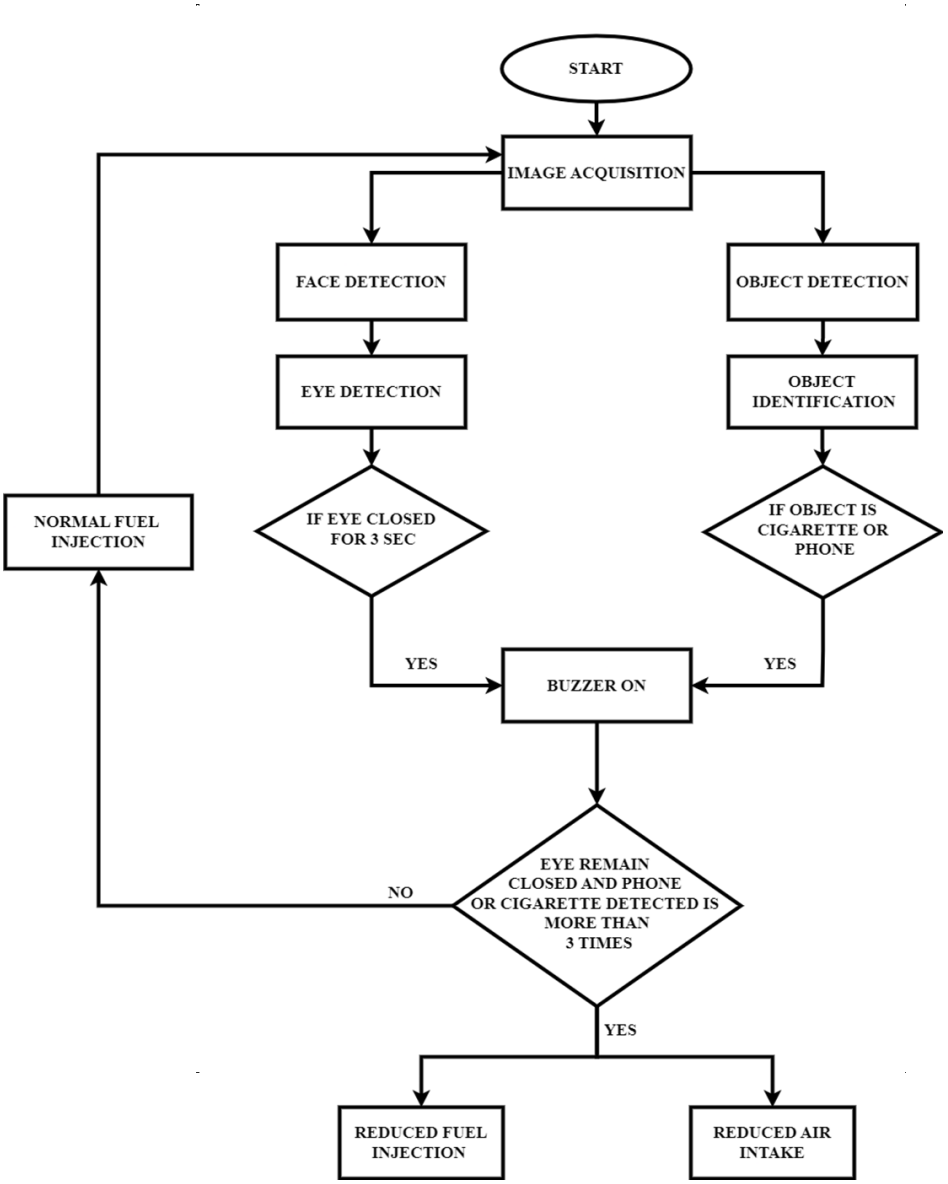
SYNOPSIS

1.	**Title of the Project**	LOW-COST SAFETY ENHANCEMENT SYSTEM FOR DRIVERS ON ROAD Project Reference No.: 46S_BE_0294
2.	**College and Department**	Sahyadri College of Engineering & Management, Mangalore-575007 (Electronics and Communication Engineering)
3.	**Name of the Students and Guide**	ABHISHEK S abhis171007@gmail.com DHEERAJ RAO B dheerajrao011@gmail.com V BALAJI balajineymarj11@gmail.com VIKAS V BANGERA bangerav72@gmail.com Dr. JOYLINE GERMINE D'SA (Guide) joyline.ec@sahyadri.edu.in
4.	**Keywords**	Driver Drowsiness Detection, Object Detection (Cigarette & Cell Phone), OpenCV, You Loo Only Once (YOLO) Algorithm, Air Fuel Ratio, Engine Control Unit (ECU), Speed Control, Controller Area Network (CAN).
5.	**Introduction**	The transport industry plays a critical role in the economy of a country, as it enables the movement of goods and people from one place to another. The transport industry is essential for economic growth, social and economic connectivity, accessibility to goods and services, international trade, and environmental sustainability. In the early days of the transport industry, safety was not a significant concern, and accidents were prevalent. However, advancements in technology, regulation, and training have led to significant improvements in safety. Presently some of the safety features available are Seatbelts, Airbags, Anti-lock Braking System (ABS), Traction Control System etc. These improvements have led to a significant reduction in accidents and fatalities, making the transport industry safer for everyone. India falls second in the usage of tobacco by country worldwide, after China. Since smoking in public places is a punishable offense, people tend to smoke in all sorts of places. Some smoke in remote areas, while some take to their terraces. Smoking a cigarette stimulates the release of adrenaline from the brain which is a sensation of joy and vigor.

		Sometimes smoking may result in light-headedness and even dizziness, even when all this happens some people smoke when driving which can cause impairment and cloud their decision making when driving. With all such distractions in mind, the Advanced Driver Safety System aims to detect the distractions such as Drowsiness, cell phone usage and even cigarette smoking. This is achieved using Image Processing using OpenCV and YOLO algorithm. When the above distractions are detected, the system alerts the driver and if the distraction persists then the speed of the vehicle is regulated via fuel injection using ECU fuel mapping control.
6.	**Objectives**	• To build a kit that is simple, efficient and cost effective to detect drowsiness in the driver and alert the driver to take control of the vehicle. • It also aims to detect and prevent the driver from using cell phone as well as smoking while driving. • If continuous distraction occurs the kit which is connected to the ECU stops the driver from over speeding by reducing the fuel injection rate and also the intake of air in the Intake Manifold.
7.	**Methodology**	Initially when the car is turned on, the device gets power from the USB port present in the car. This is used to power ON the Jetson Nano Microprocessor, which powers ON a camera which captures video in real time and feeds it back into the Jetson Nano. In the Jetson Nano two image processing algorithms run simultaneously. The first algorithm is used to determine the driver drowsiness. The second algorithm determines whether the driver is using a cell phone or smoking a cigarette while driving. The first algorithm localises the face and detects the key facial structure of it. The facial detection is done through OpenCV and NumPy and mainly a library called Mediapipe. The face is continuously captured using the USB camera, and the Mediapipe gives the facial landmarks of the driver using which the landmark indices of both eye area are highlighted in the frame. Now to check for drowsiness the eye aperture is calculated using both the horizontal distance of the eye and the distance between the upper and lower eyelid, both the distances are acquired using the facial coordinates and using Euclidean distance. If the eye aperture ratio is less than a certain threshold value, a timer is initiated up to three seconds after which a sound alarm is turned on to alert the driver.

This alarm is sounded using a small buzzer which is used to bring back the attention of the driver back to the road.



The second algorithm that runs in the Jetson Nano is used to determine the usage of cell phone or a cigarette while driving. The same image acquired before for drowsiness is also given to this algorithm from the USB cam. The algorithm is called YOLO (You Only Look Once), here the image is converted it into a 19X19 grid image that will give the feature of the multiple objects within a single image. Then using the OpenCV the input image data points are read and given to specified image in a NumPy array. As a result, image with a rectangular box (boundary box) is obtained using YOLO and the object is labelled using COCO data sets. But in this case the YOLO algorithm is used to only detect two objects that is, a cell phone and a cigarette.

		If the driver is using a cell phone or cigarette when driving the YOLO algorithm detects the objects and issues a warning using the same buzzer as the previous algorithm to alert the driver. The speed of any vehicle is controlled by the driver using the throttle, this information is relayed to the brains of the vehicle, the ECU. The ECU receives the information as to how much the air intake has to be increased and sends a signal to the air intake manifold to do the same. Concurrently the ECU also needs to increase the Fuel injection rate as the throttle increases, this is achieved using an Air Fuel ratio lookup table. Both the signals are in PWM format and hence Duty cycle is used to control the throttle of the vehicle. In extreme cases even after the sounding of alarms, if the driver is still drowsy or distracted on his/her cell phone or smoking a cigarette. The Jetson Nano generates a signal which is fed into the ECU of the vehicle. If the speed of the vehicle is above a certain limit, the ECU will reduce the fuel injection and air intake, hence controlling the speed of the vehicle rather than turning it off completely. This achieved by reducing the duty cycle of both the Air Intake Manifold and hence reducing the air entering the engine and also the Fuel Injectors which reduces the fuel being squirted into the engine. Hence the speed of the vehicle is regulated and the driver is not allowed to overspeed when driving impaired.

8.	**Results and Conclusions**	The camera starts taking input of the face of the driver which is then processed for drowsiness. The image is also processed for cell phone usage and smoking of cigarette. If both the processes yield a negative result the cycle continues until the car is turned off. If the processes yield a positive result the buzzer is sounded which alerts the driver to take control of the vehicle and asses his/her situation. Furthermore, if the driver is still drowsy or distracted after giving the warning, a signal is generated by the Jetson Nano and fed into the ECU. The ECU is simulated in this instance using a Raspberry Pi 4. Once this condition is achieved the driver can't accelerate past a speed limit due to airflow restriction on the engine, which is achieved by PWM (Pulse Width Modulation) on the Intake Body and on the Fuel Injector.

		Comparing with previous work were they only used 68 facial points to detect drowsiness, while our use of 468 facial points is more accurate. There is a training sets in place to detect even cigarettes, unlike other papers that only employed training sets to detect cell phones using YOLO. Finally, no one has integrated the three elements drowsiness, smoking, and cell phone detection to regulate the speed of the vehicle in any of the papers mentioned above. By offering all these features, it is possible for people to drive safely in cars.
9.	**Scope for Future Work**	● To implement a camera to monitor the road and combine it with artificial intelligence to inform the driver about the obstacles ahead and the minimum distance to be maintained to avoid the colliding for better safety