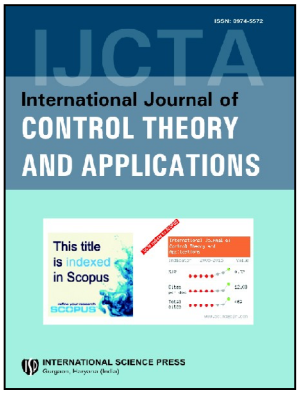

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Autonomous Solar Car to Avoid Road Accidents

[1]Durga K. Prasad Gudavalli, [1]Sumanth Pemmada and [1]Bh. Sudha Rani

[1] *Asst. Professor EEE Department, S. R. K. R. Engineering College, Bhimavaram, 534204, India*

Abstract: According to the statistical survey made by the Transportation Research and Injury Prevention Program IIT Delhi, in India 1,41,562 people were died and 4,77,731people were injured by road crashes in the year 2014.The official accident death report rate is 11.0 deaths per 100,000 persons but World Health Organization (W.H.O) estimated it as 16.6.The survey reports concludes that number of victims of road crashes/collision of vehicles is huge in India, not only in India it is a global issue too. Hence we came up with an idea which is an Autonomous Solar Car to avoid road accidents; it's having two operating modes: one is Self-Speed Adjusting System (SSAS) and second one is Signal Alerting System (SAS). Here HCSR04 ultra sonic sensor (distance measuring sensor) is used to give input command signals to the Micro Controller Unit, it senses the obstacle movements in front of the car and it gives the information to the Micro Controller Unit (MCU) to rise or down the running speed of current vehicle and along with that it gives the automatic signal alerting system (Red Green Yellow LEDs) provided at the back side of the vehicle to alert the back coming vehicles. Therefore the proper co ordination between the vehicles and automatic speed an adjustment of vehicles provided by the proposed method reduces the road accidents. Hence this system has very useful in day by day developing countries and as well as in developed countries to develop the nation by reducing the road accidents.

Keywords: autonomous solar car; self-speed adjusting system; signal alerting system; micro controller unit; moving vehicle; following vehicle; foregoing vehicle.

1. INTRODUCTION

Now a day's vehicle users are increasing rapidly along with the population. Lack of awareness on road safety, misuse of traffic rules causes huge traffic creation and road accidents/vehicle crashes in the country.Fig.1.shows the proto type of proposed solution, its motto is to avoid road accidents by providing a proper coordination between the vehicles.

The proposed system uses an HCSR04 ultra sonic sensor to estimate the obstacle movement in front of the moving vehicle, because as normal human beings we cannot predict the foregoing vehicle speed this it leads us to crashing the vehicles one to one. Hence to estimate the foregoing vehicle speed for adjusting the speed of vehicle followed by it and controlling the accident between those vehicles, we propose a solution Autonomous Solar Car.

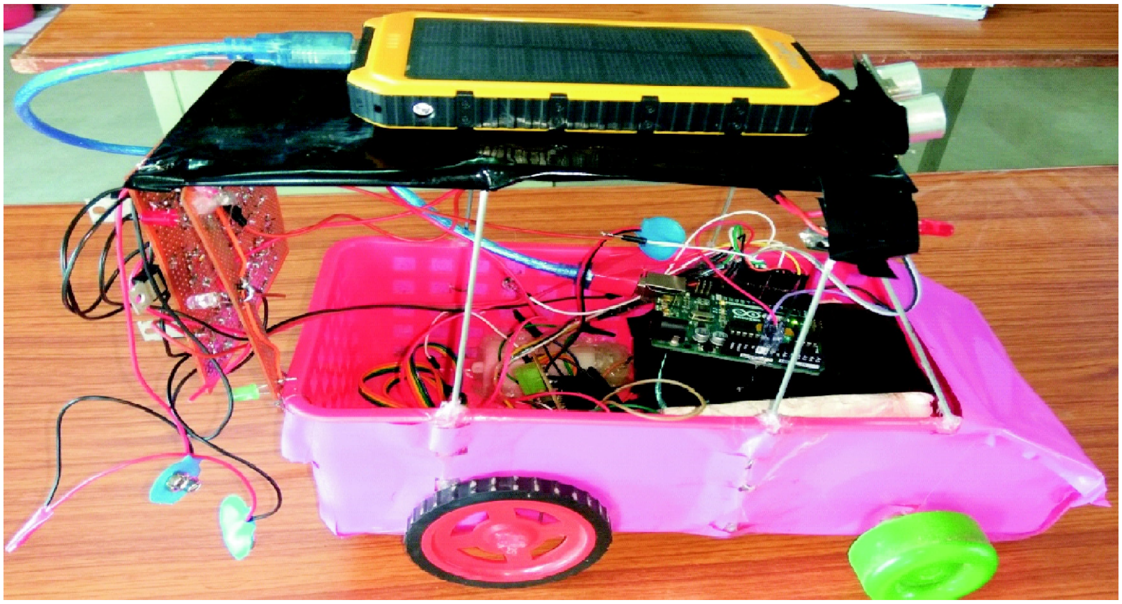


Figure 1: Proto Type of Autonomous Solar Car

In year 2015 Chenyan Qu, Denis A, Bharath K, Bhargava, has revealed that exchanging data between vehicles and base stations contains road accidents and traffic jams information's through an image and video capturing systems, this helps the users to aware on traffic jams and accident prone areas [1]. In the reference paper [2] they found a solution for driver distraction prediction and warning system, when driver did not concentrate on driving or he is in drowsy mode the environmental sensor senses his behavior and it predicts the situation of the driver. For this driver warning control system they used an inverse sub optimal control to predict all the aspects in visually distracted lane keeping.

In the present scenario due to the heavy traffic and sudden breaks applied by vehicles causes unexpected accidents. To avoid such problem [3] proposes a methodology vision based threat object detection system, here a camera attached on back side of the bus to detect oncoming objects and another camera at the door to analyze objects status. For this purpose they used a fast motion analysis algorithm based on subtracted images to alert the vehicle user along with the oncoming vehicles and in 2016 a project Safe Drive: Autonomous Driver Safety Application in Aware Cities is proposed a solution for controlling the road accidents. It estimates the mental fatigue condition of a driver by using a brain sensor and it predicts the collision probability by fusing car parameters with driver mental behavioral condition [4]. Hermann kopetz, stephean poledna [5] has developed a method, which is an autonomous emergency breaking system to stop the car when pedestrians are suddenly coming in front of the car. To apply this breaking mechanism they found a solution in this paper in year 2013.

All the systems discussed above have experimented on different kinds of methodologies to controlling the road accidents and our proposed system also a kind of road accident controlling methodology. The rest of the paper is prepared as follows: Section 2 gives the overview of proposed methodology, section 3 discusses the working, section 4 has experiments made and finally section 5 concludes the paper.

2. PROPOSED METHODOLOGY

The Autonomous Solar Car to Avoid Road Accidents mainly concentrated on avoiding road accidents by providing proper coordination between the moving vehicles. The moving vehicles mean foregoing vehicle and its followed vehicle. Normally foregoing vehicles has some speed but its following vehicle does not know or cannot predict how much speeds it's moving in front of it. Therefore lack of coordination or lack of predication by following vehicle causes to occur more road accidents between them. Hence to estimate or predict the foregoing vehicle speed, the system uses an ultrasonic sensor which is a distance measuring sensor it predicts the foregoing vehicle speed. According to the ultrasonic sensor distance measured values the followed vehicle adjusts its speed which is nothing but a self-speed adjusting system and as well as it gives the current status of it to its followed vehicle through a signal alerting system. Therefore there exists a proper coordination between the vehicles, so moving vehicle cannot hit foregoing vehicle by controlling its speed and no followed vehicle hit this moving vehicle because of its signal alerting system provided at the back side of moving vehicle.

The block diagram representation of proposed system is as shown in Fig. 2. Here the Solar energy is used as a prime input source for the whole system and it uses two modes: one is Self-Speed Adjusting System (SSAS) for controlling the motor speed based on distance between the vehicles and another one is Signal Alerting System (SAS) for controlling the following vehicle speed to alerting the followed vehicle.

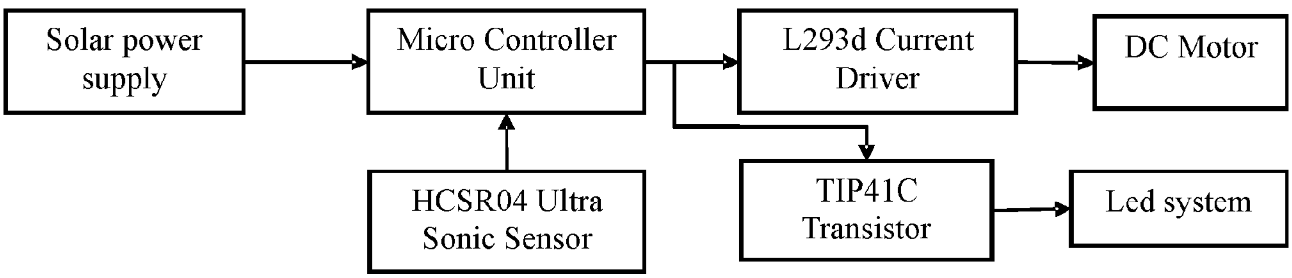


Figure 2: Block Diagram of Proposed Methodology

The detailed descriptions of individual sub systems used in the proposed system are explained as follows

(A) Solar power bank

The solar power bank is acted as a prime input source to operate the entire system. It is operated on two ways i.e., day and night times. When sunlight (sun radiation) falls on the solar PV panels it generates 5volts DC supply and for stand by condition it stores the energy in storage battery for delivering the power in non sun light conditions. The battery storage capacity is 10400mha, it is charged through a USB cable and as well as a <45°C temperature PV radiation. The rated current capacity of the power bank is 5volts DC, 2 amps applications.

(B) Arduino Uno micro controller

The Arduino Uno is a micro controller board it is having 14 digital input/output pins out of which 6 pins are used for PWM controlling and it is operated at 5volts dc supply. It has great key features than other Micro Controller Units, with this MCU we can modify the program (code) along with the hardware connections; therefore we can easily check the working of hardware by changing the codes simultaneously. Here in our proposed solution the MCU operates the outputs (motors speed & led's) based on ultra sonic sensor (distance measuring sensor) values.

(C) HCSR04 ultra sonic sensor

The HC-SR04 ultra sonic sensor is nothing but a distance measuring sensor, it operates on 2 cm to 4 mtr of range and its operating voltage and current ratings are 5V dc & 12mA.Here in this system the ultra-sonic sensor plays a vital role, because the sensor gives input command signal to the Arduino MCU based on the distance measured values by the sensor.

(D) L293D Motor Driver

The L293D Motor Driver having a dual H-bridge driver Integrated Circuit (IC), it is used as a current amplifier for driving the motors satisfactorily. It takes 9 volts DC supply externally and it sufficiently runs two 5 volts dc motors at a time. When there is a low current in the circuit, the driver module enhances its current to drive the motor in sufficient current mode and for high currents it limits current to protect the motor. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.

(E) 6v DC, 160 rpm, and micro dc geared motor

Here we used 160 rpm dc geared motor with a back shaft to connect the robot wheels to it; hence we used two motors for this application autonomous solar car to run the car on four wheels. This motor set is operated by the Arduino Uno micro controller instructions according to the distance measuring sensor commands.

(F) TIP41CTransistor

The TIP41C is an NPN power transistor, which is used for driving array of LEDs. Here three transistors are used for signal alerting system of red, orange, green LEDs respectively. It maintains uniform currents and voltage rating throughout the array system. It is used for reliable power supply applications.

(G) LED system

The LED system is nothing but a signal alerting system for proposed method. It contains three groups of LEDs namely red, orange, and green. A light emitting diode is a PN junction diode, when positive charge is applied to the anode and negative is applied to cathode, it acts as a forward biased junction and after breaking the depletion layer between the P&N junctions, the charged particles are moved from anode to cathode then it emits the lighting.

3. WORKING

The working over view of the system is as shown in the below Fig. 3. As per the diagram Ultra-sonic sensor (distance measuring sensor) gives the three different input commands to the Micro Controller Unit (Arduino Uno) to operate the car (motor) speed & signal alert (LEDs).

When the sensor value is >160 cm (the distance from foregoing vehicle to the following car) the motor speed is high (maximum) and the green LED (signal alerting system) glows at the back side of the car. If its value is between 49 cm and 160 cm, the motor speed is gradually decreases automatically and orange LED glows at the

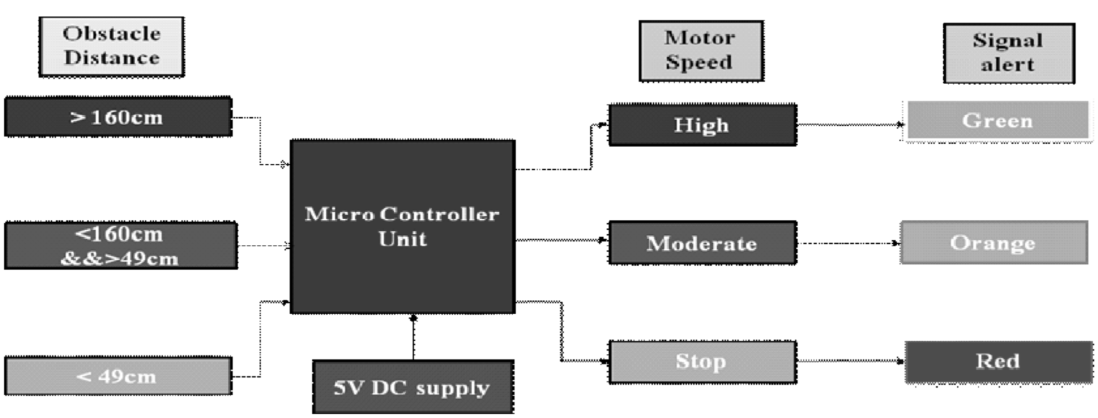


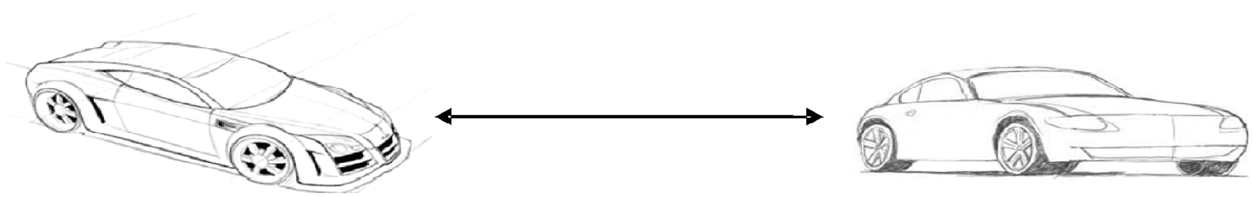
Figure 3: Working over view about the proposed solution

back side of the car. Finally the third result of ultrasonic sensor when it is <49 cm, the motor is stopped (Engine remains ON) and the red LED glows at signal alerting system. Therefore there is a possibility of coordination between the two vehicle drivers and it avoids maximum road accidents/crashes.

4. EXPERIMENTAL RESULTS

In our proto type work we have taken three kinds of distance measuring values from HCSR04 ultra sonic sensor. These three different kinds of values are used as threshold values in our micro controller programming. First value is the maximum value of the sensor and second one is the medium value between the low and high level values and finally the third value is taken as lowest value. Hence these three lowest, moderate and highest values represent low speed, moderate speed and high speed of the vehicle along with that Red, Orange and Green led indications presents at the back side of the vehicle. Therefore the following results shown below conclude the experimental set up.

CASE1: If the vehicle or car is far away from front going vehicle (foregoing vehicle), it means that the distance between two vehicles is more. Therefore there won't be any problem between these two vehicles. Hence they can move freely one after one with their specific speeds.



CASE1 : > 160cm

In case 1 the distance measuring sensor (HCSR04 ultra sonic sensor) value >160 cm (we have taken 160 cm as threshold value) which means it is the maximum value to its rated value i.e., greater than the 160 cm, then the motor speed attains its maximum speed and along with that the green LED glows in the signal alerting system. The practical results are shown in the below Fig. 4.

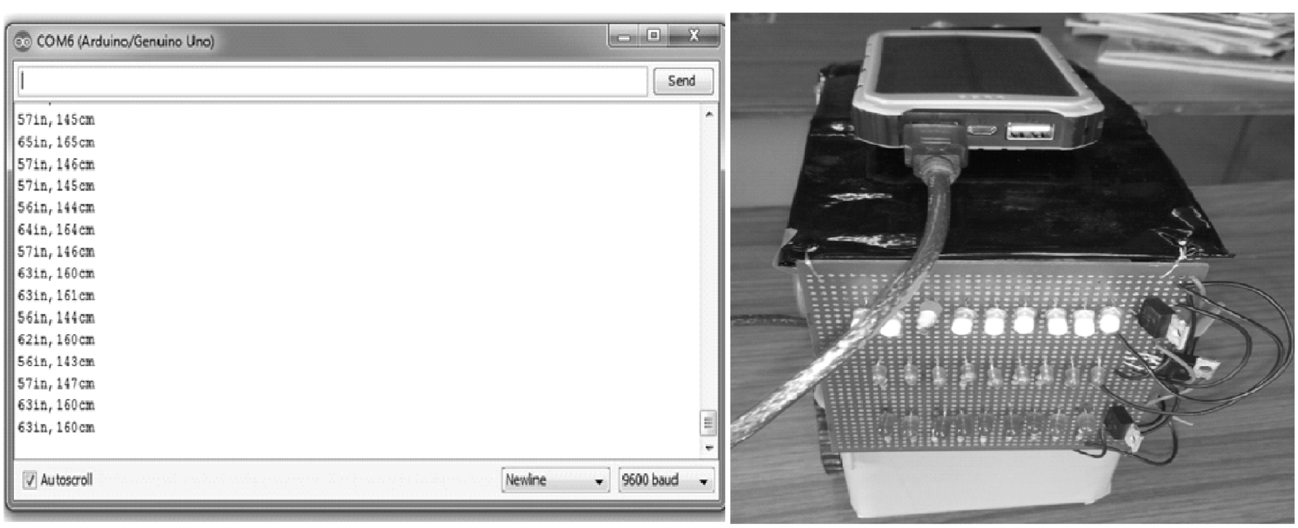
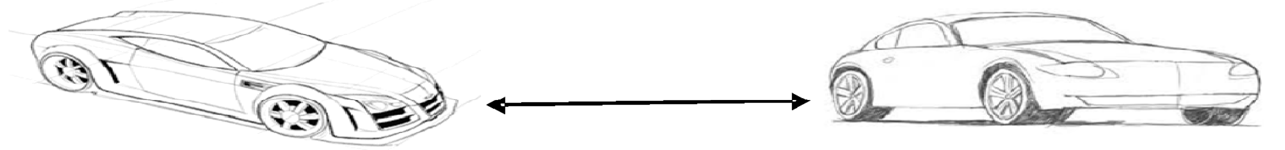


Figure 4: Practical Results for No Obstacle Detection

The left side results shown in the fig. 4 are HCSR04 sensor measured results which are found in serial monitor results while the sensor did not detects any obstacle in front of the vehicle and the right side results are vehicle signal alerting results. Here in this case the car speed is high and green LED glows on the back side of the vehicle to give the present status of the car to the back coming vehicles. Now the vehicle followed by the car freely moves behind the car and he knows the foregoing vehicle movement whether it is high speed or not.

CASE 2: Here the distance between two vehicles is moderately less; hence the gap between the cars or vehicles is somewhat nearer to each other. Therefore some speed control or speed limiting is required to the followed vehicle to avoiding the collision between those vehicles.



CASE 2 : > 49cm&&<160cm

In case 2 if the distance measuring sensor (hcsr04 ultra sonic sensor) value is in between the range of 160 cm & 49cm, which means it is the medium value to its rated value i.e., less than the 160 cm value, the motor speed of our solution is decreases according to the front going vehicle movement (speed) and the orange LED glows in the signal alerting system to give the current status of the moving vehicle to the back coming vehicle.

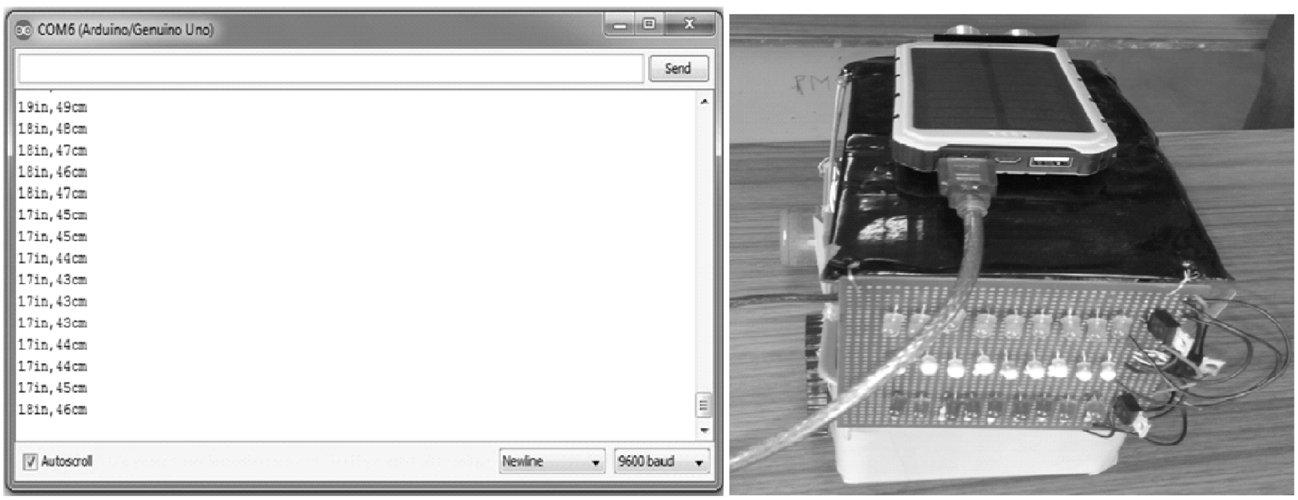
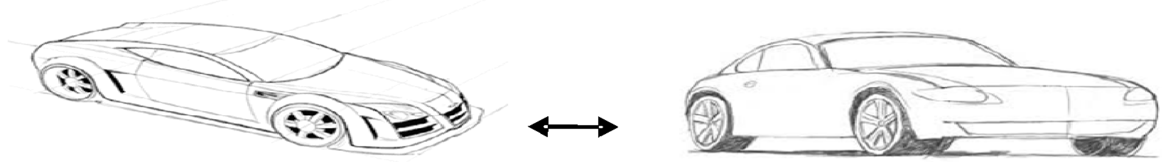


Figure 5: Practical Results when Obstacle Detected

The Fig.5 shows the practical results at obstacle detection. When there is a vehicle or obstacle in front of the moving vehicle with some distance between them. The left side results are appeared as above and the right side results are vehicle signal alerting results. Here in this case the car speed is gradually reduced and orange LED glows on the back side of the vehicle to give the present status of the moving vehicle to the back coming vehicles.

CASE3: The Vehicle or an obstacle is very near to the front going vehicle, it means that the distance between two vehicles is very less; hence there is a chance to collide or crashing the vehicles.



CASE 3 : < 49cm

In case3 the distance measuring sensor (hcsr04 ultra sonic sensor) value <49 cm which means it is the minimum value to its rated value, then the motor speed will be very low or zero and the red LED glows in the signal alerting system.

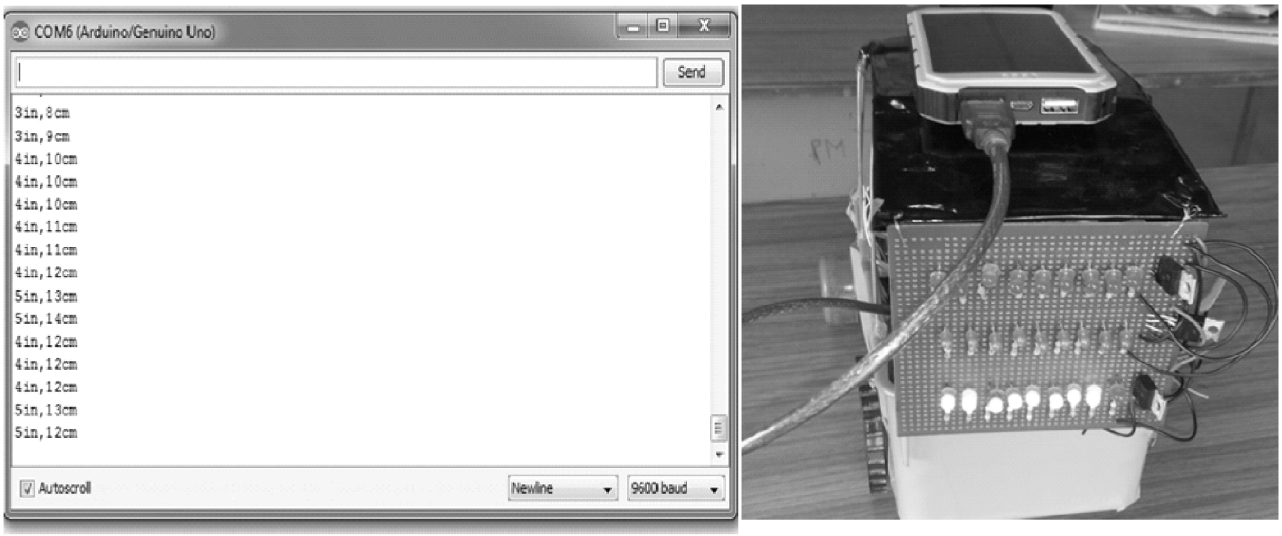


Figure 6: Practical Results at closed Obstacle Detection

The practical results are shown in the above Fig.6.When there is a vehicle or obstacle is very close to the front of the car, the left side results are appeared as above and the right side results are appeared at vehicle signal alerting system. Here in this case the car speed is very low or zero and red LED is glows on the back side of the vehicle to give vehicle status to the back coming vehicles.

5. CONCLUSION

The proto type of Autonomous Solar Car to Avoid Road Accidents is developed and tested in different ways. The proposed system has successfully operated on two modes both Self-Speed Adjusting System (SSAS) and Signal Alerting System (SAS). To use HCSR sensor nothing but a distance measuring sensor, the car speed is adjusted according to the sensor measured values and at the same time alerting system is provided behind the vehicle. Therefore the current going vehicle did not hit any vehicle in front of it and it gives the vehicle current status information to the followed vehicle to avoid the other vehicle hitting. Hence the system allows avoiding road accidents while maintaining proper communication between the vehicles. This is very helpful in present scenarios, because it automatically controls its speed and it automatically controls the following vehicle speed by signal alerting system.

Future scope: The future scope for this work is very elaborative because we can make many changes in the automobile system by developing more feature technologies to the proposed system. One of the future scopes for this solution is automatic side signal alerting system based on the vehicle wheel movements. As we already know based on the steering movement the front wheels of the vehicle are moved but back coming vehicles (followed vehicles) cannot find or predict the direction of vehicle until the vehicle turns to its direction. Therefore Many times it leads to major road accidents because of sudden making turns by the driver; if we can provide the solution for this problem we can control the accidents in all the directions. As we already proposed by our solution reaming all cases we can control the road accidents. For future work our wish is to provide a best side signaling system for the back followed vehicles. Hence we can make comfort driving and accidents free India.

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