
Team 49

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1. Abstract:

This report focuses on building a sustainable solution to prevent large-scale road accidents caused by the **sudden opening** of car doors on the street. The primary victim happens to be the two-wheeler rider approaching from behind at a considerable speed. Most of these accidents are **fatal**, leading to the loss of life and property. The saddest part is that no proper solution exists for this. What remains is a blame game regarding the victim label.

2. Problem Statement:

To make a device that can control the accidents caused by **sudden car door openings** on the streets.

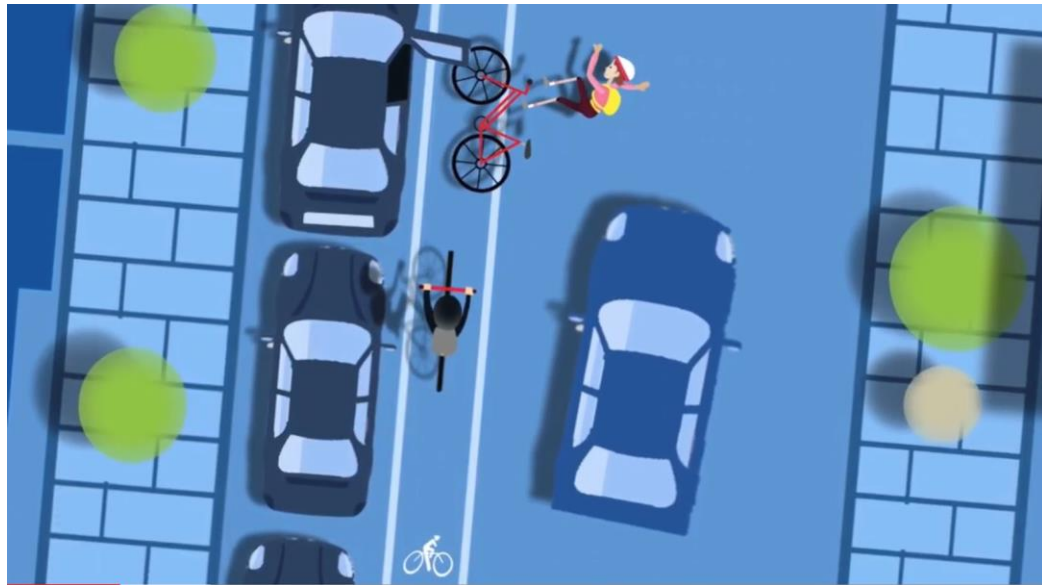


Fig: A fatal problem, prevalent yet unnoticed

3. Problem Validation:

According to a National Crime Records Bureau report, the number of traffic-related accidents in 2021 was 4,22,659. A significant contributor to this figure was road accidents which amounted to 4,03,116. This figure itself has seen a rise of 13.6 percent compared to the previous year. These road accidents took 1,55,622 lives while 3,71,884 people were left injured. A staggering 44.5 percent of the deaths involved two-wheelers.

A vast proportion of these accidents are due to the negligence of the car rider while opening the door.

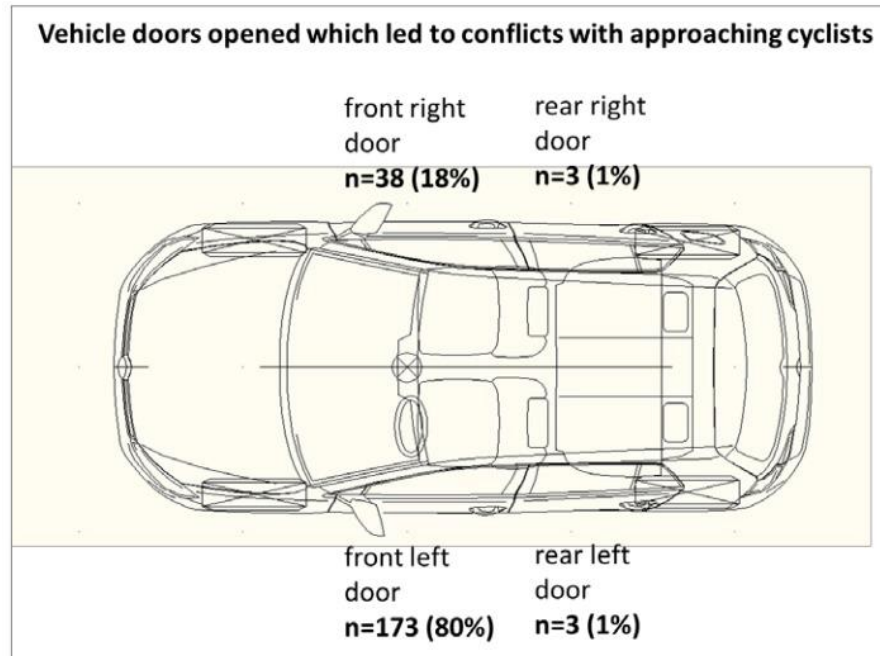


Fig: Distribution of Accident Percentages in car doors

4. Existing Solutions:

- Disembarking rear view mirrors for rear seats:
 - These mirrors are designed to fit adjacent to the car's rear seat. They are meant to **assist the rear passengers** in checking the road conditions while disembarking from the vehicle.
- Seatbelt warning lights:
 - These lights are attached to the passenger seat belts. The device is so designed that it **glows whenever the seatbelt is removed**. These lights **signal the two-wheeler** approaching from behind regarding the door opening.



Fig: Rear disembarking mirror



Fig: Seatbelt warning system

5. Our Solution (MinD The dOOr):

MinD The dOOr is a device specifically designed to prevent accidents caused by the sudden opening of car doors. This device **detects the approaching object** from a distance and **locks** the car door until the approaching two-wheeler safely passes by. The machine takes up two prominent cases:

- The door is still closed, and the object is detected:
 - The sensor detects and gives a warning alarm. Automatic locking of the door follows the alarm to prevent a possible accident.
- The door is slightly opened, and the object appears suddenly:
 - In this case, an automatic door freeze follows the alarm simultaneously.
 - A **door freeze** is used instead of **door retraction**, considering the possibility of the user's foot being placed out of the car gate.

A switch accompanies the system providing the user with the autonomy of lock control. The user, as per his will, can disable the automatic door lock. The alarm, though, will remain active.

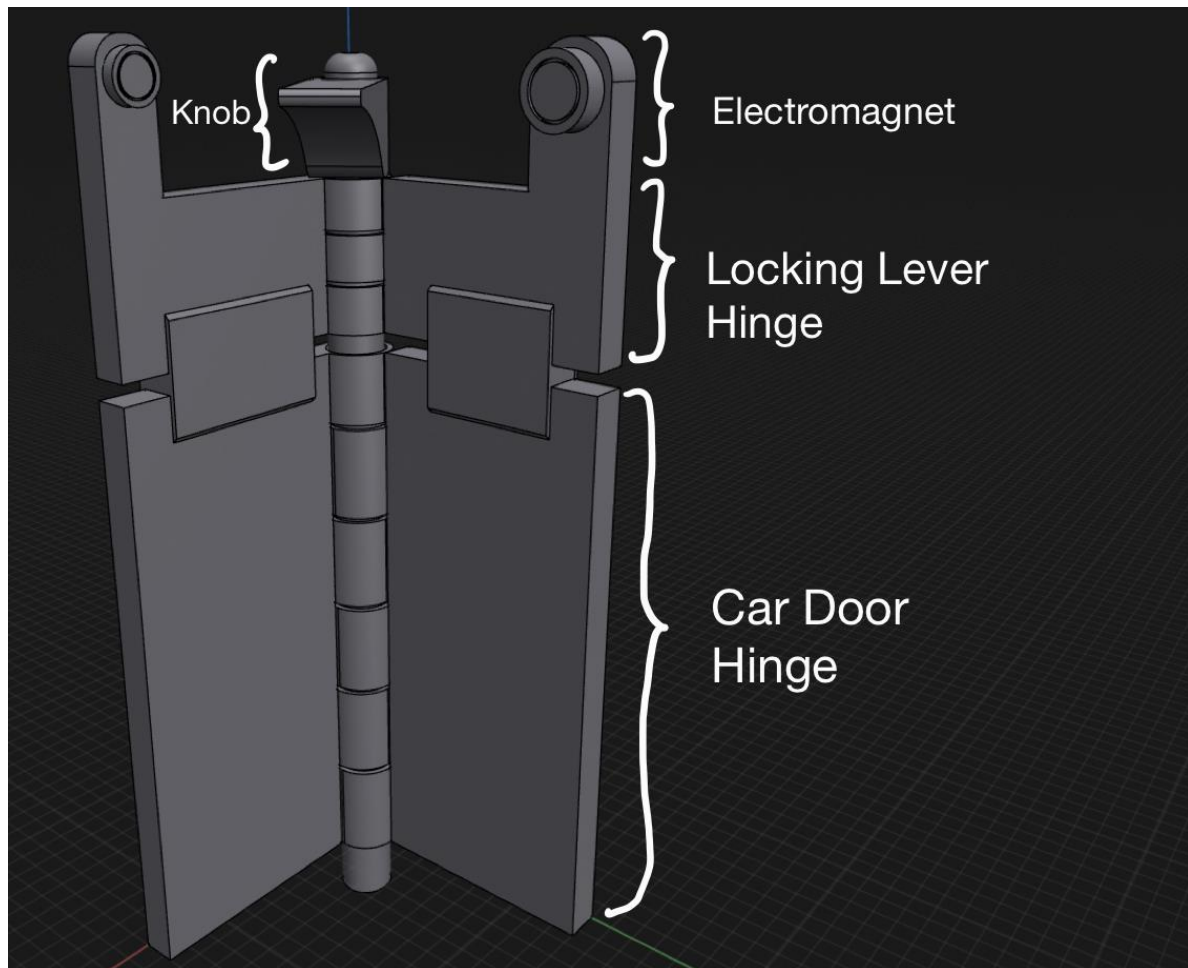


Fig. CAD model of Hinge system (View 1)

As the object is detected, the electromagnet of one side is activated. The knob rotates towards the magnet and causes the hinge to freeze. When the thing safely passes by, the 1st electromagnet is discharged, and the 2nd forces the knob to return to the initial position and release the hinge.

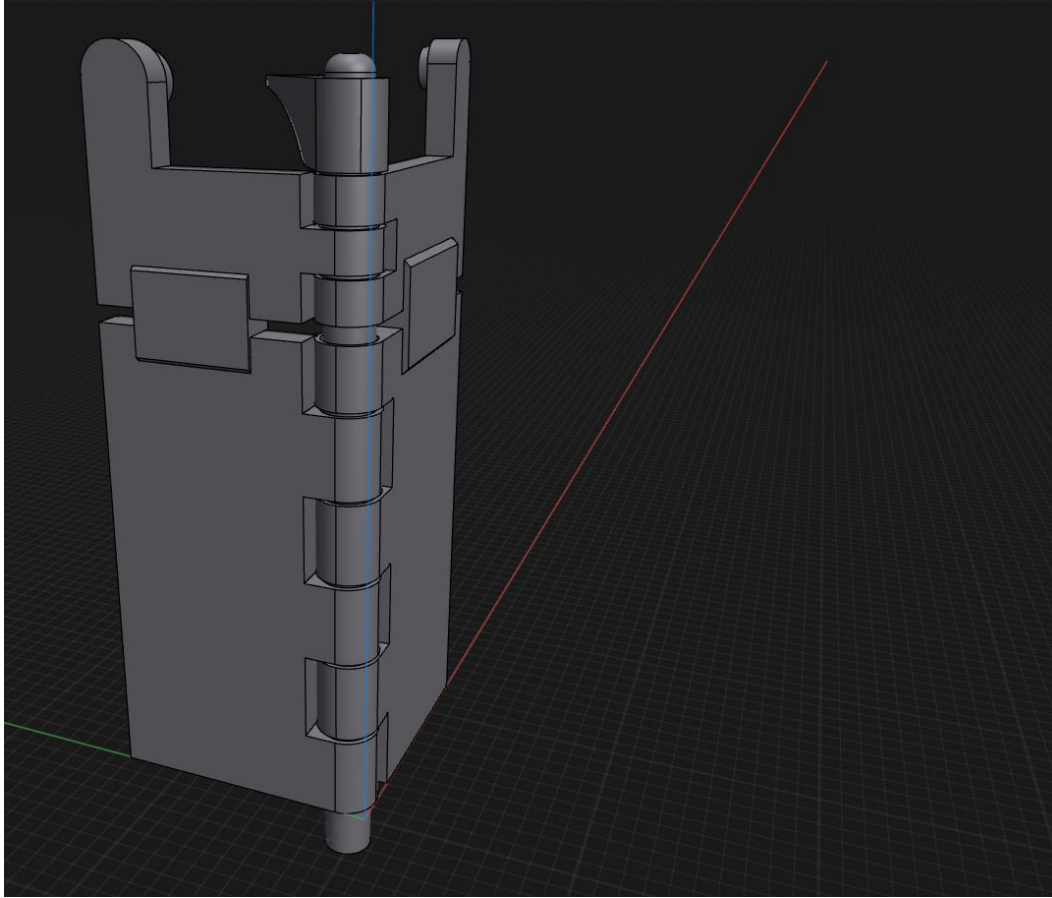


Fig. CAD Model of Hinge System (Veiw2)

6. Salient Features:

- The product is user-friendly as it can be easily turned on and off, considering the user might feel opening the door is safe or in case of some emergency.
- Door can be frozen at every position according to the situation. This covers the case when the person has already opened the door, and the sensor detects moving objects after a few microseconds, thus freezing the door at that position.
- You can easily install the product.

7. Schematic Diagram:

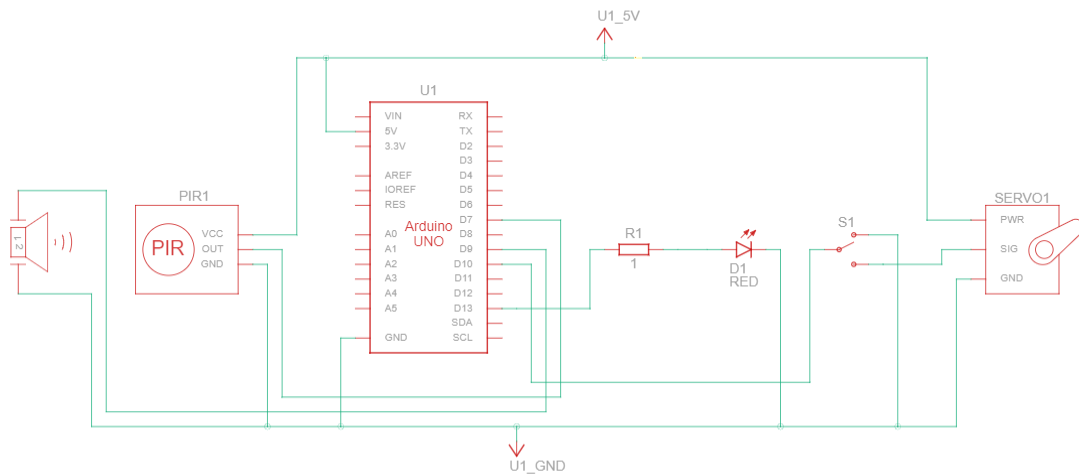


Fig: Schematic Circuit Diagram

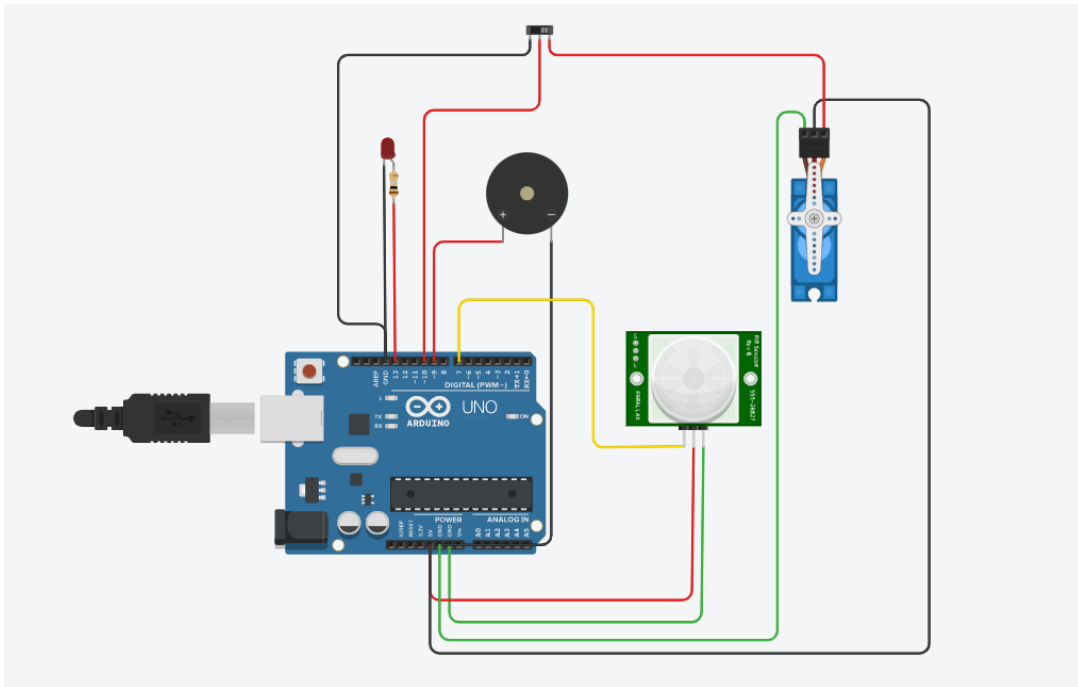


Fig: Electronic Circuit Design

The PIR sensor detects the motion of the object approaching and sends a signal via the Arduino. The resultant output signal rotates the servo motor and locks the door. The door locking follows an LED alert accompanied by an alarm.

8. Components Used:

a. Arduino UNO:

Arduino UNO is an easy-to-use programmable open-source microcontroller board that can be integrated into various electronic projects. This board contains a USB interface, and Arduino software is used to program the board IDE.



Dimensions of standard Arduino UNO board: 68.6 mm x 53.4 mm

Net mass = 25g

b. PIR sensor:

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view.



Dimensions Length: 24.03mm x 32.34mm, Screw hole distance: 28mm.

c. DC 12V KK-P25/20 8KG Lifting Solenoid Electromagnet:

This DC 12V KK-P25/20 8KG Lifting Solenoid Electromagnet consists of an iron core and a coil to attract magnetic substances, using the magnetic action induced by electric current only while the current is applied. This compact, functional device offers high power with high reliability.



Fig: DC 12V KK-P25/20 8KG Lifting Solenoid Electromagnet

d. Buzzer:

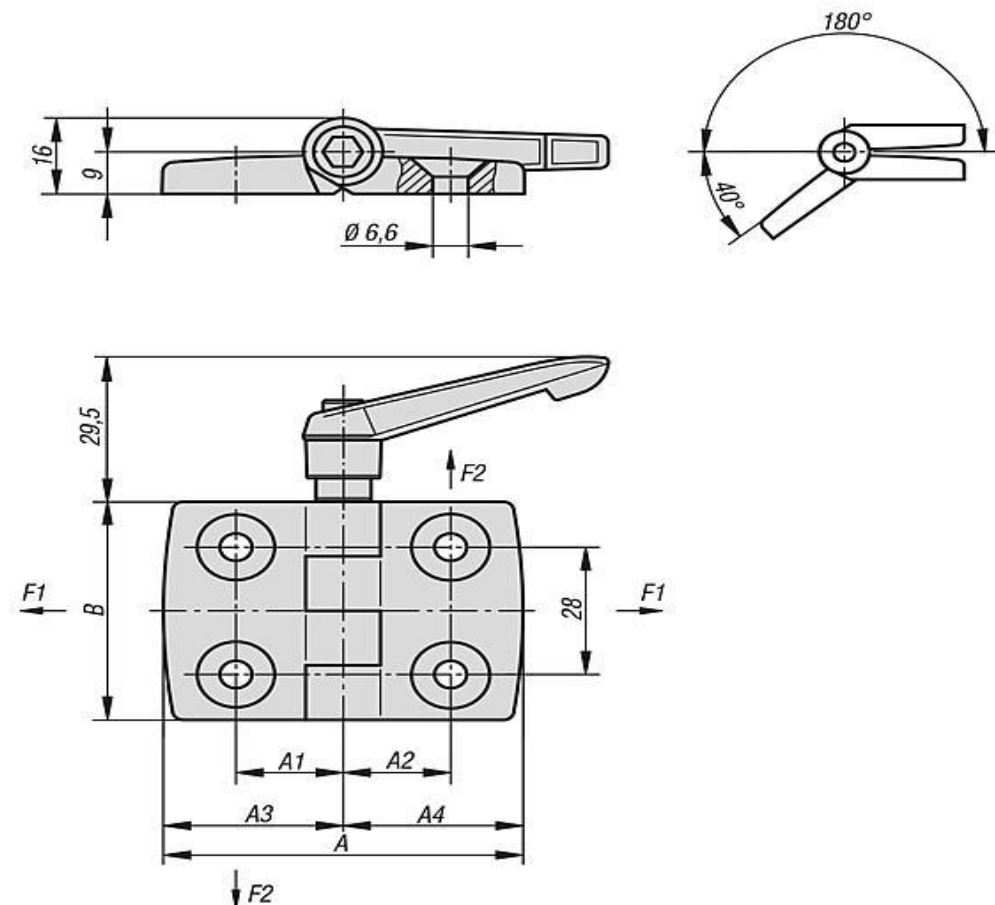
The piezo buzzer produces sound based on the reverse of the piezoelectric effect. The underlying principle is the generation of pressure variation or strain by applying an electric potential across a piezoelectric material. These buzzers can alert users of an event corresponding to a switching action, counter signal, or sensor input.



Dimensions: Diameter: 11.90mm/0.47in. Height: 6.53mm/0.26in.

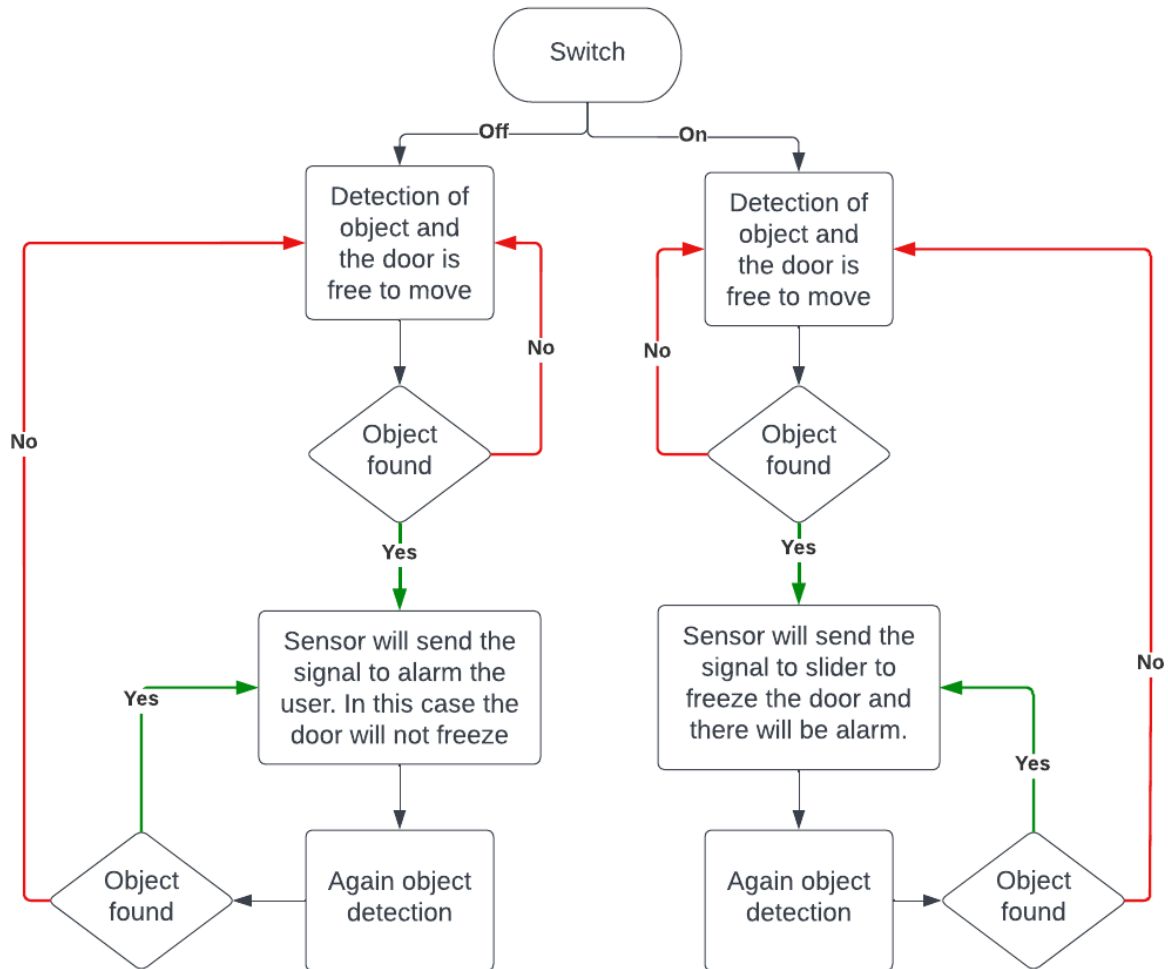
Weight: 0.70g/0.02oz.

e. Hinge with locking lever:



Its indexable lever allows the user to lock the hinge in any position. The hinge can be locked in place using the clamping handle attached to the hinge to enable the user unrestricted access to the job without worrying about the door or window closing.

9. Solution Workflow:



10. Prospects:

- We can reduce the product cost by assembling the product during manufacturing.
- We can propose a government collaboration so that the system can be mandated across all the newly designed vehicles keeping safety concerns in mind.
- In the future, using GSM (Global System for Mobile Communication) technology, in case of an impact, we can inform the nearest hospital or police station.

Annexure

I. Calculation:

The typical opening force for exterior doors ranges from **40N to 45N**, and an average door has a length of 2.4m.

Thus, the maximum torque required to resist the motion of the door is
 $48 \times 2.4 \text{ Nm}$, i.e., 108 Nm.

The force between an electromagnet and a ferromagnetic material is given by:

$$F = \frac{(NI)^2 \mu_0 A}{2g^2}$$

F- Force of Interaction

N- Number of turns of the Electromagnet

I- Current Passing through the Coil

A- Frontal Area of the Ferromagnet

g- Distance between the ferromagnetic material and electromagnet

Considering the force on the hinge to be 45N, an average separation of 5cm from the magnet and a cross-sectional area of 30, cm² we have $NI = 7725.5$ Ampere-turns.

II. Cost Estimation:

S. No.	Equipment	Quantity	Price
1.	Arduino UNO R3	x1	Rs. 650
2.	Buzzer	x1	Rs. 25
3.	PIR Sensor	x1	Rs. 80
4.	Electromagnet	x2	Rs. 480
5.	Hinge with Locking Lever	x1	Rs. 400
6.	Other material	x1	Rs. 30
Total Cost			Rs. 1665

III. Code:

```
// C++ code
//
#include <Servo.h>

Servo servo_10;

void setup()
{
  pinMode(9, OUTPUT);
  pinMode(7, INPUT);
  pinMode(13, OUTPUT);
  servo_10.attach(10, 500, 2500);

  digitalWrite(9, LOW);
  digitalWrite(13, LOW);
}

void loop()
{
  if (digitalRead(7) == 1) {
    digitalWrite(9, HIGH);
    servo_10.write(90);
    digitalWrite(13, HIGH);
  }
  if (digitalRead(7) != 1) {
    servo_10.write(0);
    digitalWrite(13, LOW);
  } else {
    digitalWrite(9, LOW);
    digitalWrite(13, LOW);
  }
  delay(10); // Delay a little bit to improve simulation performance
}
```

IV. References:

- [Nearly half of Indian road accident deaths involve two-wheelers: Overspeeding biggest killer - Times of India](#)
- [Major causes of road accidents in India: Why do accidents occur?](#)
- [KIPP Hinges with locking lever](#)
- [Arduino UNO R3 Board](#)
- [Hinges plastic, with locking lever](#)
- https://robocraze.com/products/dc-12v-kk-p25-20-8kg-lifting-solenoids-electromagnet?currency=INR&variant=42779388510432&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&https://robocraze.com/?utm_source=googleads&utm_medium=ppc&gclid=EAIaIQobChMI2syv4b2S-wIVV6mWCh1dowTNEAQYAiABEgJeJfD_BwE
- [IRC-15-11 IRCOBI Conference 2015 - 13 - - Investigation of bicycle accidents involving collisions with the opening door of parking vehicles and demands for a suitable driver assistance system. M. Jansch, D. Otte, H. Johannsen](#)