Collision Avoidance System (CAS) for Automobiles using Embedded System

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1 About CAS

1.1 Abstract:

- The study addresses the problem of slow reaction time to braking by implementing a collision avoidance system fixed that aids the driver in ensuring safety.
- The system consists of the autonomous car and the collision avoidance system. Based on the signal received from the ultrasonic sensor, the micro controller unit sends a signal to the braking unit for applying the brake automatically as per braking & throttle control logic fed in to the micro controller unit.
- To avoid the collision between the vehicles during the period of running conditions and automatically applying the brake by means of actuators, distance measuring sensors & Electronic control module.

1.2 Introduction:

- Nowadays, the number of accidents is so high and uncertain. Accidents causes worst damage. These accidents are mostly caused by delay of the driver to hit the brake.
- Collision avoidance systems concentrates on advanced ideas such as pre-crash sensing, an ultrasonic sensor is used to sense the object in front of the vehicle and gives the signal to the microcontroller unit.
- Based on the signal received from the ultrasonic sensor, the microcontroller unit sends a signal to the braking unit for applying the brake automatically.

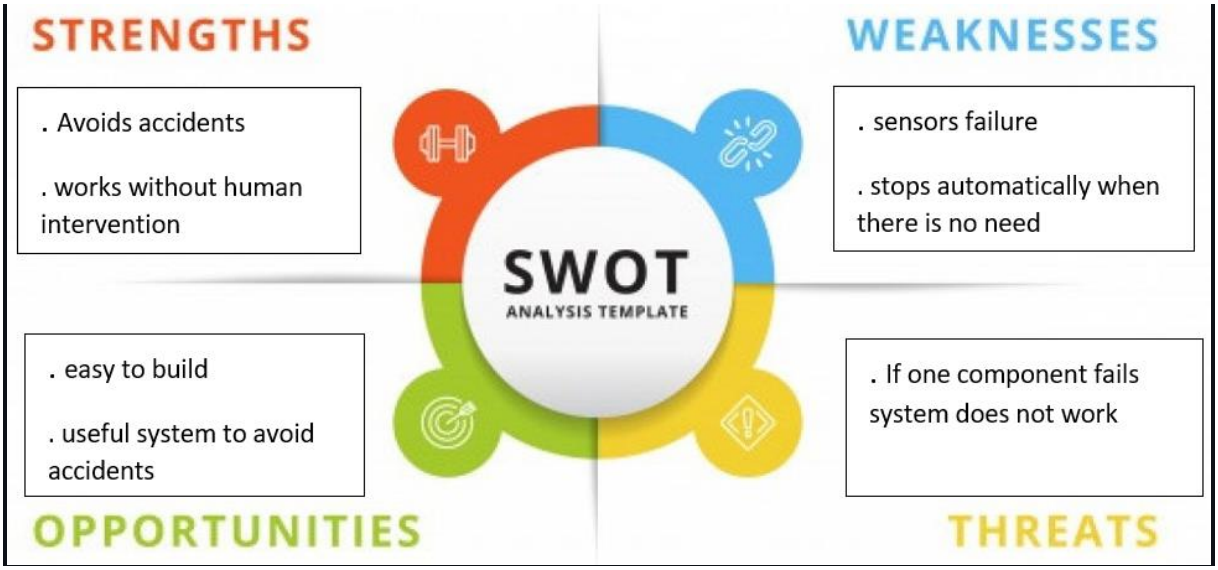
1.3 Objectives:

- To design an obstacle sensor system.
- To develop a system that applies to brake at a safety distance.
- To ensure the system responds in real-time

1.4 5W's 1H

What	Where	When	Who	Why	How
Collision avoidance for ensuring safety	Used for vehicles	When there is possibility for an accident	People having vehicles	To avoid accidents	Through sensors and control unit

Swot Analysis



2 Requirements

2.1 High level Requirements

ID	Description
HLR-1	system shall be able to sense the objects through the ultra-sonic sensor
HLR-2	System shall send the signals from sensor to control unit
HLR-3	The control unit shall operate the actuator to control the brake pedal or throttle pedal
HLR-4	system shall avoid the accident

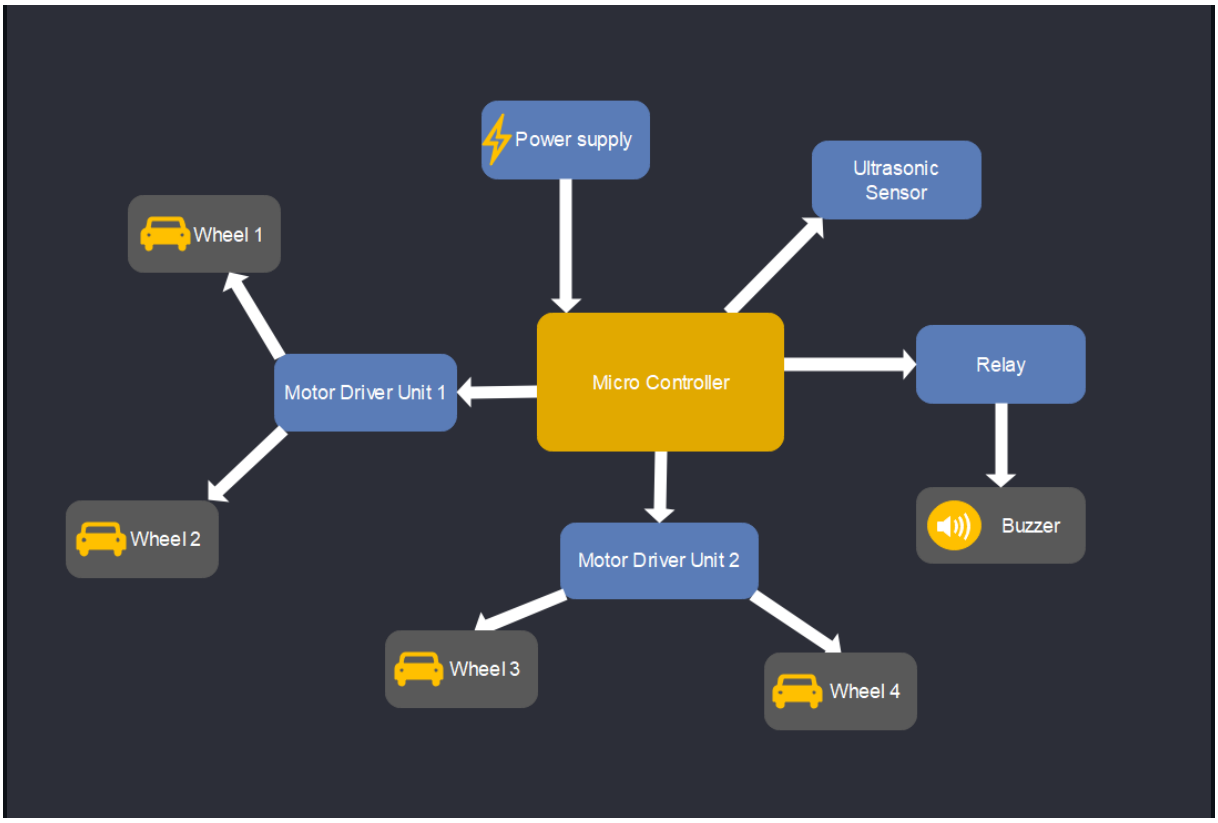
2.2 Low level Requirements:

ID	Description
LLR-1	Sensor shall not send any signals to control unit when there is no Object

ID	Description
LLR-2	The control unit shall stop the control on actuator when there is no object present

1 Block diagram and Block's Explanation

1.1 Block Diagram



1.2 SENSORS USED

- Ultrasonic sensor:

  The ultrasonic sensor is a very low-cost device and has found its application in most areas of autonomous robots and cars. When an ultrasonic sensor is induced with voltage, it generates sound waves that are emitted through the emitter component of the sensor. The generated sound waves are inaudible to humans (frequency of 20Hz to GHz). The waves travel until such length that they are reflected back. The reflected waves are picked up by the receiver component of the sensor. Ultrasonic sensor in this project is used to detect objects and sends controller the distance between the object and the system.

- Relay:

  Relays are switching that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit.

- Potentiometer:

  A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.

- Buzzer:

  A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short).In this project these are used to warn the driver to apply brake.

1.3 ACTUATORS

- Dc motor:

  Dc motor is used to control the throttle pedal of the system.

1.4 MICRO CONTROLLER

- Arduino:

  This is the main component which controls all the above-mentioned parts of our embedded system. This interfaces all the sensors and actuators.

1.5 SUBSYSTEM

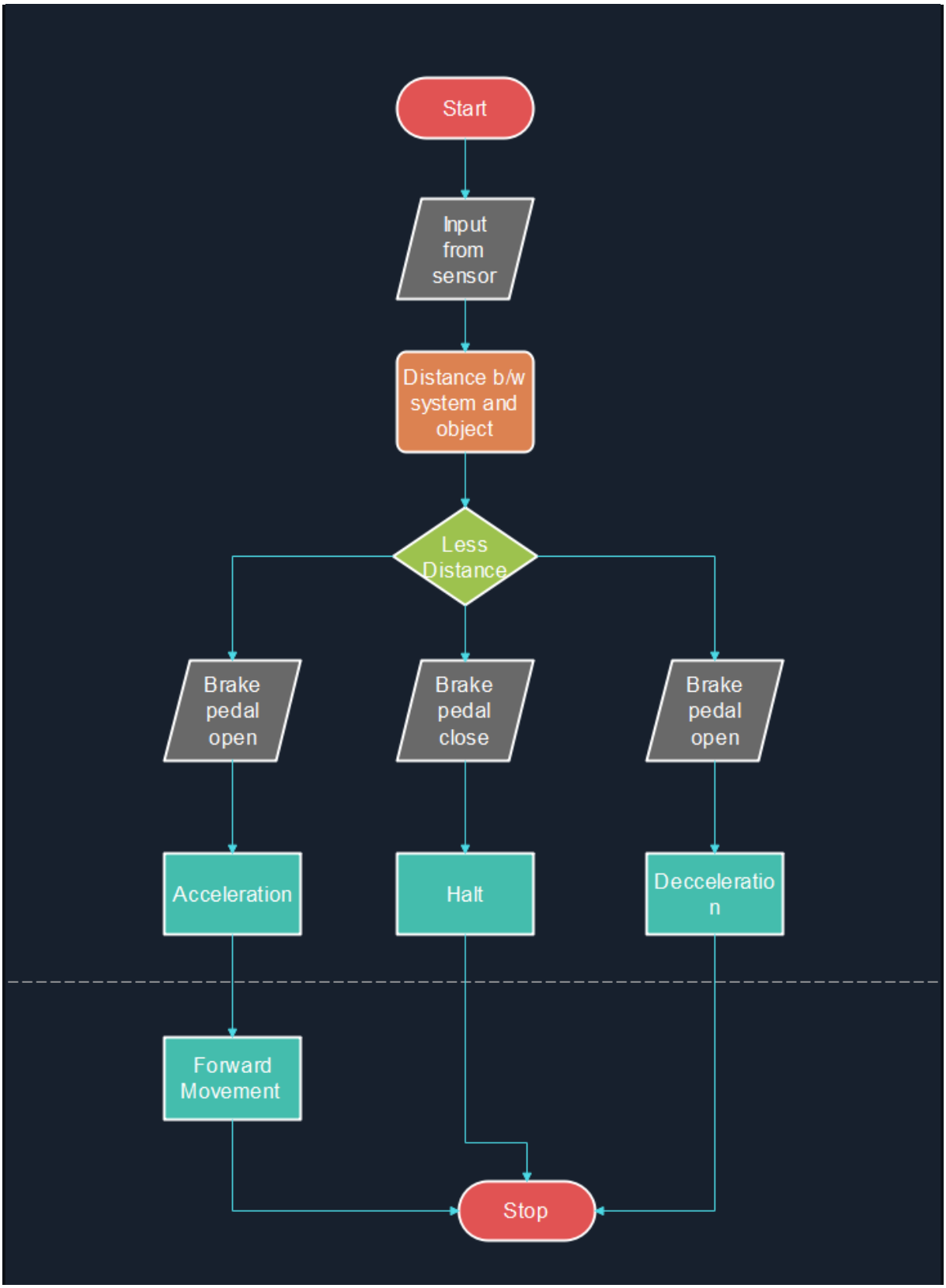
- Motor Driver:

  Motor driver in this project is used to drive the motors connected to wheels to propel the system.

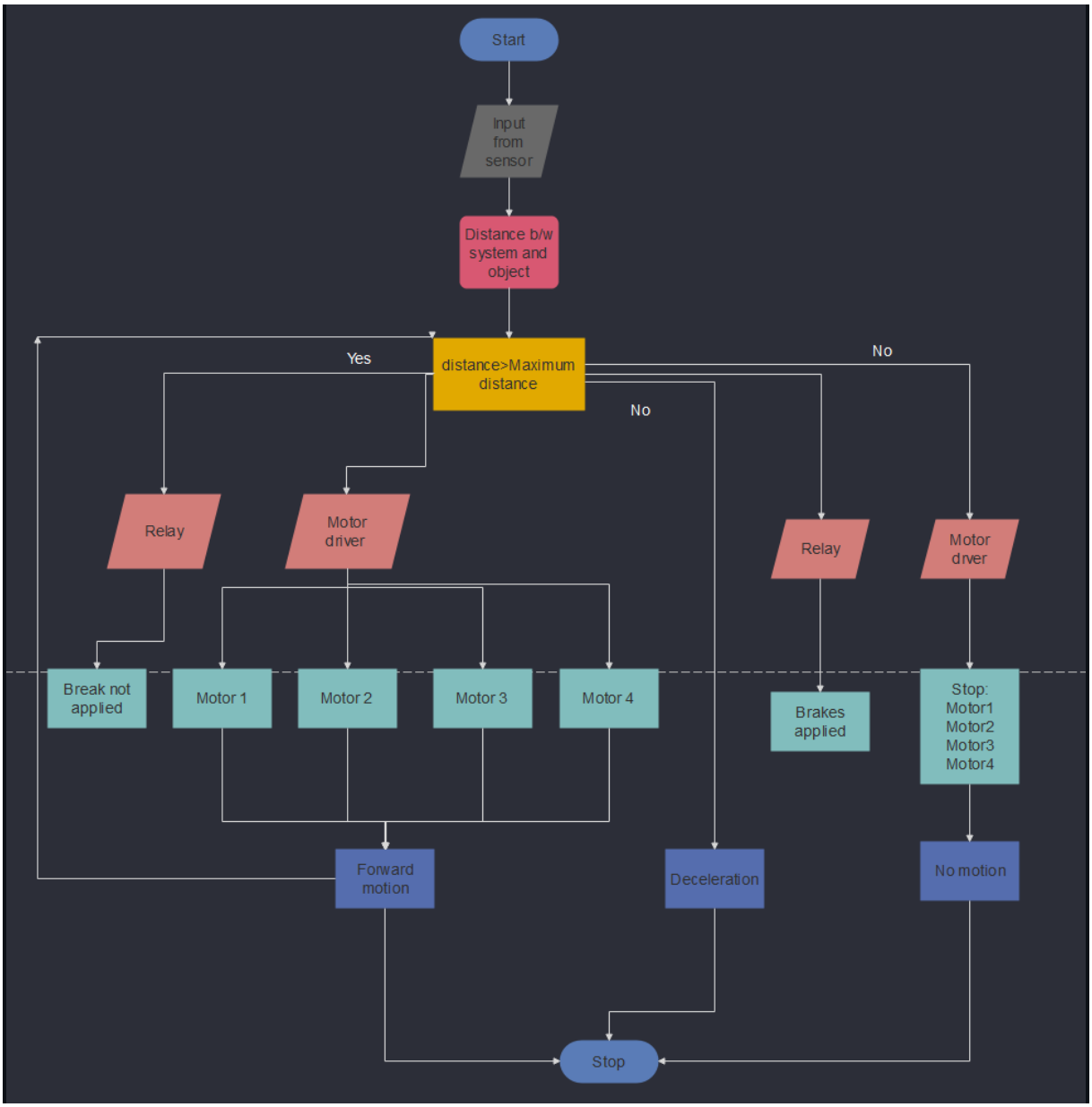
2 Architecture

2.1 Behavioural Diagram

2.1.1 High Level Flow Chart Behavioural Diagram

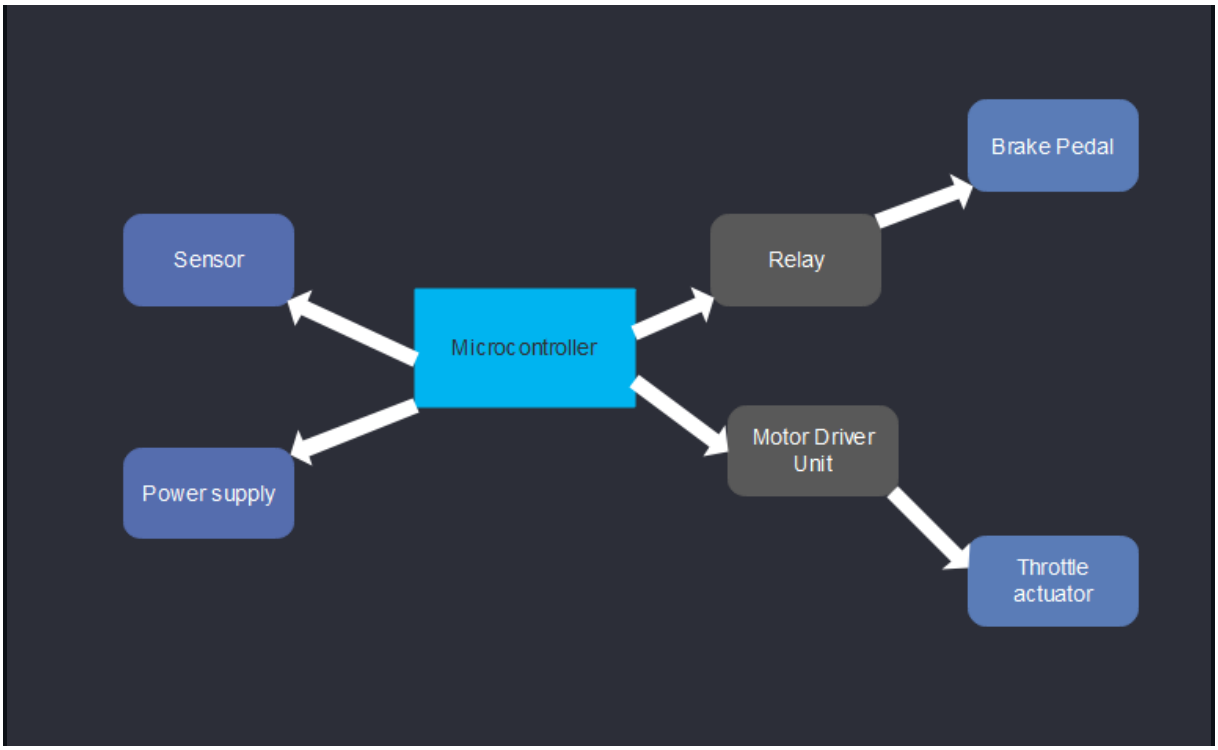


2.1.2 Low Level Flow Chart Behavioural Diagram



2.2 Structural Diagram

2.2.1 Functional Diagram



1.1 HIGH LEVEL TEST PLAN

Test number	Description	Input	Expected output	Actual output	status (passed or not passed)
1	Ultrasonic sensor	Object detected at a distance > 20cm	motors running in forward mode	forward motion of motors	✓
2	Ultrasonic sensor	Object detected at a distance < 20cm	Motors stopped	Motors in halt position	✓

Test number	Description	Input	Expected output	Actual output	status (passed or not passed)
3	Ultrasonic sensor	Object detected at a distance 28cm	motors running in forward mode	forward motion of motors	✓
4	Ultrasonic sensor	Object detected at a distance 10cm	Motors stopped	Motors in halt position	✓
5	Relay	motor position	Relay is open when motors are in forward motion	Relay contact open	✓
6	Relay	motor position	Relay is closed when motors are stopped	Relay contact closed	✓
7	Relay	motor position	Relay is open when motors are decelerating	Relay contact open	✓
8	Buzzer	object position	Buzzer on when object is detected	Buzzer on	✓
9	Buzzer	object position	Buzzer off when there is no object	Buzzer off	✓

1.2 LOW LEVEL TEST PLAN

Test number	Description	Input	Expected output	Actual output	status (passed or not passed)
1	motor driver	object position	object at distance <20cm stops the motors	stops motors	✓
2	motor driver	object position	object at distance >20cm runs motors	Runs motors	✓
3	motor driver	object position	object at distance 10cm runs motors	Runs motors	✓

6 Application

- A collision avoidance system, also known as a driver assistance system, is a safety system designed to prevent a collision or decrease its severity in the few seconds before it occurs.
- Slowing the speed of a vehicle by a few kilometres before impact can save lives.
- Active safety systems have the potential to not only reduce the number of accidents, but also can reduce the consequences of an accident if a collision cannot be avoided.
- The application will help drivers avoid accidents by being more aware of their surroundings.
- This awareness comes from the decrease of distracted drivers due to the early warning system in the application

7 Assumptions

- Relay is used to represent brake pedal
- Motors represent wheels of vehicle

8 Output

8.1 Simulation Images