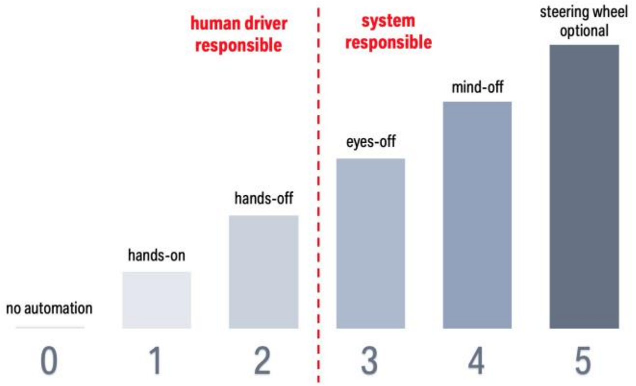
SAE AUTONOM 2021-22

- Team : *Spark Wit*
  Team ID : *2015481*

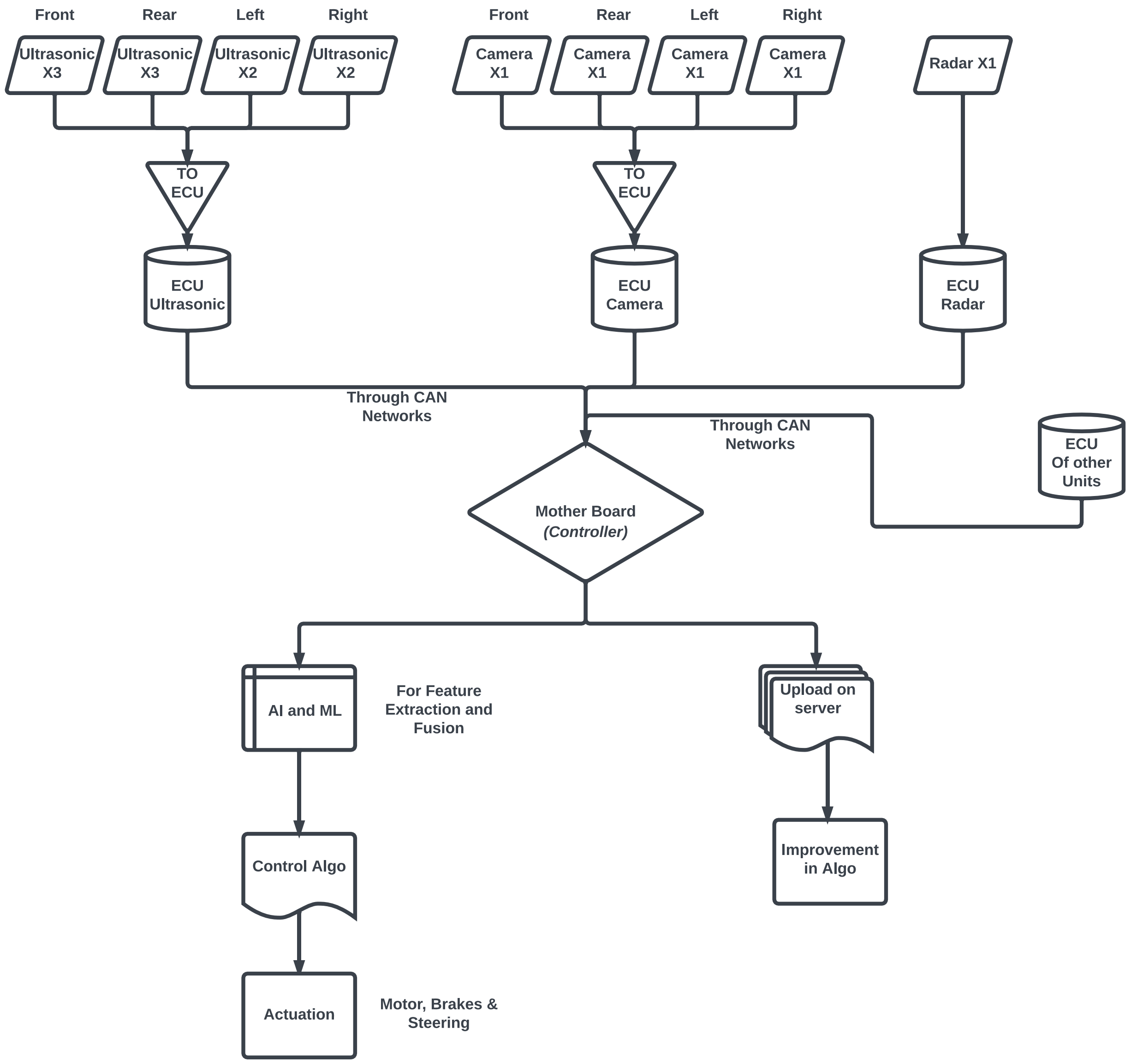
Final Round Submission

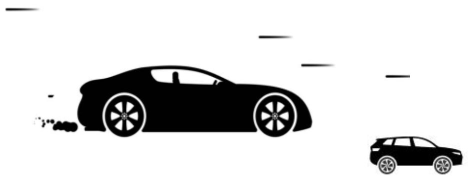
Philosophy Behind the Autonomous Vehicle Solution Implemented

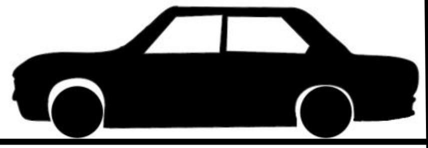
- ✓ General Solution to ***All the Possible Scenarios*** rather than the Scenario Specific Solution.
- ✓ The Primary focus was to achieve ***LEVEL 1 & LEVEL 2*** and somehow reach to Level 3 of Autonomy.
- ✓ The Sensor Model was developed considering the ***Specification (Eg. FOV, Range) of the Available Sensors*** in the market and tried to develop a Cost Considered model.
- ✓ The properties which we accounted for the consideration and data were those which could be actually given by that particular sensor.
- ✓ The Basis of Decision was done on basis of ***Worst/Maximum Condition*.**
- ✓ The lane designation for object localisation is taken with consideration of drive lane as zero irrespective of lane marking



System Architecture In General to be Followed







In the Particular Case of the Model Developed By Us:

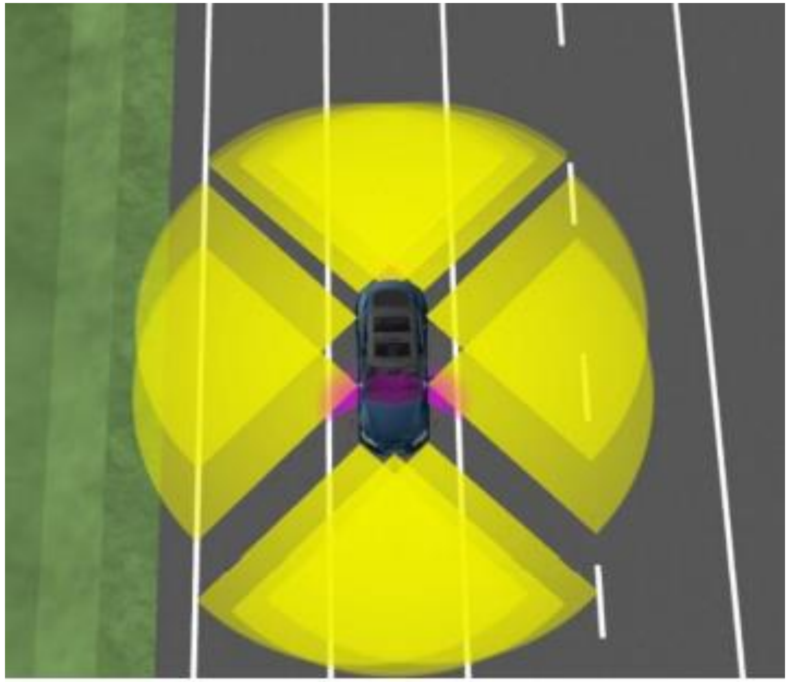
- *No role of CAN Networks.*
- *No role of AI and ML for feature Extraction*

The main aim was to Focus on Sensor Fusion & Control Algorithm Part.

Reasons for Selecting the Sensors

Sensors	Primary Function
Camera (4 in Number)	Distance and Type of Object
Ultrasonic (10 in Number)	360 cover in Short Range (6m)
Radar*	Adaptive Cruise Control

**Can be removed in near future*



- **The sensors selected were sufficient to control the vehicle.**
- **No blind spot around vehicle which is uncontrollable.**
- **Economic Optimisation is done to a certain level.**

Camera

- For Initial distance and type for assigning the block in which the object lies
- Use of Depth Algo (*AI and ML*)
- Generally used for distance, area and Type of object identification
- 4 cameras are there with a FOV (H/V) of 123 and 23 deg. (upto 150m) each in each of 4 sides.

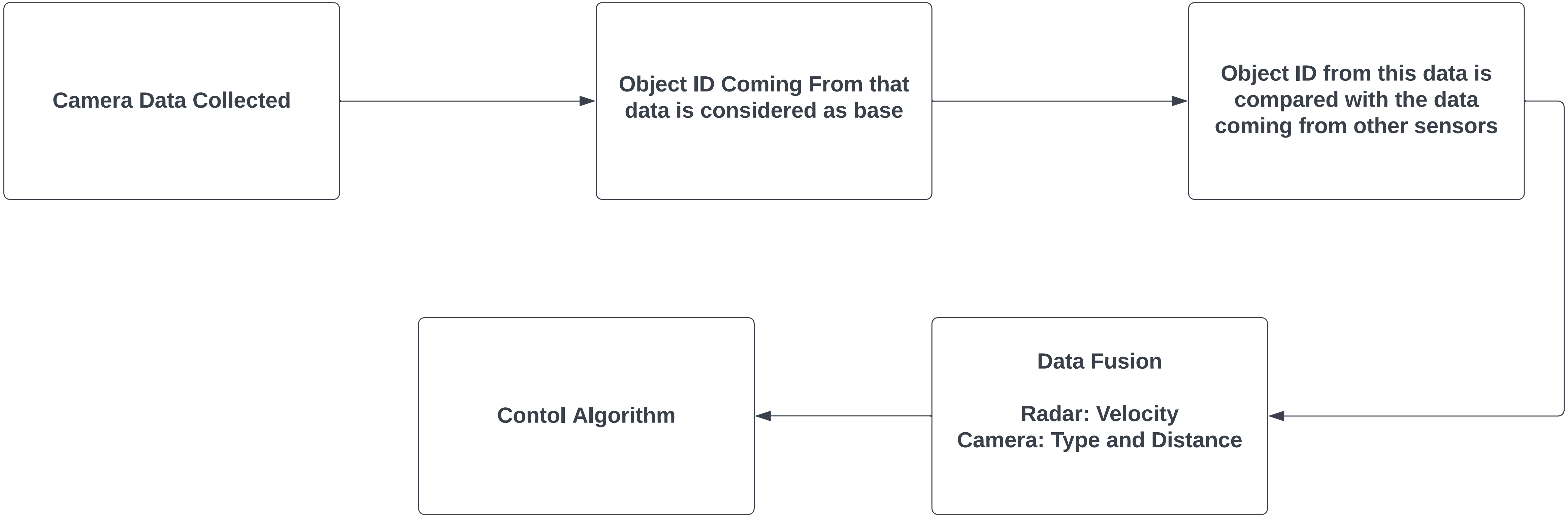
Ultrasonic

- To contribute to get an overall view around the car including barriers.
- 10 Ultrasonic (3F,3R,2L,2R) are there with a FOV (H/V) of 90 and 3 deg. (upto 6m).
- The sensors generally give us the velocity and distance of the object(s) in the range.

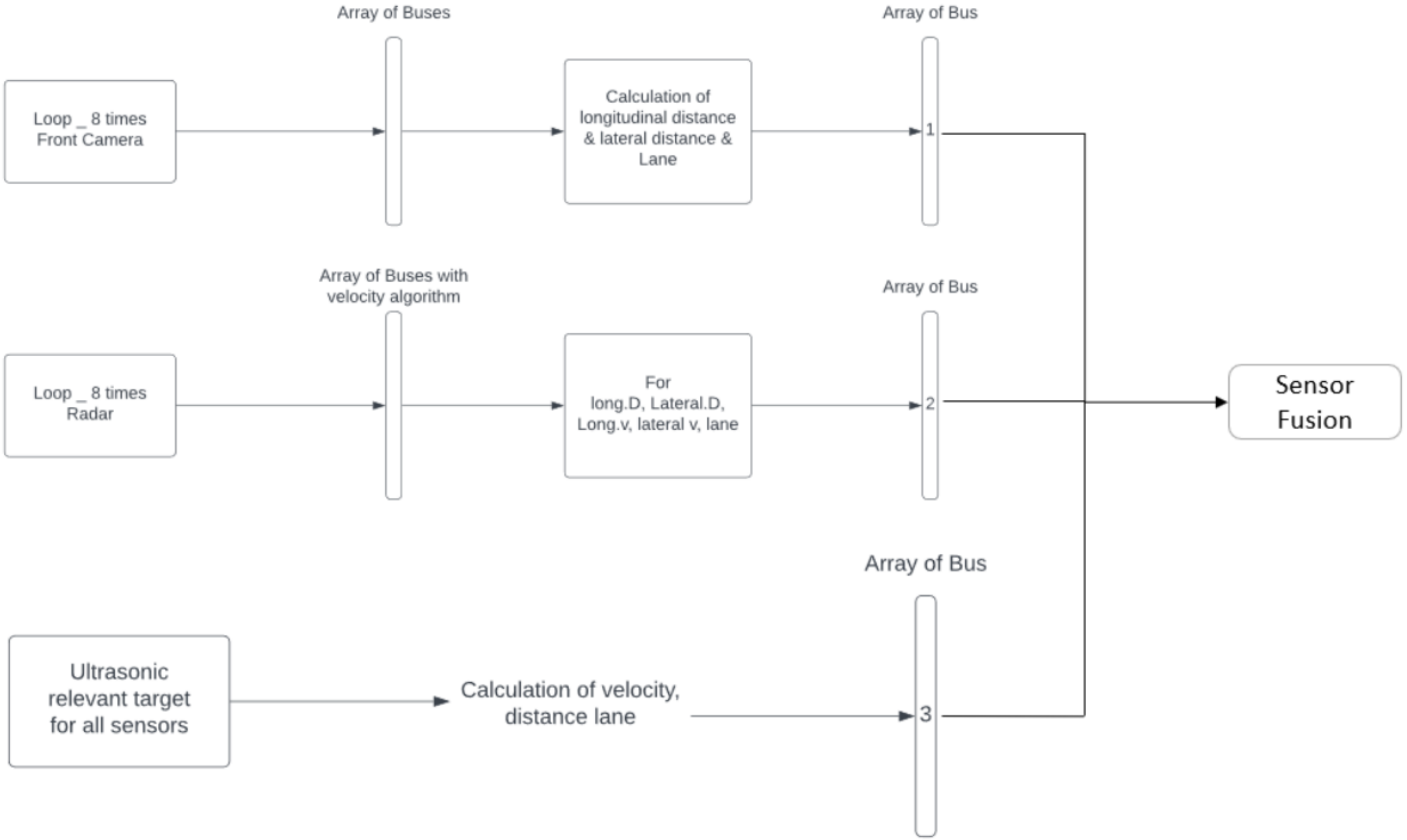
Radar

- To cover Front traffic, see traffic lights and traffic signs.
- ACC
- 1 Radar (F) are there with a FOV (H/V) of 90 and 20 deg. (upto 80m).

AV Algorithm



Sensor Fusion Algorithm



Object id (base for comparison)

Sequence of adding data

→Front Camera
→Ultrasonic FC
→Ultrasonic FR
→Ultrasonic Side R1
→Ultrasonic Side R2
→Ultrasonic FL
→Ultrasonic Side L1
→Ultrasonic Side L2

Rear C, Rear L, Rear R

Control Algorithm:

- No parallel calculation
- Condition was checked on every detected object
- Action taken on basis of trajectory
- Condition was checked in Series using if else condition
- Action on Most Prominent Condition

If vehicle is in front of base vehicle & coming towards base vehicle (moving in opposite direction) and in Same Lane
Then vehicle comes in the most appropriate lane

If the vehicle is in front of base vehicle & moving in same direction
Braking distance and braking accordingly.

If the vehicle is in front and moving in same direction and coming towards “LANE 0”
Check for trajectory and apply steering and brake accordingly

If the vehicle is just in side of base vehicle

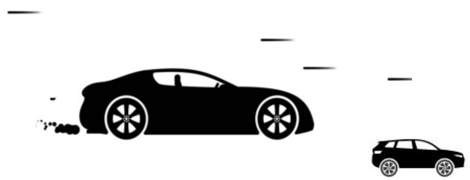
Check for trajectory and apply steering and brake accordingly

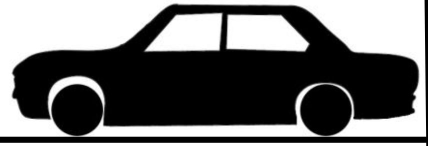
If the base vehicle is taking the reverse direction

Then the relative velocity of the object behind the vehicle is checked and if its –ve and distance is equal to or less than 5m then we stop there immediately, if its not –ve then we make sure the speed comes down to 2.5km/hr and till the distance is reduced to 0.5m.

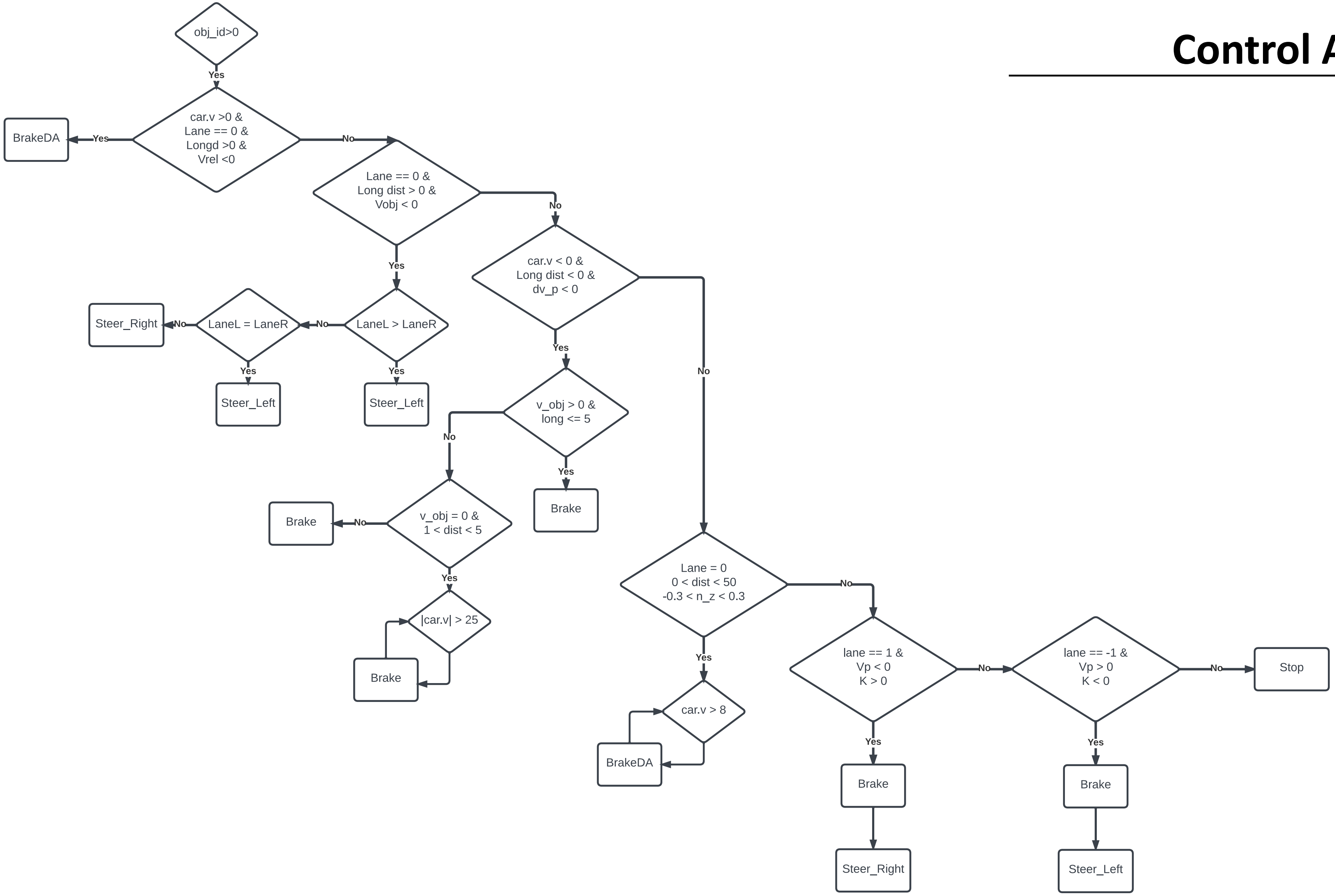
In case of Bumps and Droops

The sensors senses the height of bumps and droops in range of (-0.3 to 0.3)m and checks the distance from 50m. If the distance keeps on reducing then the braking distance algorithm is applied and braking is made accordingly, to make sure that the vehicle passes through those in an appropriate speed.





Control Algorithm



Innovation Especially In India’s context

Innovation 1:

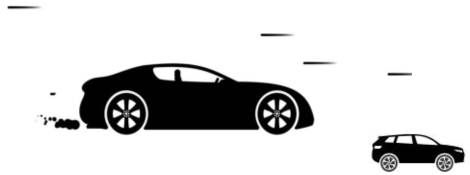
(Stopping Distance Algorithm) = 1.5m

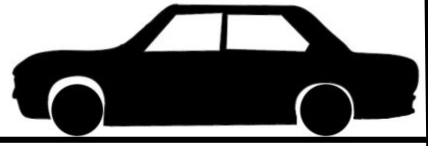
This algorithm calculates the distance available for the base vehicle to stop the vehicle to avoid the collision at the scenario at real time and apply braking accordingly.

Innovation 2:

(Trajectory Identification & Control)

This identifies the trajectory of the base vehicle and the vehicle around it. If the trajectory identified, show the chances of collision, it will apply steering and brakes in a way that it will be deviated from that trajectory.





Innovation 3:

(Most Appropriate Lane)

This is particularly used when the vehicle in front of you is coming towards you. In that situation just applying brakes wont help much. So, the base vehicle steer will make sure that it comes to the most appropriate lane.

Innovation 4:

(More Minimum Safe Distance)

Checks whether the vehicle behind the base vehicle is moving or not while the base vehicle is being taken in reverse direction. If yes then more minimum safe distance is considered and the base vehicle will move slowly.

Innovation 6:

(Lane System Not in accordance to Road Marking)

Done because the traffic here, does not follow the road marking. Even the situation is worse when there is no road marking. Therefore, the road marking system for lane is not considered.

Innovation 7:

(Multiple Bump problems)

Proper consideration of multiple road bump is taken so that car not get stopped between bumps

Our Team

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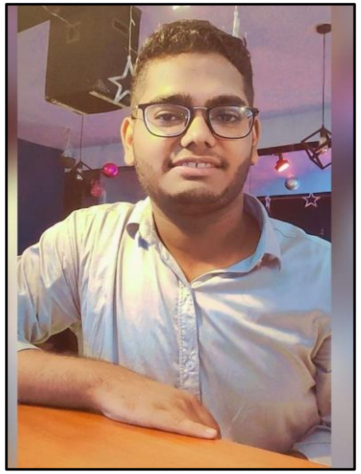
Sambhav Jain


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THANK YOU!