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Smart Ambulance with Patient Health Monitoring

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ABSTRACT

India being one of the most populated countries in the world, the emergency medical response in the country is lagging behind other countries. Delayed provision of medical attention and road traffic congestions are the major issues in emergency services. It is also due to the lack of knowledge and implementation of technology at ground zero. Here we are introducing smart ambulance with patient health monitoring. It would make us a competitive position in emergency services around the world. This is achieved by using system in the ambulance that transmits information to the hospital regarding the status of patient. After receiving information, the hospital can prepare their staff for proper treatment of coming patient which helps to improve the medical care. The system is also designed to take necessary actions for the smooth passage of the ambulance through junctions. IoT being a revolutionary development over the last few years it can be widely used in large number of end system.

Key words: Ambulance, Biomedical sensors, Health monitoring, IoT, Traffic control

1. INTRODUCTION

Nowadays, many cities are working on transforming themselves into smart cities by means of all possible advancements in the sector of smart technology. Improving efficiency in healthcare sector is one of the most difficult and challenging jobs. It includes various aspects such as giving ambulatory health care for the patient so that the chances of surviving increases in critical condition [1]. It is also necessary to avoid traffic congestions so that the ambulance can reach within minimum, amount of time.

If a person suddenly falls ill and he is carried to the hospital, the doctor will get to know about his condition or the cause only after diagnosing him which is a time consuming process. So it is necessary to have a monitoring technology in the ambulances so that we can avoid the wastage of time for giving him the proper medical care. This can be achieved by implementing IoT in healthcare[2].The Internet of things (IoT) is a system of interrelated computing devices which has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [2]. The critically ill patients and accident victims requires more medical attention. Here it is achieved by using a system in the ambulance to transmit their status to the hospital. So that the doctor understands the conditions and he can take right decisions regarding the administration of drugs to the patient. Also can make up with good time management by having an effective traffic control over traffic jams.

2. LITERATURE REVIEW

2.1 Smart Ambulance System

The paper describes about building a platform with the help of IoT and smartphone technologies. Here the application uses Global Positing System (GPS) hardware to collect the location information.The Google Map Application Programming Interface (API) is used to plot the details of the ambulances. It is plotted on the Google Map Client of the Smartphone App. The other module here follows the same functionality that enables user to find the hospitals. With the help of this smart ambulance, information regarding the patient's health can be transferred to the hospital for improved medical care. The interaction between the smartphone and the centralized database is achieved using Representational State Transfer Application Programming Interface (REST APIs) [1].

2.2 Monitoring Patient's Health with Smart Ambulance system using Internet of Things (IOTs)

This paper describes about an intelligent smart health system. An IOT-based live monitoring system is developed with the help of sensors and microcontrollers.The sensors are used to collect the patient vital details. These details are then send to the collaborated hospital's website. If the condition is critical, an alert notification will be sent to the hospital monitoring website.There is also an implementation of live trafficking systemusing Google map. The ambulance driver will use google map with the help of the website to reach the hospital on time which also helps to avoid accidents and obstacles. Here an integrated hardware is made using Arduino and sensors [2].

2.3 A Smart Ambulance System

This paper describes a system which provides clearance to ambulance vehicle by turning all the red lights on the path of the emergency vehicle to green. This gives a complete green bay which is the synchronization of the green phase of traffic signals to the desired vehicle.In addition to the green bay path, the described system will also provide patient monitoring from the hospital. In every few minutes the current condition of the patient is send to the hospital to get the suggestions. The system is implemented using GPS, GSM and smart mobile along with ZigBee Technology. After choosing the path to hospital the traffic signal within this direction will be green light. This route will be considered as green bay. For the implementation the ARM Cortex-M3 is interfaced with traffic signal and ambulance section [3].

2.4 Smart Ambulance Guidance System

This paper describes a method for alerting or controlling the traffic signal before the ambulance reaches the traffic signal with the concept of Internet of Things (IoT). System uses a central server to control the traffic controllers. The traffic signal controller is implemented using Arduino UNO. The ambulance driver uses a web application. It makes request to the traffic controller to make the signal green on the same path. The hardware components used are ArduinoUno and ESP8266 Wi-FiModule. The system is of low cost [4].

2.5 Smart Ambulance System using IoT

This paper comes with a concept 'Green Corridor' by which patient will get needed treatment on time. The ambulance is equipped with a system having different sensors like heart rate sensor, blood pressure, ECG which is used to monitor the patient vital parameters. This parameters are then send to hospital's database. At the same time traffic signals will be operated using GPRS message through cloud. After getting status of vital parameters, hospital authorities prepares themselves for the proper treatment of coming patient. As when the smart ambulance is within range of 100m from the traffic island, signal will be turned to green in the direction. Communication between smart ambulances is done by GPRS through cloud. The system ensures quick response in emergency situations [5].

3. SYSTEM ARCHITECTURE

The objective of our project is to build an efficient system in ambulance for patient health monitoring and for traffic signal control. Such a system in ambulance can come up with good emergency medical responses[1]. Our system consists of an IoT based patient health monitoring and a traffic control part using simple wireless transmission [4]. Figure 1 shows the block diagram of our system.

In health monitoring,biomedical sensors are used for capturing the patient vital details such as temperature, heart beat rate, pressure. This collected details are processed by the microcontroller and are then send to the server with the help of a Wi-Fi module so that it can be accessed by the hospital. They can access this server through a website that is opened and monitored for 24x7 by the staff. When ambulance carries apatient the data enters to website and the hospital staff will make a contact with the medical assistant in the ambulance and gives necessary instructions about giving the correct medical care. This communication will be through the mobile phones since there may occur some lagging and connectivity issues with internet in some areas. The hospital staff will also continuously monitor the sensor measurements shown to analyze his condition. Thus it makes the doctor aware of the patient condition before he reaches the hospital.

The second part of the system is the traffic control, as already mentioned here we are adopting a wireless transmission technique[6] [7]. There is a joystick placed in the ambulance for the purpose of direction selection. When the ambulance approaches the junctions the driver selects the direction using the joystick. This signal is then processed and send to the traffic island with the help of microcontroller and the transmitter respectively. There is a receiver in the traffic island which receives this signals and analyze them with the help of microcontroller. After analyzing the microcontroller makes the traffic light in the selected direction to green [3]. Thus ensures the smooth passage of ambulance through the junctions. This improves in the time management

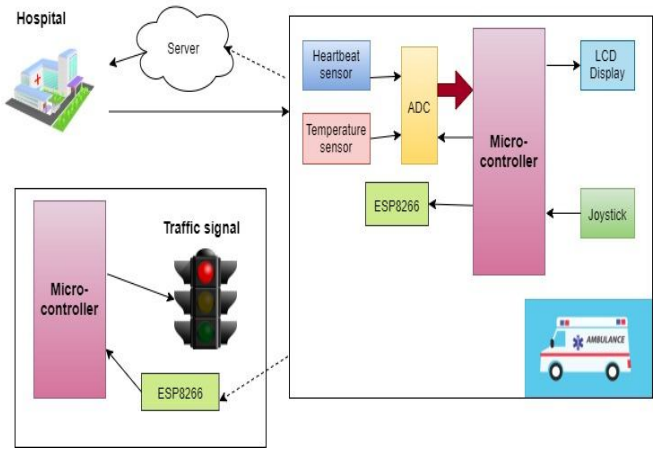

Figure 1: Block diagram

The system consists of three modules:

- Ambulance
- Hospital
- Traffic Island

3.1 Ambulance

The module includes Bio-medical sensors for capturing the patient vital details, the microcontroller used as the central controlling unit, the joystick for the direction selection, and component for Wi-Fi connectivity and data transfer.

Here we are using two types of biomedical sensors the temperature sensor and the pulse rate heart beat sensor

A) Temperature sensor

The LM35 is the temperature sensor used in the system. It measures the body temperature with an electrical output that is proportional to the Celsius temperature [3]. This sensor generates a high output voltage thus avoiding amplification. The scale factor is0.01V/°C. Figure 2 shows LM35

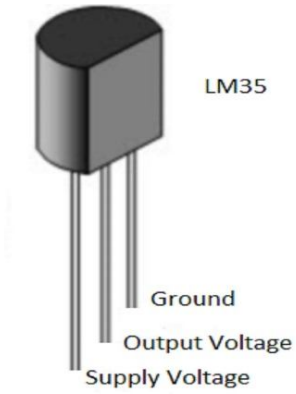

Figure 2: LM35

B) Pulse rate heart beat sensor

It senses the pulse and gives the heart beat rate, systolic and diastolic pressure. The front of sensor with heart logo makes the contact with the skin.Also you can see a small round hole, it is where the LED shines. There is also a little square just under the LED. The square is an ambient light sensor used to adjust the screen brightness in different light conditions, see in Figure 3. The LED shines light into the fingertip or other capillary tissue, and sensor reads the light that bounces back.

Figure 3: Pulse rate heart beat sensor

C) ATmega32 microcontroller

It is a low power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It is central controlling unit of the system. It has got 32 x 8 general working purpose registers and contains 2K bytes of internal SRAM and 1024 bytes of EEPROM. Figure 4 shows the pin diagram.

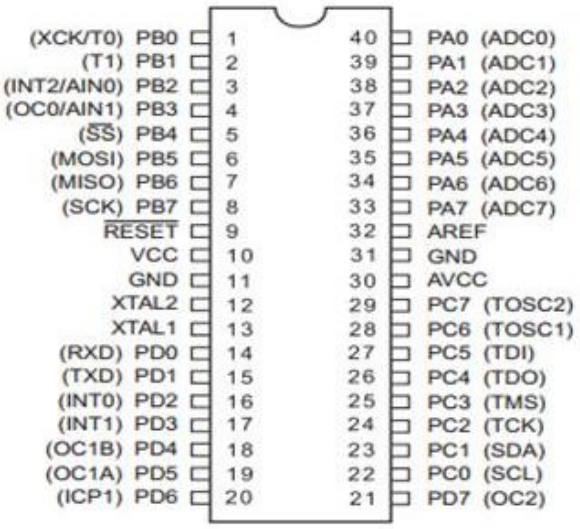

Figure 4: Pin diagram of ATmega32

D) Joystick

It is used for direction selection. While approaching the junctions the ambulance driver selects the direction to which he needs to move. See Figure 5.

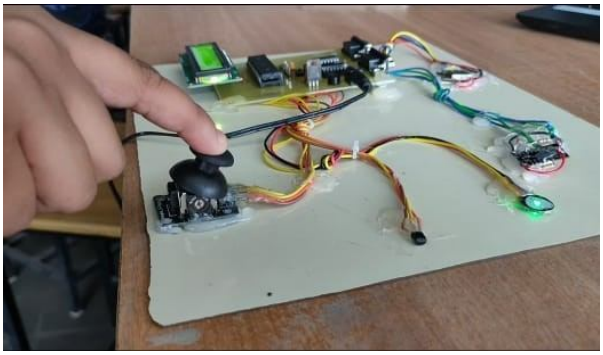

Figure 5: Selecting direction using joystick

E) ESP8266

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP capability. The board also has an integrated MCU (Micro Controller Unit) [4]. Here there is two ESP8266 in the ambulance module one is for the Wi-Fi connectivity to send the patient details to the server and the other act as a signal transmitter from the ambulance to the traffic island for the selection of direction. Figure6 shows ESP8266.

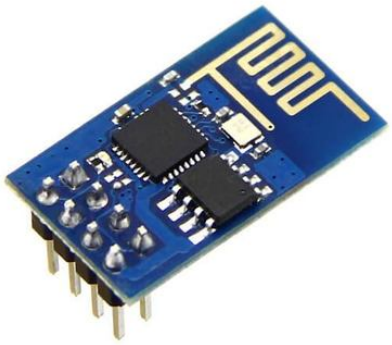

Figure 6: ESP8266

3.2 Hospital

A website for accessing the server is opened for whole 24x7 days. The hospital staff will be monitoring the patient condition through this. Further they make a contact with the medical assistant in the ambulance and gives necessary instruction about giving proper medical care. The hospital staff utilizes this facility to make necessary arrangements for treating the coming patient.

3.3 Traffic island

It consist of the traffic lights controlled by a microcontroller and an ESP8266 placed in the traffic island which act as a receiver. The direction selection signals initiated from the ambulance are received by ESP8266. These signals are then analyzed by the microcontroller and the signal in the selected direction is turned to green, see Figure 7 This allows the smooth passage of ambulance through the junctions.

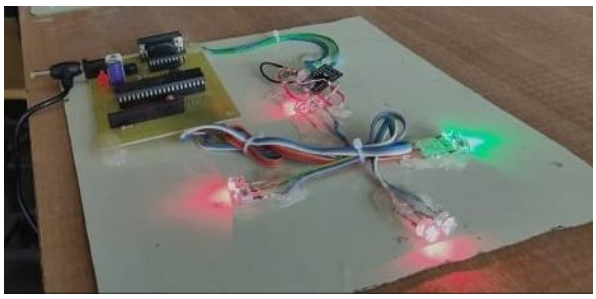

Figure 7: green light in the selected direction

4. EXPERIMENTAL ANALYSIS

The sensor values collected by the biomedical sensors Figure 8and are shown in the LCD display see Figure 9. This data is passed to the server and analyzed by the hospital staff. Table 1 shows some test cases with various people.

Table 1: Test cases

SL NO	Temperature	Heart Rate	Systole Pressure	Distole Pressure
1	31	65	80	40
2	31	75	85	45
3	33	45	90	50
4	31	50	95	55
5	31	55	100	60

The data in the table are collected by the sensors. These are then send to the server using ESP8266. The data enters to the website which is kept opened in the hospital.

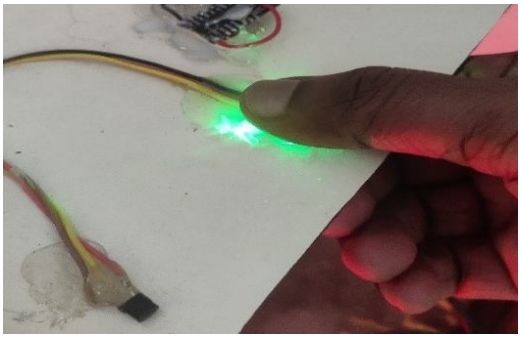

Figure 8: Taking the sensor reading

In the Figure 5 the direction selected is ‘forward’ and the from Figure 7 we can see that the green light glows in the selected forward direction

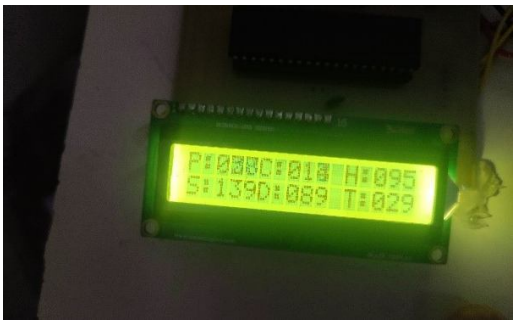

Figure 9: Reading shown in LCD

5. CONCLUSION

In this project we introduce an efficient smart ambulance with patient health monitoring. With the help of this project a critically ill patient or an accident victim carried by an ambulance gets immediate medical attention from the hospital. The doctors are well aware of the patient present condition from the ambulance. So, the hospital staffs can make necessary arrangements for treating him. We implements the patient heath monitoring using IoT and the traffic control using wireless transmission technique. When the ambulance approaches the junctions the direction from the junction is selected with the help of the joystick. And the signal to the selected path becomes green so the ambulance doesn't get stuck in the junctions.

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