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REALTIME PATIENT MONITORING SYSTEM USING IoT

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ABSTRACT

The study helps to improve the scope of IoT in Healthcare with a diverse range of enhancements. The study proposes Textile- based Wearable System Technology, Unobtrusive Biosensors, Intelligent Medical Boxes, and a Cloud Computing Architectural Framework amongst other technologies and advancement that would propel the Health Care Industry to unparalleled heights in terms of efficiency and Patients Comfort. The paper proposes to revolutionize the industry by real time exchange of data to seamlessly and proactivelyoffer prediction, diagnosis and remedies. The framework this paper proposes is aptly called the Internet of Medical Things (IoMT) which opens a whole new avenue for the Patient-Health Care provider Interface (PHI) and Wearable Health Technology(WHT).

Key words*:* IoMT, Cloud, IoT, HealthIndex, ThingSpeak, Smart Sensors, Arduino

1. INTRODUCTION

India, today, is confronted by an issue of the disproportionate ratio between Doctors and Patients. According to a latest report from the MCI (Medical Council of India), there are only a paltry 10 lac 40 thousand specialists registered in RIM (Register of India Medical). This relates to a specialists to patient ratio of around 1:1568 as compared to the WHO's (World Health Organization) ratio standard- 1:1000. One of key visions of the healthcare industry is to offer better healthcare to all people irrespective of where they are or what time it is. This should be done in a way which is more patient friendly and economic. To augment the patient care efficiency, we need to improve the patient-monitoring instruments. The healthcare industry, as of now, faces 2 issues in patient-monitoring- first, the need of doctors and care takers to be there at the bedside of the patient and second ,the patients limited to be dandwired to large monitoring machines.[1][12]

In order to accomplish malleable, mobile and responsive care of the patient, the problems which have been mentioned above need to be solved and because of the advancements in the fields of telecommunications and bio-instrumentation, it is even more practical to design a home-based monitoring system measuring the vital signs to display, accumulate, store and transmit the physiological data of the patient to the healthcare provider present in any location at any point in time.[15]

Surprisingly, inhabiting e-healthcare tactic has been achieved through wired conversations within notable fields, for example, network protocol and database in the healthcare sectors. There is an upsurge in use of the mobility characteristics[13][14] and wireless communication by the healthcare system and related advancements have allowed smart devices and appliances with appraising energy to take advantage of wireless sensor nodes. [2]

Aligned with the trend, a number of Internet of Medical Things (IoMT) devices measuring body conditions of humans have been introduced. The existing system is very isolated and outdated which causes lapses in communication, delayed responses, inaccurate data collection and processing, and miscommunication.[2]

2. RELATED WORKS

Mr.G.subramanya sharma and P.raga lavima discuss regarding the potential ZigBee possesses for the transfer of sensor values effectively in their paper. However, the ZigBee fails in the case where a continuous real time transfer of information is

required. [3]. Reduction of the sampling rate resolves the difficulty but at the same time affects the signal quality.

Geng yang, matti mäntysalo, li xie discussed an intelligent home- centric health platform with IoT which flawlessly links smart sensors for physiological monitoring and intelligent medical packing for daily medication organization [4]. Recently, the bio-patches (used in unobstrusive bio-sensors) have a lamination, that is, a skinny plastic insulation coating on the bio-patch to guard the conductive traces and for the exploration of new application scenarios to improve the electrical and mechanical reliability for this IoMT platform are open issues to workon.

Nigel H. Lovellv et. al. [7] displayed an approach for the procurement, retrieval, and storage of bio- medical signals through the web. The remote patient is to be monitored to record their pulse, blood-pressure, breath via a health-terminal. The records are conveyed to the hospital and stored at the database.

R. Shaikh et. al. used an ARM processor based approach, which worked in real-time for the collection and monitoring of ECG, temperature, and heartbeat data of patients [9].

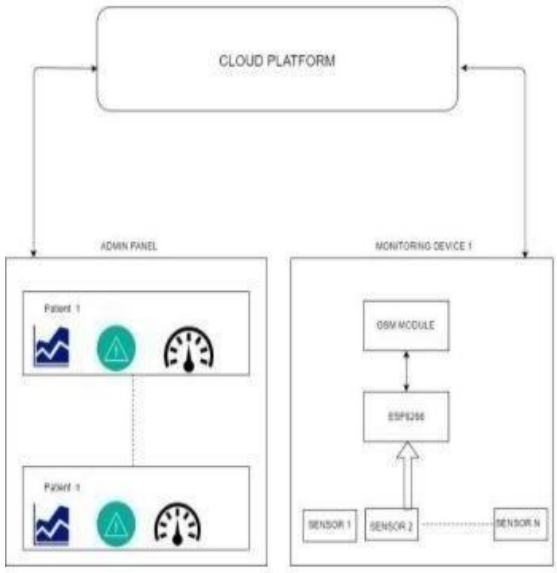
Current apprises of patients were sent to the healthcare provider using GSM and ZigBee wireless technology so that the healthcare providers can take the necessary action in time. A Wireless-Body Area Sensor Networks (or WBASNs for short) approach with the usage of ZigBee was described to monitor the location and health of the patient in[10].

A module, based on Radio Frequency, to collect the real-time data of soldiers in the combat zone was discussed by G. Raj et. al.[11].

3. PROPOSED SYSTEM

This proposed system consists of 3 modules: Cloud platform, admin panel, monitoring device. In monitoring devices it consist of various sensors , the microcontroller and a GSM module. And in admin panel it is having the number of patients.

In the cloud platform the database is recorded regarding the patients health details.



The GSM module is used to send SMS to doctors with the values of the report and the cloud is the database system which stores the health report of the patient's, from here using GSM sends it. The technology used here is IoT and the arduino IDE is used for programming and the proteus software is used for circuit designing.

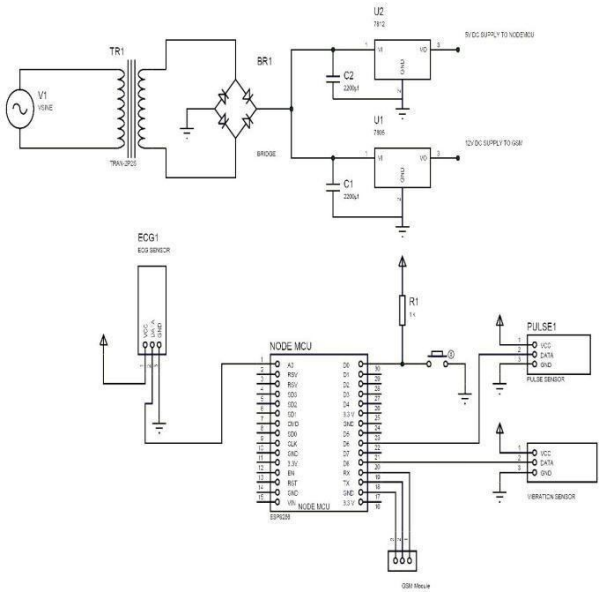


Figure 1: The architecture

Body Temperature Sensor

Arguably one of the most accurately affordable body temperature sensor, the DS18B20 was used to measure real-time temperature of the body (accurate to +- 0.5°C about the range of -10°Centigrate to 85°Centrigrate). These sensors may be placed at diverse places on the body such as under-arms, the forehead and, even, under- the-tongue due to its water-proof abilities. It comes with 3 wire, namely, VCC, GND, and DATA, attached to a single wire. These may also be integrated into clothing using textile based system technology. [3]

Table 1: Specification of The Body Temperature Sensor

Power Supply Range:	3.0V to 5.5V
Operating Temperature Range:	-55^0 C to $+125^0$C (-67 F to +257F)
Storage Temperature Range:	-55^0 C to $+125^0$C (-67 F to +257F)
Accuracy over the range of -10C to +85C	$\pm 0.5^0$ C
Size of Sheath:	6*50 mm
Connector:	RJI1/RJI2, 3P-2510, USB
Pin Definition	RED: VCC YELLOW: DATA BLACK: GND
Cable Length :	1 meter, 2m, 3m, 4m are available

Generally, these body temperature sensors contain a silicon sequential number, therefore, a great number of these sensors can subsist on the same single-wire conveyance. This allows us to put the DS18B20 in a broad domain of places. The body temperature sensor has various irreplaceable applications such as integrating HVAC natural controls, measuring the temperatures inside assemblies, equipment or devices, and procedure examination and control.[5]

Pulse Rate Sensor

A heart rate sensor attachment for Arduino, the Pulse Sensor Amped is basically a visual heart-rate sensor with noise-cancellation & enhancement technology allowing us to get effective readings of the heartbeat easily. Also, since the Pulse Sensor Amped tests control with current of 4mA drawn at a voltage of 5V, therefore, it is highly usable in mobile applications. To obtain the heartbeat of any person, you simply need to connect the sensor to the fingertip or the cartilage of the ear to the 5V pin, Arduino can be enabled to measure the heart rate of a person. The illustration code for Arduino Uno is easily accessible and in addition to that ,a sketch from Processing for displaying heart-rate data along with computing them to the respective heart- indexes. [5]

Features:

a. Diameter: 25/4'' (~= 16millimetres)
b. Thickness: 0.12'' (~=3millimetres)
c. Current Consumption = ~4mA at5V
d. Voltage =3V-5V
e. Cable Length = 24"(~609mm)

Essentially, the Heart Rate sensor is a Photo-Plethysmograph (PPG) that may be used to measure the levels of blood oxygen (SpO2). PPG provides us with the heart rate data represented by a voltage swing (analog).[5]

The Pulse Sensor can be used to measure:-

1. Pulse with the live heartbeat waveform
2. Heartbeat with thepulse.
3. Heartrate updated with eachbeat.
4. Time between theheart-beats

ECG Measuring Sensor

Utilised for the analysis of the ECG and the EMG, The AD8232 is an Arduino module used to monitor the Heart Rate. The Electrocardiogram sensor comes with 3 tips that can be positioned on different spots upon the body like the torso, limbs et cetera. The heart, through the heart muscle, is responsible for the emission & for generating the electric signals; it contracts and relaxes regularly for pumping of blood throughout every subsequent heart-beat. Depolarization is referred to as an instantaneous change inside the cell where the electric change

allows it to become positive till a brief period has elapsed. It begins with the pacemaker, which contrasting every former nerve cells that requires a stimulus to fire, spread out via the AVC node to the package of this fiber cells in the sinoatrial nerve (SAN) and to the fibers of purkinje and spiral down towards west via the ventricles. The SAN may be deemed self- oscillating/self-firing as it frequently emits the depolarization release and after that again repolarizes so that it can fire again. The SAN or the Sinoatrial Nerve may be likened to the functioning of the relaxation oscillators (RO). As a matter of fact, in pacemakers, the use of ROs is seen, which behave astonishingly similar to the SAN. The existing cell boundaries behave similar to the charge capacitors, the only difference being that the rate of charging and discharging is much slower in the existing cells which may be credited to the sluggish nature of the existing cells. The Electrodes which are placed in the bodyof the patient detect the miniscule changes in electrode potential that ascend

from the depolarization of the heartmuscles through each heartbeat on the skin in contrast to an antiquate tripled ECG, that perceives the electrodes positioned on the limbs and torso of the patient. In this, we have utilized the AD8232 heartbeat monitor kit (single lead) with Arduino Uno. This kit is suitable because it contains all the essential equipment. The Arduino Uno is only used to provide 3.3 volts of power-supply (to the board) and to transmit data to the private system (desktop/laptop). We can also utilize the energy from the ECD board through two AA-batteries and then view the same picture by attaching the oscilloscope. A computer deprived of the AC power is utilized for security causes. The ECG sensor contains everything that's essential for the extraction, amplification, and filtration of the small bio-potential. The EMG recordings for the electrical activity of muscles is processed as an analytical method. [5]

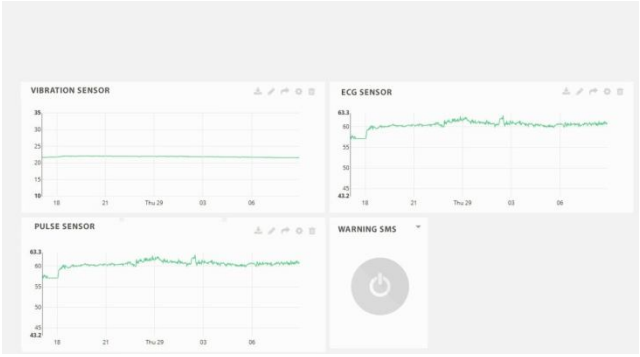
Vibrator Sensor

The Grove - Vibration Sensor (SW-420) is a high sensitivity non-directional vibration sensor. When the module is stable, the circuit is turned on and the output is high. When the movement or vibration occurs, the circuit will be briefly disconnected and output low. At the same time, you can also adjust the sensitivity according to your own needs.

GSM Module (SIM808A)

GSM Module is an entire Quad-Band GSM/GPRS module which mixes GPS technology for satellite navigation. The compressed design which integrated GPRS and GPS during a SMT package will significantly save both time and costs for patrons to develop GPS enabled applications. Featuring an industry standard interface and GPS function, it allows variable assets to be tracked flawlessly at any location and anytime with signal coverage.

4. EXPERIMENT AND RESULT



5. CONCLUSION

A system having increased functionality and efficiency is made with the help of the concept of Health Indexes, Arduino Uno, Respective Biosensors and ThingSpeak Server and Application Website.Space is maximised for critical cases which require immediate physical attention and care in hospitals

and clinics while the cases which just require regular check-ups are managed by the proposed system. An alert is sent to emergency contacts and respective

healthcare providers in case the Health Indexes exceed the normal values thereby leading to better prognosis thus preventing the illness before it takes an extreme form. The parameters measured have minimum error as everything is computed using the software thus minimising the ambet of human calculation error. Real Time Data is being provided to the hospice care specialists which enables them to make informed decisions and provide prediction-based remedies. The patient has the experience of special quality attention and is prioritised in the Health IoT framework. The framework leads to timely interventions, pre-emptive treatment, and improved accuracy in diagnosis and effective outcomes which further lead to a desirable rise in accountability thus, increasing the overall patient experience. Security and Data Theft is an issue which persists even after the inclusion of the unique API key. Also, for more patients, big data handling might be required to handle the enormous amount of data that is generated. For IoMT to become commercially and publicly available, a more user- friendly UI is desirable. A dynamic multimedia interface would also help to increase usage. Exploring various other sensors which can be attached to sensors other than the Arduino could also be looked into. Another area to be looked into could include these sensors to be integrated into apparel (such as ECG sensor in gloves) and the data be transmitted through Bluetooth (using the ESP8266, perhaps) so that it becomes much more convenient. Lastly, many other user-friendly automated functions could be added to the project (such as automatic ambulance calling in case of emergencies) so that it becomes even smarter.

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