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Smart Detecting Accident by IoT and Smart Rescue System

Sowmya Shree B V[1], Ramesh T S[2], Lakshmisha S Krishna[3], Rangaswamy Y[4]

PG Student, VLSI Design & Embedded Systems, Alpha College of Engg, Bengaluru, India[1]

Assistant Professor, Dept of Electronics & Communication Engg, Alpha College of Engg, Bengaluru, India[2,3]

Professor & HOD, Dept of Electronics & Communication Engg, Alpha College of Engg, Bengaluru, India[4]

Abstract: Road accidents and traffic congestion are the major problems in urban areas. Currently there is no technology for accident detection. Also, due to the delay in reaching of the ambulance to the accident location and the traffic congestion in between accident location and hospital increases the chances of the death of victim. There is a need of introducing a system to reduce the loss of life due to accidents and the time taken by the ambulance to reach the hospital. To overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident through sensors provided in the vehicle. A main server unit houses the database of all hospitals in the city. A GPS and GSM module in the concerned vehicle will send the location of the accident to the main server which will rush an ambulance from a nearest hospital to the accident spot. Along with this there would be control of traffic light signals in the path of the ambulance using RF communication. This will minimize the time of ambulance to reach the hospital. A patient monitoring system in the ambulance will send the vital parameters of the patient to the concerned hospital. This system is fully automated, thus it finds the accident spot and helping to reach the hospital in time.

Keywords: Wireless Sensor Networks, Accident Detection, IoT, Blynk App, Traffic Light Signals, GPS and GSM Module, Arduino, Patient Monitoring System.

I. INTRODUCTION

Nowadays Wireless Sensor Networks (WSN) has been applied in various domains like weather monitoring, military, home automation, health care monitoring, security and safety etc. or in a nut shell one can say wireless sensor network can be applied in most of the domains. Currently there is no technology for accident detection. Also, due to the delay in reaching of the ambulance to the accident location and the traffic congestion in between accident location and hospital increases the chances of the death of victim. There is a need of introducing a system to reduce the loss of life due to accidents and the time taken by the ambulance to reach the hospital. To overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident through sensors provided in the vehicle. A main server unit houses the database of all hospitals in the city. A GPS and GSM module in the concerned vehicle will send the location of the accident to the main server which will rush an ambulance from a nearest hospital to the accident spot. Along with this there would be control of traffic light signals in the path of the ambulance using RF communication. This will minimize the time of ambulance to reach the hospital. A patient monitoring system in the ambulance will send the vital parameters of the patient to the concerned hospital. This system is fully automated, thus it finds the accident spot and helping to reach the hospital in time. These sensors run on both battery power as well as solar energy. They have the capability to draw solar energy so that they can use sunlight for functioning in bright and sunny condition and the battery power for functioning at night or in cloudy or foggy condition. Sensors used in the Wireless Sensor Network for traffic signal systems are mainly of two types:

1. Intrusive type: Intrusive types of sensor are kept under the road and sense the traffic waiting at the signal. This type of sensor has the same working principle as that of a metal detector.
2. Non-Intrusive type: Non-Intrusive types of sensor is fitted on the road. The installation of this type of sensor is easy as no cutting of road is needed to be done. Non-intrusive sensor includes acoustic sensors or video image processors to detect the presence of vehicles waiting at the traffic intersection.

Although Intrusive sensors are very effective still Nonintrusive sensors are preferred over Intrusive sensors as they are cost-effective, easy to install, immune to natural corrosion and degradation.

The main objective behind this is to minimize the time gap between the occurrence of accident and time required for ambulance to reach at the location of accident for giving treatment to the victim. When accident takes place lot of time

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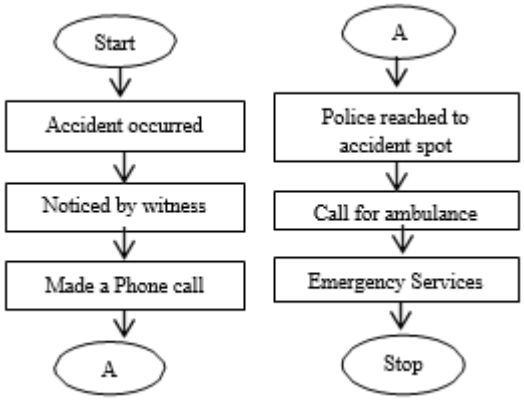
is wasted for searching the location of accident, such a time our system work faster and avoid the loss of life due to time delay. Project is based on four main modules:

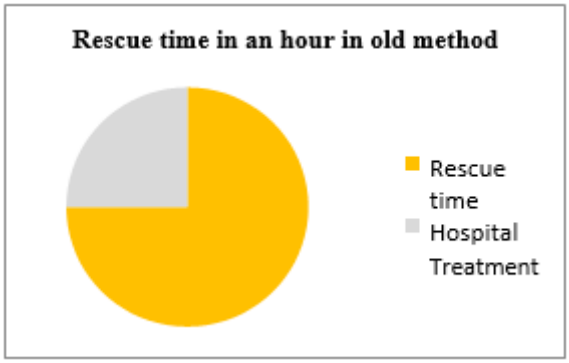
1. Sensor
2. Controller
3. Hospital
4. Ambulance Sensor acts as a trigger that senses the location of the accident place and sends notification to the main controller.

II. COMPARISION OF EXISTING AND PROPOSED SYSTEM

1. Existing Methods:

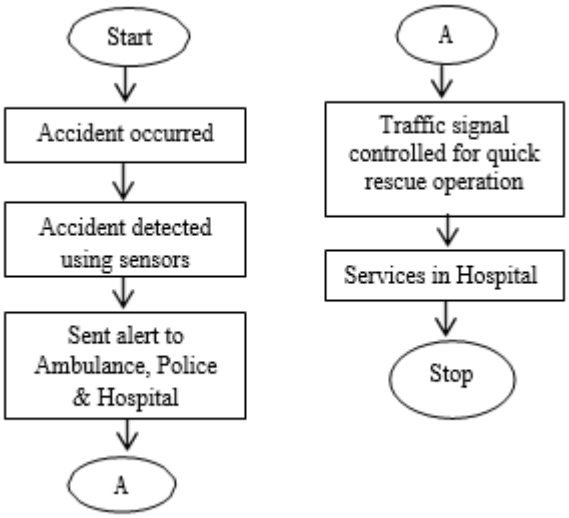
Currently there is no technology for accident detection. As it is done manually there is loss of life in golden hours. The accident victim is dependent on the mercy of others to rush him to hospital. Many a times an accident goes unnoticed for hours before help comes in. Due to all these factors there is a high rate of mortality of the accident victims. In addition to this there is delay in the ambulance reaching the hospital due to the traffic congestion between accident location and hospital which increases the chances of the death of victim.

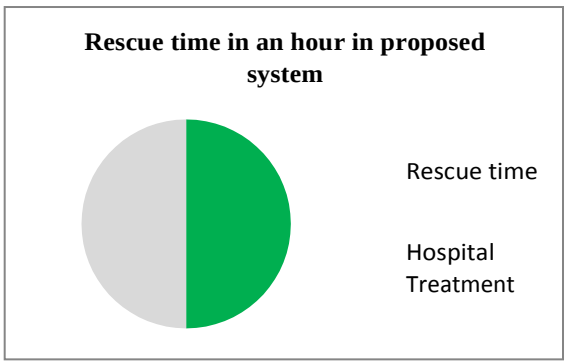




2. Proposed System:

To overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident. A sensor, GPS, GSM unit fitted in the vehicle detects the accident and sends the accident location to a main server unit which houses the database of all the nearby hospitals. An ambulance is rushed to the accident spot which carries the patient to the hospital and simultaneously monitors the vital parameters like temperature and pulse rate and conveys them to the concerned hospital via RF communication to provide a clear path for the ambulance.





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III. COMPONENTS

1. Hardware

Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. For advanced Arduino users, prowl the web; there are lots of resources. The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program. The ATmega48PA/88PA/168PA/328P provides the following features: 4/8/16/32K bytes of In System Programmable Flash with Read-While-Write capabilities, 256/512/512/1K bytes EEPROM, 512/1K/1K/2K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes.

ARM7 LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer. ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture developed by British company ARM Holdings. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use. These are desirable traits for light, portable, battery-powered devices—including smartphones, laptops, tablet and notepad computers), and other embedded systems. A simpler design facilitates more efficient multi-core CPUs and higher core counts at lower cost, providing higher processing power and improved energy efficiency for servers and supercomputers. The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low-end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

GSM: Global System for Mobile Communications, it is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. A Modem is a device which modulates and demodulates signals as required to meet the communication requirements. It modulates an analog carrier signal to encode digital information, and demodulates such a carrier signal to decode the transmitted information. A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals. The modem we are using is SIMCOM SIM900. It is a Tri-band GSM/GPRS

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Modem as it can detect and operate at three frequencies (EGSM 900 MHz, DCS 1800 MHz and PCS1900 Mhz). Default operating frequencies are EGSM 900MHz and DCS 1800MHz. Sim900 is a widely used in many projects and hence many variants of development boards for this have been developed. These development boards are equipped with various features to make it easy to communicate with the SIM900 module. Some boards provide only TTL interface while some boards include an RS232 interface and some others include an USB interface. If your PC has a serial port (DB9) you can buy a GSM Modem that has both TTL and RS232 interfacings in economy. Sim900 GSM module used here, consists of a TTL interface and an RS232 interface. The TTL interface allows us to directly interface with a microcontroller while the RS232 interface includes a MAX232 IC to enable communication with the PC. It also consists of a buzzer, antenna and SIM slot. Sim900 in this application is used as a DCE (Data Circuit-terminating Equipment) and PC as a DTE (Data Terminal Equipment).

Global Positioning System (GPS, all process used to establish all position at any point on the globe) the following two values can be determined anywhere on Earth. GPS receivers are used for positioning, locating, navigating, surveying and determining the time and are employed both by private individuals (e.g. for leisure activities, such as trekking, balloon flights and cross-country skiing etc.) and companies (surveying, determining the time, navigation, vehicle monitoring etc.) GPS (the full description is: Navigation System with Timing and Ranging Global Positioning System, NAVSTAR-GPS) was developed by the U.S. Department of Defense (DoD) and can be used both by civilians and military personnel. The civil signal SPS (standard positioning service) can be used freely by the public, whilst the military signal PPS (Precise positioning service) can only be used by authorized government agencies. The first satellite was placed in orbit on 22nd February 1978, and there are currently 28 operational satellites orbiting the earth at a height of 20,180km on 6 different orbital planes. Their orbits are inclined at 55degree to the equator, ensuring that at least 4 satellites are in radio communication with any point on the planet. Each satellite orbits the earth in approximately 12 hours and has four atomic clocks on board.

Temperature Sensor LM35 series are precision integrated-circuit LM35 temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 sensor thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 sensor 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 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C sensor is rated for a -40° to +110°C range (-10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D sensor is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Heart Beat Sensor: A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.
Two Ways to Measure a Heartbeat
a. Manual Way: Heart beat can be checked manually by checking one's pulses at two locations- wrist (the radial pulse) and the neck (carotid pulse). The procedure is to place the two fingers (index and middle finger) on the wrist (or neck below the windpipe) and count the number of pulses for 30 seconds and then multiplying that number by 2 to get the heart beat rate. However, pressure should be applied minimum and also fingers should be moved up and down till the pulse is felt.
b. Using a sensor: Heart Beat can be measured based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes.

Blood Pressure & Pulse reading are shown on display with serial out for external projects of embedded circuit processing and display. Shows Systolic, Diastolic and Pulse Readings. Compact design fits over your wrist like a watch. Easy to use wrist style eliminates pumping.

ESP8266 WIFI Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WIFI-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective

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board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to integrate with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below, you will find many resources to aid you in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution.

2. Software

Arduino IDE (Integrated Development Environment) has a text editor for writing the code, a message area to display the errors and warnings, a text console, a tool bar with buttons and few menu options. Arduino IDE helps us to connect to the Arduino hardware so that we can upload the programs. The program is developed using embedded C. C is the most widely used programming language for embedded processors/controllers. AT Commands are used to control GSM modems to communicate with them and do the required functions. The set of commands consists of a series of short text strings. Commands are used for operations such as dialing, hanging up and sending messages. In the beginning, a set of commands are required to establish a connection between the mobile operator and the GSM modem. In this project, we are calling the AT commands from the program for sending, receiving and deleting messages. All these operations will be carried out automatically when the program runs without any manual intervention for sending AT commands.

µVision IDE is a window-based software development platform combining a robust editor, Project Manager, and Make Utility tool. µVision supports all the Keil tools including C/C++ Compiler, Macro Assembler, Linker, Library Manager, and Object-HEX Converter. µVision helps expedite the development process by providing: Device Database for selecting a device and configuring the development tools for that particular microcontroller Project Manager to create and maintain projects Make Utility for assembling, compiling, and linking your embedded applications Full-featured source code editor Template Editor that is used to insert common text sequences or header blocks Source Browser for rapidly exploring code objects, locating and analyzing data in your application Function Browser for quickly navigating between functions in your program Function Outlining for controlling the visual scope within a source file Built-in utilities, such as Find in Files and functions for commenting and uncommenting source code µVision Simulator and Target Debugger are fully integrated Configuration Wizard providing graphical editing for microcontroller startup code and configuration files Interface to configure Software Version Control Systems and third-party utilities Flash Programming Utilities, such as the family of Keil ULINK USBJTAG Adapters Dialogs for all development tool settings

On-line Help and links to microcontroller data sheets and user guides

Blynk App is a toolset for all makers, badass inventors, designers, teachers, nerds and geeks who would love to use their smartphones to control electronics like Arduino, RaspberryPi and similar ones. We've done all the hard work of establishing internet connection, building an app and writing hardware code. With Blynk, you simply snap together an amazing interface from various widgets we provide, upload the example code to your hardware and enjoy seeing first results in under 5 minutes! It works perfectly for newbie makers and saves tons of time for evil geniuses. Blynk will work with all popular boards and shields. We wanted to give you full freedom when deciding how to plug Blynk into your existing or new project. You will also enjoy the convenience of Blynk Cloud. Which is, by the way is free and open-source. Imagine a prototyping board on your smartphone where you drag and drop buttons, sliders, displays, graphs and other functional widgets. And in a matter of minutes these widgets can control Arduino and get data from it. Blynk is not an app that works only with a shield. Instead, it's been designed to support the boards and shields you are already using. And it works on iOS and Android.UPD: Blynk also works over USB. This means you can tinker with the app by connecting it to your laptop or desktop while waiting for some internet shield to arrive. Blynk works over the Internet. So, the one and only requirement is that your hardware can talk to the Internet. No matter what type of connection you choose - Ethernet, Wi-Fi or maybe this new ESP8266 everyone is talking about – Blynk libraries and example sketches will get you online, connect to Blynk Server and pair up with your smartphone.

IV. IMPLEMENTATION

Our system is divided into following three units:

1. Vehicle Unit
2. Ambulance Unit
3. Hospital Unit

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Vehicle Unit: The vehicle unit installed in the vehicle senses the accident and sends the location of the accident to the Controller According to our system; every vehicle should have a vehicle unit. The vehicle unit consists of a sensor, Arduino, a user interface by Android, GPS system and a GSM module. The sensor used in the vehicle will continuously sense for any large-scale vibration in the vehicle. The sensed data is given to the controller GPS SYSTEM inside the vehicle. The GPS SYSTEM finds out the current position of the vehicle (latitude and the longitude) which is the location of the accident spot and gives that data to the GSM MODULE. The GSM MODULE sends this data to the control unit whose GSM number is already there in the module as an emergency number.

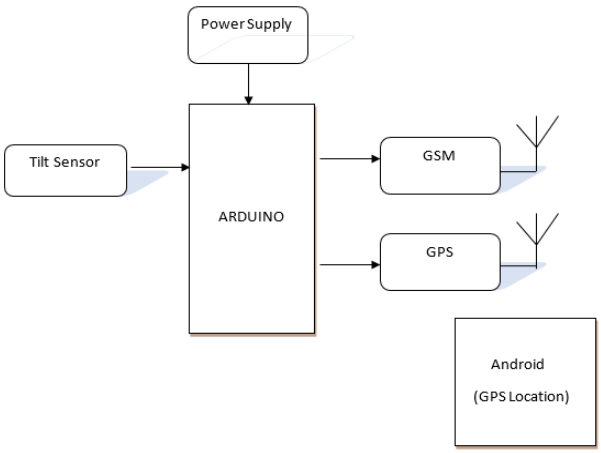

Fig 1 Block Diagram of Vehicle Unit

Ambulance Unit: The message send by vehicle unit is received by ambulance unit. The rescue team in the ambulance immediately traces the location by putting geographical location coordinates in GPS viewer application. It reaches the location of accident spot the ambulance unit will starts its rescue operation. At the same time, the ambulance unit turns ON the RF transmitter. This will lead to communicate with the traffic section. Sends the data of patient to the nearest hospital. We can trace does ambulance is reaching nearest hospital.

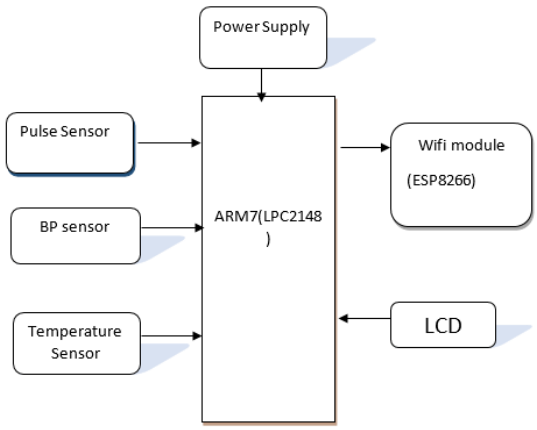

Fig 2 Block Diagram of Ambulance Unit

Hospital Unit: Unit Receives data of the Patient by Ambulance Unit and take the appropriate action for the patient if that person is having any diseases like diabetic or heart patient, etc.,

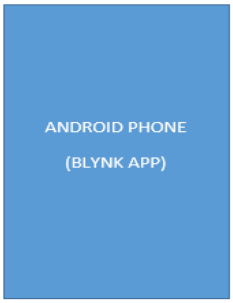

Fig 3 Block Diagram of Hospital Unit

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V. RESULTS

We did the real time execution of complete project. Results of all three project units are observed. The overall developed circuit looks as shown in the following figure:

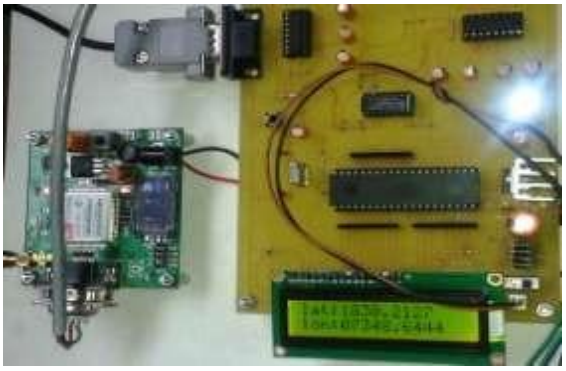

Fig 4 Vehicle Unit using Arduino , GSM & GPS

Fig 5 Ambulance unit with ARM

Fig 6 Blynk App for data transmission

VI. CONCLUSION

This system can detect the location of accident spot automatically & accurately through the GPS and transmit the information through the GPS transmission. Consequently, it will save the people form wasting their time in searching of location and lives of the victims of accident. The victims condition can be known by the temperature sensor which measure temperature of the victim, pulse sensor which sense heartbeat of the victim and BP sensor which measures the victim blood pressure. The victim's condition is send to the nearest hospital or doctor through WIFI module in Blynk app. The experiment proved that this system can automatically detect accidents and information to the main controller is sent relatively and the traffic unit is also controlled by the ambulance unit to reach the accident spot in time and from accident spot to hospital without delay. Such functions can be useful for "help" and "safety", of humans and society.

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