

Auxillary Safety Locking System of Vehicle Doors using Arduino



P. Vijaya Rajan, T. Babu, G.Karthik Pandiyan, D. Venkatragavan, R. Shanmugam

Abstract: The main aim of the project is to prevent the Dooring accidents and to provide safety for the passengers and pedestrians. We are eliminating this problem by the use of Auxiliary Safety locking system connected to each door of the vehicle using Arduino. To prevent accident due to passenger's carelessness, the upcoming vehicle is sensed using an ultrasonic sensor and the doors of the vehicle are locked automatically. Due to this, the passengers can't open their car door from inside while the vehicle is moving towards the car. After the vehicle is passed, the doors are unlocked.

Keywords : Arduino IDE, Fritzing, Motor drive L298N

I. INTRODUCTION

Now a days road accident are major problem which happened in our day today life and some may be unwanted thing, violating the rules while driving. While driving, we must learn the general rules and regulations. During driving all should know the awareness and the safety measures, most of the accidents happen by human errors which cause accidents and crashes. Main reasons for accidents are done by human, which leads to a major problem.

Dooring accidents, is a type of accident which is occurred in traffic collision or error caused by sudden opening of the door without checking other riders by using the side mirror. Accidents are occurred by sudden opening of the door. When the door opens in the path of an unsuspecting cyclist, causing him to fall down, or swerve into traffic to avoid being hit. Many vehicle Dooring accident are non-fatal, it result to serious injuries. Laws generally require drivers to check for nearby pedestrians and cyclists before entering or exiting their cars. However, it's not uncommon for busy people to swing their vehicle doors open without thinking and without checking whether someone is in their path.

Some bike lanes are also built within the 'door zone,' which can expose cyclists to hazardous obstructions. The door zone is the approximately 5 feet of space in which a cyclist faces the highest probability of being hit by a parked car. The door zone can be larger or smaller depending on the type of vehicle.

Revised Manuscript Received on November 30, 2019.

* Correspondence Author

P. Vijaya Rajan*, Assistant Professor, Sri Sairam Engineering College, Chennai, Tamilnadu, India

T. Babu, Assistant Professor, Sri Sairam Engineering College, Chennai, Tamilnadu, India

G.Karthik Pandiyan, Assistant Professor, Sri Vidya College of Engineering and Technology, Virudhunagar, Tamilnadu, India.

D. Venkatragavan, UG Scholar, Mechanical Department, Sri Sairam Engineering College, Chennai, Tamilnadu, India.

R. Shanmugam, Sri Sairam Engineering College, Chennai, Tamilnadu, India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](http://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Even for the most skilled cyclists, reacting safely to a sudden door movement is difficult. Many who attempt to dodge a door unexpectedly opening in front of them instead end up colliding with incoming traffic with fatal results.

II. LITERATURE REVIEW

Hampton. C. Gabler and **William. T. Hollowell** [2014] investigated the compatibility of cars, light trucks, and vans (LTVs) involved in traffic crashes. This provided the necessary parameters and needs that can be compatibly installed in a vehicle to reduce such accidents.

Md. Khaled Hossain and **Sayed SamialHaq** [2013] framed a system having accident detection technique with pin point location tracking using GSM. This provided detailed implementation of automatic mechanism in a vehicle.

Venkatesh and **Vivek**[2014] designed a setup to control the car door locking automatically using distance measuring system, child lock and ultrasonic sensors.

Othman M.K. Alsmadi, Anas A. Al Jallad did a research on Arduino-Based Automatic Safety Vehicle Control "California Vehicle Code section 22517" - California Legislative Information, Retrieved February 13, 2018 states that, no one can open the door during movement of the vehicle unless it is for reasonable or for safety precautions during traffic.

Bruce Rauner, Chicago Governor signed into law House Bill 5143, which adds the Dutch Reach strategy to Illinois' Rules of the Road manual, as well as adding bicycle safety questions to the state driver's license test.[Aug 2018].

D. Otte and **H. Johannsen** works consists of detailed survey and analysis regarding the accident contribution by dooring. Claims of accidents due to dooring in Netherlands, forced the government to implement Dutch Reach, however every time there won't be surety that people would follow in all other countries regularly if implemented everywhere. This concept leads the way for introducing a safety locking mechanism which is automatic and cheaper.

Mehmet Akif stated that Arduino-based robot projects spread quickly and effectively was the first thing that this study found. Due to the contribution of Arduino technology to design and development process of educational robotics system, this study revealed that recent studies mostly focused on the efforts of integration and implementation of Arduino boards into educational activities and curriculum. This study also determined the research methods and technological tools used in the prior research and reported the difficulties and problems related to the use of the Arduino boards.

III. COMPONENTS USED

The following are the components used in the system:

Arduino UNO, Ultrasonic Sensor, Buzzer, Solenoid, LED, Motor Drive L298N, Jumper Wires.



Auxiliary Safety Locking System of Vehicle Doors using Arduino

A. Arduino UNO

The Arduino UNO is a micro controller board based on the ATmega328 (data sheet). It contains 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, USB connection, power jack, 16 MHz ceramic resonator, an ICSP header, and a reset button. It contains everything which is needed to support the micro controller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Arduino UNO Board is a standard device. The availability of Arduino board in market is the best start for the beginners. The board is well-suited with more shields (add-on boards) than other models. The process for Arduino with micro controller is simple and it is understandable by students and professor. The Arduino/Genuino UNO has a number of facilities for communicating with a computer, another Arduino/Genuino board, or even other micro-controllers.



Fig.1. Arduino UNO

B. Ultrasonic Sensor

Ultrasonic sensor emits ultrasonic pulses, and by measuring the time of ultrasonic pulse reaches the object and back to the transducer. The waves which are emitted by the transducer and it is received after it strikes the objects, the waves are received by the transducer will switch ON the ultrasonic sensor to receive mode. The time between the sender and receiver is directly proportional to the distance between the sensor and object.

Working Voltage- 5 VDC

Quiescent Voltage - <2 mA

Working Current - 15 mA

Detecting Range - 2 Cm - 4 Cm

Trigger Input Pulse Width - 10 uS



Fig.2. Ultrasonic Sensor

C. Buzzer

Buzzer it is an audio signaling device, which is a piezoelectric or electromechanical device. By the application of computer mouse or key we can, set timers or alarm are the typical use of buzzers. It is a structure of electronic transducer which is used in computers by supplying DC power and is also used in printers, kid's toys, automatic equipment's, and telephones.

The buzzer is directly connected to the module board in a simple circuit design, to "plug and play."

Input supply - 5 VDC

Current consumption - 9.0 mA max.

Oscillating frequency - 3.0 ±0.5 KHz

Sound Pressure Level - 85 dBmin.



Fig.3. Buzzer

D. Solenoid

Solenoids are basically electromagnets. Solenoid is a coil of wire which is used as an electromagnet. This device converts electrical energy in terms of mechanical energy form.

The linear motion is obtained by the application of magnetic field which is created by the electric current; the armature is mainly made by copper coil wire (slug of metal). The slug moved to the center of the coil, by energizing the coil. This energizing coil makes the solenoid to move front (from one end) and backward (from the other).

Solenoids are incredibly versatile and extremely useful. They're found in everything from automated factory equipment to paintball guns and even doorbell. The solenoids help the power to switch ON, acts as a starter for automobile vehicles, for valve opening operations.

Working Voltage- 5 VDC

Working Current - 0.63 A

Stroke - 10 mm

Holding Force - 0.3 N



Fig.4. Solenoids

E. Motor Drive L298N

The type of L298N is an H-Bridge motor which is used to control the rotational speed, and at the same time the rotational direction of the DC motor also monitored. The voltage of the DC motor defers from 5V to 35V and the power range is up to 2A. Two motors A and B have two screw terminal, one for grounding and another for VCC for motor. And the 5V pin is used for input or output terminals. The motor VCC depends on the voltage used. The module has an on board 5V regulator which is either enabled or disabled using a jumper.

To enable the 5V regulator, the motor voltage is maintained at 12V and 5V pin is used as the output. The motor voltage should not exceed 12V, because it will destroy the board 5V regulator and it is controlled by disconnecting the jumper. In this case the 5V pin will be used as input as we need connect it to a 5V power supplies in order the IC to work properly.

F. Jumper Wires

A jumper wire (also known as a jumper wire or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end. It is inter-connected with the bread board internally or by other equipment's without soldering. The jumper wires are attached by inserting their "end connectors" in the slots allotted in a breadboard.

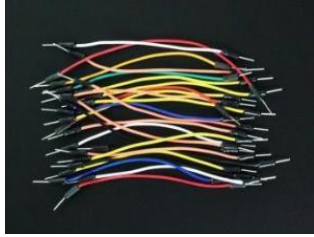


Fig.5. Jumper Wires

IV. DESIGN IMPLEMENTATION

A. Software Used Fritzing

The electronics accessible are made creative for all users by FRITZING software. It provides the software tool as a community website and service point for all user to document their models and developed program to share them with others, teaching electronics in classes, and layout and manufacture professional PCBs.

Documenting the Arduino prototype are done by the artist, research scholar or designer by the application of programming language and by micro controller and a PCB layout is created for manufacturing. The created software acts as a software module to share details and experience and also reduces the manufacturing cost.

B. Arduino IDE

Arduino IDE is an Integrated Development Environment, an application for Linux, Mac OS and for Windows. Mainly JAVA programming language is used for developing application. For Arduino IDE C and C++ language is used, by following rule of code structuring. Version 2 codes for IDE which is released by GNU (General Public License), IDE delivers only the similar inputs and outputs and it is supplied by the software library.

Only two basic functions are required for the user to start the sketch and main program loop which are compiled together and linked with program by stub main () which is converted to executable program with help of GNU tool. The IDE program is converted to hexadecimal encoding by executable code, and these codes are uploaded into the ARDUINO IDE by loader program in the board's firmware.

C. Circuit Connection

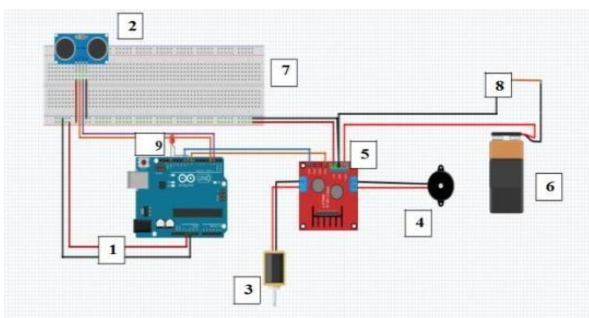


Fig.6. Circuit Connection

- 1- ArduinoUNO
- 2- Ultrasonic Sensor
- 3- Solenoid
- 4- Buzzer
- 5- Motor Drive L298N
- 6- 12 V Battery
- 7- BreadBoard
- 8- Switch
- 9- LED

D. Assembly

The connections are made suitably based upon the circuit diagram. Proper wire with adequate lengths and type, say male or female are chosen depending upon the position and nature of ports. The Board is fixed rigidly and safely in suitable Arduino case.

The wires are properly soldered at required areas to ensure its circuit completion. Proper insulation is provided to reduce the occurrence of short-circuiting problems. The freely moving components are fixed to the wooden board using glue gun. Now the circuit is checked for its completion by switching on the battery and verifying using multi-meter for current passage at different junctions in the circuit. Now the USB cable is inserted at the USB port for the coupling of Arduino with the PC for inputting the necessary code.

Program

```

Const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor
const int echoPin = 6; // Echo Pin of Ultrasonic Sensor
void setup() {
  Serial.begin(9600); // Starting Serial Terminal pin
  pinMode(8,OUTPUT);
  pinMode(9,OUTPUT); pinMode(10,OUTPUT);
} void loop() {
  digitalWrite(8,HIGH);
  digitalWrite(9,LOW); digitalWrite(10,LOW);
  long duration, inches, cm;
  pinMode(pingPin, OUTPUT); pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delay(Microseconds(2));
  digitalWrite(pingPin, HIGH);
  delay(Microseconds(10));
  digitalWrite(pingPin, LOW);
  pinMode(echoPin, INPUT);
  duration = pulseIn(echoPin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
  Serial.print(inches);
  Serial.print("in, ");
  Serial.print(cm);
  Serial.print("cm");
  Serial.println();
  if(cm < 50){
    digitalWrite(8,LOW);
    digitalWrite(9,HIGH);
    digitalWrite(10,HIGH);
    delay(1000);
  }
  delay(100);
}
long microsecondsToInches(long microseconds){
  return microseconds / 74/2;
}
long microsecondsToCentimeters(long microseconds){
  return microseconds / 29 /2;
}

```

V. CODE IMPLEMENTATION

The program is entered in the Arduino IDE software by creating a new file. Then the program is compiled for any bugs or error. It is done by pressing CTRL+R or simply compiles option from the Sketch menu. If any errors rectify it and again compile. There would be “done compiling” message if no errors. Select the Arduino UNO Board from the board manager. Now upload the coding to the kit.

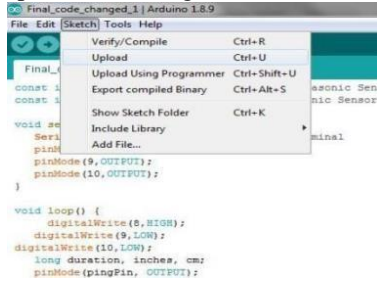


Fig.7. IDE Upload process

A. Practical Implementation

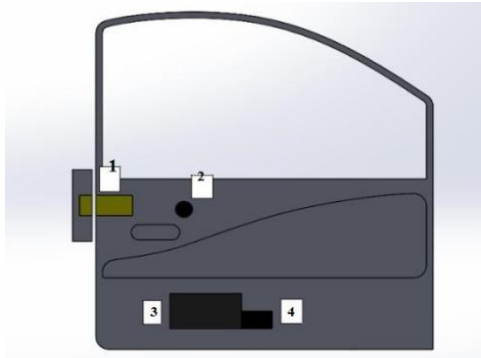


Fig.8. Car door with auxiliary lock

- 1- Solenoid
- 2- Buzzer
- 3- Circuit Box
- 4- Battery

- The setup can be installed as an auxiliary lock in a vehicle door.
- The wire connections are made internally inside the door as per the circuit diagram with proper insulation and protections.
- The Safety locking mechanism is energized separately using a 12V battery.
- The buzzer and LED Display are installed at a suitable position inside the car where the driver can be easily alerted. The bypass button is installed at a suitable ergonomic position for easier reach by the passenger or driver.
- This button can be used in case of emergency during an approach or in the event of circuit failure or in the event of Traffic.
- There is also a possibility of connecting the Circuit with the ECU of the vehicle by activating the setup only when the engine is turned on. This would reduce the lock engaging during parking and wastage of battery voltage.

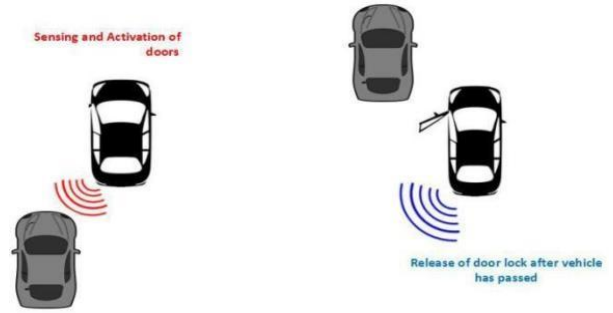


Fig.9. Visual representation of working conditions

VI. CONCLUSION

To conclude this project would have a bright future in the field where automobiles are using more and more electronic enhancements for safety feature. It could be successfully applicable to Lorries, trucks and other vehicles where accidents could be prevented most. We believe that a more concentrated research in this field could help produce technologies that could reduce accidents caused by the ignorance of the drivers by 80%. We have been successful in sensing the vehicles and locking the doors. Also, proper intimation will be given to the driver or passenger by using the LED and buzzer. Solenoid delay timings could be altered and varied by simple coding in Arduino. A total implementation of this setup in a vehicle is feasible, easy and cost-effective.

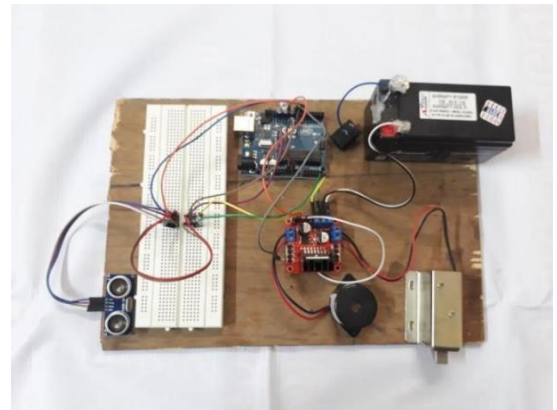


Fig.10. Assembled View

As of now our model is using close range sensors to detect the approaching vehicles and pedestrians which could be replaced with high definition cameras. This could lead to implementation of Image Processing Systems controlled by microprocessors. This would result in more precise system for preventing the dooring accidents. Also, the microprocessor could be integrated with ECU of the vehicle for efficient functioning of the system.

Sl. No.	Parts	Quantity	Price(INR)
1	Arduino UNO Kit	1	415
2	Solderless Bread Board	1	68
3	Jumper Cables	22	198
4	LED	1	10

5	Buzzer	1	22
6	Motor Drive L298N	1	76
7	Battery 12V	1	400
8	Solenoid 12V	1	850
9	Switch	1	10
10	Resistor	1	10
11	Ultrasonic Sensor	1	110
Total			2166



R. Shanmugam currently pursuing his undergraduate degree in Sri Sairam Engineering College, Chennai affiliated to Anna University. His fields of interest are Automotive and Integrated Product Design. He is currently a member of Society of Automotive Engineers (SAE) Collegiate Club and Imperial Society of Innovative Engineers (ISIE). He is currently working as Transmission Lead in SAE BAJA 2020.

REFERENCES

- Otte D, Pund B, Jansch M "A new approach of accident causation analysis by seven steps", ACASS 21st International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2009, Stuttgart, Germany.
- M. Jansch, D. Otte, H. Johannsen, " Investigation of bicycle accidents involving collisions with the opening door of parking vehicles and demands for a suitable driver assistance system", Journal of Safety Research. 8 (4): 126-139.
- YoungK.John Abraham, "Reduce Risk: Be Alert: Doors Are Dangerous". Cambridge Street Code - Rules & Etiquette for GettingThere Together (Report). Massachusetts, USA: City of Cambridge. December 2016. p. 9. Retrieved June 25, 2018
- The World staff (September 27, 2016). "This easy maneuver, borrowed from the Dutch, could be life-saving for cyclists". The World. Public Radio International. Retrieved July 13,2018.
- Macmillan, Thomas (August 5, 2013). "Danger: Drivers Dooring Cyclists". New Haven, CT: New Haven Independent. Retrieved June 28, 2018.
- S. Peter Olsen "7th International Cycling Safety Conference 2018". ICSC 2018. International Cycling Safety Community. October 10, 2018. Retrieved July 10, 2018.
- Lott, D. F.; Lott, D. L. (1976). "Effect of Bike Lanes on Ten Classes of Bicycle-Automobile Accidents in Davis, California". Journal of Safety Research. 8 (4): 171–179.
- Brain.W. Evans, Digital I/O, Arduino Programming Notebook
- Michael McRoberts, Chapter14, Ultrasonic Rangefinders, Beginning Arduino, 2nd edition
- Alan. G. Smith, Sensors Galore, Introduction to Arduino, 2011 Edition

AUTHORS PROFILE



P. Vijaya Rajan Currently working as Assistant Professor in Sri Sairam Engineering College and having more than 9 Years of experience in the field of Manufacturing and Automobile Engineering



T. Babu Currently working as Assistant Professor in Sri Sairam Engineering College and having more than 9 Years of experience in the field of Engineering Design and Analysis.



G. Karthik Pandiyan received his B.E degree in Mechanical Engineering from Anna university Chennai in 2012 and ME degree in Engineering Design in 2014 from Anna University Chennai. Currently he is pursuing his Ph.D from Anna University Chennai. Presently he is working as assistant professor in Sri Vidya college of Engineering and Technology, Virudhunagar. He has published many Research papers in various fields. His Research area includes Materials processing Techniques, Optimization, and Powder Metallurgy.



D. Venkatragavan UG Scholar in Mechanical Department, Sri Sairam Engineering College, Chennai, India. Member in SAE. Participated in the "International Conference on Multifunctional and Hybrid Composite Materials for Energy, Environment and Medical Applications (ICMHCEE 2019)" held at NIT, Trichy.