOn (PO) and only 9% for Empatica (E4). PulseOn (PO) shows better inter heartbeat detection accuracy than Empatica (E4) in all activities.

2.6: Patient Monitoring System Based on Internet of Things

The main purpose of this paper work is to develop a solution based on ontology with ability to monitor the health status and recommendations of workouts with chronic diseases architecture. It uses glucometer and ECG signals to find glucose level in blood and pulse rate.

2.7: Health Care Monitoring System in Internet of Things (IoT) by Using RFID

RFID, NFC and small sensor nodes are used to here to find a person's pulse rate, bloodpressure, temperature, blood glucose level. Here all the sensors are connected to arduino and then to the Wifi module. So without internet connection, it is difficult to get the data.

2.8: Remote prescription and I-Home healthcare based on IoT

When the finger is placed on its sensor it measure the heart beat per second. Through the raspberry pi, the sensor readings are received and it can be displayed by monitor. If the patient's abnormal heart condition has not recovered within a certain time period, e.g., 10 min, the iMedBox will automatically send out a text message to the doctor.It will helps to doctors and

family members to Checking whether they are following their prescribed treatment on time by Real Time Clock (RTC) and RFID tags.

2.9: Remote health monitoring system for detecting cardiac disorders

The sensor transmits ECG data to the user's smartphone using Bluetooth. It is deployed as an Android Service. It supports seamless capture of 12-lead ECG data from HW6E via Bluetooth and transfers the data over HyperText Transfer Protocol (HTTP) using proprietary JavaScript Object Notation messages with 3G/wireless fidelity (Wi-Fi). It is capable of receiving notifications sent by the server and also has a provision for sending symptoms and demographic information.

2.10: Incorporating Health Monitoring and Duress Detection into Mobile Device Authentication

The work describes the use of Electroencephalogram (EEG) for authentication. When mature, this technology may be trusted to uniquely authenticate an individual using a single factor. It addresses the needs and constraints faced by first responders in the near term. It is an active approach that continuously monitors the user and fails authentication only when the user readiness status is deemed to be weak.

Tabular column:

S.No	Paper	Approach	Result	Issues
1.	Resting heart rate estimation using PIR sensors	Pyroelectric infrared sensor (PIR) and Photoplethysmogram sensor (PPG) are majorly used.	95% of the estimated heart rate values are within 4 beats per minute.	Heart rate can be calculated only during rest conditions.
2.	Flexible heartbeat sensor for wearable device	Flexible strain – gauge sensor is compatible with flexible printed circuit board.	This sensor detects a bending radius from 5mm to 100mm.	100% accuracy is not achieved.
3.	Spot and continuous monitoring of heart rate by combining time and frequency domain analysis of photoplethysmographic signals at rest conditions	Photoplethysmogram sensor (PPG) are majorly used.	100% accuracy at rest conditions.	This accuracy fails when body movements are encountered.
4.	Evaluating the accuracy of wearable heart rate monitors	Photoplethysmography sensors (PPG) are popularly used though its accuracy is not 100%.	Gives the same results when compared with ECG at rest conditions.	A maximum of 10% variation is observed during body movements.
5.	Evaluation of the accuracy and reliability for photoplethysmography based heart rate and beat-to-beat detection during daily activities	PulseOn (PO) and Empatica E4 (E4) are the two wearable devices being used.	PulseOn (PO) shows better inter heart beat detection accuracy than Empatica E4.	Empatica E4 gives only 68% accuracy during rest and only 9% accuracy during hand movements.
6.	Patient Monitoring System Based on Internet of Things	Internet is used as a medium for communication.	Constant monitoring by the doctor to the patients with chronic diseases and timely	There might be loss of internet connection during emergency.

			treatment being provided.	
7.	Health Care Monitoring System in Internet of Things (IoT) by Using RFID	RFID and Zigbee play the main role	The data from the sensors are uploaded to the cloud and mail is sent for alerting.	Without internet connection, cannot send alert messages.
8.	Remote prescription and I-Home healthcare based on IoT	RTC and RFID is used here	Heart beat rates are measured and sms is sent to doctor and family members	Internet connection is always required and does not show 100% accuracy
9.	Remote health monitoring system for detecting cardiac disorders	LED ECG sensors, Bluetooth and HTTP protocol	Early detection of acute episodes of MI	Does not give potential information about ECG signals
10.	Incorporating Health Monitoring and Duress Detection into Mobile Device Authentication	Kalman filters compute predicted values for variables	Continuously monitors and fails authentication when the user is weak	User will lose connectivity in remote areas

3. Conclusion:

From the review of different papers, it is concluded that there are various methods to collect and store data about the vital body parameters. But each paper contains issues and problems. Since PPG signals are not accurate during body movements, ECG should be used to find the pulse rate accurately. Alert messages are sent to both patients and relatives in case of emergency.

4. Future works:

When going to product level, this system can be compact and fit for everyday use.

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