GRADUATION PROJECT 2022/2023

Faculty of Engineering
Alexandria University

Advanced Driver Assistance Systems

- **Proposal of SMART VEHICLE USING ADAS FEATURES AND V2V**

OUR TEAM

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CVs Drive

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1. MOTIVATION

Recently, it was reported that Egypt occupies the tenth position globally in road accidents, 94% of car accidents are due to human error. Human reaction time cannot compete with the machine's reaction time during emergencies therefore technological solutions such as Intelligent vehicles were introduced. Vehicle Systems offer great potential for future mobility. An increase in intelligent vehicle applications may improve safety and provide comfort. Several sources indicate the benefits of Advanced Driver Assistance Systems and other Intelligent Transportation communication Systems (V2V for example) to be significant.

2.OVERVIEW

Our ADAS is level 2 of Autonomous driving which is Semi-Automated. The vehicle can control both steering and accelerating / decelerating. This system will provide :

- **Lane keeping assist (LKA)** is a feature that uses a video camera to detect the lane markings on the road and monitor the vehicle's position within its lane. If the vehicle starts to drift out of its lane, the lane-keeping assist system will take action to help keep the vehicle within its lane.

- **Collision Avoidance System (CAS)** is an automobile safety system designed to reduce the severity of an accident using a forward collision warning system or collision mitigating system. These systems either provide a warning to the driver when there is an imminent collision or take action autonomously without any driver input according to the situation. Collision avoidance by braking is appropriate at low vehicle speeds.

- **Adaptive cruise control (ACC)** helps a vehicle maintain a safe distance from other vehicles on the road. If the leading vehicle changes its speed, ACC will automatically adjust the speed accordingly to maintain the desired distance. ACC is designed to make driving easier and more convenient, especially on long trips or in heavy traffic.

- **Driver monitoring system** is the use of technology to monitor the behavior and performance of drivers while they are operating a vehicle. The goal of driver monitoring is to improve safety by detecting and alerting drivers to potential risks or distractions, and by providing feedback to help drivers improve their performance.

- **V2V communication** is a technology used to exchange information about the location, speed, and direction of travel of nearby vehicles, as well as other data such as road conditions and traffic congestion.V2V communication has the potential to improve safety on the roads by enabling vehicles to "see" beyond their immediate surroundings and to be aware of potential hazards that 3. OVERVIEW Our ADAS is level 2 of Autonomous driving which is Semi-Automated. The vehicle can control both steering and accelerating / decelerating. This system will provide: might not be visible to the driver.

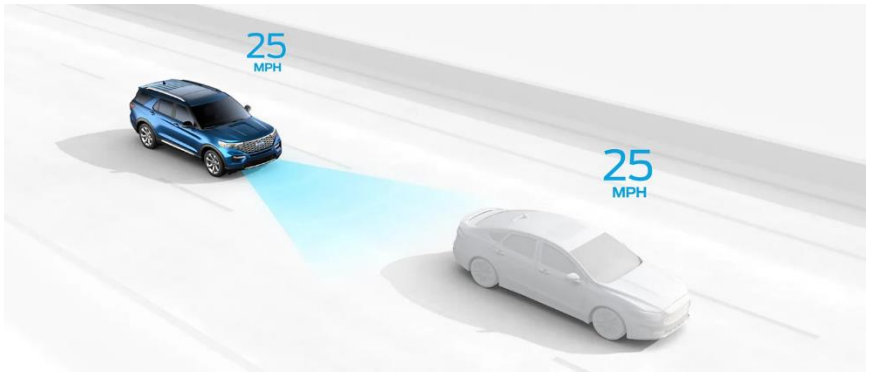
3.Methodology

In general, we will use the two vehicles:

- **The main vehicle that has all the features.**
- **A secondary vehicle to validate features like V2V communication and Collision Avoidance.**

Adaptive Cruise Control:

An ultrasonic sensor will be attached to the main vehicle to measure the distance between the two vehicles and according to the reading of the sensor we get the error between the desired safe distance and the real distance in the same instant and by using a closed loop system as PID controller, we get the required correction in the speed and achieve the desired speed by using a magnetic encoder sensor.

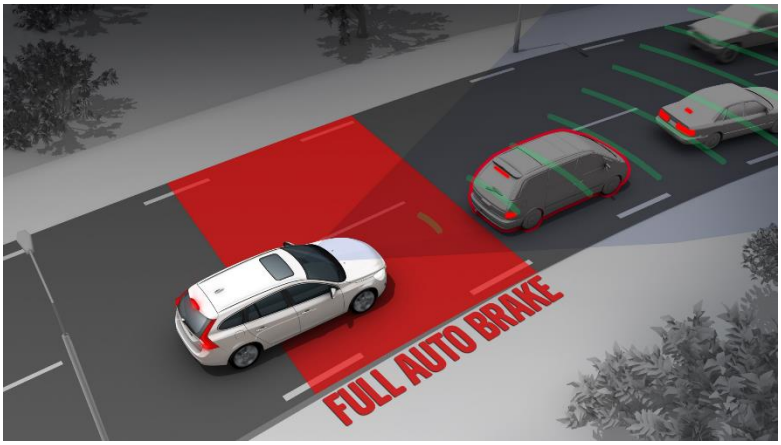


Lane Keeping Assist:

LKA typically uses a front-facing camera to identify lane markings and will automatically intervene if the car drifts toward or over the marking without using a turn signal. The system uses steering correction and/or selective braking on the opposite side of the vehicle to nudge the car back into the lane. We use Deep Convolution Neural Networks (DCNN) and Recurrent Neural Networks (RNN), and we present a hybrid deep neural network for road lane detection (RNN). The proposed model comprises a DCNN from a wider perspective that incorporates different sequential images as feedback and predicts the lane path in an SVM classification manner in the current frame. After the detection of the lane, we use a control algorithm to compare the position of the lane with respect to the vehicle and get the correct steering angle to adjust the vehicle between the two lanes.

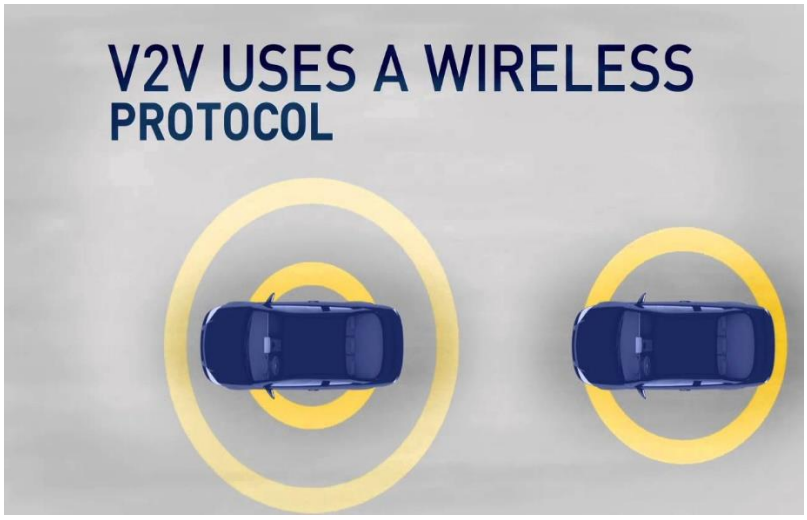
Autonomous Breaking and Collision Warning:

We will use the validation vehicle for breaking suddenly and the main vehicle will handle this situation when its speed is in the safe range to break. The main vehicle will monitor the readings of the ultrasonic periodically to be convenient for this action and then decelerate until it stops within a safe distance from the validation vehicle. When the main vehicle is driving at high speed (with no safe range to break) and the validation vehicle breaks suddenly the main vehicle will initiate a warning with a buzzer.



V2V Communication:

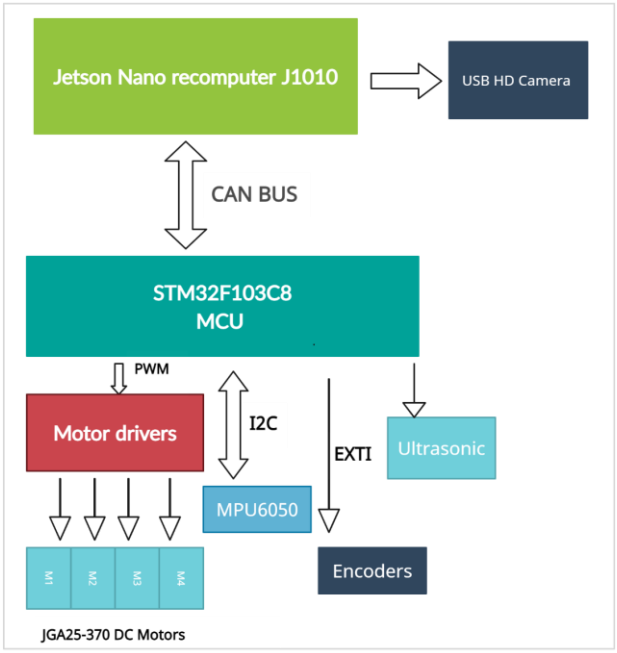
We will initiate a server between the two vehicles to achieve communication between them. the validation car will send the readings of its sensors periodically to the main one. When the readings of the sensors indicate that there might be an obstacle that will impede the movement of the validation vehicle, the main vehicle will decelerate to avoid collision with the validation vehicle.



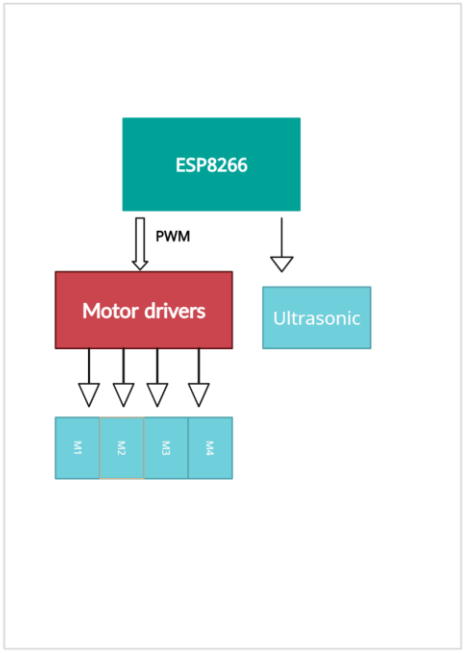
4.Hardware Architecture

1. NVidia Jet-son nano reComputer J1010 kit
2. Microsoft L2 LifeCam HD-3000, Black
3. Microcontrollers ex: stm32f103c8 blue pill
4. MCP2515 CAN-BUS Controller and Transceiver Module.
5. ESP 8266 WIFI module
6. JGA25-370 DC motor
7. Car base (dimensions ….
8. Sensors
    - Ultrasonic and VL53l0X Sensor
    - Magnetic Encoder
    - MPU6050

Main Vehicle



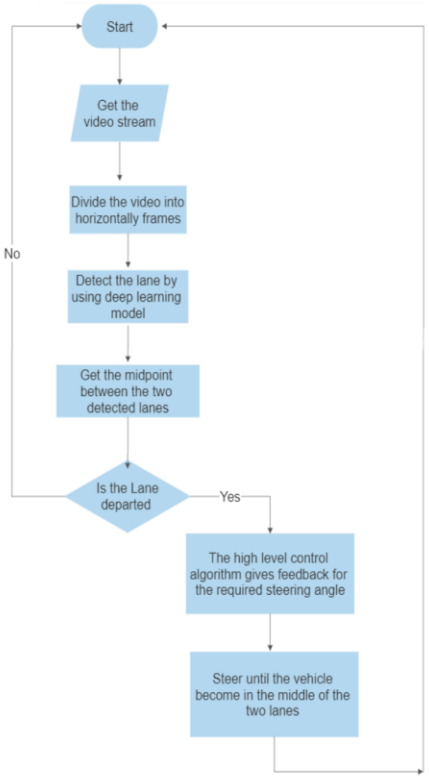
Validation Vehicle

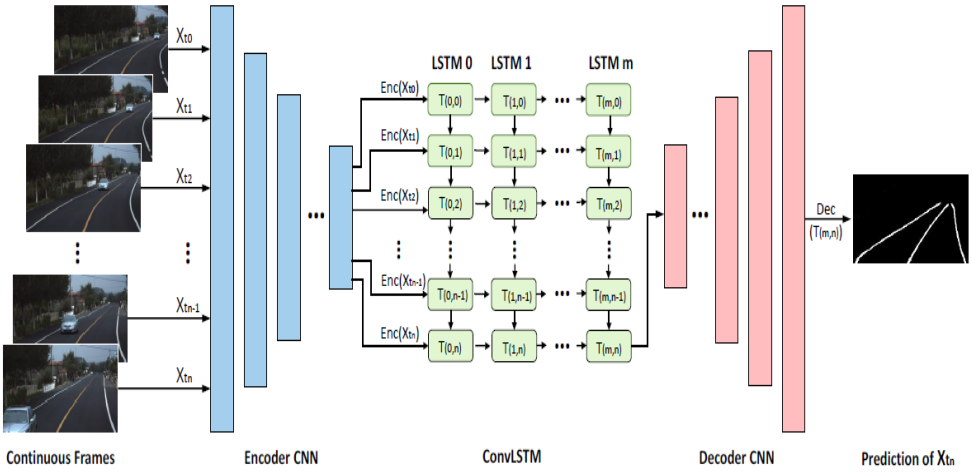


5.Design of software

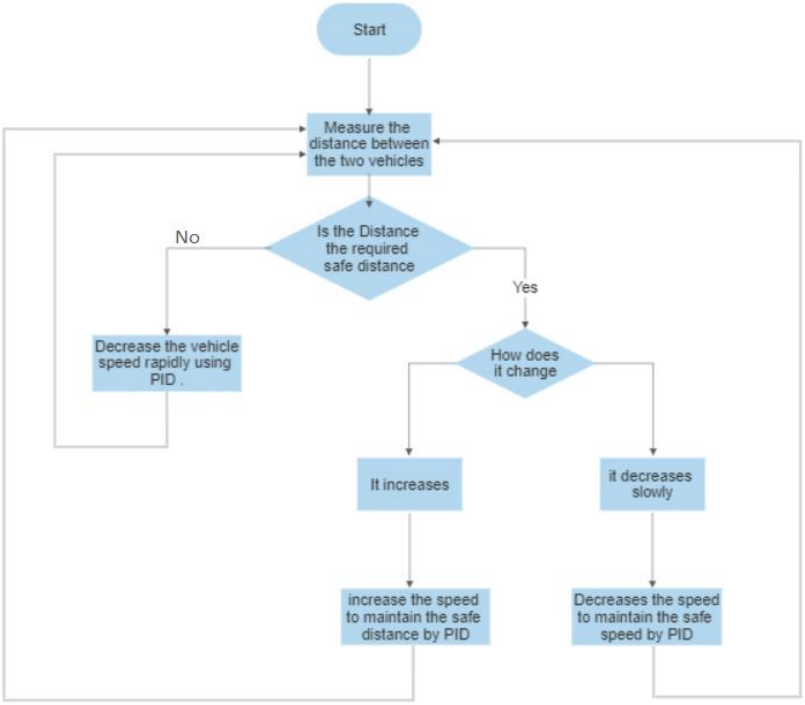
The design is consisted of three parts. System Implementation using Flow charts:

1.The Lane detection and keep algorithm:

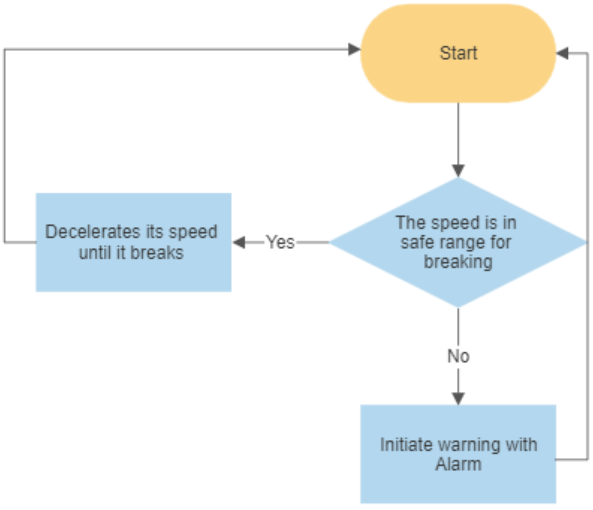




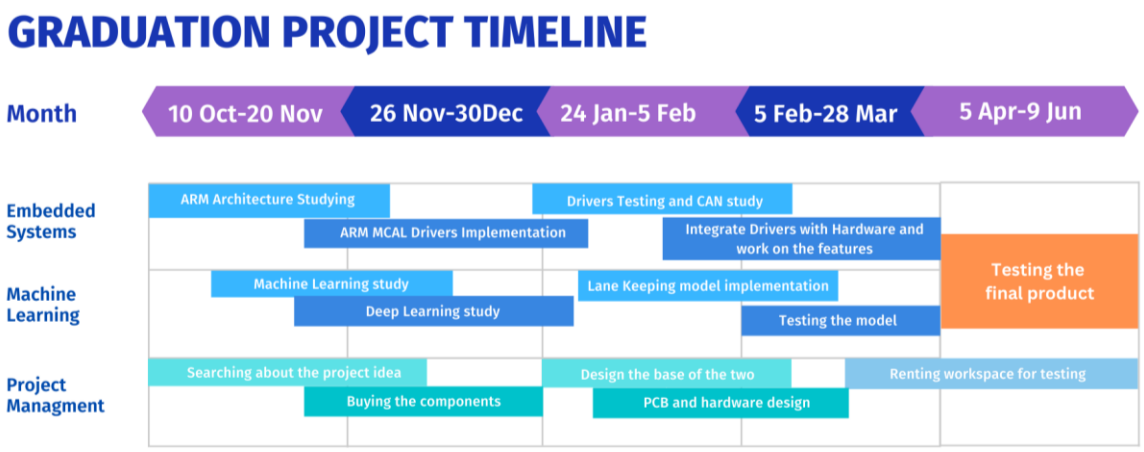
2.Adaptive cruise control:



3.Autonomous Breaking and Collision Warning:



5.Timeline



6. Budget

Components	Quantity	Price
Nvidia jetson Nano reComputer J1010	1	8800
STM32F103C8 blue pill	4	700
MCP2515 CAN-Bus Controller	4	800
Esp8266	1	200
JGA25-370 DC motor with encoder	4	1500
MPU6050	1	120
Ultrasonic sensor	4	300
USB web camera	1	700
Li-Battery 12V	1	600
Li-Batteries 3.3V	4	360
Main vehicle wooden base	1	300
Validation vehicle plastic base with motors and wheels	1	250
PCB and its components	–	400
Total	_	15,030 EGP