An IOT Based Smart Medical Systems in Trains for Passengers

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***Abstract*- Among different modes of transportation, railway transportation offers excellent energy conservation, environmental protection and reduced time period. Invariably, this mode of transportation plays a serious role not only within the transportation of products, but also of passengers. Even many technological developments arise within the field of railways: healthcare remains not in concern. This paper proposes a controller based technique to offer care support to the emergency patient and therefore the details are going to be transferred to the loco pilot by implementing this system to save lots of the lifetime of emergency patient in travel. This paper approach an IOT based healthcare services during a medical emergency situation while travelling in train**

***Index terms*- IOT, Microcontroller, Heartbeat Sensor, Respiratory Sensor, Ventilator Mechanism, CPR Mechanism, Arduino**

I.INTRODUCTION

The railway is the lifeline of India and it is being the cheapest modes of transportation are preferred over all other means of transportation. When we go through the daily newspapers we come across many train accidents. Train carry over 20 million passengers and 2 million tons freight daily. About 15000 train's work every day, unfortunately, there have been many accidents involved in the railway. The review of train accidents of the last 5 years (2013-17) for which the data is available indicates that a large number of accidents happen because of derailments and at level crossing.

Internet of things is nothing but connection between a networks of physical devices through the internet. These devices can be smart phones, tablets, and laptops etc. almost anything, which includes sensor on it. In the recent years, the vast development of IoT makes all objects to be inter-connected. Some of the applications of IoT are home automation, smart city, smart environment, automated transportation, smart retail and health-care. IoT provides an extended development in health-care system, in the areas of patients care and communication. The major advantages of Internet of Things in health-care organizations are decreased costs, improved outcomes of treatment, improved disease management, reduced errors, enhanced Patient experience, and enhanced management of drugs. The children with Autism Spectrum Disorder faced challenges of communication and interaction with the society. Aarya - A Kinesthetic companion for children comes with a virtual environment based on IoT .Kinetic motion sensor receive the input in the form of gesture. Sensing the children's movement the virtual interfaces can help autistic children with their social skill. This application should also improve the healthcare system.

The major aspect in the health-care system is monitoring the patient's vital signs [6] such as temperature, oxygen saturation percentage and pulse rate. Pulse oximetry which is often referred to as SpO2 (saturation percentage of oxygen), is a non-invasive method of measuring a person's blood oxygen saturation percentage without pricking and taking the blood samples. Pulse oximetry allows physicians to assess and monitor a patient's respiratory functions with ease [8].

The personalized healthcare in smart homes is monitoring health information continuously for further processing forms the basis for smarter and connected healthcare system. The IOT architecture functionalities are served to the clients using Restful web service. The physical devices are interconnected with the wearable sensors and combing different sensor data to control the home automation devices for health sensor information [5]. Cloud Computing

is another highly used technology. It is also known as networks of networks and remote computing. This is adapted in most of the IT organization as it capable of handling demands based on its increased and decreased usage. So, cloud computing is known for its scalable characteristics. The main and common characteristics in cloud are on-demand usage, ubiquitous computing, resources pooling, scalability, and measured usage. Cloud system enables users to access data from anywhere. In this paper, data are stored in cloud to enable the doctors and guardians to view the patient's data up to date. Since the data are highly sensitive, security is more important, so that no intruders can modify the values. Nowadays, any cloud based organization that provides service for clients for data storage, are highly concentrating on the securing the data. The health cloud platform serves as promising solutions for combining big data from various sources like patient's health information, pharmacies, laboratories where the data can be monitored continuously [6]. It is a challenging work for cloud data providers especially in healthcare system as it should be available and feasible to access from anywhere at any time.

Fig.1. Characteristics of IOT

II. RELATED WORK

In recent times, the field of technology has attracted so much attention from people around the world. With technology being multifaceted, scientists and researchers have harnessed the opportunities offered by IoT in the field of the healthcare industry, as well as the practical challenges it faced [5][15]. Over the years, the application of internet-based technologies in healthcare rehabilitation has become more prominent, most especially after the introduction of new concepts, such as Smart City and Smart Planet [4][16]. Wearable body sensor devices are used in monitoring patient's vital signs from a distance which helps to save time and cost of transportation and improving healthcare [6]. According to the authors [7][12], the proposed real time human body vital signs monitoring system using Bluetooth, Wlan and Raspberry Pi is having the drawback in transmitting the patients data because WLAN and Bluetooth technology cannot travel a far distance and patient's data are not transmitted in real time to physicians. Patil & Umale [8] proposed a wireless biomedical parameter monitoring system based on Arduino using Zigbee. The main problem in this system is, the system is wireless and it can transmit the data within the range of 30 meters in an indoor non-line of sight environment and within 100 meters in line of sign environment.

Author Madhu & Rao [9] proposed, IoT based remote patient health monitoring system. The major problem is, in the case of emergency, email alert or SMS is sent to physician or patient relative thereby creating a gap between patients and physicians to monitor patient's vital sign in real time. According to the authors of [10, the proposed IoT-Based Ambulatory Vital Signs Data Transfer System has the drawback that the system produces enormous amount of data and need huge storage space. Also, some classification algorithms cannot classify large amount of data. Patient's data cannot be sent in real time because of batch processing. Swaroop et.al proposed a health monitoring system to monitor the vital sign of the patient based on Internet of Things. But the accuracy of the system is limited to the accuracy of the sensors. The cloud based patients record automation system proposed in does not monitor the records remotely.

Yeh, Kuo-Hui [11] introduced how security is implemented in IOT based on healthcare system. They succeeded it by using BSN (Body Sensor Networks). In these infrastructures, they have used two processes of Authentication that satisfies the security for IOT in securing the healthcare. They have developed this model using the raspberry pi-2 development platform. They say that the system efficiency can be further enhanced if the crypto-has-

modules are replaced by SHA-2 techniques. They have proved the robustness of their methodologies.

Gupta [12] developed a health monitoring system that is robust and intelligent to monitor the patient's health and collect the information like blood pressure, heartbeat rate and ECG using IOT. The patient or users can send these data to the doctor rather than visiting the doctor directly in the hospital. The hardware used by them is 2nd generation Intel Galileo board. This is an Intel quark based single board. It is an embedded board and Arduino certificated. This is an embedded system as it is designed to act as hardware and software and also pin compatible. This Intel Galileo board provides a Linux platform and supports SD card. The details are transferred to the database server. This data can then be accessed from any part of the world.

Jimenez [13] discussed on building an ad-hoc extensible monitoring system of patient's health. They have used low cost sensors and also used existent IOT technology as a platform for establishing a communication. They developed this monitoring system concerning to help elderly people. Their system is mainly on alerting patient's guardian or the physician if the any aged people is in need of medical aid. Also, they performed performance testing if the system is capable of handling multiple request at a time and also if the number of sensors are increased.

Xican [14] reviewed on new advancements in radar sensors design system that offers low power healthcare, indoor real time positioning and different applications in IOT. To improve the detection accuracy, detection range and power consumption they have proposed different radar frontend architecture and digital processing methods. Some of the recent developments are beam forming and duty cycle. They say that CMOS technologies are used for low power and low cost radar sensors that can further studied for developing applications using IOT and WSN. They have compared the different radar architectures.

III. METHODOLOGY

In this paper, approach a IOT based smart medical system for patients who travel in train. This system is designed for emergency cases. The system is based on ventilator mechanism and CPR mechanism. It has two sections namely, engine section and compartment section. Compartment system performs signal acquisition and detection of abnormalities, it has IOT module to transfer patient data to engine section. Engine section is used as an alert system.

A. COMPARTMENT SECTION:

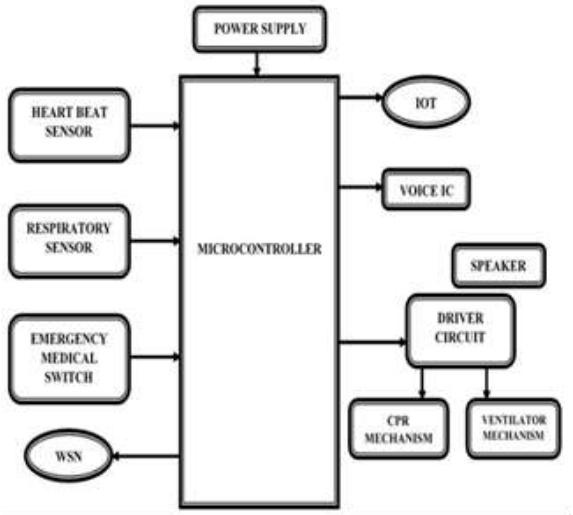

Fig 2:Block Diagram for Compartment Section

B. Engine Section

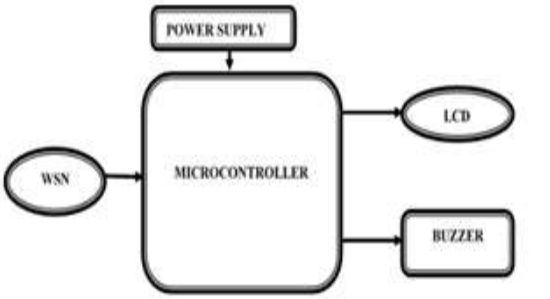

Fig 3: Block Diagram for Engine Section

C. Hardware Requirements

- Power supply
- Arduino Development Board
- Zigbee Module
- IOT module
- Heartbeat sensor
- Respiratory sensor
- Ventilator mechanism
- CPR mechanism
- Driver circuit
- LCD
- Voice IC
- Speaker

D. Software Requirement
- ARDUINO IDE
- Embedded C

IV. HARDWARE IMPLEMENTATION

A. Arduino Mega 2560

Arduino Mega 2560 consists of ATMega 2560 microcontroller which has 70 pins including digital and analog. Out of the 54 digital pins, 14 pins can also support PWM output (Fig. 4). It is operated at a clock speed/frequency of 16MHz. The Mega board can be powered in three ways: by connecting the Personal Computer or Desktop directly with the USB cable, via Vin pin of the board, or through an AC-DC adapter.

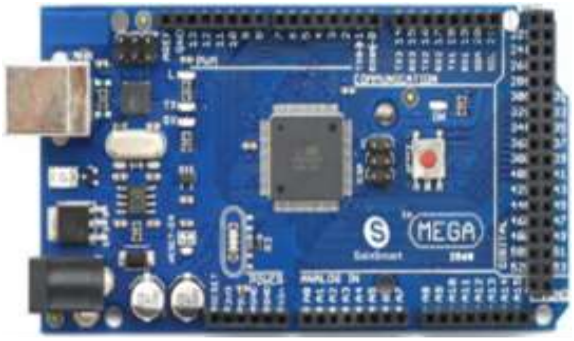

Fig. 4. Arduino Mega 2560 Board

B. POWER SUPPLY

The potential transformer will step down the power supply voltage (0-230V) to (0-12V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

C. Heart Beat Sensor

Heart rate is a window into your muscles and lungs as it reveals how hard they are working! The need for an accurate, yet affordable heart monitor is essential to ensure ones health quality. So here's a prefatory article to help you design/build a compact and cost-efficient heart rate (pulse rate) monitor that will provide an accurate reading of one's heart rate. Remember, your heart rate is a very good indicator of your physical condition.

The non-invasive type of optical heart rate sensor consists of an electronic circuit that monitors heartbeat by clipping onto a fingertip. It does this by shining light into (or through) the finger and measuring how much light is reflected (or absorbed). This goes up and down as blood is pumped through the finger.

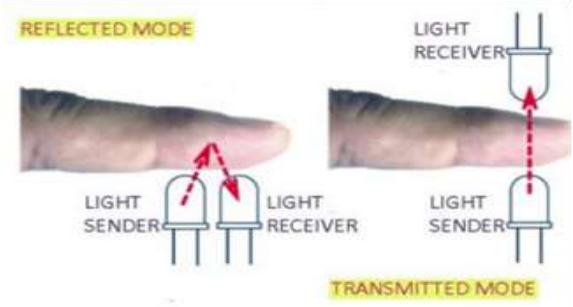

Figure 5. Heartbeat sensor

D. ZIGBEE MODULE

ZigBee is a low-cost, low-power; wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memories. ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates varies from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low rate WPANs.

E. Respiration Sensor

The Respiration Sensor is a sensitive sensor worn by using an easy fitting high durability woven elastic band fixed with a length adjustable webbing belt. It detects the chest or abdominal expansion and contraction and outputs the respiration waveform. This respiration sensor is latex-free, magnet-free, and

Velcro-free, and can be worn over clothing it helps to protect from pollution. Since the respiration sensor can be used with any sampling rate, this can be connected to any input of any encoder (with the exception of channel A of the Procom 2). Generally, this type of sensor is connected to an input with a lower sampling rate.

Fig. 6: Respiration Sensor with Face Mask

F. LCD Monitor (LCD-016M002B)

The Fig.7 illustrates the front view of LED monitor before its integration to the Arduino board. It is a 15 inches' monitor used in viewing resultant output from the system. It is a 16 × 2- character LCD, equipped with 5 × 8 dots with cursor, built-in controller (KS 0066 or equivalent), 1/16 duty cycle, B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED), N.V. optional for × 3v power supply. The LCD monitor displays the reading from the integrated sensors, such that users can see their vital sign reading in real time.

Fig.7 LCD Monitor (LCD – 016M002B)

G. IoT System

The complete system at work, with the corresponding user's vital signs (temperature and heartbeat) reading. Wi-Fi chip turned on and placed on the Arduino board, temperature sensor, buzzer light turned on, heartbeat sensor port for sensor connection; voltage regulators, capacitors etc are assembled properly. The buzzer is triggered when the patient heart rate exceeds a minimum or maximum reading threshold. The system is paired with IoT gecko; hence all the patient's reading is seamlessly relayed to the website via IoT, for viewing by healthcare providers.

H. WORKING

In proposed system, two different sections namely compartment and pilot sections. In the compartment section, when an emergency situation occurs then there will first aid set available in the compartments. While turning on the setup, it able to monitor the heartbeat and respiratory level of the patients through respective sensors. If any value goes beyond threshold value then the controller will give assistive support by prerecorded Voice from the voice IC. When the respiratory level comes down then the controller will give command to turn on the ventilator mechanism to give breath support to the patient. Likewise when the heartbeat range goes down then the controller will activate the CPR mechanism. During this state the emergency message will be sent to the loco pilot through WSN module. In addition to that patient health status will be uploaded in the web server through IOT module

V. RESULTS AND DISCUSSION

In the existing system, there is no new technique had been implemented till now to help the emergency patients in the train travel. Till now emergency wire pulling method is used to stop the train for emergency. But, by stopping train will increase the time to reach to the hospital. It will result in delay in process. Thus an automated electronic system for medical emergency condition during train travel is successfully achieved. This system provides preliminary medical support for patients before reaching railway station for providing further medical treatment.

Fig 8. Experimental Setup For Compartment Section

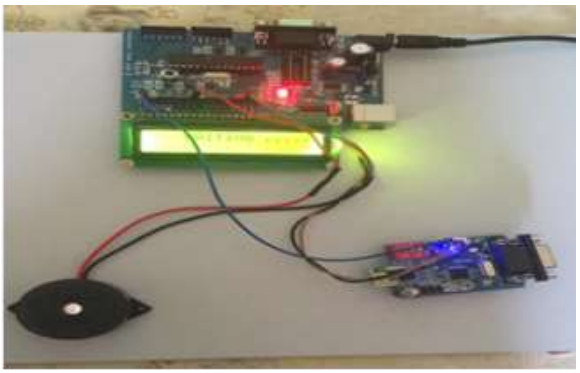

Fig 9. Experimental Setup for Engine Section

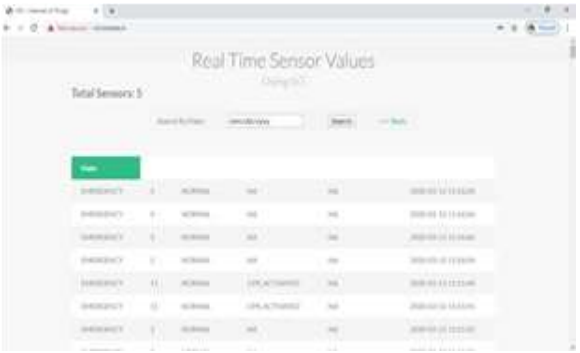

Fig 10:Iot Server Update

VI. CONCLUSION

The automated electronic system for medical emergency condition during train travel is successfully achieved. This system provides preliminary medical support for patients before reaching railway station for providing further medical treatment. IoT and cloud integration in healthcare provides safe and secured data's for the patients. The proposed system provides accurate data's, low cost system for monitoring the heartbeat and respiration rate for the train passengers. The system makes use of a single Arduino MEGA board and the sensors that makes the system a cost efficient and also useful. The system mainly focuses on the people to live a happy and healthy life and also on the security of an IoT device

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