

Intelligent Ambulance with Traffic Control

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Abstract-Now-a-days considering the fast moving world scenario especially in large cities many services get delayed due to traffic jams. Ambulance service is one of the crucial services that get delayed very often. Also sometimes on-sight doctors are not available. So the patient does not get medical attention immediately. To overcome this situation this paper describes a solution that is 'Intelligent ambulance with traffic control' which includes intelligent traffic controlling as well as a health monitoring system. In health monitoring system, the patient's vital health parameters such as ECG, Heart Rate and Body Temperature are monitored. For ECG measurement, a 2-lead Electrode Electrocardiogram technique is used. Heart Rate measurement is done using photoplethysmography method. LM-35 is used to measure the patient's body temperature. These parameters are sent to a PC in ambulance via serial communication and this data will be sent to the hospital server. In traffic control part an RF transmitter on the ambulance will communicate with the RF receiver mounted on the signal post. An algorithm is used to control the traffic signals automatically based on the key pressed by the driver from keypad in the ambulance.

Keywords- Intelligent Ambulance, microcontroller, Traffic Control

I. INTRODUCTION

Today's world is developing at a very high speed. Everyday a new technology is discovered. However at the same time everyone is facing many problems in these smart cities. Some of these problems are health issues as well as high traffic jams in big cities. Traffic congestion causes many adversary effects on countries transportation. Ambulance service is a service which gets widely affected because of these traffic jams. If there is a delay in reaching of ambulance to hospital, a patient may lose his life. This is a very serious problem in case of the heart attack patients. A direct clot removal in Heart attack patients becomes possible if the electrocardiogram is analyzed by a cardiologist. This system transmits the ECG at a regular time intervals to the hospital [1].

Also the vehicles on the road have to make way for the ambulance. But sometimes, the ambulance gets stuck in the traffic which in turn wastes a lot of time. Hence to overcome all these situations a solution of 'Intelligent ambulance with traffic control' is proposed in this paper. This paper describes monitoring of health parameters of the patient in ambulance and transferring these to the

hospital [1]-[4] and at the same time traffic lights are controlled by the driver of ambulance to reach hospital as early as possible [5]-[8]. Health parameters such as ECG, Heart rate, body temperatures are calculated by hardware and further using serial communication are stored in PC present in ambulance through which they are transferred to hospital. For traffic controlling purpose RF communication is used. Traffic density is also considered while designing the algorithm to control the traffic lights. Embedding of health

Monitoring system and traffic controlling system may lead to save one precious life.

II. BLOCK DIAGRAM

The following two systems are combined in this paper. Data acquisition will take place in Health monitoring system and parameters will be sent to the hospital server via PC. The driver of the ambulance will be able to control the traffic signal from a keypad present in the ambulance.

A. Health Monitoring System

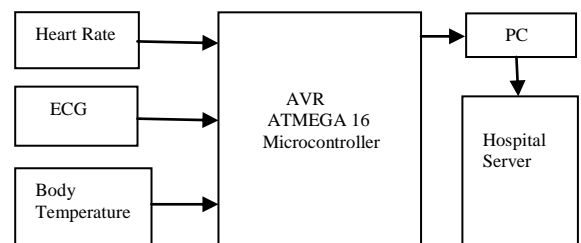


Figure 1: Block diagram health monitoring system

B. Traffic Control System

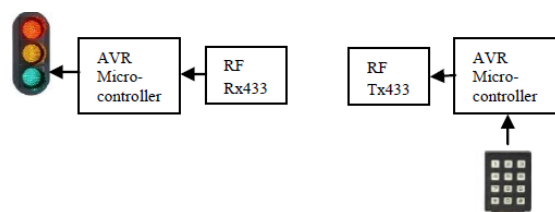


Figure 2: Block diagram of traffic control system

Both health monitoring and traffic controlling systems will work simultaneously. Patients health parameters are monitored by doctor in hospital and at the same time driver of the ambulance can manipulate the traffic signals.

III. HEALTH MONITORING

A. ECG(Electrocardiogram)

ECG is an electrocardiogram system in which electrical activity of the heart is recorded via electrodes placed on body. Here 2-lead Ag-Cl electrodes along with conducting gel (to reduce the skin resistance) are used. ECG signal is of a very small amplitude (1mV-5mV).Electrodes measure the impulse signals (Bio-potential signals) generated by the heart which are transferred to the surface of the body.

a. System block diagram

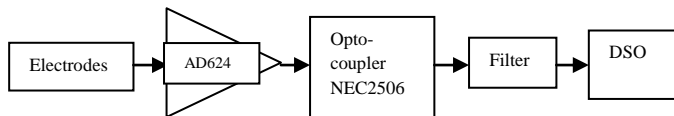


Figure 3: Block diagram of ECG

AD624AD is an analog instrumentation amplifier IC used to amplify signals generated due to contraction and relaxation of heart. The AD624 is set up with a gain of 1000, and is supplied by +9 V and -9V power supply. Opto-coupler NEC2506 is used to isolate the input of amplifier from the rest of the circuitry. Band pass filter containing low-pass and high-pass filters are used with the RC & time constants as follows:

b. Filter Design

TABLE I: Filter Design

Parameter- > Type V	R	C	Time constant t	3-DB Frequency
Low pass filter	4MW	1mF	4 sec	0.04 Hz
high pass filter	10KW	0.1mF	0.001 sec	159 Hz

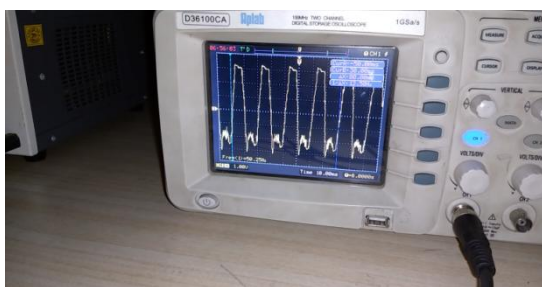


Figure 4: ECG measurement

B. HEART RATE

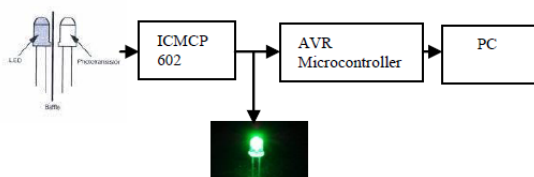


Figure 5: Block diagram of Heart Rate measurement

Heart rate measurement gives the rate at which blood is pumped from the heart per minute by the human cardiovascular system. This technique demonstrates how to measure the heart rate by sensing the change in blood volume in the finger blood vessels. 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 diode sensor. The changing blood volume with heartbeat results in a train of pulses at the output of the photo diode, the magnitude of which is too small to be detected by a microcontroller. Therefore, a two-stage high gain, active lowpassfilter is designed using two Op-Amps to filter and amplify the signal to appropriate voltage level so that the pulses can be counted by a microcontroller. Heart rate is the number of heart beats per minute (bpm). In adults, a normal heart rate is about 60 to 100 beats per minute during resting condition. The resting heart rate is directly related to the health and fitness of a person. The most common sites to measure the heart rate are wrist and neck. We can count the number of pulses within a certain interval (say 15 sec), and easily determine the heart rate in bpm.



Figure 6: Heart rate measurement

Gain of each stage is given by an equation

$$G = (1 + \frac{R_f}{R_1}) \tag{1}$$

Cut off frequency is given by an equation

$$f = \frac{1}{2} * \pi * R_f * C_f \tag{2}$$

C. BODY TEMPERATURE

IC LM35 is used as a temperature sensor with an output voltage (10mV=1°C) linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55°C to 150°C temperature range.



Figure 7: Temperature measurement

IV. DATA ACQUISITION

The Heart Rate and body temperature of the patient are sent to the PC by the microcontroller using serial communication. For which the serial to TTL logic converter chip CP2102 is used. This chip helps in serial to USB communication. The silab's USBXpress drivers along with the RealTerm software are used to acquire the data. The ECG of the patient is viewed on an oscilloscope; and the oscilloscope is connected to the PC using USB cable. The image of the ECG is captured by controlling the DSO virtually by using the software provided by DSO manufacturer. This data can be further sent to the hospital server with the help of internet protocols. At the hospital, a doctor will be able to see the ECG image along with the body temperature and Heart rate on a computer. This data will help him to treat the patient immediately after the ambulance arrives.

V. TRAFFIC CONTROLLING

In cities due to high traffic density patient may loses life, hence the goal is to optimise the traffic density. Therefore in second system a traffic controlling method is described to provide congestion free path for ambulance to reach hospital within a short time.

A. SIGNAL FROM AMBULANCE

Every ambulance contains a navigation module for routing purpose. But as GPS signal only detects large distance displacements instead of that a keypad which contains possible routing options is used. As the driver presses one key, a binary signal will be send to the microcontroller, which it will send to the RF transmitter via the Tx pin. This binary signal contains the current location of the ambulance, the future path, and the traffic congestion information.

B. RF433 Module



Figure 8: RF 433 Tx-Rx

A radio frequency module (RF433) is used which operates at a frequency of 433MHz. A RF transmitter

placed on emergency vehicle transmits signal to receiver which is fixed on traffic lights in emergency mode. The signal received by receiver is then decoded and processed by a microcontroller. The RF module, operates at the Radio Frequency of 433MHz. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The range of this RF433 module is 500 meters. As any other RF device, the performance of an RF module will depend on a number of factors. For example, by increasing the transmitter power, a larger communication distance will be achieved. However, this will also result in a higher electrical power drain on the transmitter device, which will cause shorter operating life for battery powered devices. Also, using a higher transmit power will make the system more prone to interference with other RF devices, and possibly cause the device to become illegal depending on the jurisdiction. Correspondingly, increasing the receiver sensitivity will also increase the effective communication range, but will also potentially cause malfunction due to interference with other RF devices. The performance of the overall system will be improved by using matched antennas at each end of the communication link.

The RF communication between the two modules was tested using DSO. The information transmitted by RF transmitter is encoded and a specific address is used to establish a secured dialogue. The receiver receives that signal and decodes it only if the correct address is present. These waveforms are shown below.

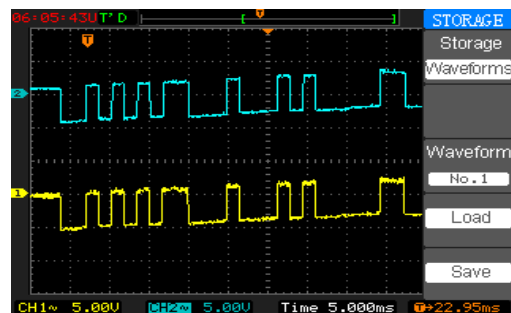


Figure 9: RF communication waveforms

C. SIGNAL POST AND SIGNAL CONTROL ALGORITHM

The receiver mounted on the signal post detects the incoming signal from RF Tx and forwards it to the microcontroller. The binary signal is used to control the traffic lights considering the information sent by the ambulance driver. Master controller pre-empts original flow sequence of traffic lights and executes emergency mode. In this mode if original signal is red then it is made green for ambulance. The driver of ambulance has a keypad for choosing path. This is implemented using keypad. A particular path or an algorithm will be selected by the controller based on the key pressed by driver in ambulance. The traffic density condition is included on the keypad itself. Based on this information, the signal will be controlled. During these operations signals from all other lanes will be red and the priority will be given to ambulance only. When ambulance crosses that lane the controller will again continue with the original sequence of traffic signals.

VI. CONCLUSION:

In this paper, a system is described which will continuously monitor the patient's health parameters and simultaneously will control the traffic signal. Ambulance service is one of the crucial services that get delayed very often. Also sometimes on-sight doctors are not available. So patient does not get medical attention immediately. This paper describes two systems viz. patient health monitoring system and intelligent traffic control system. In health monitoring system, the patient's vital health parameters such as ECG, Heart Rate and Body Temperature are monitored. This information is sent to the hospital for analysis. In traffic control part, RF transmitter on the ambulance will communicate with the RF receiver mounted on the signal post. An algorithm is designed to control the traffic signals automatically based on the key pressed by the driver from keyboard in the ambulance. The traffic control algorithm considers the current & destination location of the ambulance to control the traffic lights. This will help in optimization of the time taken by the ambulance to reach the hospital. Also, the monitoring of the patient will help the doctors to give him the necessary treatment for the time being.

Considering the real time scenario this system can be improved by adding an actual GPS navigation system along with a congestion detecting module for an optimized traffic control algorithm.

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