

AN AUTOMATED EXTERNAL DEFIBRILLATOR IN ROBOTIC AMBULANCE(AMBUBOT)

Mr. M. Gajendiran,
UG Student, Dept. of EEE, Ranipettai Engineering College, Vellore, India
Gajaprasath796@gmail.com.

ABSTRACT

The development of technology has brought up a significant change in almost every field and branch of science. As considered to the improvement of technology in terms of medical field various gadgets and robots are brought up. One such Robotic bestowment to the world is the AMBUBOT, Which focuses on the patients who at cases suffer from the Cardiac Arrest. Time is a critical issue when dealing with people who experience a sudden cardiac arrest as it could even lead the victim to death due to inaccessibility of the emergency treatment within the appropriate time. Hence, the AMBUBOT is preferred for an immediate treatment using Automated External Defibrillator (AED) to administer the victim within a few minutes after collapsing by facilitating various modes of operation from manual to autonomous functioning to save someone's life in the smart cities. Details, Design and Development of such robot is presented in this paper.

Index Terms: ROBOT, Smart healthcare, smart cities, emergency management, AED.

1. INTRODUCTION

Robotic systems are one of the key solutions for providing smart services. AMBUBOT is preferred for an immediate treatment using Automated External Defibrillator (AED) to administer the victim within a few minutes after collapsing by facilitating various modes of operation from manual to autonomous functioning to save someone's life in the smart cities. The prototype with biomedical sensors are used for monitoring the patient health continuously. The location of the patient can also be tracked in case of emergency via GSM. The concept of high-tech machines that can serve the people well or relieve humans of tiresome chores has been an object of human imagination. It can be seen with many of today's occupations have been replaced by automation in order to help prevent manual handling injuries in the workplace. The smart world is expected to involve ubiquitous sensing, computing, and communication to achieve comprehensive interconnections of physical perception, cyber interaction, social correlation, and cognitive thinking. Increasing population density in urban environments demands adequate provision of services and infrastructure. This explosion in city population will present major challenges including air pollution, traffic congestion, health concerns, energy and waste management. As an emerging platform for that domain, a mobile robot can be employed in order to facilitate the health care operation as a smart operating vehicle in smart cities. Most rescuers occur shortly after the event of a calamity happens. In that event, human rescuers will organize the rescue planning to get out to the calamity areas, find the victims, and In contrast, a mobile robot would be able to travel throughout the environment and can put their position wherever its condition. Mobile

robot is an autonomous or semiautonomous machine that is capable to move around in their environment and also can perform various tasks either with direct or partial control by human supervision or completely autonomous. With using multiple sensors for navigation, this robot is able to navigate from a point to a given destination without losing the correct path or hitting obstacles. There are various sensor types used for autonomous navigation in mobile such as vision and range sensors.

Mobile robots are mostly used to investigate hazardous and dangerous environments where the risks for human operation exist. This robot can also be used to interact with human such as take care the elderly and doing household chores. In future smart cities, mobile robots can take over some tedious and time-consuming tasks to help them as fast as possible. They have very short time to find the victims in any calamity situation; otherwise the likelihood of finding the victims still alive is nearly zero. In such a critical situation, technology can be used to support rescuers in different tasks. Intelligent mobile robots and cooperative multi- agent robotic systems are increasingly being used in many different ways to find and save the victims in a faster and more efficient way. The robot that can do such tasks is well known as rescue robot. Rescue robot is a robot that has been precisely designed to do rescuing jobs in situations that are hazardous for mankind to handle it, for instance rainstorms, collapsed buildings, obstructions, and dangerous substances.

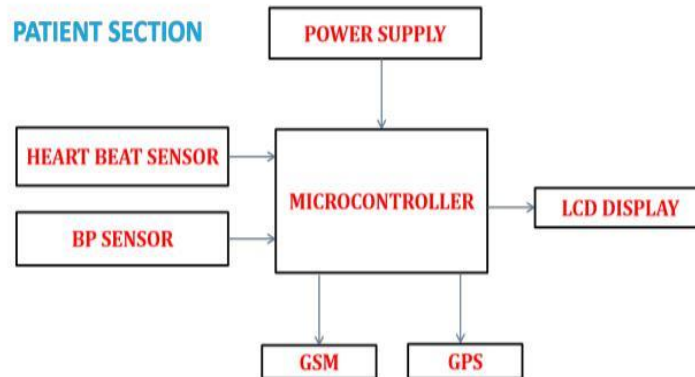
In the case of health emergency situation, it is common to call the emergency hotline to seek for assistance which often the ambulance will be dispatched to the scene in average of ten minutes time. Details of that information are depicted in Figure 1 for various territories. In practice, the advent time of ambulance is far above the ten minutes standard. This is owing to many obstructions during the process of dispatching an Ambulance and it may defer the patient from receiving the service on time. Substantially different factors prevail in this issue ranging from traffic congestion, difficulty to locate the address, long distance, and so forth. Any one of these delays can lead to increase response time. Meanwhile, it is a very hard task for bystanders to locate the nearest Automated External Defibrillator (AED) in a situation where someone is suffering from sudden cardiac arrest. In order to tackle these problems, we have designed and developed an ambulance robot (AmbuBot), which can place a small package containing an AED to save lives of cardiac arrest victim. Our developed robot is presented.



The Block diagram of this robotic vehicle comprises of three different sections. They are,

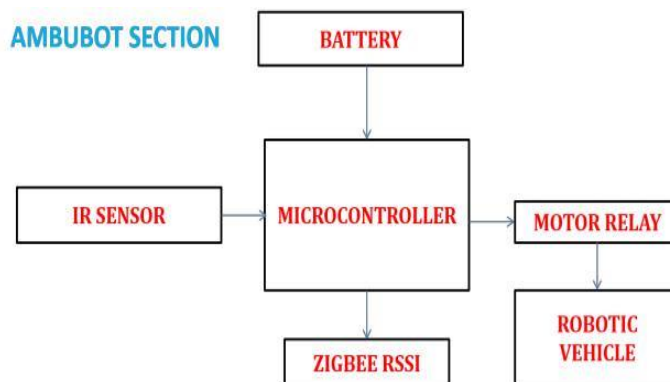
- a. Patient Section.
- b. Ambubot section.
- c. Control Section.

A. PATIENT SECTION:



This section has the GSM and GPS units followed by a Micro-controller which is latterly connected with the Heart beat sensor and the BP sensor. The LCD display is used to provide the output in a digitalized and viewable manner.

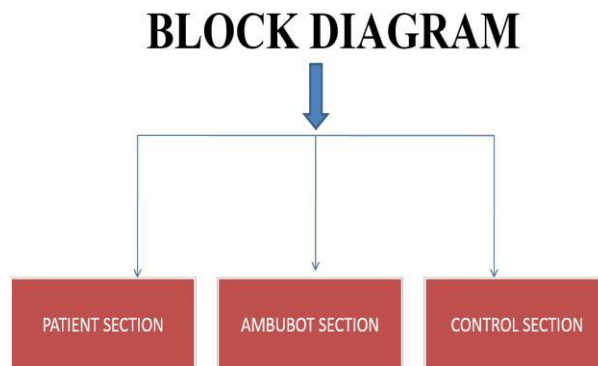
B. AMBUBOT SECTION:



2. PROPOSED SYSTEM

The proposed ambulance robot for smart cities provides the service of ambulance with AED to help someone having a cardiac arrest. No need to wait for the ambulance to give first aid solutions. An emergency message and current position of victim will be generated. Also, the message can be sent to the family members regarding current situation of the victim. It performs time - consuming tasks. It can be operated in auto or manual mode. This section of our project has the Micro-controller part attached with the Motor relay and with the wheels of the robotic vehicle. The IR sensors along with the DC Battery is also observed in this section. The Zigbee RSSI is Used for Communication Between the Various sections of our project.

C. CONTROL SECTION:



This section has an operational PC in which the Zigbee acts as a Transceiver.

3. HARDWARE IMPLEMENTATION

A. PIC MICROCONTROLLER

Peripheral Interface Controller (PIC) was originally designed by General Instruments. In the late 1970s, GI introduced PIC 1650 and 1655 – RISC with 30 instructions. PIC was sold to Microchip Features: low-cost, self-contained, 8-bit, Harvard structure, pipelined, RISC, single accumulator, with fixed reset and interrupt vectors

B. BP SENSOR

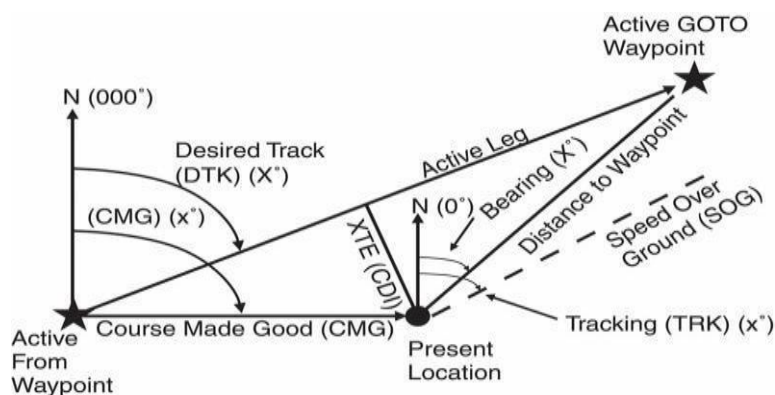
Manual blood pressure monitors are cost effective as compared to digital monitors, but their usage is more difficult. They are also known as aneroid monitors. Sometimes referred to as sphygmomanometer too, the setup includes an arm cuff, squeeze bulb to inflate the cuff, stethoscope and a gauge to measure the blood pressure. Blood pressure is displayed on a dial with a needle.

Rising pressure in the cuff makes the needle move clockwise and falling pressure results in anti-clockwise movement. The dial markings indicate the pressure level. It is also difficult for a person with hearing issues to hear the heart beat through the stethoscope.



C. GLOBAL POSITIONING SYSTEM (GPS)

The Global Positioning System (GPS) is a satellite based navigation system that can be used to locate positions anywhere on earth. Designed and operated by the U.S. Department of Defense, it consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and uses triangulation to calculate a user's exact location. GPS is used in a variety of ways such as, To determine position locations; for example, If you need to radio a helicopter pilot the coordinates of your position is located so that the pilot can pick you up.

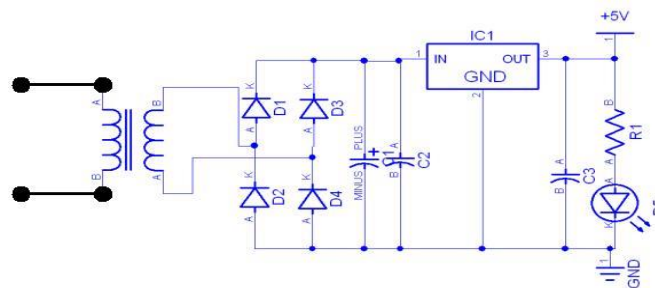


GPS Navigation Terminology

The basis of the GPS is a constellation of satellites that are continuously orbiting the earth. These satellites, which are equipped with atomic clocks, transmit radio signals that contain their exact location, time, and other information. The radio signals from the satellites, which are monitored and corrected by control stations, are picked up by the GPS receiver. A GPS receiver needs only three satellites to plot a rough, 2D position, which will not be very accurate. Ideally, four or more satellites are needed to plot a 3D position, which is much more accurate.

D. REGULATED POWER SUPPLY

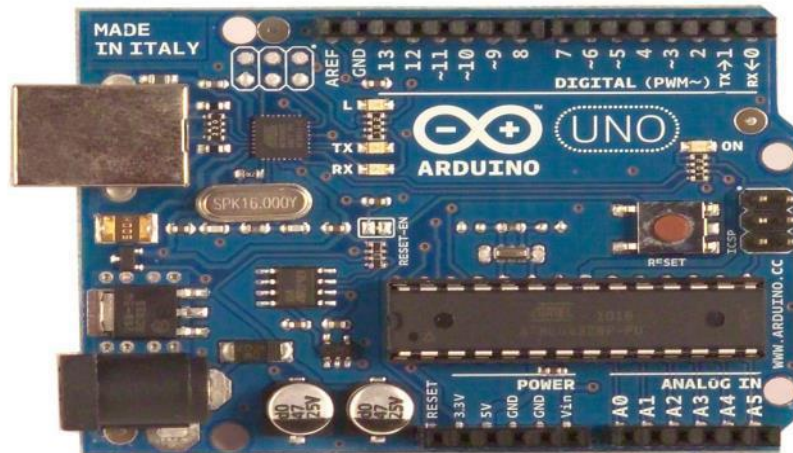
Almost all electronic devices used in electronic circuits need a dc source of power to operate. The source of dc power is used to establish the dc operating points (Q-points) for the passive and active electronic devices incorporated in the system. The dc power supply is typically connected to each and every stage in an electronic system. It means that the single requirement, common to all phases of electronics is needed for supplying dc power.



Regulated power supply circuit

For portable low-power systems batteries may be used, but their operating period is limited. Thus for long time operation frequent recharging or replacement of batteries become much costlier and complicated. More frequently, however, electronic equipment is energized by a power supply, derived from the standard industrial or domestic ac supply by transformation, rectification, and filtering. (The combination of a transformer, a rectifier and a filter constitutes an ordinary dc power supply, also called an unregulated power supply). The concept and definition smart cities have evolved gradually since first proposed in the nineties, and a core set of principles related to them have been developed to guide the future direction of urban sustainability. The smartness of a city can be as simple as a single function provided to a certain group of citizens or as complicated as an entire administration process which represents the restructuring efforts of government procedure. As such it is difficult to formalize the definition.

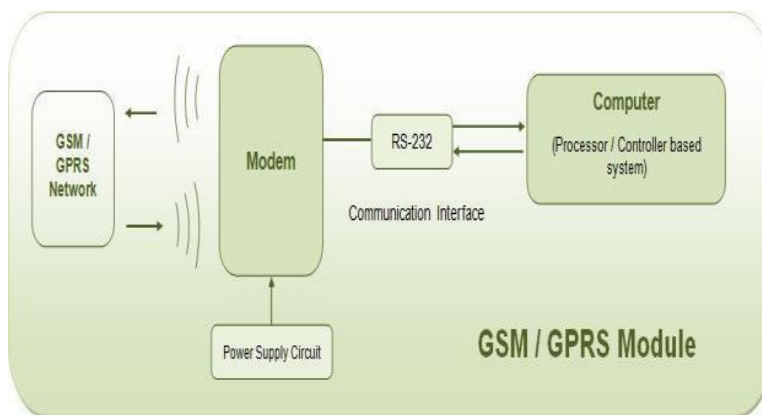
E. ARDUINO – MICROCONTROLLER - ATMEGA258



The ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

F. GSM

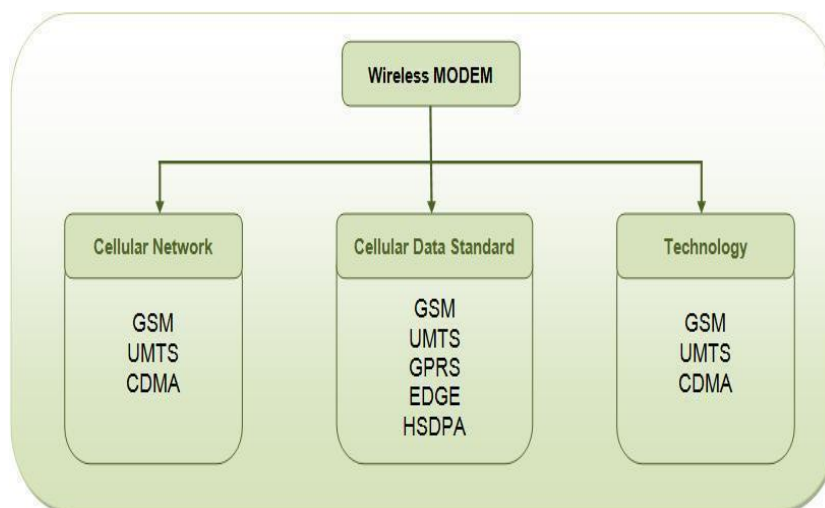
GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.



Global System for Mobile communication

WIRELESS MODEMS

Wireless MODEMS are the MODEM devices that generate, transmit or decode data from a cellular network, for establishing communication between the cellular network and the computer. These are manufactured for specific cellular network (GSM/UMTS/CDMA) or specific cellular data standard (GSM/UMTS/GPRS/EDGE/HSDPA) or technology (GPS/SIM). Wireless MODEMS like other MODEM devices use serial communication to interface with and need Hayes compatible AT commands for communication with the computer (any microprocessor or microcontroller system).



Types of MODEM

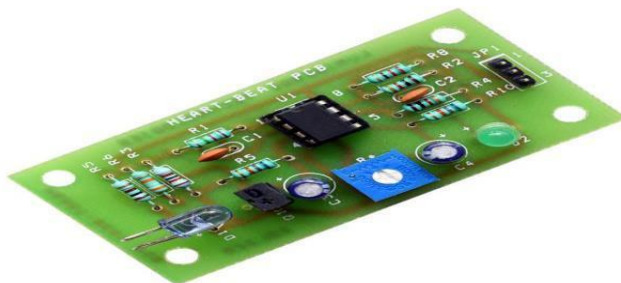
H. BLOOD PRESSURE SENSOR

Manual blood pressure monitors are cost effective as compared to digital monitors, but their usage is more difficult. They are also known as aneroid monitors. Sometimes referred to as sphygmomanometer too, the setup includes an arm cuff, squeeze bulb to inflate the cuff, stethoscope and a gauge to measure the blood pressure. Blood pressure is displayed on a dial with a needle.

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HEART BEAT SENSOR

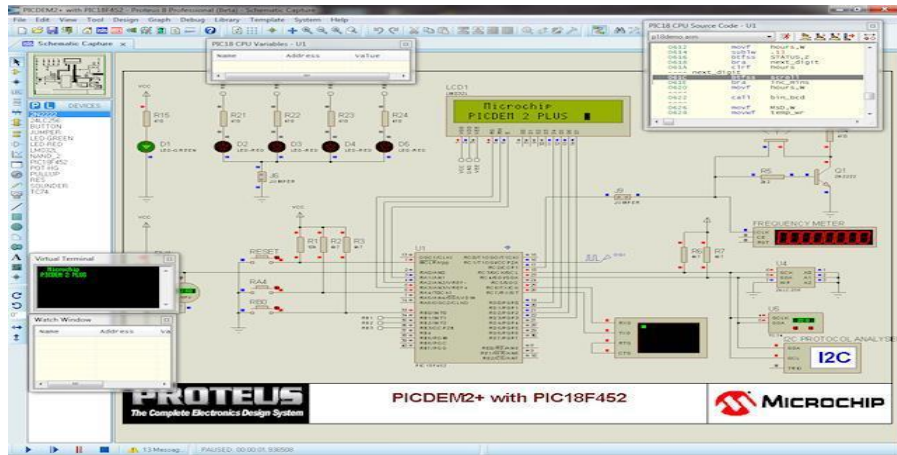
The operation of the board is very simple. After powering the board from a 3-5.5V supply, the Enable (EN) pin must be pulled high to activate the IR sensor. Next, place the tip of your forefinger gently over the sensor on its face. Your finger should be still and should not press too hard on the sensor. Within a couple seconds the circuit stabilizes and you will see the LED flashing synchronously with your heart beat. You can feed the output signal (Vout) to either a digital I/O or an ADC input pin of the microcontroller for measurement of the heart beat rate in BPM. The output voltage waveform can also be viewed on an oscilloscope. connected Digilent's Analog Discovery tool to check the input PPG and the output waveforms from the two LPF stages.



J. ZIGBEE RSSI

The ZigBee (cc2530) is a true system on chip (SoC) solution for IEEE 802.15.4 applications. It combines the excellent performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, in system programmable flash memory, 8 kB RAM, and many other powerful features. Received Signal Strength Indicator (RSSI) is a measurement of power present in a received radio signal. . In an IEEE 802.11 system, RSSI is an indication of the power level being received by the receive radio after the antenna and possible cable loss. Therefore, the higher the RSSI number, the stronger the signal. The CC2530 comes in four different flash versions: CC2530F32/64/128/256, with 32/64/128/256 KB of flash memory, respectively. The CC2530 has various operating modes, making it highly suited for systems where ultralow power consumption is required. Short transition times between operating modes further ensure low energy consumption. RSSI is usually invisible to a user of a receiving device.

4. SIMULATION RESULT



CONCLUSION

Now a days time is a critical issue when dealing with people who experience a sudden cardiac arrest that unfortunately could die due to inaccessibility of the emergency treatment. Therefore, an immediate treatment using automated external defibrillator (AED) must be administered to the victim within a few minutes after collapsing. Hence, we have designed and developed the ambulance robot, which brings along an AED in a sudden event of cardiac arrest and facilitates various modes of operation from manual to autonomous functioning to save someones lives in smart cities

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