INTERNATIONAL JOURNAL OF RECENT TRENDS IN ENGINEERING & RESEARCH
Impact Factor 4.101 ISSN -2455-1457
RECENT ADVANCES IN ELECTRONICS & COMMUNICATION ENGINEERING (RAECE-2K17)

INTELLIGENT AMBULANCE WITH TRAFFIC CONTROL FOR MONITORING THE BIOMEDICAL PARAMETERS

Umadevi Gurram[1],
Assistant Professor
Nalla Narasimha Reddy Group of Institutions,

G.Swathi,
Assistant Professor
Nalla Narasimha Reddy Group of Institutions

Abstract— This paper presents an Intelligent Ambulance system which enables wireless transmission of biomedical parameters along with the traffic control system to allow the ambulance to pass through traffic with ease. The system uses Global Position System (GPS) to track the location of the nearest hospital. It also establishes a wireless communication using Global System for Mobile Communications(GSM) connection between the ambulance and the hospital to transmit the Important Medical Parameters such as heart rate, body temperature and stress to the hospital. Those parameters help the doctors to analyze the status of the patient before reaching the hospital. The system also enables a doctor to communicate with the persons in the ambulance and give guidelines based on the patient condition. Main purpose of the system is to eliminate the delay caused in treatment of patients. To implement this system here PIC microcontrollers are used to interface all the units.

Keywords—Intelligent Ambulance, Global System for Mobile Communications (GSM), Global Position System (GPS), medical parameters;.

I. Introduction

India is the second largest populated country in the world. The traffic in major cities of India is increasing by huge proportions on a regular basis. Traffic congestion became a huge problem in metropolitan cities like Delhi, Mumbai, Kolkata, Bangalore etc. Ambulance services are widely affected by the traffic congestion. As the ambulances are not able to reach the hospital in time many lives have been lost inside the ambulance. As per the reports it is noted that it is due to the congestion. The vehicles on the road should give a way for ambulance to move fast. But sometimes the ambulance may get stuck at traffic signals which cause the delay to reach the hospital.

Here we propose an intelligent ambulance system with traffic control that could eliminate delay in the treatment of patients. Here we describe the system installed in the ambulance capable of locating the nearest hospital. Once the hospital is located, traffic signals can be controlled by the driver of the ambulance to reach hospital as early as possible. Health parameters such as heart rate, stress and body temperature are calculated and are transmitted to the hospital using GSM.

.

II. System Architecture

A distinctive feature of the presented system is, not only transmitting the medical parameters to the hospital for pre-medical care, but also intending to clear the route for an ambulance to reach the hospital quickly. The system also provides the nearest hospital's location co-ordinates to the ambulance. This system basically consists of three blocks

- Ambulance unit
- Traffic signal control unit and
- Hospital unit

A. *Ambulance unit*

The ambulance unit consists of various sensors to acquire medical parameters from the patient, an LCD, a GSM module to communicate with the signaling unit and the hospital unit and a GPS module. All these devices are interfaced to a PIC Microcontroller. The block diagram is shown in figure 1.

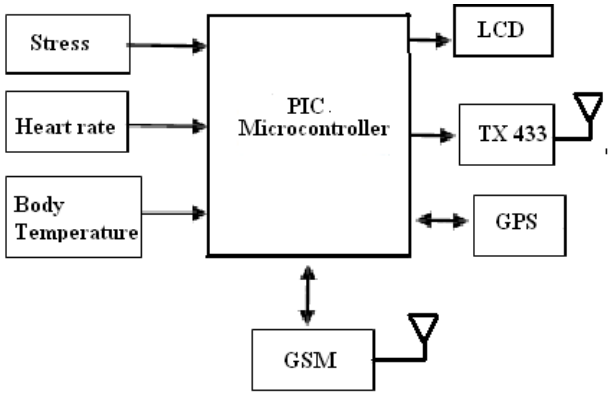

Figure 1. Block diagram of the ambulance unit

PIC16F18875: It is an 8 bit PIC microcontroller. It is a powerful easy-to-program CMOS flash based Microcontroller with RISC architecture. This product utilizes a 12-bit program word and provides the right amount of features including 14kB of addressable program memory size. It has 1024bytes of data memory size, 36 general-purpose I/O pins, two comparators, 35-channel 10-bit analog-to-digital (A/D) converter and one 5-bit digital-to-analog (D/A) converter. This device operates at a maximum frequency of 32MHz with wide operating voltage of 1.8 to 5.5V.

- ***Stress:*** Stress can be measured using stress sensor based on Galvanic skin response controlled by Zigbee [6]. A Galvanic Skin Response (GSR) device detects the different conductance of the skin when a person is under stress. It uses just two electrodes which are placed on the fingers and act as if they were the two terminals of one resistance

- ***Heart rate***: This parameter is measured using IR sensor based heartbeat sensor. IR sensor basically measures the reflected infrared light from tissue (photoplethysmography). Here we use the sensor TCRT1000. It consists of an infrared LED that transmits an IR signal through the fingertip of the subject, a part of which is reflected by the blood plasma. The reflected signal is detected by a photo transistor sensor. The changing blood volume with heartbeat results in a train of pulses at the output of the photo diode. The detected signal will be given to signal conditioning circuit and then microcontroller unit.

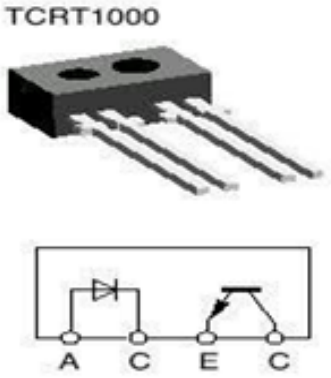

Figure 2. Heart rate sensor

- ***GSM:*** Global system for Mobile Communication or GSM module is used for communicating the ambulance unit with the hospital to send the acquired medical parameters. The doctor in that hospital can send prescriptions/messages back to the ambulance unit. Sim 900 module is used that provides 2.5G communication. It allows voice and text transmission with the frequency range of around 900-1100Mhz. GSM module is easily available and it provides support for various sim cards.

- ***GPS***: It is used to track location of an ambulance. After every short interval, the co-ordinates of the ambulance will be sent to the hospital so that the hospital will send nearest hospital locations to the ambulance. Therefore, a route is selected and all signals in that particular route is turned green.

- ***LCD:*** Liquid Crystal Display or LCD is used to display various parameters such as heart rate, body temperature and their abnormal conditions. It also displays text sent from the hospital and also the location co-ordinates.

- ***RF Transmitter Receiver section:*** It mainly consists of two modules called Transmitter (TX 433) and Receiver (RX 433). Transmitter module is used in the ambulance unit and receiver module is used at the traffic signal unit. It can cover a range of 100m. The modulation used in this is ASK type.
TX 433: It is a transmitter section which transmits the Radio Frequency signals of around 433Mhz. HT-12E is an encoder IC used for interfacing the microcontroller and TX 433. It converts parallel data from controller into serial data that can be transmitted through transmitter section. This section is used to transmit the control signals to the signaling unit making the traffic lights green in the required routes.

Figure 3. RF 433 Tx-Rx

B. *Traffic Signal control unit*

This unit mainly consists of a microcontroller and a receiver module. For controlling the traffic lights we are using 8051 family microcontroller AT89S52. RX 433 along with the HD-12D acts as receiver module.

- ***AT89S52***: It is a most commonly used 8 bit microcontroller. It turns traffic lights in to green in one route based on the signals transmitted from ambulance unit.

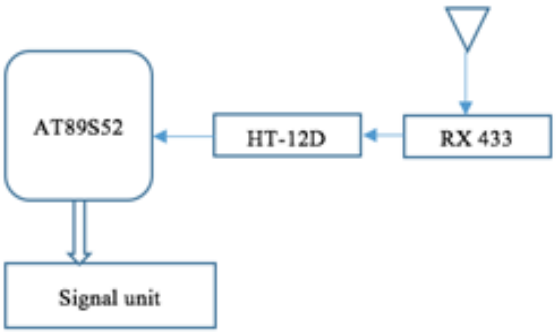

Figure 4. Block diagram of the signaling unit

- ***RX 433:*** It receives the signals from transmitted by the transmitter section through antenna and transfers to HT-12D which acts as interfacing unit. It decodes the signal and sends to the microcontroller for processing.

B.

C. *Hospital unit*

Hospital unit consists of a GSM receiver or a mobile phone. Doctors can receive text messages sent from an ambulance and then send a reply back to the ambulance.

The System flow chart is shown in figure 5. The proposed system consists of three sections. Firstly, the ambulance section which is used for acquisition of medical parameters and communication with the signaling unit and hospital unit. Second section is the signaling unit which is used to receive a signal from the ambulance and to control signals in the junction shown in figure 3. Final section is the hospital section through which doctor-patient communication is established.

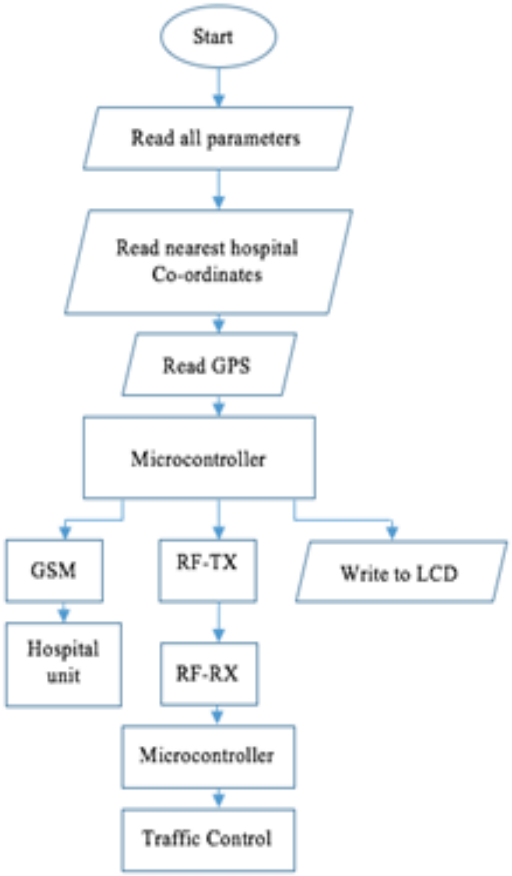

Figure 5. Flow diagram of the proposed System

III. Functional description

Temperature, stress and heart rate are measured using specific devices. These parameters are sent to the microcontroller for processing. Abnormal conditions are indicated on the LCD display. These conditions are sent to the hospital with the help of GSM module. Based on the status of these medical parameters, doctors can prepare themselves to perform medical procedures on the patient before the patient even reaches the hospital. GSM module is programmed using attention commands. The messages are sent to the respective doctor whose mobile number is programmed into the GSM module. When driver arrives at the location of the patient, on pressing a button, the co-ordinates of the nearest hospital is sent to him. Based on these co-ordinates driver selects a route to the hospital.

All the signal junctions in the selected route are turned green in the favor of the ambulance. The RF transmitter section in the ambulance communicates with the signal junction. When the ambulance is within the 100m range, signal in that particular road is released thereby eliminating the traffic congestion. The GPS module tracks the current location of the ambulance and transmits this location to the hospital on a regular basis. The latitude and longitude co-ordinates of the nearest hospital is sent to the current location so that driver can decide on a route. All the signals in this particular route are turned green for the ambulance to pass through with ease. If the selected route has a railway gate which is closed, pre-communication takes place using RF to indicate the driver to take a different route thereby avoiding further delay. In case of critical emergencies, doctors can contact or send instructions to the paramedics present in the ambulance to provide pre-medical care to the patient. The ambulance also comes with an accident detector attached at the front. On any impact, the location co-ordinates are sent to the hospital saying "Accident detected at the corresponding location".

IV. Software requirements

- ***Keil µVision4***: It is an Integrated Development Environment (IDE) that combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. This tool is easy-to-use and accelerates our embedded software development. µVision supports multiple screens and allows us to create individual window layouts anywhere on the visual surface. This software is used to generate the required hex file for the written program [9].
- ***Proteus***: This software tool is a design suite used to design the circuits and to verify the output virtually on the screen. This software provides various set of libraries that includes all the required components to build the circuit. A hex file or a debug file generated by keil software can be virtually dumped on to the microcontroller part on the schematic and the animated outputs can be observed. The designed circuits then have to be imprinted on the PCB
- ***Wellon VP-290***: It is a universal programmer kit which is used to load the program on to the microcontroller of any type. Hence the same software is used for both 89S52 and PIC microcontrollers. The hex file created by Keil will be embedded on to the chip.
- Two programs are written for two microcontrollers. One program is required for the ambulance section and another program for the signal section to control the traffic light.

V. Result

The prototype shown in the figure 6 was able to function as intended. Various medical parameters like heart rate, body temperature, and stress were successfully collected and fed to the microcontroller. Those parameters along with their conditions were displayed on the LCD. This was later sent to the hospital unit through GSM networks. The suggestions sent by the hospital unit was also received and displayed on the LCD unit. The nearest hospital's location co-ordinates were sent to the ambulance unit to set a route. Apart from this, the ambulance unit was able to communicate with the signaling unit effectively over a 100m range. On receiving the notification from the ambulance, the signaling unit also turned the traffic light green in that particular route. The signal values are tabulated as shown in Table 1.

TABLE 1. Response of The signaling unit

Distance of Ambulance from the junction	Red Signal	Yellow Signal	Green Signal
150 meters	On	Off	Off
100 meters	Off	On	Off
99 meters	Off	Off	On

Under emergency situations like the railway gate being closed, communication was established and the ambulance was notified to take a different route. On applying pressure on the accident sensors, a message saying "Accident detected" and the corresponding latitude and longitude co-ordinates were sent to the hospital.

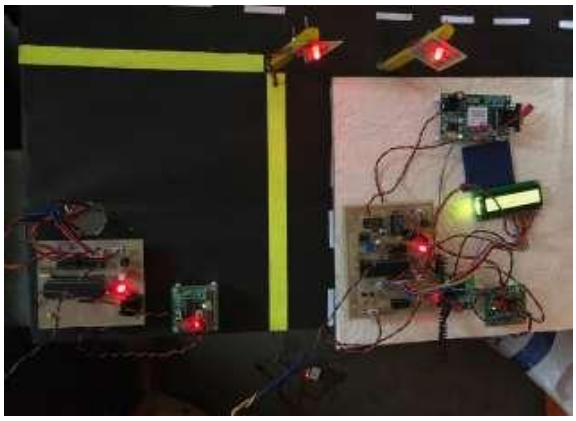

Figure 6. Prototype after completion

VI. Conclusion and future-scope

The proposed system eliminates the significant delay that usually exists in treatment of patients. The system successfully helps the ambulance to avoid traffic. And due to the communication between doctor and patient, doctor can analyze patient's condition before reaching the hospital. Despite the advantages, there are some limitations to our proposed system. Since RF transmitter-receiver is used, there can be obstructions and 100m range might reduce. Since we are using GSM for communication there can be network drops which would halt communication between both ends. The proposed system can be subjected to various upgrades. Video live stream can be implemented so the doctors could see patients and provide necessary treatment. Various other parameters like blood pressure, blood oxygen level etc. can also be measured and sent to the doctor wirelessly.

References

[1] Jurgen, R.K., "Medical electronics: Ultrasonics in medicine: Strong; getting stronger: Two- and three- dimensional imaging breakthroughs may spark the next generation of ultrasonic imaging systems," Spectrum, IEEE, vol.11, no.8, pp.62, 66, Aug. 1974

[2] S. Pavlopoulos et al., "Emergency telemedicine applications using mobile andinternet communication links - The AMBULANCE Project", Proceedings of EURO-MED NET 98 Conference, Nicosia, Cyprus, pp. 281-282, 1998

[3] F. Castanie, C. Maihes, and M. Ferhaoui, "The U-R-Safe project: A multidisciplinary approach for a fully 'nomad' care of patients," in "IST Project Report," IST-2001-33352, 2002.

[4] Hung, K., and Y.T. Zhang. "WAP In Physiological Monitoring". 2001 Conference Proceedings of the 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (2003): n. pag. Web. 19 Mar. 2017.

[5] Hu, Chao et al. "Wireless Acquisition System For The Real Ambulance Field". International Conference On Robotics And Biomimetics.Bangkok, Thailand: IEEE, 2017. 1083. Print.

[6] Villarejo M.V., Zapirain B.G., Zorrilla A.M., "A stress sensor based on Galvanic Skin Response (GSR) controlled by Zigbee", PubMed Central, Sensors 2012; 12:6075–6101. doi:10.3390/s120506075 [Online] Available: https://www.ncbi.nlm.nih.gov/pmc/ articles/PMC3386730/

[7] Rahnema, M. "Overview Of The GSM System And Protocol Architecture". IEEE Communications Magazine 31.4 (1993): 92-100. Web. 19 Mar. 2017.

[8] MAZIDI &MAZIDI, "8051 Microcontroller and embedded systems (2nd Edition)", Prentice Hall Publications, 2009.

[9] "Keil Embedded Development Tools For ARM, Cortex-M, Cortex-R4 8051, C166, And 251 Processor Families.". Keil.com. N.p., 2017. Web. 18 Mar. 2017.

