Detection of Car Pre-Crash with Human, Avoidance System & Localizing through GSM

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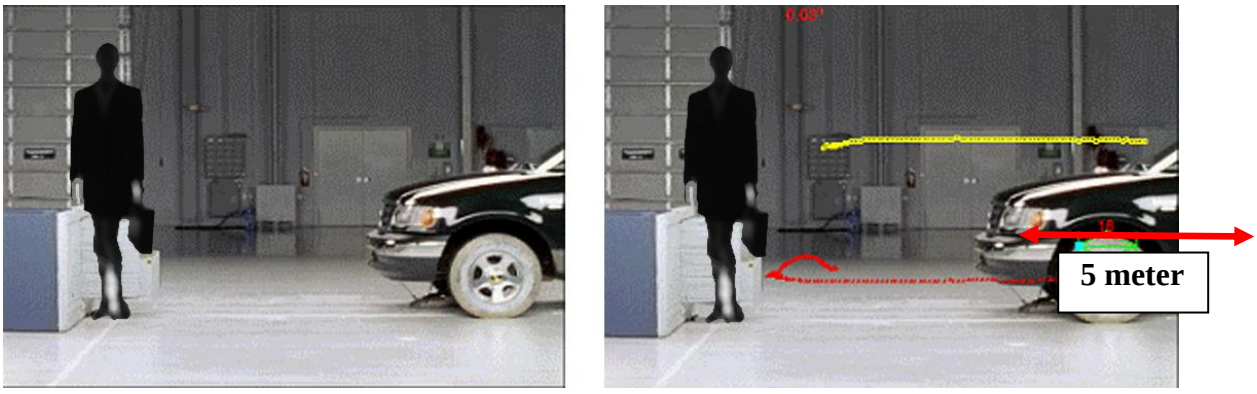
Abstract- Human lives can be saved from an accident by detecting an accident before it occurs. But this need advance accurate human detection and also accident detection capability. At present there are several works regarding pre crash detection & avoidance system from obstacle. But we are lacking to priorities crash with human or animals compared to obstacles. What would be the situation when a system has to choose between human and obstacles? If the system is unable to detect human then there is a probability to hit humans instead of obstacles. To solve this problem in this work we have priorities humans or animals first. Car will avoid human or animal first then if possible it will try to avoid obstacles also. If the system is unable to avoid accident then our system has accident detection technique with pin point location tracking using GSM only.

Index Terms- Pre-crash Detection, GSM, accident detection, vehicle tracking.

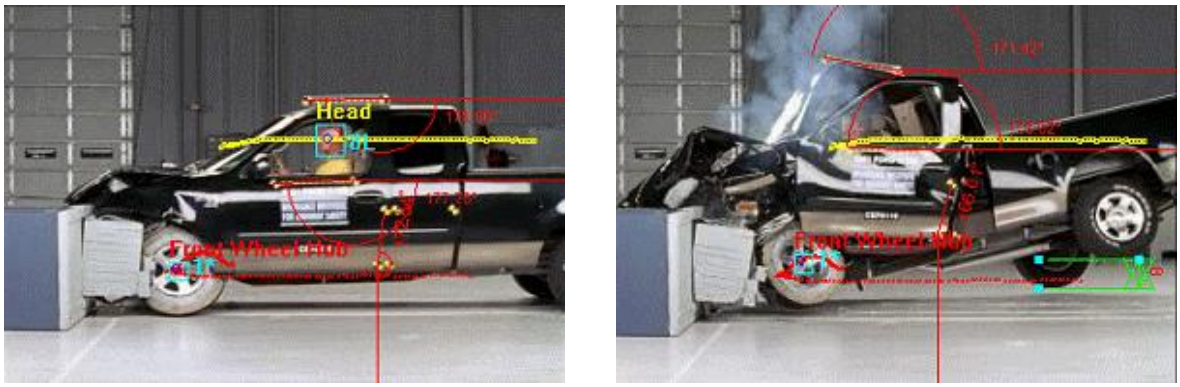
I. Introduction

According to the WHO 2013 Global Status Report on Road Safety [1], road traffic deaths would become the fifth leading cause of death. The report showed that there had been no overall reduction in the number of people killed on the world's roads: about 1.24 million deaths occur annually. Among them cyclist, motorcyclists, car occupants & unspecified road users are high. Number of animals die in road accident is also quite good. Even in several countries the number is pretty high. In order to reduce the number of car crash Charles Birdsong, Ph.D., Peter Schuster, Ph.D., John Carlin, Daniel Kawano, William Thompson has designed Pre-crash detection system using ultrasonic, laser range finder and radar sensors [2]. Accident Avoidance and Detection on Highways is designed by S.P. Bhumkar, V.V. Deotare, R.V.Babar [3]. These systems have the ability to detect obstacles but the most important to detect human being or animals and avoid them are missing. This sensing technology can reduce a large number of bikers, cyclist and passerby death. There are also lots of research work is available on accident avoidance, crash detection and alarm system. Megalingam, Rajesh Kannan & their group mate have developed "Wireless vehicular Accident Detection and Reporting System" [4]. Automatic Accident Detection via Embedded GSM message interface with Sensor Technology is developed by C.Vidya Lakshmi, J.R.Balakrishnan [5]. These methods uses break system, windows close, seat belt stiffen to save life from the accident but if the obstacle is human or animal then our system uses avoidance system also. If avoidance is not possible and accident happens then this system generate an SMS, also internet based alert through GSM module only, including tracking the position of accident using GSM.



(a) (b)

Figure 1: a) Human Detected before 5meter b) Human avoidance system executing.



(a) (b)

Figure 2:- a) Unable to avoid obstacles. b) Accident Detected & Alarm generated.

II. MAIN TECHNOLOGY USED

A. *Passive Infra Red sensor:-*

Human sensing technology is the key of this project. Passive Infra Red sensor has been used to detect human in this project. Infrared radiation exists in the electromagnetic spectrum at a wavelength that is longer than visible light. It cannot be seen but it can be detected. Objects that generate heat also generate infrared radiation and those objects include animals and the human body whose radiation is strongest at a wavelength of 9.4um [5].PIR sensor is able to detect the change of radiation of these infrared radiation. Bellow is a picture of working principle of PIR sensor.

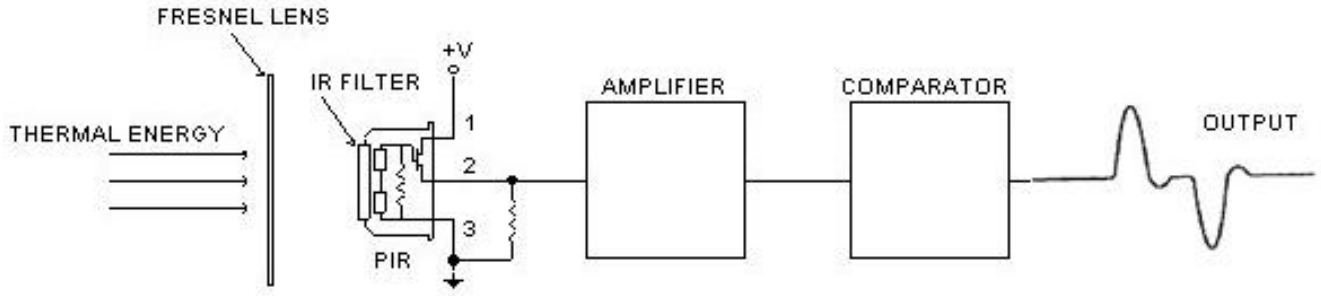


Figure 3:- Typical Configuration of PIR [5].

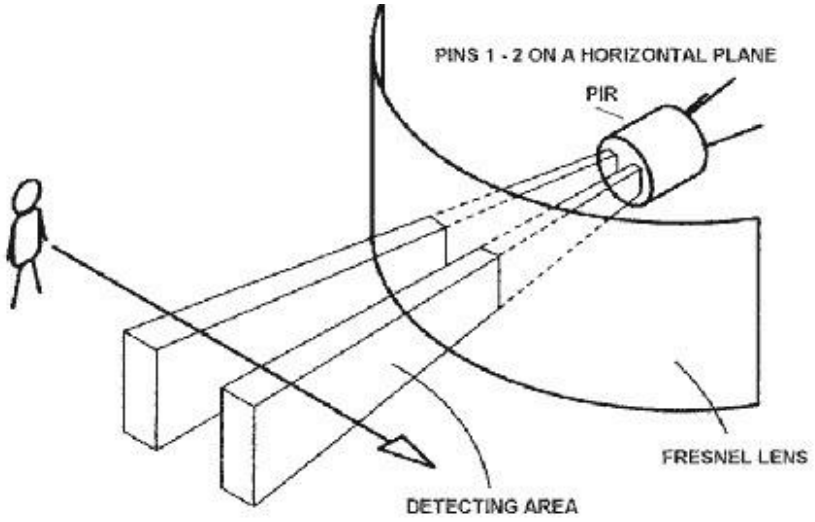


Figure 4:- Working principle of PIR sensor [6].

If any human or animal passes in front of the PIR sensor or any movement is detected of human or animal in front of PIR sensor it generates +5v and -5v sine signal. A breakout board is used to detect this signal and convert it into a longer digital signal. The output of PIR sensor can be adjusted. For max it can create an output signal for approximately 1.2 seconds [6]. This is more than enough to detect the signal.

B. *Fresnel lenses*

FL65 Fresnel lens is made of an infrared transmitting material that has an IR transmission range of 8 to 14um which is most sensitive to human body radiation. It is designed to have its grooves facing the IR sensing element so that a smooth surface is presented to the subject side of the lens which is usually the outside of an enclosure that houses the sensor.

The lens element is round with a diameter of 1 inch and has a flange that is 1.5 inches square. This flange is used for mounting the lens in a suitable frame or enclosure. Mounting can best and most easily be done with strips of Scotch tape.

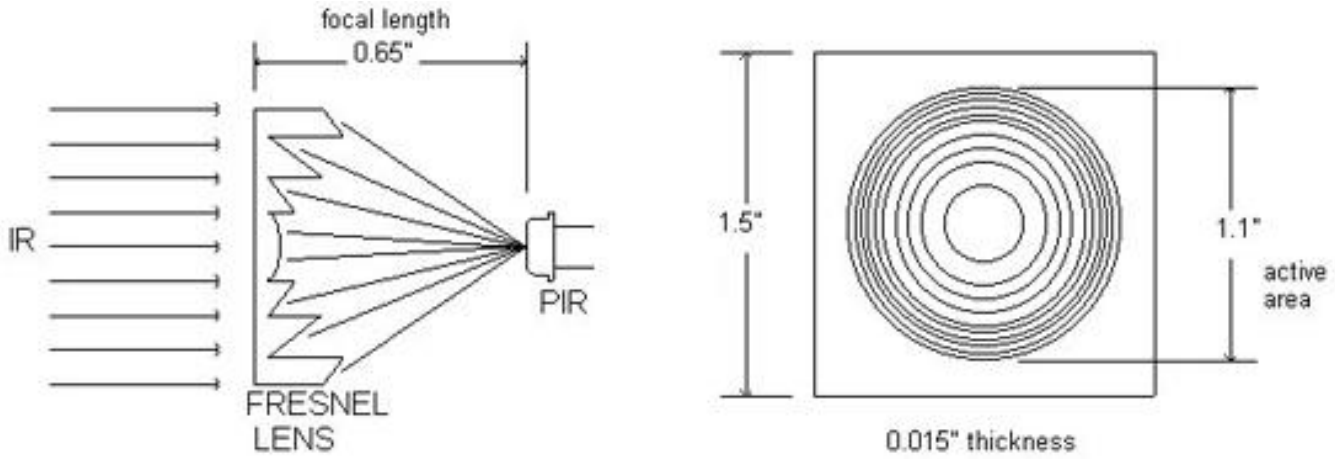


Figure 5:- Fresnel Lens, increase sensitivity and range of PIR sensor.

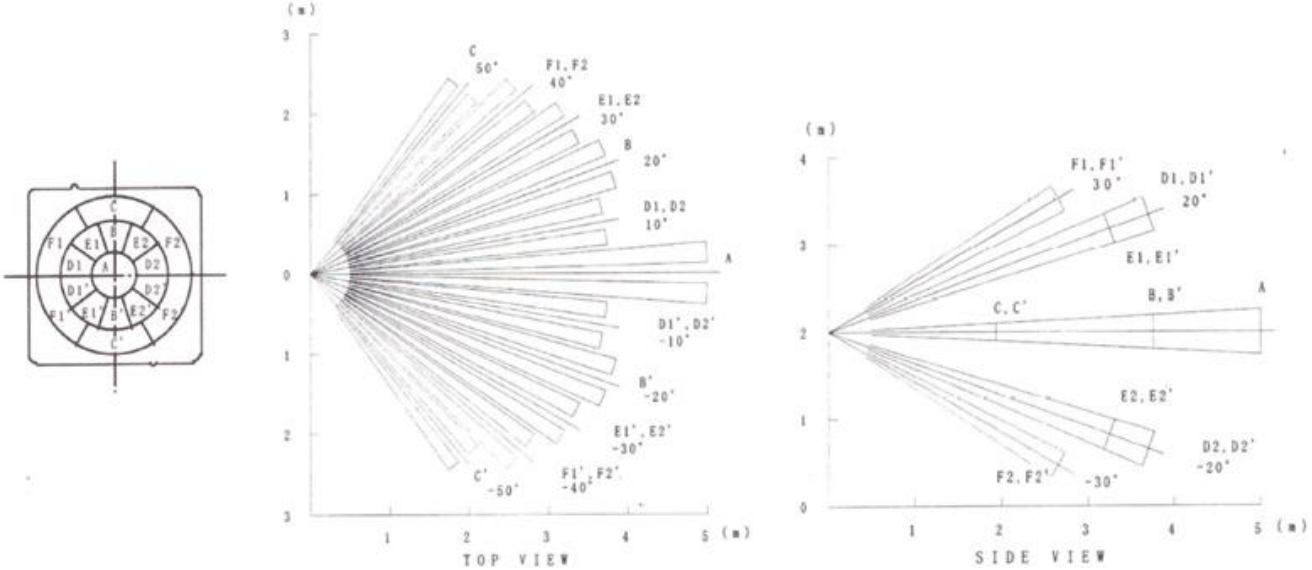


Figure.6:- Detection area of PIR sensor with Fresnel lens.

Detection area of a PIR sensor is 3m in width, 5m in length & 3m in height. But on average the width of any car is around 1.5m. We have to detect humans or animals within this width. So, we have covered the lens area to reduce the width to 1.5m. Here is a picture bellow.

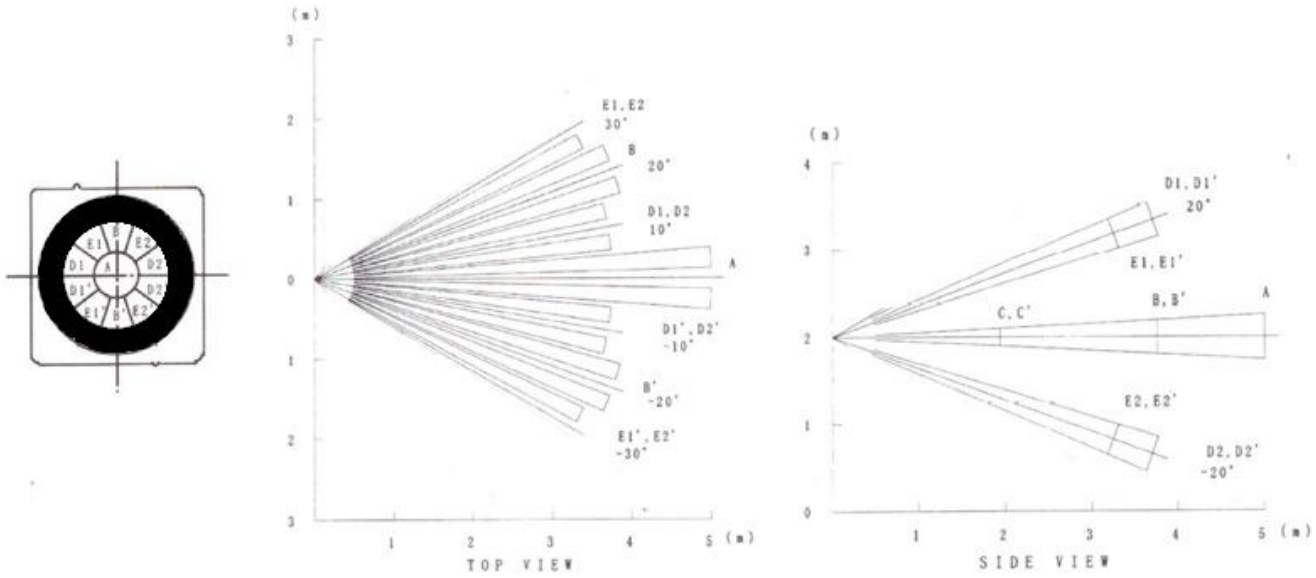


Figure 7:-. Reduced width of PIR sensor.

In order to identify the position of the human being we need two sensors. Their detection area will overlap each other at the center. If both the sensor detect human means human is at the center. If left PIR only detect means the person is at the left side of the car and same for the right side. Here is a figure describing the covered area.

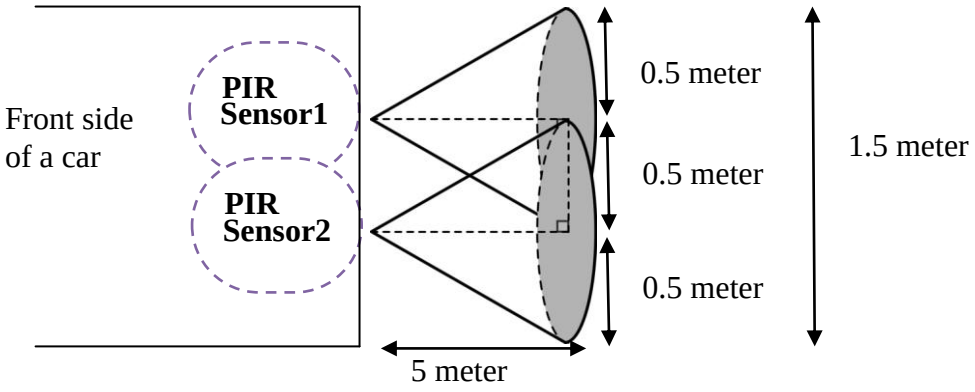


Figure 8:- Area covered by PIR sensors & human position detection.

With the help of distance sensor this system [2] is also able to find out the distance of the human.

B. Accident avoidance system:-

An advance pre-crash system is also capable of avoid accident sensing human and their distance from vehicle. For example this system can execute an automated braking force. Determining the position of human or obstacle the system can handle the steering also. Also the system can generate an auto horn to indicate the person that a car is coming if driver forgets to press horn.

C. Accident Detection:-

Most of the accident detection system uses complex 3 axis accelerometer, gravity sensor or costly android mobile phones with complex circuitry. In this system the accident detection method is also cheap and simple. We have used a tilt sensor to detect accident. Whenever any major accidents happens car jump or even flip over. We are detecting the amount of angle it rotated from ground. Tilt sensor can measure a rotation of minimum +15degree or -15 degree [7].

TILT SENSOR

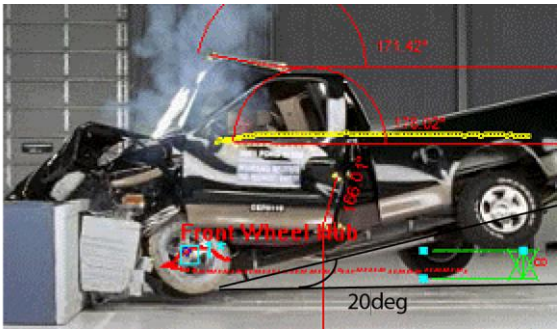


Figure 9:- Accident Detection using tilt sensor.

D. Location tracking without GPS

As all of us think that without GPS locating any object is not possible, but this information is not valid anymore. By the help of unique code, broadcast by each BTS tower it is possible to get the location of any GSM module at about certain limit of acceptability. Of course the location provided by this method is not as accurate as GPS data, but still its error margin is small enough to consider.

How the method works:

Code description: MCC – Mobile Country code
MNC – Mobile Network Code
LAC – Location Area Code
CID – Cell ID

This set of code can be extracted from the GSM module, which is continually given by every BTS tower. When a GSM tower is under any tower, module gets this information at the very beginning. This code can be posted in the website [8] to get the location of device. Detailed code description can be found in wiki [9].

Example of the code: For Bangladesh using Grameenphone operator:

MCC - 470 MNC – 01 LAC – 21534(random), CID – (random)

Device will take the above mention code and send an SMS to the nearest emergency help point. With the help of more developed software it is possible to send the location or even Google location link.

E. Atmega8

Brain of this project is Atmega8 micro-controller. It is a 8 bit Micro controller with RISC architecture. Its speed is up to 16MIPS throughput at 16MHz. It has 8K bytes of flash and 512bytes EEPROM. Operating voltage 2.7v -5.5v, in active mode it consumes only 3.6mA & in sleep mode it consumes less than 1uA current [10]

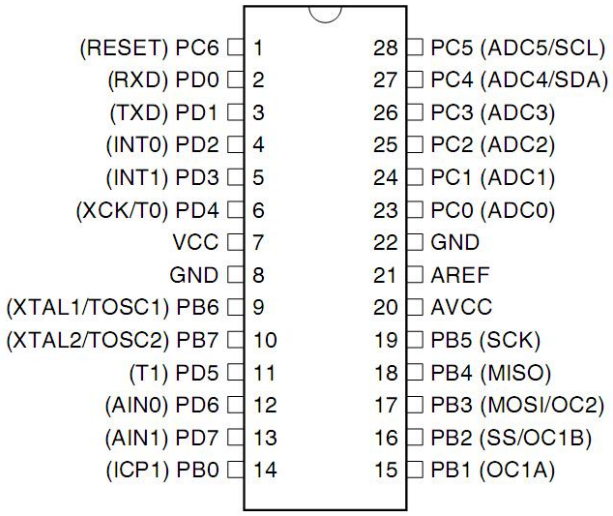


Figure 10:- Atmega8 Pinout.

III. Circuit Description

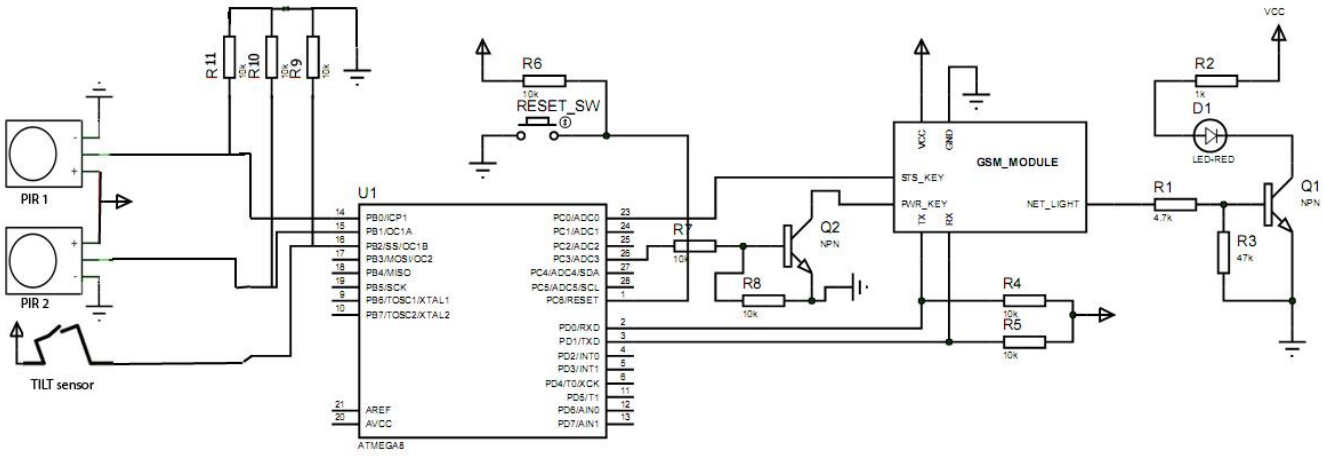


Figure 11:- Schematic Diagram

The controller used in this project is ATMEGA8. Two PIR sensors are connected to PORTB0 & PORTB1 bit. One tilt sensor is connected to PORTB1 bit. All these sensors give digital input that's why all these 3 pins are pulled down by 10K resistors. Here all the VCC are +5v. GSM module communicates with microcontroller through UART. Other 2pins used to control the GSM module. Through PWR_key GSM module can be turned on or turned off through microcontroller. STS_key gives the turned on or off status of GSM module to microcontroller. One led is connected with Net_light pin. This led shows the availability of network of GSM module.

Circuit operation is simple. First step is to detect human. There are three possibilities, human is at left side of the car, at the middle of the car or at right side of the car. If human is at left side only PIR1 will generate a high signal, if human is at the center both the PIR will generate high signal & if the person is at right side only PIR2 will generate a signal. According to the PIR a signal will be sent to turn the staring to avoid the human. If avoidance of obstacle is not possible then the tilt sensor will be get shorted and a +5v will go through PINB2 bit. When microcontroller gets this signal it initiates an alarm and send a sms through GSM module finding the coordinate location.

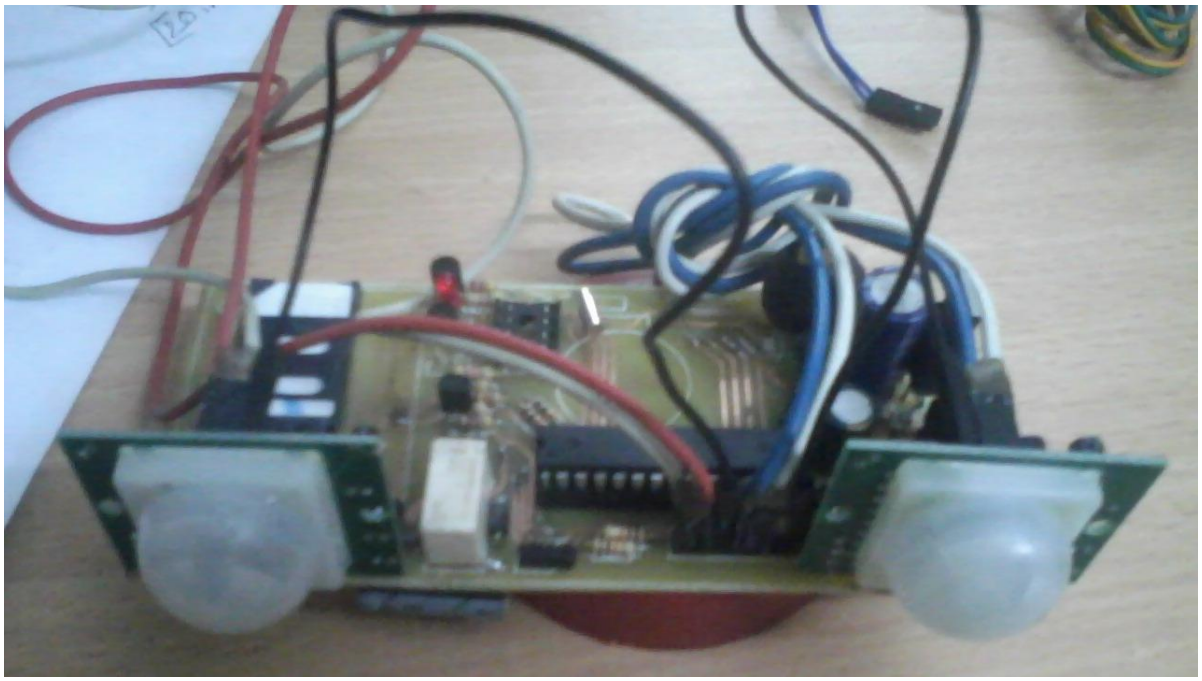


Figure 12:- Front view of the Hardware

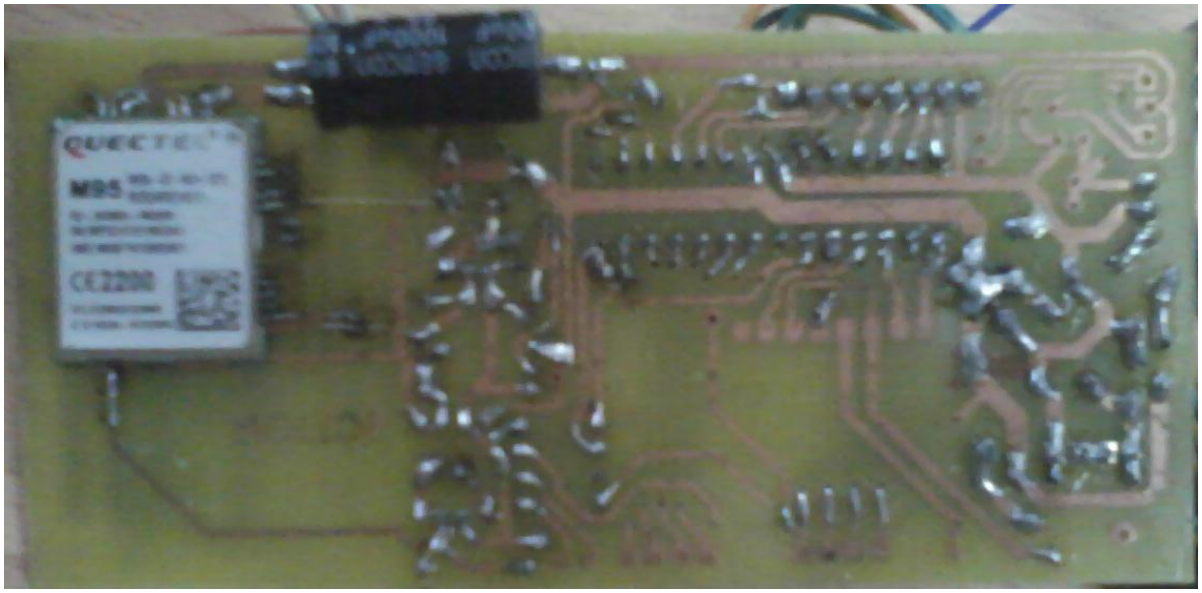


Figure 13:- Backside of Hardware

IV. Further Application

1. Avoiding Helicopter or Air plane collision with birds.
2. Robots will be able to identify humans & animals.
3. In NASA robot to detect presence of life using sensor.
4. Earthquake survival finding inside buildings.
5. Fire survival finding inside buildings.

V. Conclusion

Passive Infra red sensor is a reliable solution for detecting human or animals and this technique certainly can save lots of life. Human lives are most valuable. Pre-crash detection system must be equipped with combination of different sensors. Detecting humans or animals including obstacles will certainly give us a better solution to reduce the death of humans in road crash.

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