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Intelligent healthcare and monitoring system using Internet of Things for railway passengers

Chandana T.
chandana.t.2016.it@rajalakshmi.edu.in
Rajalakshmi Engineering College, Thandalam, Tamil Nadu

Anugraha S.
anugraha.s.2016.it@rajalakshmi.edu.in
Rajalakshmi Engineering College, Thandalam, Tamil Nadu

Deepika U.
deepika.u.2016.it@rajalakshmi.edu.in
Rajalakshmi Engineering College, Thandalam, Tamil Nadu

Tamil Arasi K.
tamilarasi.k@rajalakshmi.edu.in
Rajalakshmi Engineering College, Thandalam, Tamil Nadu

ABSTRACT

Among different modes of transportation, railway transportation offers reduced travel time, dependability and excellent energy conservation. Invariably, this mode of transportation plays a vital role not only in the transportation of goods and commodities, but also helps in passenger itinerary. Many technological developments have ascended in the field of railways but healthcare is a major concern. Internet of Things (IoT) is a revolutionary technology that is being widely used to integrate advanced medical resources thereby offering effective health care services to human beings in an effortless way. In this project, we are proposing a controller-based technique to give first aid support in case of emergency, to the patients who are in immediate requirement of medical assistance. The abnormality is detected with the help of wearable sensors. Once the abnormality is detected, the first aid system is triggered to life. The information is transferred to the loco pilot who is in-charge of operating the train and the nearest station. Thus, with the help of this system, we will be able to save the life of patients in case of emergency during transit.

Keywords— *Internet of Things, Wearable Sensors, Immediate aid, Health Care, Railways*

1. INTRODUCTION

The Railway transportation is one of the biggest, cheapest and fastest mode of transportation that is ideal for long distance travel and movement of bulk commodities. In India, the rail network is widespread and tremendously massive and plays a vital role in socio economic life of the country. The Indian Railways is one of the largest rails.

Networks in the world. Indian Railways Catering and Tourism Corporation (IRCTC) endorses railways as a kaleidoscope of tourism across the country. Trains are preferred for short distance and long-distance journeys in India. Trains carry ginormous number of passengers from one station to another. With increased number of passengers travelling in trains that cover long distances, health care facility in trains is a requisite. Unlike Airlines, railways do not have a first aid mechanism to help passengers in trains who are in immediate need of medical assistance. One of the major technologies that helps in health care is the Internet of Things (IOT) which helps in attaining next-level health care services [13]. With the help of this revolutionary technology, we will be able to observe the vitals of the patient effectively and effortlessly. In this project, an Intelligent health care and monitoring system is being developed for railway passengers that incorporates the Internet of Things technology by making use of cost-effective sensors such as Pulse sensor and Respiratory sensor to check the vitals of human beings such as heart rate and breathing rate respectively. This is done with the help of WIoT (Wearable IoT) that aims at connecting the body-worn sensors with the medical infrastructure by unobtrusively enveloping the body to capture health-centric data [14]. The health-centric data are chronicled by the sensors in a continuous manner and are correlated with the essential physiological parameters and are communicated over the wireless network. This data is analyzed and further action of providing immediate medical help is carried out, such as giving CPR to a patient whose pulse rate and breathing rate are abnormal and it is predicted that the person will suffer from cardiac arrest within a few minutes. This will ensure the sustainability of life till the train reaches the nearby station where the physician will be able to carry out immediate diagnosis and treatment. Thus, with the help of this system, the patient's vitals are recorded and if any abnormality is detected, immediate relief measures are triggered thereby acting as a life-saver in times of criticality. This progressive technology will have a transformative impact in the life of passengers travelling in trains that cover long distances.

2. BACKGROUND

Latterly various systems were developed for health monitoring. Here are some corresponding works that deal with the health monitoring system. M. Satya and S. Madhan [1] developed a system using advanced sensors to continuously monitor the health of a patient. The collected information can be analyzed

to perform the early prediction of diseases. The sensors in the IoT are handled through the internet via the concentrator which can even be a smartphone. Uzzal Kumar Prodhan and Mohammad Zahidur Rahman [2] developed a toolkit for collecting patient's data. By using a developed application, the tool is controlled and data is sent to the server. The data are collected from patients through different sensors. The telemedicine tool consists of different components which are connected. A Visualization technique [3] was urbanized by Moeen Hassanalieragh, Alex Page and Gaurav Sharma to monitor, mine and aggregate the collected data of a patient. Sensors are used for the transmission of data to the gateway server through Bluetooth. Using cloud processing analytic visualization, the health professionals are assisted and the information's are stored. Ngo Manh, Saguna Saguna, Karan Mitra and Chester [4] created an IOT based [IReHMo] health monitoring system for smart regions to monitor the health of elderly people without a trade-off. AES encryption and AES decryption are used for the conversion of data. A mobile-based healthcare system was created by Sasipriya Saminandhan and K. Geetha [5] using a pattern matching algorithm for monitoring the patient's health condition and to forewarn the patient's state to the doctor. This system monitors the patient's health state and this technique can be deployed in wearable alert systems using Wireless Body Area Network [WBAN]. Using machine learning techniques, Srinivardhan Reddy, Sidaarth, Sai Aneesh and Dr. Rajashree [6], data are fed to the prototype for detecting any unusual behaviour in the patient's health. This system will trigger immediate relief measure and with the help of machine learning, it will identify the reason for the anomaly of the patient. An IoT based smart healthcare kit was designed by Punit Gupta and Deepika Agarwal [7] to provide emergency medical services. This device record, analyse and share a large data in real-time. This system gives effective medical service to the patient. Jeya Priyadharsan, K. Kabin Sanjay, S. Kathiresan, K. Kiran Karthik and K. Siva Prasath [8] deployed a modern technology (IoT, AI, Machine Learning), were patient health monitoring device was designed. The statistical study is executed from data collected inside the cloud from IoT device to evaluate the exactness in prediction percentage. Jerrold and Madankumar [9] created a temperature-based respiratory monitor using LMRD (Linshom Respiratory Monitoring Device) sensors. These sensors collect the data and compare it with fixed rates. Ananda Mohan, Halder and Hossian

[10] enhanced mobile devices to facilitate remotely caring. Mobile Technologies and Internet of Things makes it simple to track the patient's health status by sharing the details to the health care team. The information is shared in an authenticated manner. Amin, Jian Ping and Sha Nazir [11] deployed a Machine Learning based detection system for cardiac infraction prediction using heart rate datasets. A wearable strain sensor is designed by Michale and Thao [12] for measuring the respiratory rate and volume high accuracy.

Strain sensors are used on the ribcage and abdomen to measure the expansion and contraction of muscles during respiration. AEDs (Automated External Defibrillators) are regulated medical device, authorized for the use of non-medically trained individuals to treat sudden heart failure.

3. PROPOSED SYSTEM

We have proposed a resilient healthcare and monitoring system for Railway passengers that is smart enough to monitor the patient's condition automatically on clicking an emergency switch, through wearable devices and take the obligatory action with the help of an IOT Module that amasses the status information through sensors such as Pulse Sensor and Sound sensor to detect the breathing rate. If any abnormality is detected, it alerts the Loco pilot and the nearest station about the patient's criticality and it automatically and simultaneously invokes the CPR and Ventilation mechanisms. This model can be deployed in various compartments of the Indian trains that travel long distances. This system employs sensors that generate raw data and this information is analyzed for deviation, if detected, this information is passed to the loco pilot compartment through WSN Module. The CPR mechanism is spontaneously invoked and provides the Cardio-Pulmonary resuscitation based the respiratory and pulse rates. Our model makes use of Arduino UNO as the microcontroller which is based on the microchip ATmega328. This acts as the brain of the system by collecting the data through the sensors and transmitting the information to the loco pilot and the nearby station through Zigbee and Wi-Fi respectively thereby paving way for further immediate actions.

This model employs Pulse Sensor and Sound Sensor to measure the pulse rate and breathing rate respectively. The Pulse Sensor is a device that is used to measure the pulse rate of humans from their fingertip. The pulse is measured in Beats per Minute (BPM). The power supply of 5V DC is given to this device. Once the sensor comes in direct contact with the fingertip of the human being, it senses the blood circulation and converts it into electrical signals. The sound sensor recognizes the breathing pattern and senses whether the breathing rate is normal or abnormal. It also requires a power supply of 5V DC. This process is followed by amplification and noise reduction. The output of the sensors which will be real-time analog voltage signals is sent to the microcontroller and undergoes A/D conversion. Through microcontroller programming, the digital signal is processed and BPM is calculated. This value is then checked for abnormality with the help of a series of comparisons and the breathing rate of the patient is predicted to be normal or abnormal. The directions for using this system is delivered through Multi-section sound recorder/replay IC APR9600. It delivers single-chip voice recording, non- volatile storage and playback of about 40 to 60 seconds. It provides level activated recording and edge activated playback switches. It requires 25mA Operating current and 1µA standby current.

The data read from the sensors are analyzed and the information is communicated to the server and the engine section of the train. The Driver Circuit is established with ULN2003 Motor Driver IC connected with the Microcontroller to evoke the entire CPR mechanism as soon as the sensors' data are analyzed and the result of the analysis is negative indicating an abnormality in the patient's condition. This automatic CPR evocation will help in stabilizing the patient's condition to a certain extent without allowing the patient to slip into an unconscious and highly critical state.

In the engine section, another MCU is used which is integrated with an alarm and an LCD Display. The LCD display displays the compartment number which signalized emergency and the message that the patient is abnormal and requires immediate medical help. The alarm is used for getting immediate attention of the loco pilot and inform the loco pilot that the train should be stopped in the next station. The information is communicated to the engine section via Wireless sensor network module. Our model uses Zigbee as the WSN module which is a close proximity wireless ad hoc network. This low rate Wireless Personal Area Network (LR-WPAN) operating within the distance of 10m will help in transmitting the message to the

engine section from the compartment section. The model also employs an Internet of Things Module that is embedded in the system to establish connectivity with wireless networks and enable the transmission and reception of the data. Expressif's ESP8266EX that delivers highly integrated Wi-Fi SOC Solution allows the Microcontroller to connect to Wi-Fi and is used for communicating the data to the server through which the operator in the nearest station would be aware that an emergency situation has occurred and would carry out further necessary actions that are to be taken when the train reaches the station.

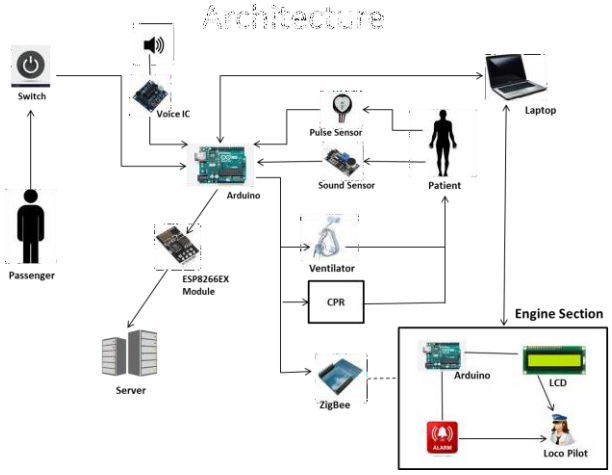

Fig. 1: Architecture of the intelligent healthcare and monitoring system

4. CONCLUSION

Providing a system that is convenient to use and ensures health safety is the most significant fragment in each and every long-distance transportation. With this project we aim to provide health safety of the passengers in trains with the help of a user-friendly and easily accessible system installed in multiple compartments. Automating the process of health monitoring and relief mechanisms through IoT is provided as a novel solution. Time is the most valuable asset that each one of us possess. This system also strives to achieve an optimal time for the entire implementation and also facilitates swift access. This system is what we need today owing to the increasing risks of unexpected health issues occurring to the passengers during travel.

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