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Automatic Anti-Reverse Braking System for Heavy Transport Vehicles

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Abstract: *The Automatic Anti-Reverse Braking System is designed with 4 infrared sensors which detect the proximity of any object behind the vehicle when operating in reverse gear and a control circuit that activates the pneumatic braking unit. The aim of this system is to reduce and avoid any damage to vehicle, property and life due to human errors or mishaps. The role of the pneumatic braking unit is to stop the vehicle whenever the control system tells it to do so. The control system detects the proximity of any obstacle behind the vehicle with the help of four independently working infrared distance sensors. This system avoids accident by taking total control from the vehicle operator and getting activated independently. This adds an extra layer of safety to people from heavy transport vehicles that have tremendous potential to damage property or lives if not controlled properly. The anti-reverse braking system is fully automated.*

Key Word: *Reverse Braking; Braking; Automation; Safety; Heavy Transport Vehicles*

I. Introduction

In the fast-moving world, automation of various systems is being done to shorten the time of operation and to avoid chances of human error. This automated braking system is perfect example of such a system. Currently, vehicles have alarm systems to maintaining safe distance between vehicles. When a vehicle approaches any object, the alarm gets triggered and warns the vehicle operator about an object. But this system has problems and is not fail safe. Also, it is not rightly implemented in the vehicles that need it the most, Heavy Transport vehicles. As they have poor rear visibility, high potential to damage lives and highly dangerous once the control is lost. We have developed a system by using infrared sensors which controls automated pneumatic braking system and restricts the backward motion of the vehicle in case of danger. The aim of the paper is to design a system which is capable of avoiding an accident when a heavy loaded vehicle like truck, bus or any vehicle consisting of pneumatic braking system is moving in reverse gear. we have developed a system for this purpose which contains a pneumatic actuator, an electrically operated solenoid valve, IR sensors, a microcontroller control unit, etc. This serves as a complete user independent system for automated braking while reversing a vehicle.

Problem Statement

When a heavy transport vehicle like Truck or bus turns in reverse directions, due to very poor visibility, they need another man to tell them the directions. Also, these heavy and powerful vehicles have high potential to damage property, lives or both. A safety mechanism is needed for such vehicle in said scenarios.

Objective –

The objective of the project is to design a system that would make such vehicles safe even when not handled properly while operating in reverse gear. The system should be fool proof and should be able to stop the vehicle at speeds of about 20 kmph within 0.5 metre. The system should be fully automated.

Methodology –

A control unit consisting of microcontroller will detect any obstacle behind the vehicle by using four infrared sensors working independently which will provide wide angle coverage and help with detecting relatively small objects. The control system will then decide when to apply brakes depending upon multiple readings to

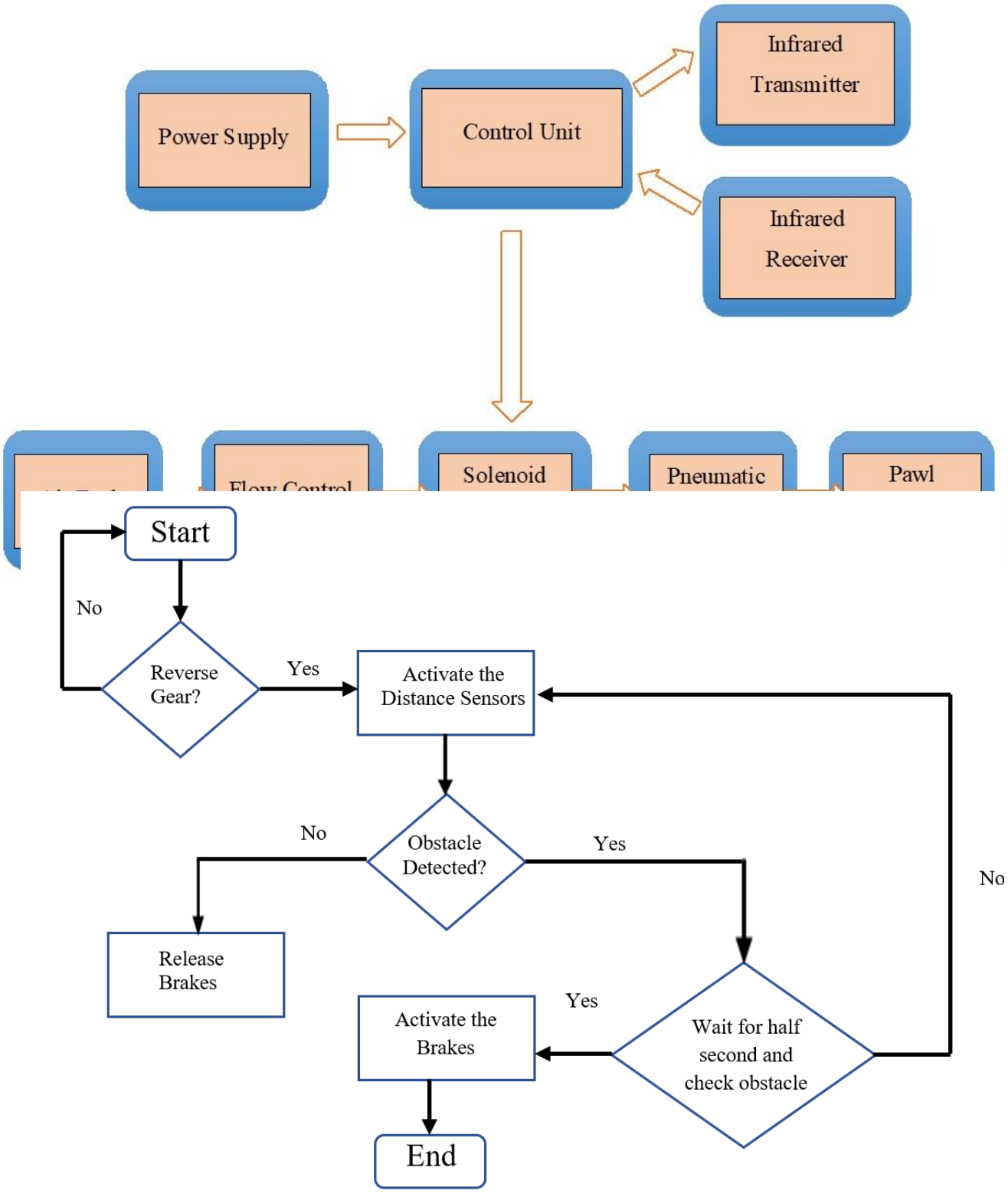
make sure that the readings are not falsely triggered from noise. The control unit will then activate a solenoid valve which will allow compressed air to pass to the pneumatic actuator which in turn will engage the pawl in ratchet. This will stop the vehicle instantly. The system will get active only when the vehicle is put into reverse gear.

II. Literature Review

Sr. No.	Name of the Author	Name of the Paper	Date of Publication	Abstract
1	Roop Singh Takur, E. Ramkumar	Improving Quality of Vehicle Tracking Systems in Hill Stations Using IEEE	01/02/2013	This paper presents concept of tracking vehicles on mountainous roads with the help of quality of service (QOS) method. The aim is to count the vehicles and record their direction on hilly roads. The results obtained with Simulation and analysis verify that the discussed system is able to keep record of vehicles by using subscriber stations with the help of QOS system.
2	Hemalatha B.K., P. Pooja, Chaithra M., Megha S., Rakshitha R.T.	Automatic Braking System for Automobiles Using IR Sensor	5/05/2016	In this paper, a system containing of an Infrared transmitter and receiver circuit connected with a vehicle. The function of the Infrared sensor is to identify the presence of any obstacle. When the sensor identifies an obstacle, the sensor unit sends a control signal to the microcontroller unit and the microcontroller unit controls the speed of the motor by communicating with the motor controller. The paper discusses concept of Electromagnetic Braking System.
3	Ramu S., Babuganesh K., Harishankar K.	Anti-Sliding Braking System for Vehicles in Inclined Road	11/11/2016	If any obstacle is detected by the IR sensor, it passes the signal to power circuit and relay circuit to activate the DC gun. The Dc gun provided with a pneumatic type, push the spring and lock the ratchet. The vehicle gets sudden break and can't move further backward motion. When a vehicle moved forward motion the lock gets released and a vehicle is allowed to move backward motion or reverse gear motion
4	Shankarappagari Girish, Chandu Lalith Nandan , K.V.N. Kavitha	Safety Auto Brake System For Vehicles In Hill Station Using Mems Sensor	Feb., 2016	This paper discusses on construction and design of a system which can operate automobiles on mountainous roads. When the vehicle is climbing the steep road, an automated braking system is implemented here. Firstly, the angle of vehicle is measured with the help of MEMS sensors. Then the speed of the motor is adjusted based on the readings from the sensor unit. The MEMS Sensor Unit is connected to the Microcontroller with the help of I2C communication protocol. The Control

				unit gathers data over I2C line and processes it within the instructions provided to the microcontroller.

III. Construction and Working



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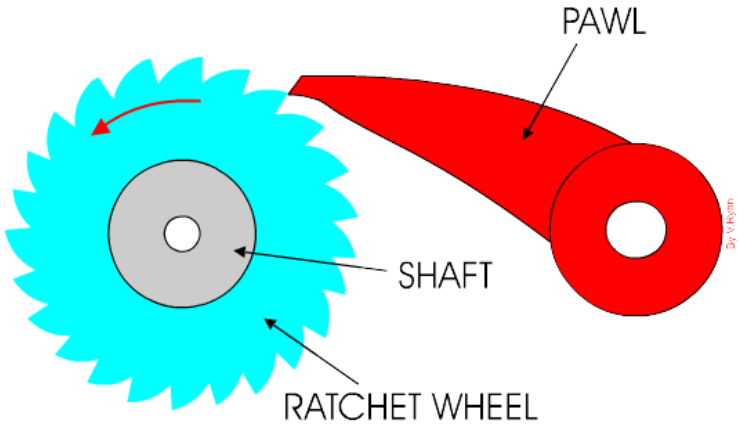
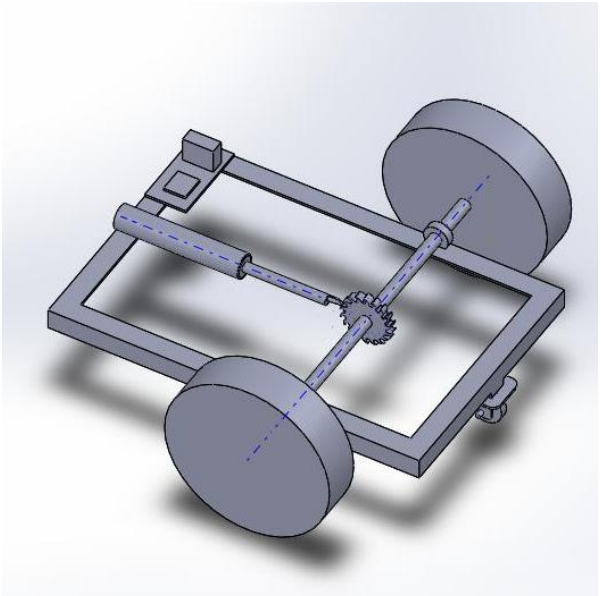
Working Principle

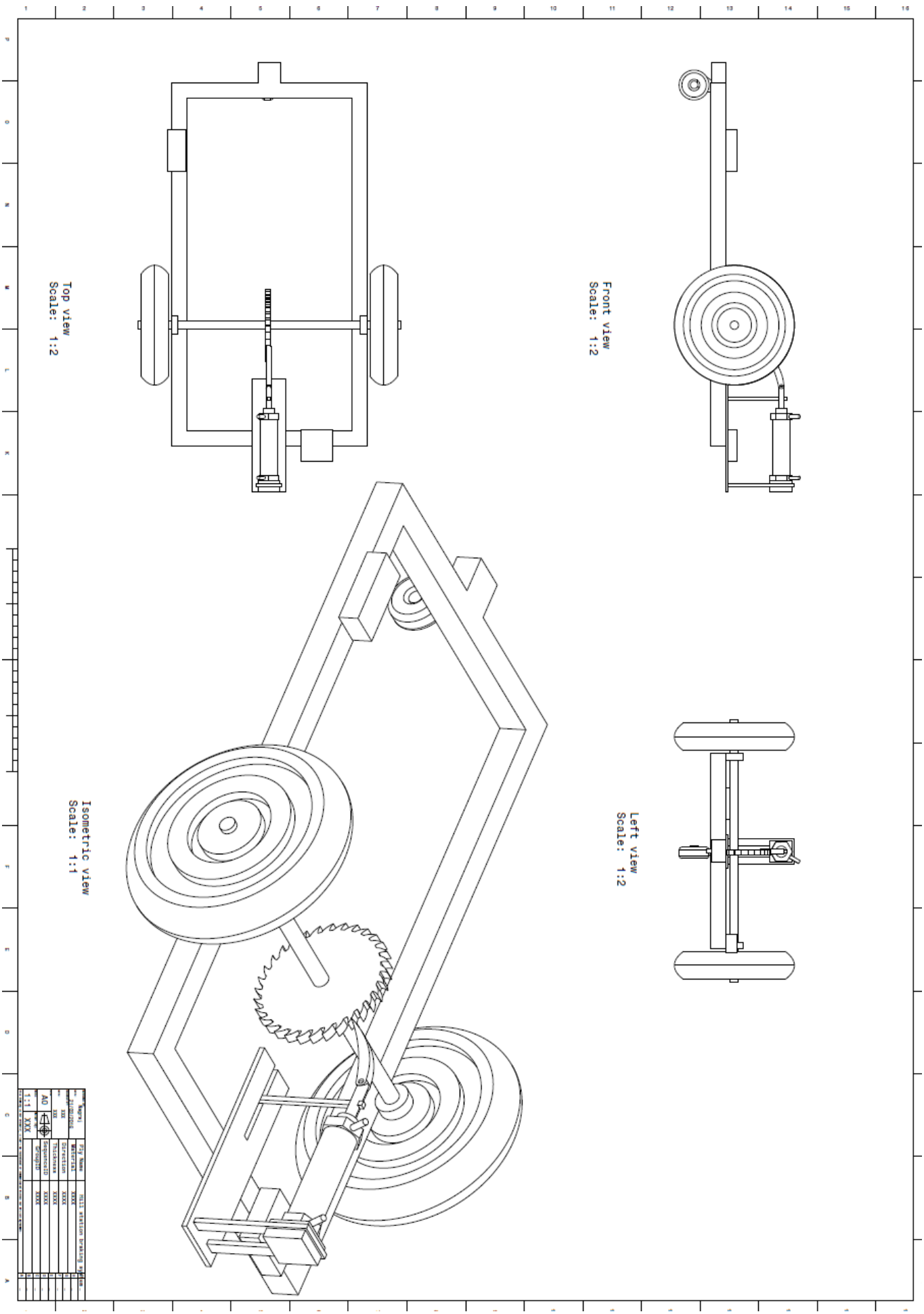


When the reverse gear is applied, a switch activates the control system.

Each one of four infrared sensors then constantly check if any obstacle is detected behind the vehicle. Once an obstacle is detected, the sensor will send a signal to the control unit. By using four Infrared sensors working independently, we can get wide angle coverage and can detect relatively small objects.
The control unit consisting of microcontroller then processes the signal and decides whether to apply brakes or not. The control unit then activates a relay which controls the solenoid valve.
The solenoid valve then passes the compressed air to the pneumatic cylinder. This compressed air then actuates the pneumatic cylinder and moves the piston rod. The piston then starts propagating forwards.
The shaft of the single acting pneumatic cylinder then engages the pawl mechanism with ratchet.
The speed of movement of pawl can be adjusted with the help of flow control valve.
In this work, Ratchet and Pawl mechanism is identified to arrest the backward motion to the car. The ratchet is attached to the drive shaft and the Pawl is attached to the frame. When the brakes are applied by the control unit, the lever forces the pawl to engage with the ratchet.
If the vehicle wants to move backwards direction, the pawl would not allow the ratchet to move and hence will arrest the backward motion of the vehicle.
So, the need to apply hand brakes is eliminated. The locking of the ratchet and the pawl mechanism is detached when the vehicle initiates motion in forward direction.

CAD Model -




Top view
Scale: 1:2
Front view
Scale: 1:2
Isometric view
Scale: 1:1
Left view
Scale: 1:2

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Results

Parameter	Value
Detection Range	2 m
Accurate Detection Range	1 m
Stopping Distance	0.39 m
Brakes Application Distance	0.5 m
Tested Speed	20 kmph

IV. Conclusion and Future Scope

Conclusion:

The system discussed here fulfills all the objectives defined and stands true for the automation of the emergency braking system and avoiding accidents while driving in reverse direction. The system discussed is for heavy transport vehicles and can be implemented in all kinds of vehicles without. The system is very accurate because of precise positioning of infrared sensors, which detect obstacles that can create imminent threat and can avoid detecting the obstacles that are not in the way of vehicle. All the four infrared sensors cover different field of view and detect obstacles accurately, any of them can trigger the braking system. All the area behind the vehicle is covered with 4 infrared sensors. Also, an override button is provided to the user to regain control of the braking system in certain conditions when unwanted obstacles get detected by the system such as bushes. Many more infrared sensors can also be used to improve reliability depending upon the size of the vehicle.

Future Scope

With above research being done, further improvements can be done by improving distance sensing mechanism and use of 'Artificial Intelligence'. The out coming system can be implemented to detect and avoid collisions in forward direction also. This would highly reduce fatality of any accident and would highly improve safety of user and in turn will save many lives on roads.

Also, an 'Artificial Intelligence' based system can be developed which with the help of face detection will detect if the driver is awake or asleep and will provide haptic feedback to the steering wheel and driver's seat to wake the driver up and will also automatically reduce the vehicle speed within non-fatal range, eventually stop the vehicle and activate emergency lights. Also, it will increase the range of obstacle detection in such scenario and react accordingly.

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