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DEVELOPMENT OF A REAL-TIME DROWSINESS DETECTION SYSTEM FOR ENHANCED VEHICLE SAFETY

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Abstract: In recent years, enhancing driver safety has become a critical focus in the automotive industry to reduce the risk of accidents caused by driver fatigue or inattention. This project aims to develop a real-time driver safety system by monitoring eye blinks to assess driver alertness. The system detects the frequency and duration of eye closures to estimate the driver's state—whether alert, drowsy, or asleep. Based on the detected status, the system can initiate control actions to ensure safety, such as triggering alarms or reducing vehicle speed. This intelligent monitoring approach enhances situational awareness and contributes to accident prevention, especially during long or monotonous drives.

Keywords: Driver Safety, Eye Blink Detection, Drowsiness Detection, Driver Monitoring System, Real-Time Vehicle Control

INTRODUCTION

Objective

Nowadays the driver safety in the car is one of the most wanted system to avoid accidents.
Our objective of the project is to ensure the safety system. For enhancing the safety, we are detecting the eye blinks of the driver and estimating the driver status and control the car accordingly.

To take input image through a web camera.
To detect face by implementing appropriate algorithms.
To detect Region of Interest(ROI).
To detect eye from the ROI.
To obtain highest possible accuracy through improved algorithms.
To detect driver drowsiness (if any) by monitoringthe eye blink rate.
To alarm the driver if drowsy.
Different steps of running this project

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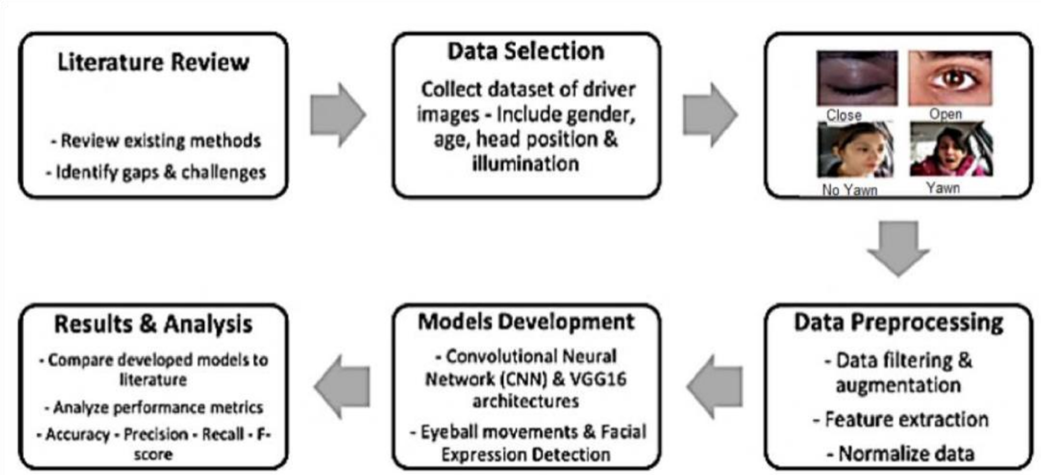
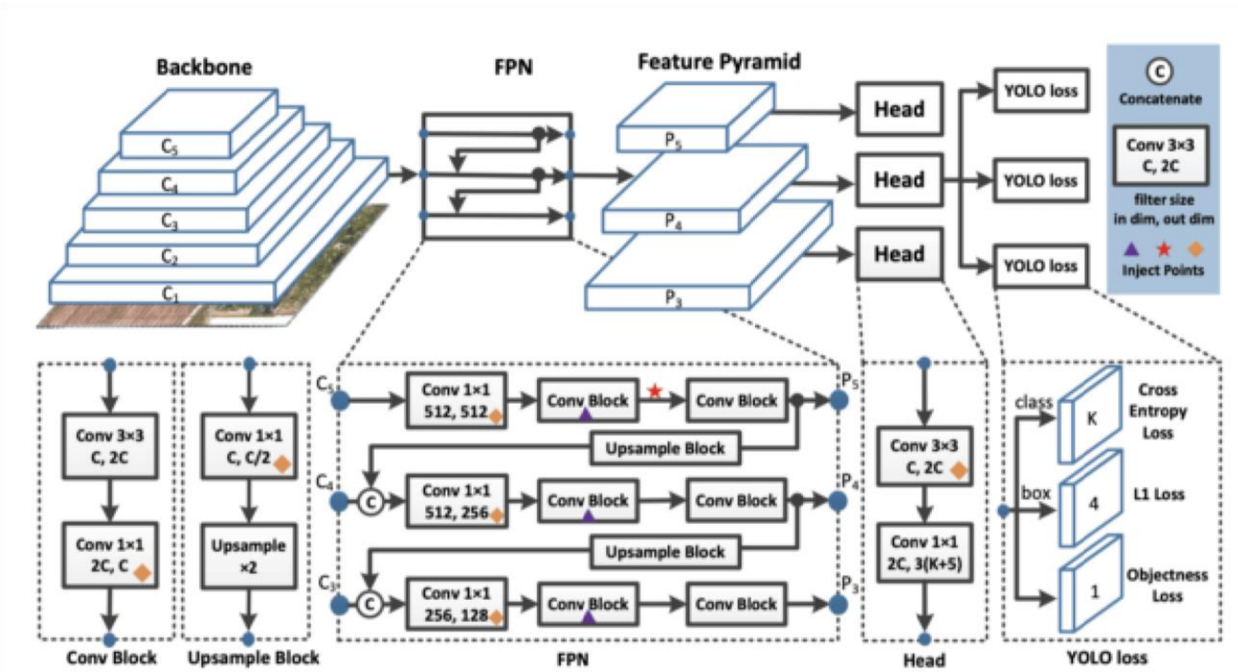


YOLO architecture:



Different blocks of YOLO

Input Block: This block is responsible for taking the input image and resizing it to the required size of the network. The input image is converted to a fixed dimension that serves as the starting point for the mesh.

Main block (Backbone): This block is responsible for extracting image features from the input image. Usually, pre-trained deep networks such as DarkNet-53 or MobileNet are used.

Detection Head block: This block is used to predict different parts of the image that include objects and the coordinates of the center, size, and confidence (probability) are detected. This block divides the results into smaller grids that provide more detailed information.

Upsampling Block: This block is used to increase the dimensions of grids in order to compensate for the reduction of dimensions in the feature extraction phase.

Boundary block (Detection Layer): This block has the task of converting the reduced information from the network into the final and understandable information for detecting objects. This block converts the output of the network into different feature vectors and performs the final calculations for object detection.

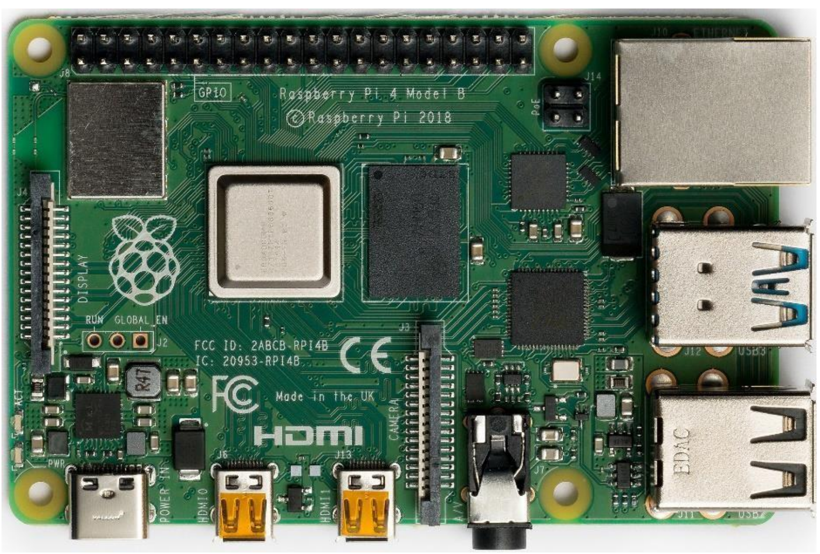
Integration Block (Non-maximum Suppression Block): In this block, a method is used to combine and select the best positions and duplicate detections in the image. This stage determines valid and acceptable roles as a post-processing stage.

Raspberry pi board

The Raspberry Pi 4 Model B was released in June 2019 with a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor,

Other specification of this board are as follow: on-board 802.11ac Wi-Fi, Bluetooth 5, full gigabit Ethernet (throughput not limited), two USB 2.0 ports, two USB 3.0 ports,

1, 2, 4, or 8 GB of RAM, a dual-monitor support via a pair of micro HDMI (HDMI Type D) ports for up to 4K resolution.



Cameras

The Raspberry Pi board is a suitable platform for connecting various cameras, because with the support of LAN protocols as well as USB protocol, network cameras and webcams or USB cameras can be used to receive images as well.

This board has its own CSI protocol called Pi Camera, which supports the special cameras of this

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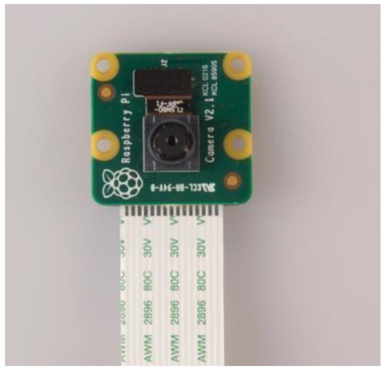
board



The complete Raspberry pi system for testing the drowsiness

Flowchart of the raspberry pi implementation

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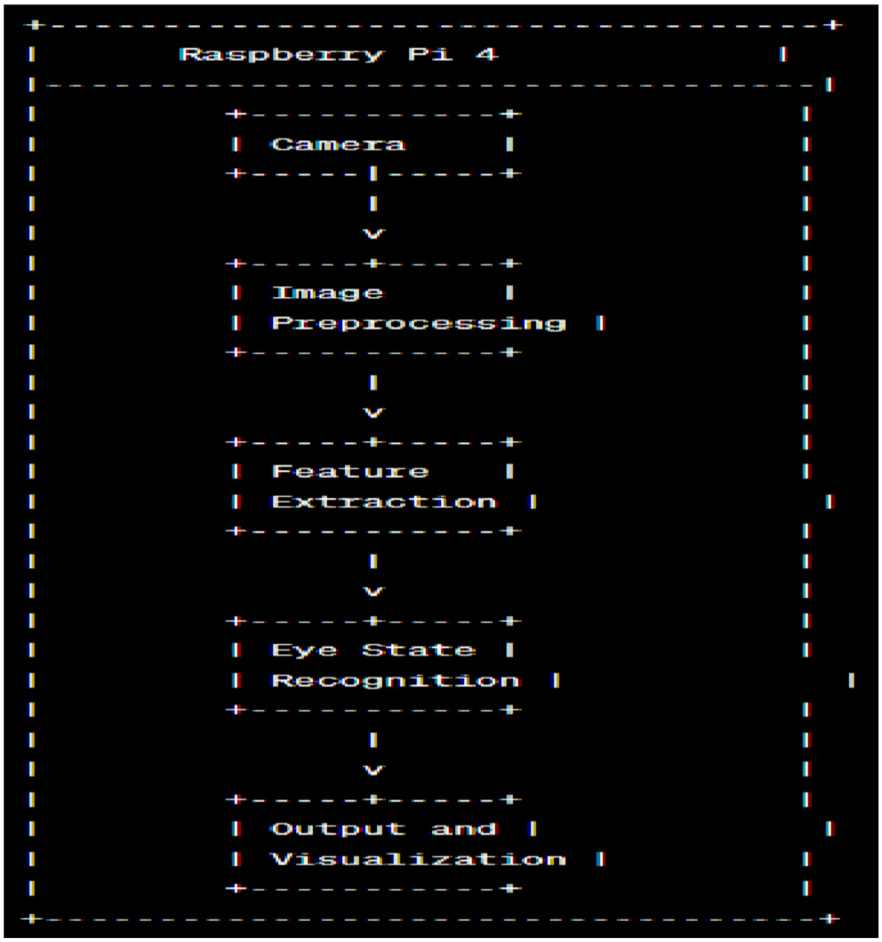
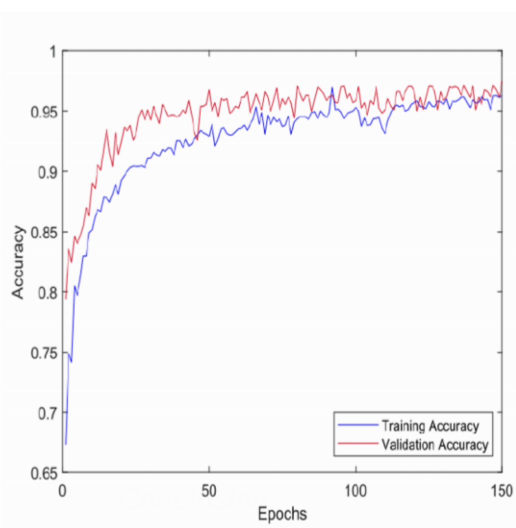
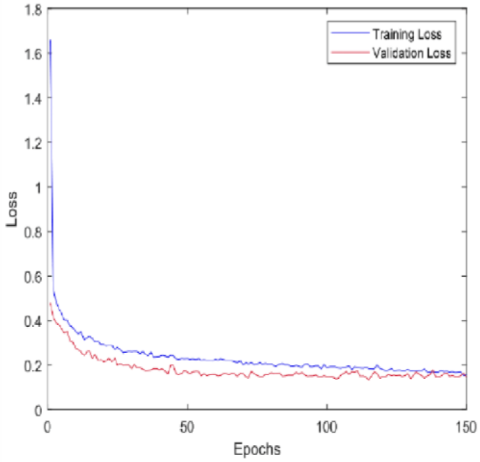


Simulation result



One of the most important factors in traffic accidents is not paying attention to the front due to fatigue and sleepiness. For this purpose, it is very important to design and implement a system to detect drowsiness.



In this thesis, the goal was to implement a system that is accurate enough to detect drowsiness and has a lower cost than similar systems.
In the upcoming project, the implementation of the algorithm is for a drowsiness detection system, and it is tried to implement the most appropriate method among the existing methods with the existing hardware and software platforms.
Accuracy and speed have been the main axis of the project.
Various research efforts have approached the problem of detecting abnormal human driver behavior to examine the driver's front face and vehicle dynamics through computer vision techniques. However, conventional methods cannot capture the complex characteristics of driver behavior.
In this thesis, Raspberry Pi based on YoloV5 architecture is implemented to detect driver drowsiness. A custom YoloV5 pre-trained architecture is proposed for face extraction with the objective of region of interest extraction.
The tests performed on different images at different angles and dimensions, as well as in different light levels during the day and in conditions with and without glasses, show an accuracy of about 95% for the implemented model, which shows its significant potential for applications. It showed practicality in intelligent transportation systems.

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