IoT based Ambulance with Advance Patient Care Monitoring

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Abstract **- The heavy traffic problems are the phenomenons which have a huge impact to the transportation system. Ambulance service is the major services which get affected by traffic jams very much. Sometime so many important schedules delayed due to these traffic jams. For solve this problem we have a new idea of "An Advance Intelligent Ambulance With Online Patient Monitoring System" .In this idea, we track the patient's health conditions with some parameters like heart rate, body temperature, etc. All the parameters are sent to a specified cell phone via GSM unit. This system is designed to operate the traffic light, when it receives signals from an emergency vehicle whose signal transmissions are based on radio frequency (RF). This system have 8052, AVR micro-controller for triggering purposes to change from normal state to the emergency state. In this idea we use an assembly programming to get better accuracy and GPS and GSM modules for tracking the vehicle anywhere on the earth. In this project, when patient's parameters crossed the normal values then the sensor will detect the signal and sends it to micro-controller. The micro-controller will send the alert message via GSM to a specified mobile number, which will help in providing better facilities to the patient.**

Keywords: GPS and GSM modules, micro-controller, radio frequency signals.

1. INTRODUCTION

All the countries are facing so major problems on traffic light. The intersections between emergency vehicles and public vehicles cause many big accidents. The ambulances mostly face difficulties to reach the destination on time because of the traffic problem. Moreover, the situation got worse when emergency vehicles have to wait for way from other vehicles at traffic signals. This causes a big delay in time and may have a big affect on emergency case. There are also chances of collisions with other vehicles from other direction at intersections when emergency vehicles had to cross the red traffic lights. These difficulties faced by emergency vehicles can be prevented by this traffic light control system based on radio frequency. In this system when ambulance vehicle reached at the traffic light junction, the signal code will sent all information of frequency modulation to receiver which will work within 100 meter range. The receiver section will demodulate the received code and the red traffic light will automatically be on at all the junctions and ambulance can easily passed and will easily reached to the destination. The ambulance will manage the traffic light by sending radio frequency signals to the traffic control unit of light. Thos way, the ambulance will have the special route then other vehicles to reach its destination. The sensors attached in the ambulance system will monitor the patient's health and if the status crosses the nominal values, the GSM module send the data to the other GSM unit. By this way the hospital unit will prepared to treat the patient before it reached to the hospital. The main advantage of this project is its operating voltage which is just 5V DC only.

2. TRAFFIC CONTROL SYSTEM

Whenever the ambulance reached nearer to the traffic signal i.e. in the range of about 100 meter, the traffic light will be change to green through RF communication. This way the ambulance will reach the hospital in time. This will save the patient's life.

2.1 Radio Frequency Transmission

A RF signal starts as an electrical alternating current (AC) signal that is mainly generated by a transmitter. This AC signal is sent through copper conductor which is mostly a co-axial cable and radiated from an antenna element in the form of an EM wave. Changes in the EM fields around the antenna are produced by change in current flow across antenna. The figure 1 is the block diagram of transmitting unit. This Decoders, PIC micro-controller with RF transmitter are the parts of transmitting unit.

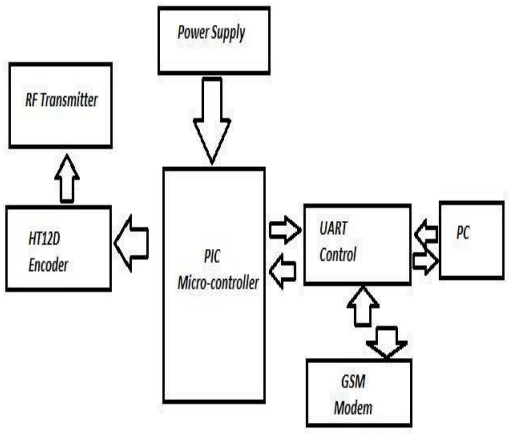

Figure 1Block diagram of transmitting signal unit

2.2 RF Based Wireless Remote Tx-Rx Modules

This circuit use RF module, transmitter and receiver (TX-RX) for making a wireless remote so it could be used to drive an output from a distance. Radio Frequency module uses radio frequency for sending signals. All the signals are transmitted at fixed frequency. A receiver configured with that frequency can only receive these signals. The figure 2 shows interfacing of PIC with HT12D encoder and GSM modem, etc.

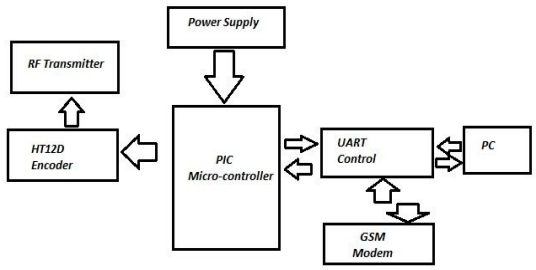

Figure 2 Block diagram for interfacing of PIC with other devices

The four channel encoder/decoder pair also used in the system. The input signals at transmitter side are taken via 4 switches while the outputs are monitored by a set of four LED systems which corresponding to each input switch. We can use this circuit can for designing remote appliance control system. This Radio Frequency system of transmission employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair which operates at frequency of 434 MHz. After taking serial input the transmitter module transmits these signals via RF. The transmitted signals which are received by the receiver module placed away from the source of transmission.

To decode the serial format we used decoder after the RF receivers which retrieve the original signals as outputs. These outputs can be seen on corresponding LEDs. RF transmission is better than infrared transmission (IR) because of many reasons. Figure 3 shows the blocks used for receiving signal unit which is connected with traffic light end.

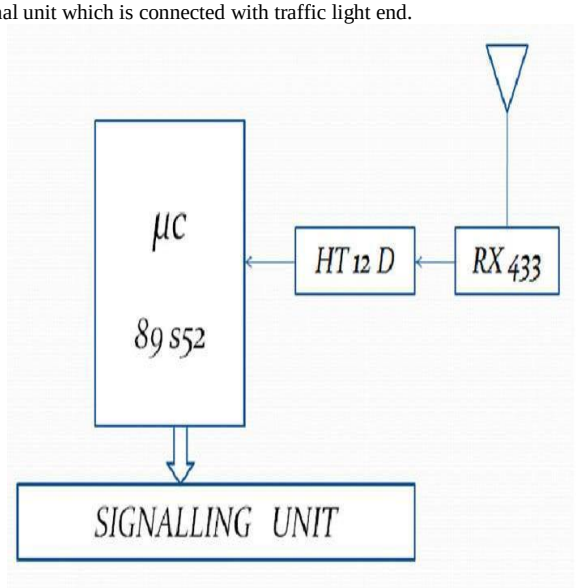

Figure 3 Block diagram of receiving signal unit

Firstly, as we know that signals via RF can travel through a very larger distances which makes it suitable for long range applications. Besides, this IR mostly operates only in line-of-sight mode, but on the other hand RF signals can travel even through an obstruction between transmitter and receiver. Next, RF transmission is much stronger and reliable in compare to IR transmission. RF communication uses a specific frequency for transmission whereas IR signals can be affected by other IR emitting sources.

3. HOSPITAL SYSTEM

Hospital unit is one of the receiver units. This unit is having GSM trans-receiver. In this setup, we use GSM as source of information to hospital from ambulance. As GSM is duplex unit so it is capable of transferring data as well as voice. Parameters of patient which are measured in ambulance are received by GSM receiver with a delay of 5 sec. As this data should be displayed on screen, so GSM unit has been accompanied with cell phone which is computer specified, this cell phone is compatible to receive data in appropriate form which make it very user friendly. For this way, we are using stack for storing received data. Data get updated after each 5 sec interval, and displayed on monitor screen. After seeing the displayed data, appropriate action required can be suggested through message or call but the process of typing message and sending it, is very time consumable, so call back is prefers. There for we are using GSM unit in simplex mode, so time restrictions can be avoided. At hospital unit the need of receiver application is fulfilled by GSM and computer. The GPS is installed in the ambulance is for sending the location. The Ambulance unit consists of a user interface, GPS system and a GSM module. Figure 4 shows the block diagram for hospital system unit.

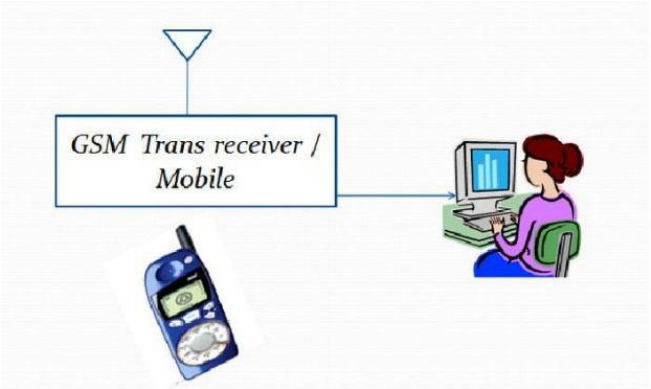

Figure 4 Block diagram of hospital system unit

4. AMBULANCE SYSTEM

As we had already discussed about the RF signals which are used for signal transmission and reception. The transmitter section for controlling the traffic light is fixed in the ambulance unit. In figure 5 we can see in the block diagram, there are many very important components which makes the ambulance unit to work properly.

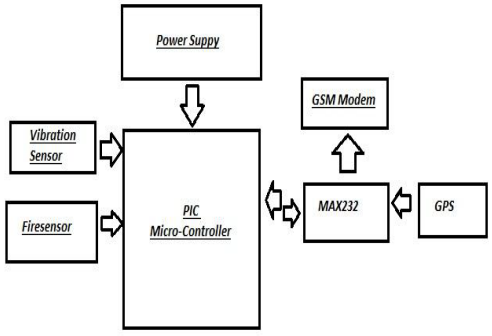

Figure 5 Block diagram of Ambulance Unit

As one of very important parameter in patient's health monitoring is Heart rate. It is being monitored by the sensing circuit which having L14F1 and LM35. Then the heart rate is interfaced with programmable interface controller (PIC). Similarly for the temperature of patient we are using LM35 as the sensing unit. As it gives the output in adequate form with respect to Amplitude and accuracy so it does not require any signal conditioning unit. The sensor consists of a super bright red LED as well as a light detector. As shown in figure 6, the light must pass through finger and detected at other end so the LED needs to be super bright. When the heart pumps blood through the blood vessels, then finger becomes slightly more opaque and there for less light reached the detector. The detector signal varies with each heart pulse. Then this variation is converted to electrical pulse and signal is amplified and triggered through an amplifier whose output is +5V logic level signal. We use a LED on top to indicate the output signal and this LED which blinks with each heartbeat.

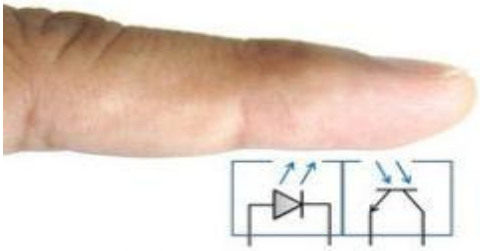

Figure 6 Heart Beat sensor principle

These are the following components which are used in this unit. Each components of this unit is very necessary for complete working this unit.

- GSM Trans-receiver
- MAX 232
- HT12E Encoder
- Tx 433 (Module for Transmitter)

This proposed system uses a micro-controller which is interfaced with sensors, which changes the junction timing automatically to accommodate movement of vehicles smoothly avoiding unnecessary waiting time at the junction. The MAX232 has two receivers and two drivers. This means only two of the RS-232 signals can be converted in each direction. Typically for TX and RX signals a pair of a driver/receiver of the MAX232 is used, and the second one is used for CTS and RTS signals. The GPS is a satellite navigation system that provides location and time information in any weather conditions, anywhere on or near the earth where there is an unobstructed line of sight for GPS satellites. We use a GPS system in this project which is attached with ambulance unit. This GPS stores the tracked location and send it to the hospital unit or the preferred destination over the GSM modem.

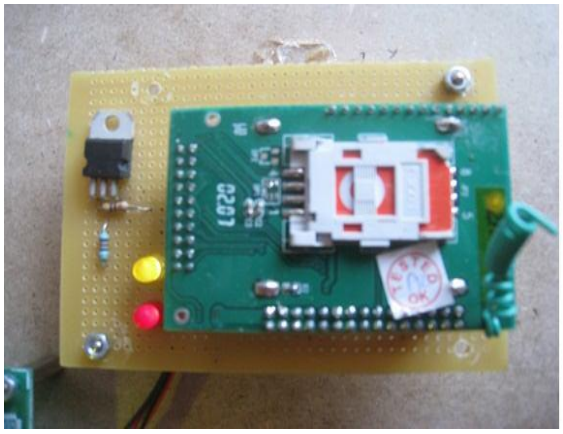

Figure 7GSM Modem with SIM card for sending patient's data

5. SIMULATED RESULTS

KEIL and PROTEUS software are used for compilation and simulation of coding. Simulation helps you to understand hardware configurations and it avoids time wasted on setup problems. MON51, MON390, MONADI, or FlashMON51 Target Monitors are used for testing the software application with target hardware, the ISD51 In-System Debugger, or the ULINK USBJTAG Adapter for download and test program code on your target system.

There are two types of AT commands: one is basic commands and other is extended commands. Basic commands are AT commands which do not start with "+". For example, D (Dial), A (Answer), H (Hook control) and O (Return to online data state) all are basic commands.

Extended commands are AT commands which start with "+". All GSM AT commands are extended commands. For example, +CMGS (To Send SMS message), +CMSS (To Send SMS message from storage), +CMGL (List SMS messages) and +CMGR (Read SMS messages) all are extended commands.

A. Traffic Light Simulation

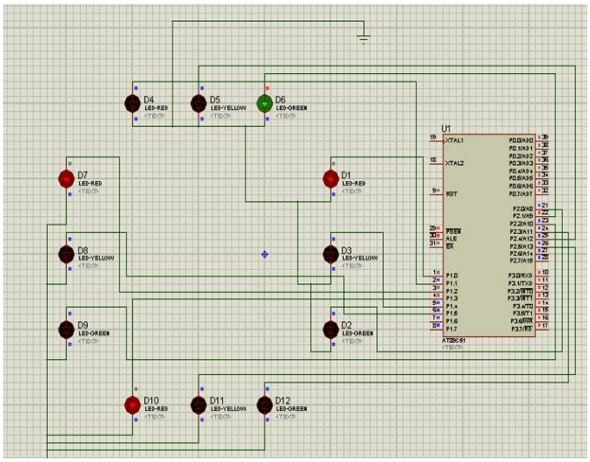

Figure 8Software simulation

Figure 9 Green light at position 1 is ON

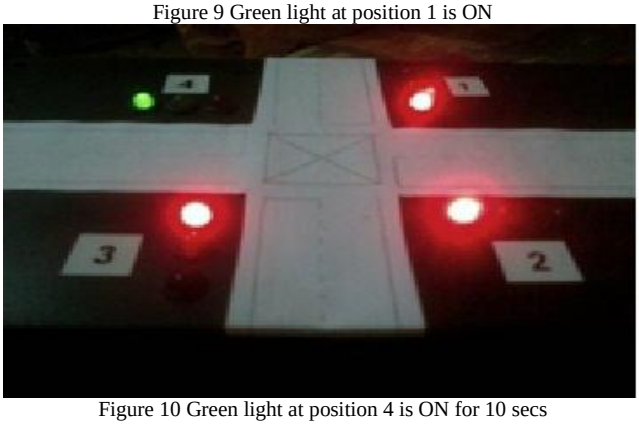

Figure 10 Green light at position 4 is ON for 10 secs

Figure 11 Yellow light at position 4 is ON for 10 secs

Figure 12 Normal traffic light sequence

B. Simulation For LCD

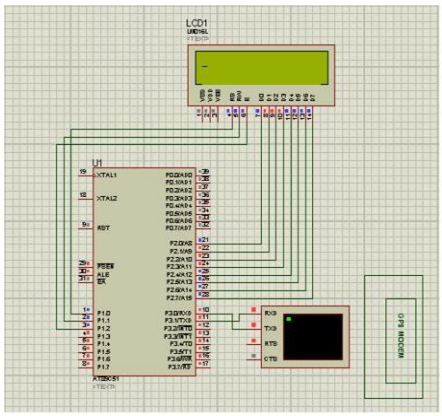

Figure 13 Software simulation for LCD

Figure 14 shows the output of LCD. The readings of patient's temperature and heart rate/heartbeat are displayed in LCD. Outputs from the software and the hardware are shown from figures 8 to figure 14.

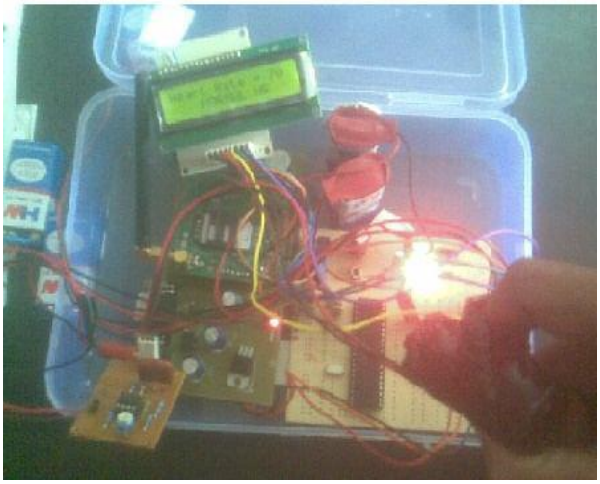
Figure 14 LCD output from hardware

6. PROJECT'S ADVANTAGES AND FUTURE SCOPES

There are many advantages of this system. We can use its concepts in implementing many useful applications.
These are some of the advantages:

- Ambulance service will have no impact of traffic jams on it.
- We can use radio frequency signal as it cannot be blocked by objects.
- It have wide range applicability.
- Only one time investment cost.
- Very helpful in saving people lives.

For future works, we can use GPS system in implementing this project. This project can be enhanced to control automatically the signals depending on the traffic density on the roads by using sensors like IRDetector/receiver module extended to automatic turn off when there is no vehicles are running on any side of the road so it helps in saving the power consumption. In ambulance system, the data of the patient from ambulance can be sent to the Hospitals using GSM technology. So, it can help in providing early and fast treatment to the patient.

7. CONCLUSION

This project has achieved the main objective which is to analyzing and implementing the wireless communication; the RF transmission is to control the traffic light system for emergency vehicles. The prototype of this project use the 434 MHz frequency compared to the range of about 3 kHz to 300 GHz frequency which have been theoretically reserved for the RF. Besides, that the other objectives have been also successfully attained which are to design an emergency sequence mode of traffic light when emergency vehicles passing by an intersection and again changing the sequence back to the normal sequence which was there before the emergency mode was triggered. We use the programming in the micro-controller AVR to develop the sequences for this project. This prototype system can be improved in future by controlling the real traffic situation and the study can be done by investigating the length, reception and transmission issue for the system which to be operated with this traffic light system. Real time Wireless technology can be implemented in the same design, where hi-tech technology can be used to send the patient's useful parameters to the hospital unit. So that the patient's exact situation will be known to the doctors and necessary initial treatment could be provided. Wireless and mobile technologies are key components which would help enable patients suffering from chronic heart diseases to live in their own homes and lead their normal life, while at the same time they are being monitored for any cardiac events. This will reduce the burden on the resources of the healthcare center also help in improving the quality of healthcare sector.

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