

An IOT Based Health Monitoring System

S. Krishnaveni and M. Thirumagal

Abstract: *This project gives us the development of a microcontroller arduino based system for wireless heartbeat and temperature monitoring using IOT. By this we can easily provide real time information available for many users and can send them alert in critical conditions over internet. In India many patients are dying because of heart attacks and reason behind this factor is that they are not getting proper help during the period. To give them timely and proper help first we want to continuous monitoring of patient health and the heart rate. The system is developed for home use by patients that are not in a critical condition but need to be timely monitored by doctor or family. In any critical condition the alert is intimate to the doctor or any family member. So that we can easily save many lives by providing them quick service.*

I INTRODUCTION

The Internet of things (stylised Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.

In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate

within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020

Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid,^[13] and expanding to the areas such as smart cities.

"Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest to look at "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring.

As well as the expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.

The concept of the Internet of Things was invented by and term coined by Peter T. Lewis in September 1985 in a speech he delivered at a U.S. Federal Communications Commission (FCC) supported session at the Congressional Black Caucus 15th Legislative Weekend Conference.

IoT devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fitbit electronic wristbands or advanced hearing aids. Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. Other consumer devices to encourage healthy living, such as, connected scales or wearable heart monitors, are also a possibility with the IoT. More and more end-to-end health monitoring IoT platforms are coming up for antenatal and chronic patients, helping one manage health vitals and recurring medication requirements.

II RELATED WORKS AND EXISTING SYSTEM

a novel signal quality aware IoT enabled ECG telemetry system for continuous cardiac health monitoring applications. The proposed quality-aware ECG monitoring system consists of three modules: ECG signal sensing module; automated signal quality assessment module; and signal-quality aware ECG analysis and transmission module. The main objectives of this paper are: design and development of a light-weight ECG signal quality assessment method for automatically classifying the acquired ECG signal into acceptable or unacceptable class and real-time implementation of proposed IoT-enabled ECG monitoring framework using ECG sensors, Arduino, Android phone, Bluetooth and cloud server. The proposed framework is tested and validated using the ECG signals taken from the MIT-BIH arrhythmia and Physionet Challenge databases and the real-time recorded ECG signals under different physical activities. Experimental results show that the proposed SQA method achieves promising results in identifying the unacceptable quality of ECG signals and outperforms existing methods based on the morphological and RR interval features and machine learning approaches. This study further shows that the transmission of

acceptable quality of ECG signals can significantly improve the battery lifetime of IoT-enabled devices. The proposed quality-aware IoT paradigm has great potential for assessing clinical acceptability of ECG signals in improvement of accuracy and reliability of unsupervised diagnosis system.

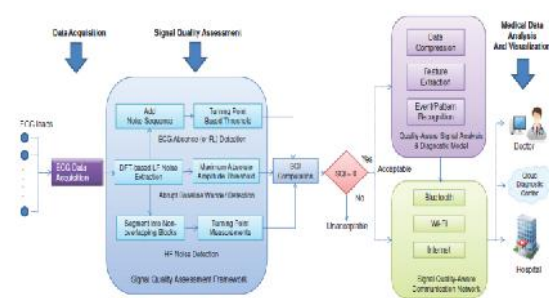


Fig.

The main modules of our signal quality-aware (SQA)-IoT framework are illustrated in Fig. 3. It consists of three modules: (i) ECG signal sensing module, (ii) automated signal quality assessment module, and (iii) signal-quality aware ECG analysis and transmission module. In this paper, we mainly focus on design and real-time implementation of automated ECG signal quality assessment method and validation of the effectiveness of the proposed SQA-IoT framework under resting, ambulatory and physical activity conditions.

The proposed automated ECG signal quality assessment (ECG-SQA) method consists of three steps such as flat-line (or ECG signal absence) detection, abrupt baseline wander extraction, and high-frequency noise detection and extraction to compute the signal quality index (SQI) for assessing the clinical acceptability of ECG signals. In this work, the ECGSQA is implemented based on the discrete Fourier transform (DFT)-based filtering, turning points and decision rules.

$X[k]$ denotes the k th DFT coefficient. The baseline component is extracted from the DFT coefficients having the frequency values below 1 Hz. The DFT coefficient index k for the component of F Hz is computed as $k = bFN/F_s$. The baseline wander signal is obtained as

$$b[n] = x[n] - \tilde{x}[n]$$

Fig.shows the baseline wander signal extracted from the ECG signal. From the results, it can be noted that the baseline wander exhibits high amplitude variation for short duration. Thus, the extracted signal is further processed to discriminate the abrupt baseline drift from slowly varying baseline wanders.

ECG Signal Absence Detection

Due to the disconnection of electrodes with skin and the electronic component saturation, sensing device exhibits the absence of ECG signal information in the acquired signal. In practice, we observe that the recording shows the presence of zero amplitude flat line (ZFL), only baseline wander (OBW), and the long pause with physiological and external noises. Existing approaches were developed for detection of ZFL event. In this work, we present a novel approach for detecting aforementioned noise events. Our approach is based on turning points (TP) which can be computed as mentioned in Algorithm

```

Step 1: For turning point calculation, we first compute both positive and negative slopes
which can be computed as,
 $SL = \begin{cases} 1: & \text{if } (x(n) - x(n-1)) > 0 \\ 0: & \text{if } (x(n) - x(n-1)) = 0 \\ -1: & \text{if } (x(n) - x(n-1)) < 0 \end{cases}$ 
Step 2: Then, for computing the local maxima and minima count all the positive and
negative slopes respectively. That is,
 $N_{ST} = 0; I = [];$ 
for( $i = 1 : \text{length}(SL)$ )
    if( $(SL(i) - SL(i-1)) < 0$  ||  $(SL(i) - SL(i+1)) > 0$ )
         $N_{ST} = N_{ST} + 1; I = [I, i]$ 
    end
end
Here,  $N_{ST}$  is total number of turning points and I contains indices of turning points.
Step 3: Now, compute the turning points (which are greater than  $\gamma_{TF}$ ) and their locations
as,
 $z = []; z[1] = 0;$ 
for( $j = 2 : \text{length}(I)$ )
 $z[j] = x(I(j)) - x(I(j-1));$ 
end
 $tp = 0; tp_{loc} = [];$  //  $tp \rightarrow$  turning points;  $tp_{loc} =$  location of turning
points
for( $i = 1 : \text{length}(I) - 1$ )
    if( $|z(i)| > |Thr|$ )
         $tp_{loc} = [tp_{loc}, I(i)];$ 
         $tp = tp + 1;$ 
    end
end
end

```

Fig: Turning point computation algorithm

The turning point with zero threshold can provide estimates of local maximum and local minimum points in the ECG

signal. The acquired signal may be considered as random if number of turning points exceeds the (2=3)th of length of a signal. This is the basis for ECG signal absence detection (or flat line detection). To compute the turning points, the value of H is set to zero. In absence of ECG signal, the recorded segment is classified as an “unacceptable”. The flat line detection (or ECG signal absence detection) algorithm is as follows:

1. Add uniformly distributed random noise of very small amplitude into the $\sim x[n]$, i.e., $s[n] = \sim x[n] + aw[n]$. The random noise is added into the signal to increase a number of turning points. The amplitude scaling a is set to 0:01 mV. In the absence of ECG signal, the noisy signal $s(n)$ results in a large number of turning points.
2. Compute the number of turning points (tp) for the noisy signal $s(n)$ with a threshold.
3. Apply decision rule for detecting the absence of ECG signal (or flat line segment),

$$SQI_{FL} = \begin{cases} 1 & t_p > 0.65M \\ 0 & \text{otherwise} \end{cases}$$

If $SQI_{FL} = 1$ then the segment is classified as a flat line or ECG signal absence segment. Otherwise the segment is further processed for detecting the presence of high frequency noises. In practice, a presence of sudden long pause event may be seen in the real-time ECG recordings due to the abnormal health condition of subjects. Therefore, the signal quality index information is stored/transmitted to the diagnostic server for each processed ECG segment. Furthermore, subject is immediately alerted when an absence of ECG signal is detected, like in the conventional ECG monitoring systems.

III PROPOSED SYSTEM

In this system, some vital parameters like temperature and heart rate is measured. Sensors are attached in this system thus it helps to take reading and display on your mobile or system. The Internet of things is increasingly allowing to integrate devices capable of connecting to the Internet and provide information on the state of health of patients and provide information in real time to doctors who assists it.

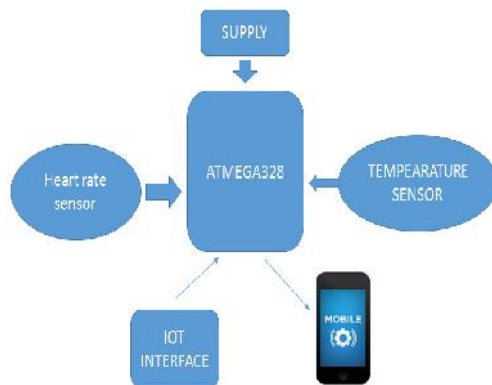


Fig. proposed block

ARDUINO

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world.

The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages.

The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be manufactured by anyone. Adafruit Industries estimated in mid-

2011 that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands.

Temperature Sensor (LM35):

LM35 is a precision IC **temperature sensor** with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 °C temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/°C.

Heartbeat/heart rate sensor

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

Two Ways to Measure a Heartbeat

- **Manual Way:** Heart beat can be checked manually by checking one's pulses at two locations- wrist (the **radial pulse**) and the neck (**carotid pulse**). The procedure is to place the two fingers (index and middle finger) on the wrist (or neck below the windpipe) and count the number of pulses for 30 seconds and then multiplying that number by 2 to get the heart beat rate. However pressure should be applied minimum and also fingers should be moved up and down till the pulse is felt.
- **Using a sensor:** Heart Beat can be measured based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes.

Principle of Heartbeat Sensor

The heartbeat sensor is based on the principle of photo plethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

SIMULATION RESULTS

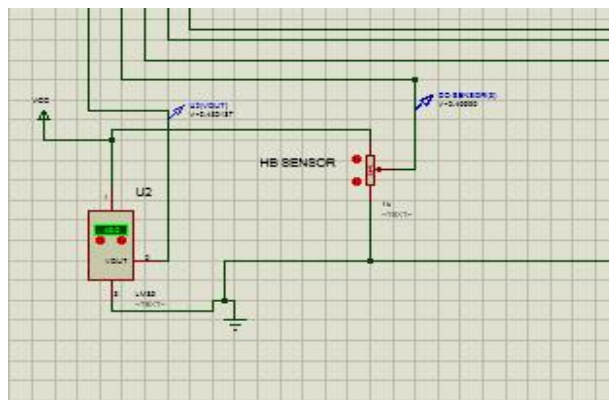


Fig. sensor unit

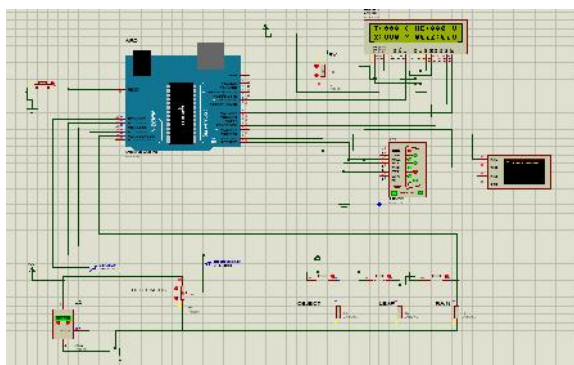


Fig. proteus design

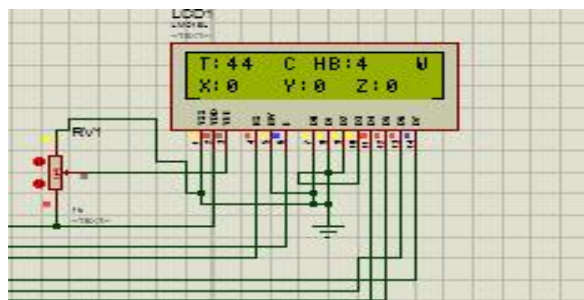


FIG. display unit

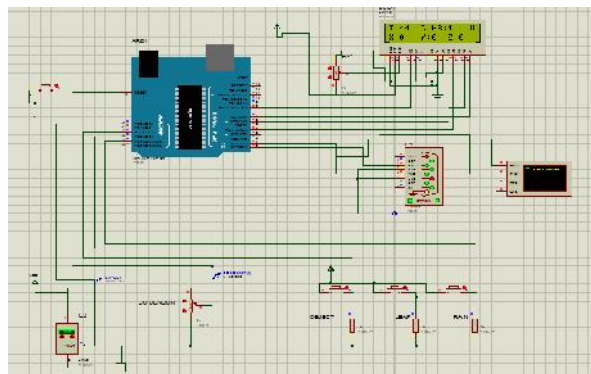


Fig. monitoring system

V CONCLUSION

As per this project, health monitoring system design is based on researcher idea that meets to the patients need. As per consideration of conventional system, this system still in use from their manufacturing but it is very bulky to handle individually and size and cost are also more compared to the advance system and also it take more than 1minute for getting the exact result. As per consideration of advance system, each system has its own advantage. Each health monitoring system has different specification as per patient’s requirement. This system provides more medical instrument facility on single system on-chip compare to conventional system. This system takes less than 1 minute to calculate result related to health condition. Size also reduces compared to the conventional system because of integration of number of medical instrument on single chip. So, size, cost and complexity also reduce.

Researchers designed health monitoring system as per patient's requirement. Because of wireless data transmission over internet (i.e) IOT, health related data will be send to doctor's personal computer or on his mobile. So, that the patient can get an immediate remedy related to their health condition.

S.Krishnaveni, PG Scholar

M.Thirumagal, AP/EEE

King College Of Technology

REFERENCES

- [1] D. He, and S. Zeadally, "An analysis of RFID authentication schemes for internet of things in healthcare environment using elliptic curve cryptography," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 72-83, 2015.
- [2] L. Catarinucci, et al., "An IoT-aware architecture for smart healthcare systems," *IEEE Internet Things J.*, vol. 2, no. 6, pp. 515-526, 2015.
- [3] R. C. Alves, et al., "Assisting physical (hydro) therapy with wireless sensors networks," *IEEE Internet Things J.*, vol. 2, no. 2, pp. 113-120, 2015.
- [4] M. T. I. ulHuque, et al., "Body node coordinator placement algorithms for wireless body area networks," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 94-102, 2015.
- [5] O. Omeni, et al., "Energy efficient medium access protocol for wireless medical body area sensor networks," *IEEE Trans. Biomed. Circuits Syst.*, vol. 2, no. 4, pp. 251-259, Dec. 2008.
- [6] B. Mortazavi, et al., "Context-Aware data processing to enhance quality of measurements in wireless health systems: an application to MET calculation of exergaming actions," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 84-93, 2015.
- [7] C. Tsirmpas, et al., "A new method for profile generation in an internet of things environment: an application in ambient-assisted living," *IEEE Internet Things J.*, vol. 2, no. 6, pp. 471-478, 2015.
- [8] O. Yurur, C. H. Liu, and W. Moreno, "Light-Weight online unsupervised posture detection by smartphone accelerometer," *IEEE Internet Things J.*, vol. 2, no. 4, pp. 329-339, 2015.
- [9] A. Ahmadi, et al., "Toward automatic activity classification and movement assessment during a sports training session," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 23-32, 2015.
- [10] S. Amendola, R. Lodato, S. Manzari, C. Occhiuzzi, and G. Marrocco, "RFID technology for IoT-based personal healthcare in smart spaces," *IEEE Internet Things J.*, vol. 1, no. 2, pp. 144-152, 2014.
- [11] P. Kolios, C. Panayiotou, G. Ellinas, and M. Polycarpou, "Data-Driven event triggering for IoT applications," *IEEE Internet Things J.*, 2016.
- [12] F. Bsching, and L. Wolf, "The rebirth of one-time pads secure data transmission from BAN to sink," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 63-71, 2015.
- [13] X. Qi, G. Zhou, Y. Li, G. Peng, "RadioSense: Exploiting wireless communication patterns for body sensor network activity recognition," *33rd IEEE Real-Time Systems Symposium (RTSS)*, pp. 95-104, 2012.
- [14] D. Tao, Y. Wen, and R. Hong, "Multi-column Bi-directional long shortterm memory for mobile devices-based human activity recognition," *IEEE Internet Things J.*, 2016.
- [15] P. Casale, M. Altini, and O. Amft, "Transfer learning in body sensor networks using ensembles of randomized trees," *IEEE Internet Things J.*, vol. 2, no. 1, pp. 33-40, 2015.
- [16] U. Satija, B. Ramkumar, and M. S. Manikandan, "Robust cardiac event change detection method for long-term healthcare monitoring applications," *IET Healthcare Technol. Lett.*, 2016.