Smart Health Data Transfer System

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Abstract— The Internet of Things (IoT) alludes to the inter-networking of physical gadgets, vehicles, structures and other things inserted with hardware, software, sensors, and network connectivity that empower these items to gather and exchange data. The main theme of the paper is to save a human life under critical circumstances. This paper comprises of two prototypes: (i) The Data Transfer Module which consists of Heart Rate sensor, Blood Pressure sensor, DHT11 sensor and Breath Rate sensor. These sensors are used for measuring the heartbeat rate, blood pressure, temperature and breathing rates of a person respectively. The data collected by these sensors will be sent from the ambulance to the hospital's server. (ii) The Health Monitoring Module which comprises of the web page for conveying the current updated status of the patients in the ambulance to the hospital. This web page comprises of two components, namely: Current readings of the patients and List of Recorded readings of the patients. By viewing these details the doctors can make prior arrangements in the hospital before the ambulance reaches there. This will reduce the time complexity and thus provides faster medical services.

Key words: Emergency Medical Services, Internet of Things, Heart Rate Sensor, Blood Pressure Sensor, DHT11 Sensor, Breath Rate Sensor

I. INTRODUCTION

The fast improvement of IoT innovation makes it workable for interfacing different questions, for example, sensors associating through the web and giving more information interoperability techniques to application reason. The Internet of Things (IoT) is the interconnection of extraordinarily identifiable inserted processing gadgets inside the current Internet framework. Crisis administration ought to be given effectively at the required time. He/she ought to be taken to the doctor's facility as prior as would be prudent and treatment as to complete quick to spare his life. The web page is a server application that enables the doctors to get an updated status of the patients which in turn enables them to make prior arrangements before they reach the hospital in the ambulance.

The idea of Internet of Things (IoT) was first presented by Kevin Ashton in 1999 [6]. IoT identifies with various unmistakable articles and their virtual depiction in the internet. The goal of IoT is to make a predominant world for the people [2].The IoT interfaces the physical environment and the virtual environment. It incorporates the growing transcendence of objects and components. The Internet of Things is the system of physical contraptions, vehicles, structures and distinctive things which are embedded with hardware, software, and sensor and system connectivity. IoT= Physical Object + Controller, Sensor, Actuators + Internet.

This paper is organized as follows. Section II illustrates the Related Works. The proposed work influences the utilization of Internet of Things in order to solve the problem faced by emergency vehicles. In the related works, a variety of methods have been prescribed by various authors to solve this problem. The major contribution of this work takes advantage of Region of Interest of vehicles in that locality, which is also time dependent and location dependent. In our proposal four types of sensors are being used, namely the heart rate sensor, the Blood Pressure sensor, DHT11 sensor and Breath Rate sensor. System methodology of Proposed Work is described in Section III; the Section IV illustrates the hardware implementation, the section V illustrates the Health Monitoring logic, the section VI illustrates the experimental results and section VII illustrates the Conclusion and future Enhancement.

II. RELATED WORKS

S.Pavlopoulos, E.Kyriacou, A.Berler, S.Dembeyiotis, D.Koutsouris proposed a methodology named, "A Novel Emergency Telemedicine System Based on Wireless Communication Technology—AMBULANCE" which enables early and specific prehospital administration to crisis case survival and a convenient restorative gadget that permits telediagnosis, long separation support, and teleconsultation of versatile medical services supplied by the doctors [1]. This system makes use of a GSM mobile telephony network in order to provide consultation services to the patients.

Poonam Gupta, Satyasheel Pol, Dharmanath Rahatekar, Avanti Patil proposed a system titled, "Smart Ambulance System" which collects the information about the location of an ambulance by means of the Global Positioning System (GPS) and plot the details on the Google maps [2]. This enables the users to gather information about the services provided various hospitals and send the patients data to those hospitals.

Veeramuthu venkatesh, M.prashanthkumar, V.Vaithayanathan, Pethuru Raj projected a methodology named, "An ambient health monitor for the new generation healthcare" which comprises of a module for transferring the patients health data to the doctor and the caretaker using Ambient Assisted Living (AAL) [3]. It also consists of a Ubiquitous Drug Indicator (UDI), for prescribing drugs to the aged persons, according to the data collected from the ambient devices.

Kumar Yelamarthi, Ahmed Abdelgawad, Ahmed Khattab presented a technique captioned, "IoT-Based Health Monitoring System for Active and Assisted Living" which enables services to enhance the lifestyle of the elderly persons [4]. It consists of a module which collects the data from the elderly persons and relies it to the cloud, where they are processed and analyzed. The feedback actions based on the data analyzed will be sent back to the user.

Prashant Patil, Rohan Waichal, Utkatsha Kumbhar, Vaidehi Gadkari proposed a system titled, "Patient Health Monitoring System using IOT" in order to minimize the deaths caused due to heart attack [5]. They designed an Android application where the data from temperature and heart rate sensors gets collected in the cloud and the medicines will be prescribed by the doctors accordingly. This application will also detect heart attack with respect to the inconsistencies in the data received and alerts the doctors and family members of the patients by sending a SMS.

Laxmi Bhaskar and Prof. Prabhakar Manage proposed a methodology captioned, "IOT based Patient Health Monitoring System using Raspberry pi 3" which monitors the heart beat rate and temperature of an individual using sensors and sends an alert message to the doctors over the internet and also alerts the caretakers by means of buzzer under extremely critical conditions [6]. This system makes use of sensors and Raspberry Pi 3 board in order to monitor the health status of the patients.

Shivam Gupta, Shivam Kashaudhan, Devesh Chandra Pandey, Prakhar Pratap Singh Gaur projected a technique titled, "IOT based Patient Health Monitoring System" for periodic monitoring of the heart beat rate and temperature of a person at home by using sensors [7]. This system is developed for home use by the patients that are not in critical conditions. In case of any critical conditions, an alert message will be sent to the doctors and family members through the SMS.

Arnob Senapati, Akash Maitra, Nilay Saha, Abhishek Kumar Kashyap, Binanda Kishore Mondal, Souvik Chatterjee presented an approach titled, "An IOT Based Portable Health Monitoring Kit" which uses sensors and arduino microcontrollers for monitoring the health details of an individual [8]. In case of greater fluctuations in the threshold of the readings the respective person and their family members will be notified by a SMS and a alarm and necessary actions will be taken accordingly.

AugustusE.Ibhaze, Francis E. Idachaba, Ezimah C. Eleanor proposed a methodology called, "E-health Monitoring System for the Aged" which checks the heartbeat as well as temperature of the patients simultaneously with the help of the heart rate and the temperature sensors by populating a centralized database with its reading of defined intervals [9].If the readings raises above a certain threshold value, then the readings gets transmitted using GSM, GPRS or GPS shield.. It also recognizes the location of the patients and uses gv powered battery.

Tess Antony, Meria M George, Nimmy Mary Cyriac, Sobin, Mathew projected a methodology titled," Patient Health Monitoring System using IoT and Android" which consists of a temperature sensor, Heartbeat sensor and accelerometer attached to the Arduino board [10]. The sensor parameters about the patient's health status can be viewed in the Android application by means of an Ethernet shield. This Android app will be installed in the doctor's Smartphone.

III. SYSTEM METHODOLOGY

The general style of the planned framework is represented in figure-3.1. This framework is actually partitioned off into 2 modules particularly, Data Transfer Module and Health Monitoring Module. Within the Data Transfer Module, the essential info concerning the patients within the ambulance will be collected by using the sensors and these data in turn will be transmitted to the hospital's server through the ESP8266 WLAN module. Within the Health Monitoring Module, the info collected from the sensors will be displayed in the hospital's webpage, which allows the doctors to visualize and analyze the conditions of the patients within the ambulance.

The hardware module is connected in the following manner: The electrical energy from the power supply is given to the 12 volt transformer. The transformer in turn sends the 12 volt current to the rectifier. The rectifier consists of capacitors, diodes, 2 voltage regulators (each 5 volt), and resistor. The capacitor which stores the electrical energy will supply the current to the voltage regulator, in case of any failure in transformer. When the current is passed through the rectifier, the voltage regulator will regulate the current to 5 volts. This 5 volt current from each voltage regulator will be transmitted to NodeMCU (Version 12). The NodeMCU, technically referred as ESP8266 is used for providing Wi-Fi connectivity to the entire module. The ESP8266 is connected to the DHT11, Blood Pressure, Breath Rate and heart rate sensors. The data collected from these sensors will get updated on to the web page portal at regular intervals of fifteen seconds.

The Fig. 1 and Fig.2 represents the Block Diagram and Architecture design for the planned system respectively.

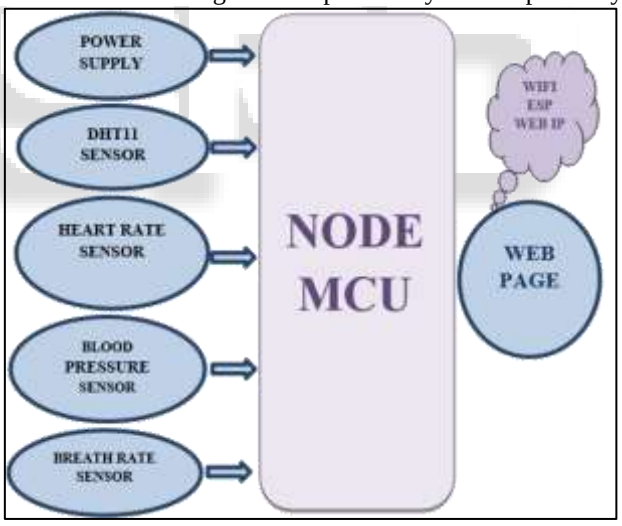

Fig. 1: Block Diagram

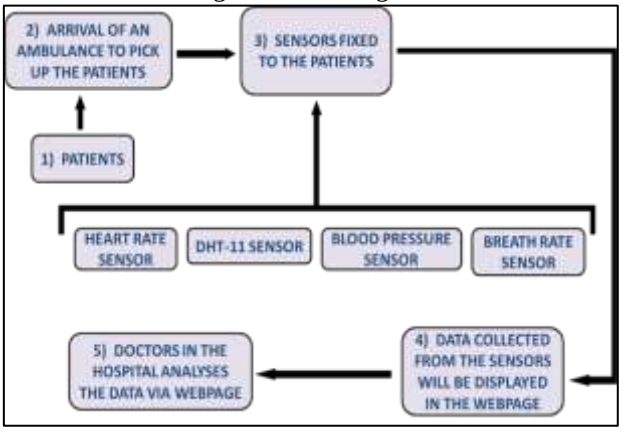

Fig. 2: Architecture Design

The real time working scenario of the proposed work is as follows. As soon as the patients enter the ambulance, the Emergency Medical Technicians (EMT) will place the DHT11, Blood Pressure, Breath Rate and Heart Rate sensors on to the patient's body. Each ambulance will be provided with a separate URL and the sensor readings will be updated on the webpage pertaining to this URL. This URL will be communicated to the nearby hospitals which in turn enables the doctors to view the patient's records and take actions accordingly before the ambulance reaches the hospital.

IV. HARDWARE IMPLEMENTATION

A. Node MCU

NodeMCU is what could be compared to Ethernet module. It is a Wi-Fi module which is used for establishing the interface among all the sensors. These highlights make the NodeMCU amazingly integral asset for WiFi organizing. It can be utilized as passageway as well as station and also has a web server to interface with web in order to collect or transfer information. It very well may be modified straightforwardly through USB port utilizing LUA programming or Arduino IDE. The ESP8266 module is associate degree IoT device involving a 32-bit ARM chip which facilitates wireless fidelity and it works in flicker memory. The Fig. 3 depicts NodeMCU. NodeMCU is a whole circumstance of hardware and software for IoT prototyping. It comprises of the following:-

- A controller board containing associate degree ESP8266 module.
- Small USB Port to regulate (5 volts) and programming.
- Ten propelled wellsprings of data GPIOs functioning at three point three volt.

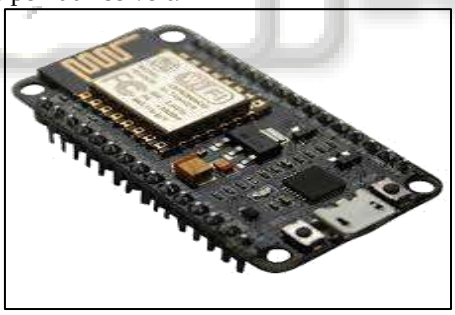

Fig. 3: Node MCU

B. Heart Rate Sensors

The Heart Rate sensor is a thumb-sized heartbeat screen intended for Arduino microcontrollers. It incorporates a Gravity interface, for direct fitting and play property. This heartbeat indicator is created based on PPG (PhotoPlethysmoGraphy) strategies. It is a direct and economical optical method that might be acclimated and it discovers consistently changing blood volume inside the little cylinder bed of tissues. The palatial component of the swaying can be clearly located in accordance with this hypothesis. The locator has 2 gaps that enable the patients to associate with the belt. This sensor can be wrapped on the patient's finger, wrist, ear flap or diverse regions wherever it has a contact with skin. The guts indicator has 2 types of flag yield mode: Similarity Beat Mode and Advanced Sq. Wave Mode. The Heart Beat identifier is designed to give a computerized yield of warmth beat once a finger is put consequently. The Fig. 4 portrays the Heart Rate Sensor.

1) Highlights

1) Microcontroller based for the most part SMD style.
2) Compact Size.
3) Working Voltage in addition to Five Volt Direct Current.

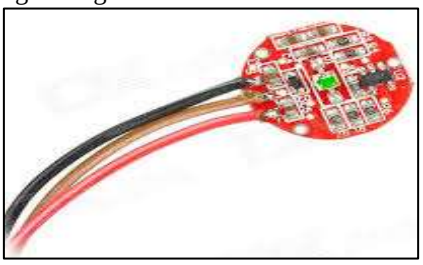

Fig. 4: Heart Rate Sensor

C. DHT11 Sensor

Temperature sensor is utilized to screen the human temperature. It is intended to provide the digital output of the temperature when the patient's finger is placed over it. The patient's prosperity condition will be recognized by the movements in the temperature. It consists of a NTC temperature identifier and an IC at the back of the indicator. For assessing the humidity of the patients in the ambulance. It makes use of the humidity sensing component that consists of 2 cathodes with sogginess holding substrate between them. Hence, in light of the fact when the humidity changes, the conduction of the substrate changes or the restriction between these terminals changes. This alteration in impediment is measurable by the IC that makes it arranged to be examined by a microcontroller. On the other hand, for evaluating temperature these identifiers use a NTC temperature sensor or a semiconductor unit. The DHT11 Temperature and Humidity Sensor includes an adjusted propelled hail yield with the temperature and humidity sensor complex. Its advancement ensures the high enduring quality and rich long run unwavering quality. This sensor joins a resistive component and a feeling of humidity NTC temperature assessing devices. The Fig. 5 depicts the DHT11 Sensor.

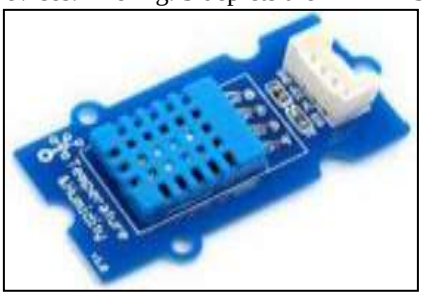

Fig. 5: DHT11 Sensor

D. Blood Pressure Sensor

Circulatory strain refers to the heaviness of the blood inside the arteries since it is directed round the body by the heart. At once when a patient's heart pounds, it contracts and pushes the blood through the arteries all over the body. This exertion makes a load on the veins. Circulatory strain is recorded as 2 numbers - the Systolic pressure (as the middle throbs) and the Diastolic pressure (as the inside loosens up between bangs). It doesn't remain the equivalent interminably. It changes to

manage your body's issues. It measures mean versus weight exploitation of the oscillometric framework. It is also used for estimating the beat rate. The heap extent of this sensor contrasts from zero millimeters to 258 torr. The conventional truth of this locator is +1 torr or -1 torr. The reimbursed temperature is -20 degree to +85 degree and accordingly the inertness is one msec. The working voltage of this indicator is +5 potential unit and 200mA regulated. The Fig. 6 portrays the Blood Pressure Sensor. It is used for measuring the Blood Pressure Rate of a person.

Fig. 6: Blood Pressure Sensor

E. Breath Rate Sensor

The Breath Rate sensor uses typical unnecessary buildup covers which gives stable yield deliberately. The Breath rate is measured by identifying the weight changes inside the duvet. Conductor from the identifier interfaces with the superfluous weight cuts of the duvet. The Breath Rate sensor gauges respiratory rate of the patients inside the ambulance. The data from this sensor is collected digitally and it is displayed in the hospital's webpage, where it is recorded for examination. This sensor recognizes every breath by discerning the gas drive in an exceedingly cloak worn by the point. The sensor chooses breath rate by assessing the time between exhalations. It yields 2 estimations: Breath Rate and Breath Rate Average. It ranges from five breath/minute to sixty breaths/minute. The Fig. 7 outlines the Breath Rate Sensor.

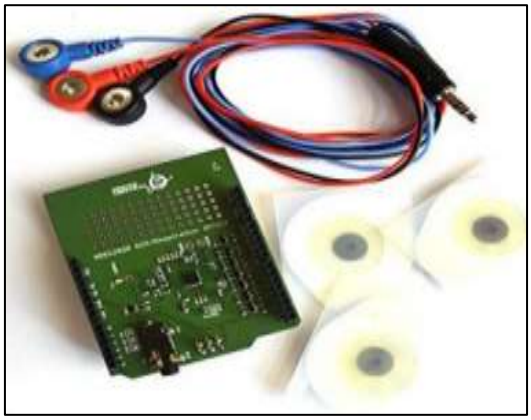

Fig. 7: Breath Rate Sensor

V. DATA TRANSFER LOGIC

As soon as the patients enter the ambulance, they will be fixed with the sensors on to their body. These sensors are used for collecting the important parameters such as heart beat rate, temperature, blood pressure and breath rate of a person in the ambulance. These parameters will be periodically sent to the hospital's server through the established IoT link which in turn will be displayed in the web page available at the hospital. Each ambulance will be provided with an unique URL by the hospital, by using which the webpage containing the details of the patients can be viewed. The doctor therefore can have a follow up of the patient's condition within the ambulance and make necessary arrangements in the hospital before the ambulance reaches. The ESP8266 Wi-Fi module plays a key role in transmitting the information from the sensors to the hospital's server. The Fig. 8 depicts the Hardware Setup.

Fig. 8: Hardware Setup

VI. EXPERIMENTAL RESULTS

A. Webpage for Displaying Patients Details

The webpage is developed by using PHP, HTML and MySQL. This webpage for displaying the patient's health data comprises of four main parts, namely:-

1) Login and Sign Up page
2) Readings page
3) Readings Download page
4) Recorded readings page.

1) Login and Sign up Page

The Login and Sign up page consists of the username and password where the users (doctors) can login into the website in order to view the patient's details. The new users can register by using the sign up option. The Fig. 9 depicts the Login Page.

Fig. 9: Login Page

2) Readings Page

The Readings page is used for displaying the present sensor readings of the patients in the ambulance and it gets updated periodically at an interval of 15 seconds. It displays the Temperature, Heart Rate, Blood Pressure and Breath Rate readings of the patients.

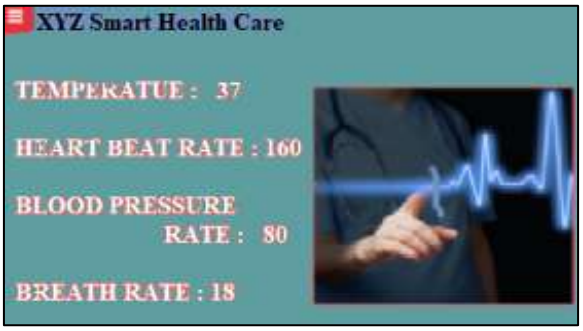

Fig. 10: Readings Page

3) Readings Download Page

The Readings Download page comprises of the Start date and End dates which when given, enables the doctors to download the health data within the prescribed dates. This helps the doctors to gain a detailed view on the patient's health condition.

Fig. 11: Download Page

B. Recorded Readings Page

The Recorded Readings page is an excel page which displays the entire readings that were recorded within the prescribed start and end dates. By using these collected data, the doctors can make prior arrangements for the patients in the hospital before the ambulance reaches. The Table. 1 portrays the Recorded readings.

S.NO	TEMPER-ATURE (^{0}C)	HEART BEAT RATE (bpm)	BLOOD PRESSURE RATE		BREATH RATE (Per Minute)
			SYSTOLIC	DIASTOLIC	
1	37	160	40	80	12
2	37.5	162	50	90	18
3	36	150	50	110	20
4	36.3	158	60	100	23
5	38	153	90	130	25
6	38.6	148	80	120	28
7	38.9	160	90	140	30
8	37.7	173	50	100	26
9	38	181	80	160	24
10	38.9	186	70	150	22

Table 1: Recorded Readings Page

VII. CONCLUSION AND FUTURE WORK

Human life is valuable and must follow safety in the real time applications. This application mainly depends on measures very conscious in all aspects. The need for present day emergency need is fulfilled with ease. Once it is implemented it will have great revolution in the emergency field. This basic concept can be upgraded and an ambulance itself can be made as equal to hospital. This system is easy to implement in the present day scenario because the project is upgraded version of the present model and there is no need for separate ambulance design for implementing this. Hence the time for implementation is made less.

This idea can be forwarded to ambulance manufacturing industries, where the module can be integrated with the ambulance during its time of manufacture itself. As there is no world without internet in the future, this will turn out to be a growing and trending one in the market. In future, additional features like GPS tracking can be implemented for traffic clearance. Once the ambulance feature is increased, it will be too possible to carry out a mini operation within the ambulance with the help of best doctors all over the world through video conference. Hence this intelligent ambulance leads to creation of a mini hospital in the ambulance itself.

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