"Stream Data Processing to guide drivers in a real time environment"

Submitted in partial fulfillment of the requirements

of the degree of

Bachelor of Engineering

in

Computer Engineering

by

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Under the Guidance of:

Prof. Pranita Mahajan

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SIES Graduate School of Technology

2021-22

CERTIFICATE

This is to certify that the project entitled **"Stream Data Processing to guide drivers in a real time environment"** is a bonafide work of the following students, submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering** in **Computer Engineering.**

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PROJECT REPORT APPROVAL

This project report entitled **Stream Data Processing to guide drivers in a real time environment** by following students is approved for the degree of ***Bachelor of Engineering*** in ***Computer Engineering***

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Name of External Examiner: _____

Signature: _____

Name of Internal Examiner: _____

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Date:

Place:

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Harsh Goyal	118A1025	_____
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Signature

Date:

ACKNOWLEDGEMENT

We wish to express our deep sense of gratitude and thank to our Internal Guide, Prof. Pranita Mahajan, for her guidance, help and useful suggestions, which helped in completing our project work in time. We are also extremely grateful to our Project coordinator Prof. Masooda Modak for her guidance provided whenever required. We also thank to our HOD Dr. Aparna Bannore for her support in completing the project. We also thank to our Principal Dr.Atul Kemkar, for extending his support to carry out this project

Also we would like to thank the entire faculty of Computer Engineering Department for their valuable ideas and timely assistance in this project, last but not the least, we would like to thank our teaching and non teaching staff members of our college for their support, in facilitating timely completion of this project.

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CONTENTS

ABSTRACT

With increasing number of vehicles and new drivers on road, the rate of vehicle accidents has considerably increased. There are many reasons that contribute to vehicle accidents such as drowsiness, mechanical failure, missing road signs, missing or skipping signals, abrupt change or drifting lanes, and so on. Multiple studies have confirmed that lane changing or drifting from lanes is one of the major reasons for road accidents. Both novice and experienced drivers are affected by unnoticed drifting of lanes. Novice drivers have lesser control over the car and often don't realize if the car is shifting lanes, while experienced drivers may miss this due to drowsiness. A system is needed in place which would notify the vehicle driver if the vehicle is moving out of their lanes. This would help greatly reduce road accidents and make roads safer for everyone. Current solutions available are expensive and available in only high-end vehicles. The majority of vehicle manufacturers do not add this system to their vehicles to avoid extra costs. In system that can be deployed over and above the current car systems is needed to ensure that all current cars can be equipped with this safety measure. This will help in effectively reducing car accidents due to lane drifting and lane changing.

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LIST OF ABBREVIATIONS

CNN	Convolutional Neural Network
YOLO	You Only Look Once

CHAPTER 1
INTRODUCTION

1.1. Problem

Vehicles are the easiest means of transportation. Every year thousands of new vehicles come on roads and millions of people learn to drive vehicle every year. However, the safety standards of the vehicles are often not up to the mark in cost based market like India. Vehicle manufacturers avoid additional safety measures as it adds on the cost of vehicle. New drivers and sometimes experienced drivers need assistance or notification if they are going to make a mistake which may result in severe outcomes. The rate of vehicle accidents has considerably increased over the years. There are many reasons that contribute to vehicle accidents such as drowsiness, mechanical failure, missing of road signs, missing or skipping traffic signals, abrupt change or drifting lanes, and so on. Many studies have confirmed that lane changing or drifting from lane is one of the major reasons for road accidents. A robust and efficient system should be available if a driver is not able to judge the vehicle drifting due to lack of experience or lack of attention or drowsiness. The existing solutions are expensive and only available in only high-end vehicles. A solution which can be integrated with existing vehicles is needed.

1.2. Motivation

With ever increasing rate in road accidents, it has become necessary to reduce the chances of road accidents. Technology has advanced and has given us a medium to solve our problems effectively. Road lane shifting is one of the major reasons for road accidents and reducing the risk involved with it can help us considerably reduce roads accidents. If a system could alert drivers if the lane is shifting, it can be corrected and the driver can become alert from making any fatal mistake. This can reduce the road accidents to a great extent and make roads much safer for everyone.

1.3. Scope

The project aims to create a low cost and effective solution to avoid road accidents by reducing the possibility of unknown drifting from one lane to another. Also it aims to reduce accidents by detecting traffic signs in advance which will help users to be aware and also avoids the chance of missing road signs and signals. The system would be an easy to use and

will be deployed over and above the current cars. The current solutions are expensive and available only in expensive high-end cars. We will track the current lane, notify if lanes are changed and also would detect and pre-inform the drivers. We also aim to help people with lower night vision to guide them in managing road lanes effectively and also to see road signs and traffic signals. This project can also be a sub-part of automated cars.

1.4. Objectives

The main objective of this project is to leverage the growing technology to reduce road accidents and make roads safer. Our system aims to reduce risk of road accidents by managing two of the most common reasons of road accidents, i.e. missing traffic signals & roads signs and changing and drifting of lanes. By use of machine learning and computer vision, we aim to make roads safer for everyone. The current solutions being expensive aren't accessible to majority of the vehicles. This drives us to make an easily accessible solution which can be deployed on the existing cars, so that majority of cars on road are able to leverage this advantage.

1.5. Outline

The project is divided into following milestones:

1. Literature review and selection of appropriate methods of classification-
   Review of existing solutions and multiple research papers to find their shortcomings and to learn ideal solution for our case.
2. Data collection and preprocessing-
   Collection of data for traffic sign detection and its preprocessing, along with implementation of real-time lane tracking system using computer vision, transformations and curve fittings.
3. Implementation of solution to build model-
   The complete solution is built by implementing the model made using the preprocessed data for real time traffic detection and lane tracking.
4. Evaluation of proposed system-
   The solution is tested under multiple scenarios and evaluated for its efficiency, accuracy, speed and shortcomings.

1.6. **Project Schedule**

Tasks	Start Date	End Date	Duration
Searching domain for BE project	01/08/2021	08/08/2021	7
Finalized 3 ideas	09/08/2021	11/08/2021	2
Research on 3 ideas	12/08/2021	20/08/2021	8
Presentation & Finalization of project idea	21/08/2021	22/08/2021	1
Literature Survey	23/08/2021	24/09/2021	32
Data Collection	25/09/2021	30/09/2021	5
Preprocessing method research	01/10/2021	15/10/2021	14
Finalizing and implementing preprocessing methods	16/10/2021	10/11/2021	25
Research on ideas to detect lane pixels	11/11/2021	21/11/2021	10
Finalization on methods to be used	22/11/2021	25/11/2021	3
Implementing lane-tracking	26/11/2021	24/12/2021	28
Including curvy lanes by using equation	25/12/2021	15/01/2022	21
Model and pipeline creation	16/01/2022	31/01/2022	15
Testing the model	01/02/2022	05/02/2022	4
Searching CNN models for traffic sign detection	06/02/2022	20/02/2022	14
Finalizing YOLO-V3 model and implementing it	21/02/2022	15/03/2022	22
Model creation	16/03/2022	26/03/2022	10
Final testing of both models	27/03/2022	29/03/2022	2

Table 1.1: Project Schedule

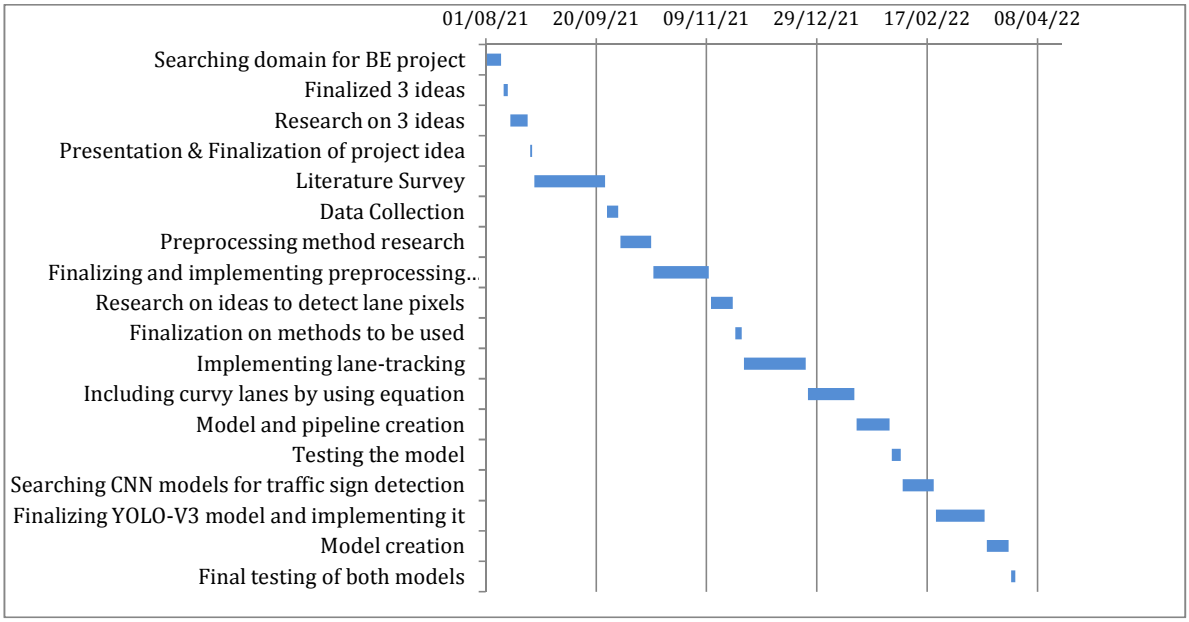

Figure 1.1: Progress Gantt chart

CHAPTER 2

LITERATURE REVIEW

Literature review is one of the most important parts of a project as it helps us understand the relevance of the project in the real world and also the past attempts at implementation. This helps us gain a new perspective towards the project by helping us think in different ways the problem can be approached. It also helps us to analyze the key strengths and shortcomings of the previous attempts. This is very helpful information as it helps to define our methodology and also provides a guiding path towards complete implementation of the project. We reviewed several papers, few of which are mentioned below which were most relevant to our aim and provided us a good framework to devise our methodology.

Sr.No	Title of the Paper	Conference Year	Key Findings	Gaps
1	A Study on Real-Time Detection Method of Lane and Vehicle for Lane Change Assistant System Using Vision System on Highway	Engineering Science and Technology, an International Journal Volume 21, Issue 5, October 2018	Here the researchers have developed a system which utilizes both lane tracking and vehicle detection for effective lane change assistant system.	The paper does not aim to create a full-fledged system and focuses on only lane tracking. Researchers used a different approach.
2	Fast lane detection & tracking based on Hough transform with reduced memory requirement	13th International IEEE Conference on Intelligent Transportation 19-22 Sept. 2010	In this researchers have used, 1D ridge detector to extract lane markings from the image by extracting each row of the image.	Encountered a problem when changing lanes as could not detect curved lines efficiently due to the use of 1D ridge detector.

3	General Road Detection From a Single Image	IEEE Transactions on Image Processing, Institute of Electrical and Electronics Engineers, 2010	This research paper attempts to trace arbitrary roads which may not be well paved or have clearly delineated edges.	It uses Gabor filters because of which it takes too high time for performing features as its dimension of feature vector is very long.
4	A Practical Method of Road Detection for Intelligent Vehicle	2009 IEEE International Conference on Automation and Logistics	Here system detects the preceding vehicles and gives lane change alert using Hough Transformation.	System fails to perform with accuracy in case of curved roads.
5	A Novel Lane Detection System With Efficient Ground Truth Generation	IEEE Transactions on Intelligent Transportation Systems 2012.	In this time slicing is used, which provides the visualization of the captured video and enables generation of ground information.	In absence of markers false lane marker is detected, and it aims to focus more on advanced lane detection.
6	A fast and stable lane detection method based on B-spline curve	2009 IEEE 10th International Conference on Computer-Aided Industrial Design & Conceptual Design	It attempts to trace roads on open uniform B-spline model using edge detection and MDPS method to search control points.	Depends on flatness of the road. When road is not level, algorithm will make a big deviation.

7	Design and Integration of Lane Departure Warning, Adaptive Headlight and Wiper system for Automobile Safety.	2019 4th International Conference on Recent Trends on Electronics, Information, Communication & Technology.	It takes video input frame by frame, filters the frame detects edges using canny edge detection, lane detection is done by Hough transform using OpenCV python software.	Works on different set of problems as part of traffic sign detection is not covered.
8	A Lane Marking Detection and Tracking Algorithm Based on Sub-Regions	Proceedings 2014 International Conference on Informative and Cybernetics for Computational Social Systems.	Here the researchers have developed a system for lane marking detection and tracking method for the Lane Departure Warning system. It can detect both straight and curve lanes.	Processing time for real time video is longer which may lead to lag error in real time user reference.
9	Research on Lane Detection and Tracking Algorithm Based on Improved Hough Transform	2018 IEEE International Conference of Intelligent Robotic and Control Engineering (IRCE)	This paper proposes the use of improved Hough transform to achieve straight-track detection, while for the detection of curved sections, the	System does not adapt to various conditions and works only on lane detection part.

			tracking algorithm is studied.	
10	Based on Digital Image Lane Edge Detection and Tracking under Structure Environment for Autonomous Vehicle	2007 IEEE International Conference on Automation and Logistics	Establish the AOI of the road edge, according to the prediction result of the Kalman filtering; adjust the size of AOI dynamically in order to track the road edge.	It assumes that both the system and observation models equations are both linear, which is not realistic in many real life situations.

Table 2.1: Literature Survey

CHAPTER 3
PROPOSED SYSTEM

After reviewing multiple research papers and existing solutions, we found many shortcomings which were not addressed by the existing solutions. The existing solutions may or may not be completely effective in achieving a smart, low cost and readily available solution. A system which can solve the shortcomings of the existing solution and also provide a holistic and complete solution to the problems is needed to effectively reduce road accidents and to make a greater impact in making roads safer for everyone.

Many of the existing solutions only covered the lane tracking system but did not provide detection of traffic and road signs. This only addresses to one of the issues and one of the other major reasons for road accidents i.e., missing roads signs, is not subjugated. We propose a system which can address both the problems in real time. Some solutions did not work properly in case of curved roads. We worked on improving this as lane detection is even more important on curved roads where many people tend to lose sense of their lanes. Some solutions also were not able to adjust immediately when the lane is changed or did not work properly when lane markers are not present on road. Also, one of the most important features of real time analysis is that the time difference between reading, analyzing and presenting the results must be very less. This was not the case is some of the existing solutions as the time for analyzing is significantly high. This makes a delay between real life environment and the intimations. We intend to make a solution where the time for processing is lesser, which can accommodate the possible real life situations.

The solution implemented by the top car makers are expensive and are available only in high end cars. In a country like India, it is very difficult to own such cars, however if a system can be implemented over and above existing cars, then it can make roads much more safer for everyone with a comparatively insignificant cost. We aim for a solution which can we integrated with existing cars without much difficulty.

By identifying these shortcomings along with the strong points of different solutions, we were able to cumulate a list of features and functionalities intended for our system.

The proposed system will have the following implementations:

- It consists of a smart computer vision system which will track lanes for the driver in a real-time environment.
- The system will also detect and recognize road traffic signals which human eyes might skip in low light.
- The project will be helpful for novice drivers as well as for experienced drivers who might skip some traffic signs or may skip their lanes due to poor lighting or some negligence.
- Thus, our proposed system will make driving on roads safer and prevent accidents at huge scale.

CHAPTER 4
METHODOLOGY

The project consists of two parts:

1. Lane Tracking
2. Road Sign Detection & Recognition

4.1. Methodology for Lane Tracking

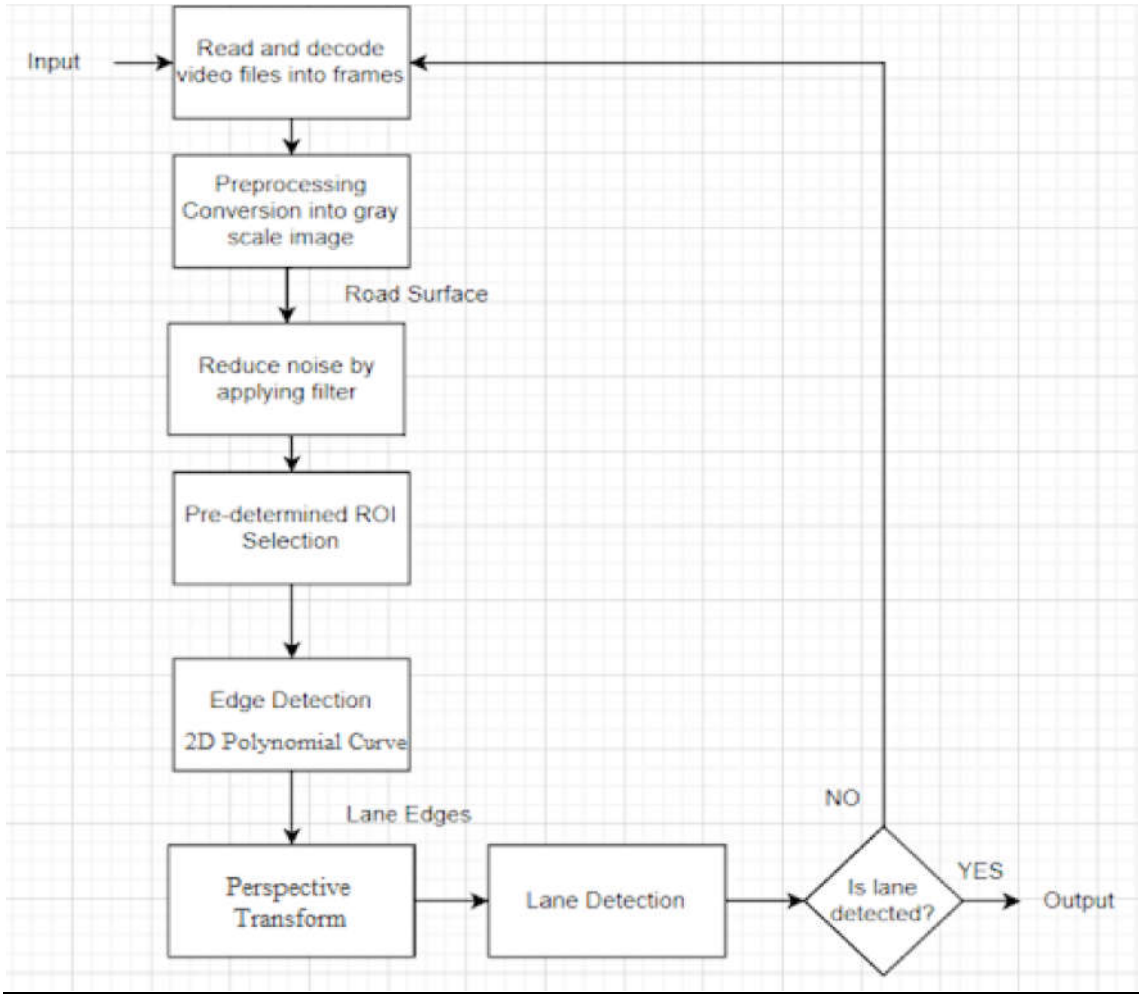

Figure 4.1: Flowchart for Lane Tracking

a. First, we read and decode the input video into frames to pass to our system.
b. After that, we begin with our preprocessing. In this step, we convert the input image into binary image by using thresholding methods. The binary image

needs to be good in order for the pipeline to function properly. If the binary image is bad, it is difficult to get results. For yellow lines (since lane lines tend to be yellow too), we used thresholding in HSV color space.

We then used Sobel kernel to get an estimate of gradients of the lines. The final step in preprocessing includes using morphological closure to fill gaps in binary image.

Figure 4.2: Image after White Mask

Figure 4.3: Image after Yellow Mask

Figure 4.4: Image after Sobel Mask

Figure 4.5: Image after closure

c. We then use Gaussian filter to reduce the noise in our input image.
d. We then convert the input binarized image into a birds-eye view using perspective transform.

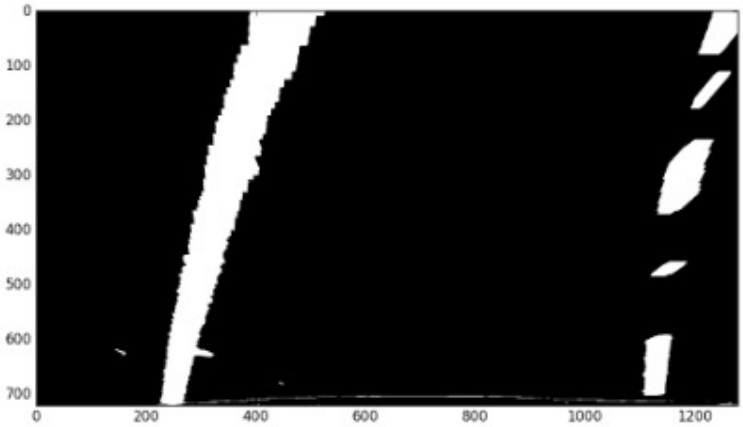

Figure 4.6: Birds Eye View of Binary Image

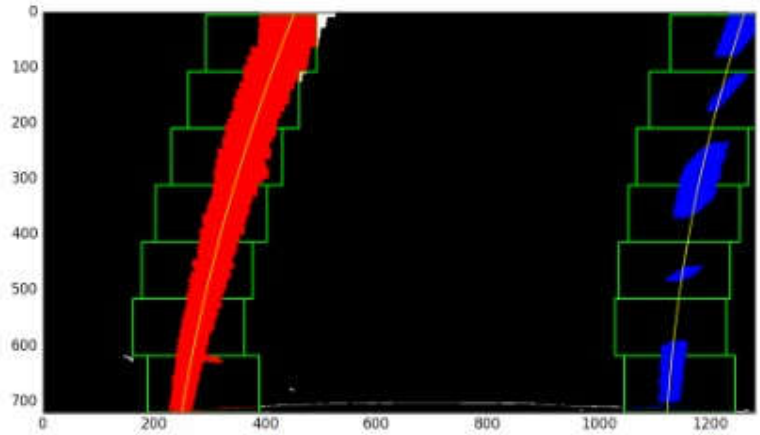

Figure 4.7: Points identified on Bird's eye view

Figure 4.8: Before Perspective Transform

Figure 4.9: After Perspective Transform

e. After that, we create a histogram of our input image and then split the image into two high-intensity peaks using which we determine the points to be plotted

on our input image. For identifying lane line pixels, we need to employ two methods. The first includes a scenario in which we have never identified lane lines on the input frame and need to perform comprehensive search. For this, we start from the bottom of the image and make use of peak locations of histogram we found of the binary image. We then slide two windows from top to bottom deciding which pixels are lane pixels. This was the method used for the first scenario.

For the second scenario, if we have already processed lane lines on the previous frame, we dont need to perform the comprehensive search again. So, we limit the search around the neighboring areas of the previously detected pixels. Using this we save time and processing power. We assume that the lane lines in the next frame are close to the ones in the first frame. The entire processing is done in a pipeline function which contains all the methods. When a detection of lane lines is available on the previous frame, directly the second method can be employed instead of the expensive sliding windows method.

f. After plotting initial points, we use 2-D Curve Fitting to trace the lane and thus track them.
g. After tracking, the lanes are then imposed on the input image and we get the tracked lanes as our final output to be displayed to the driver.
h. The distance of the vehicle from the center of the road is also calculated to guide drivers to steer according to their position on the road. We assume that the dashboard camera of the vehicle is located at the middle of the car for processing this method. We then approximate the offset from the center as the distance between the midpoint at the bottom of the image and the center of the screen (frame).
i. We have also taken into consideration the curved nature of the road. In that case the traditional lane processing we used can be inefficient while giving results. For this, we deploy a 2nd order polynomial equation fitted on each lane line. This helps us to mark curvy lanes too.

4.2. Methodology for Road Traffic Signal Detection

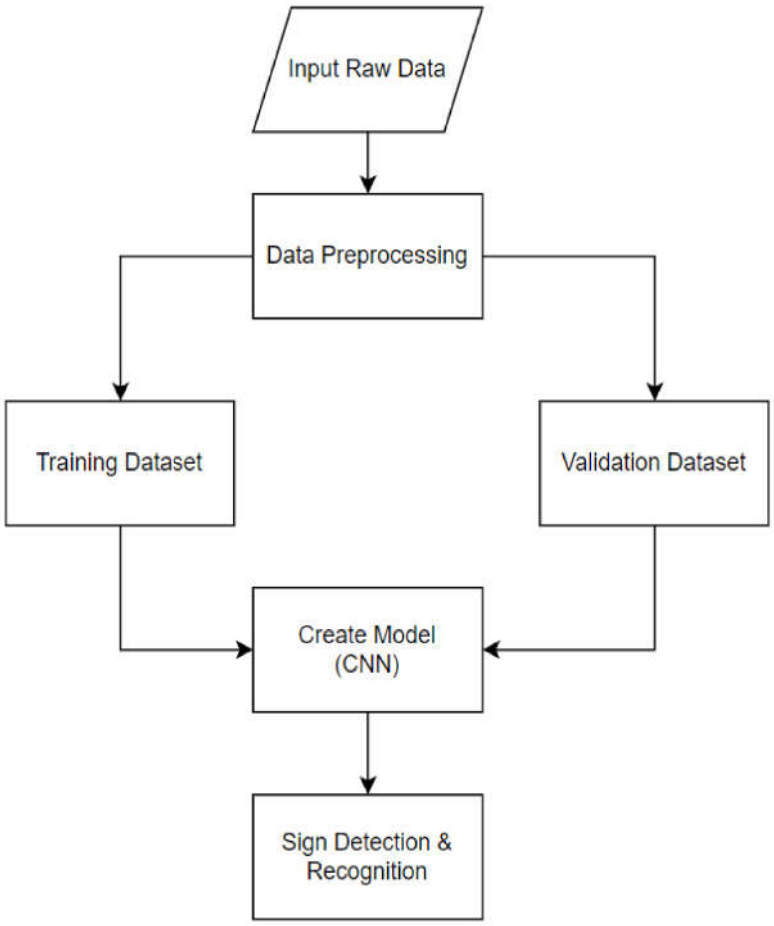

Figure 4.10: Flowchart for Road Sign Detection

a. Similar to the first task, we take as input the video as frames and pass to our system.
b. For training our model, we split the dataset obtained into training and testing set.
c. We then implement a Convolutional Neural Network to create a model for tracking and recognizing road signs.
d. After that, we pass the input frame to our model and the output frame along with the tracked and recognized traffic sign to our driver.

4.3. Software Requirements

- Programming Language: Python
- Libraries: OpenCV, numpy, os, Keras
- Technology: CNN Architecture (YOLO-V3)

4.4. Hardware Requirements

- Dashboard camera for live input of video feed
- Display device to show tracked output.

CHAPTER 5
RESULTS AND DISCUSSIONS

5.1. Results for Lane Detection

Here we can see that the lane in front of the user is being tracked and at the same time, the offset from the center is being represented to the user. This offset is then used to guide the user to steer his/her vehicle accordingly to stay at the center of the road. Image processing is used to achieve this result and quadratic equation is used to track curved lanes. The captured frame is passed through a pipeline of operations which include binarization of the input image, histogram creation and the tracking the white lanes using this intensity of histogram. This system will in turn help novice drivers monitor their lanes and avoid sliding from their lanes which will reduce road accidents.

Figure 5.1: Lane detection output 1

Figure 5.2: Lane detection output 2

Figure 5.3: Lane detection output 3

5.2. Results for Traffic Signal Detection

Here we can see that the signals are tracked in the original frame and accurately recognized by our system. Our system uses a yolo-v3 deep learning architecture for traffic signal detection. Our model accurately detects traffic signals when they enter the frame and also recognizes the type of signal displayed and displays the corresponding output to the user so that any novice driver will not miss

traffic signals which will lead to a decrease in signal jumping and will in turn reduce the probability of road accidents.

Figure 5.4: Traffic Sign Detection Output 1

Figure 5.5: Traffic Sign Detection Output 2

Figure 5.6: Traffic Sign Detection Output 3

Figure 5.7: Traffic Sign Detection Output 4

CHAPTER 6
CONCLUSION AND FUTURE SCOPE

With the ever evolving technology, come many great possibilities. Technology has been solving problems which could never be imagined before. With advancements in computer vision, there are several possible applications which can improve the human life. One such attempt is our project, which tries to make roads safer for both drivers and pedestrians.

Our project solves 2 of the major problem which can cause road accidents, one being unnoticed drifting from one lane to another, which is common with novice drivers; and other being missing of road traffic signals. As per statistics, these are the reasons behind a lot of road accidents and solving this problem becomes necessary.

Our project solves these problems by tracing the road lanes and by intimating the driver about possible drifting. The project also identifies the traffic signal and it indicates the same.

Future Scope

Integration of voice and maps along with this solution can make a comprehensive information system for the cars. This can be a great add on to which can act as a complete solution for vehicle drivers. The project can also be integrated in automation cars as sub-part, where the cars need to track lanes and the traffic signals effectively to avoid accidents. Additionally, proximity sensors can be added, to the current solution which would improve the system by helping it detect nearby cars.

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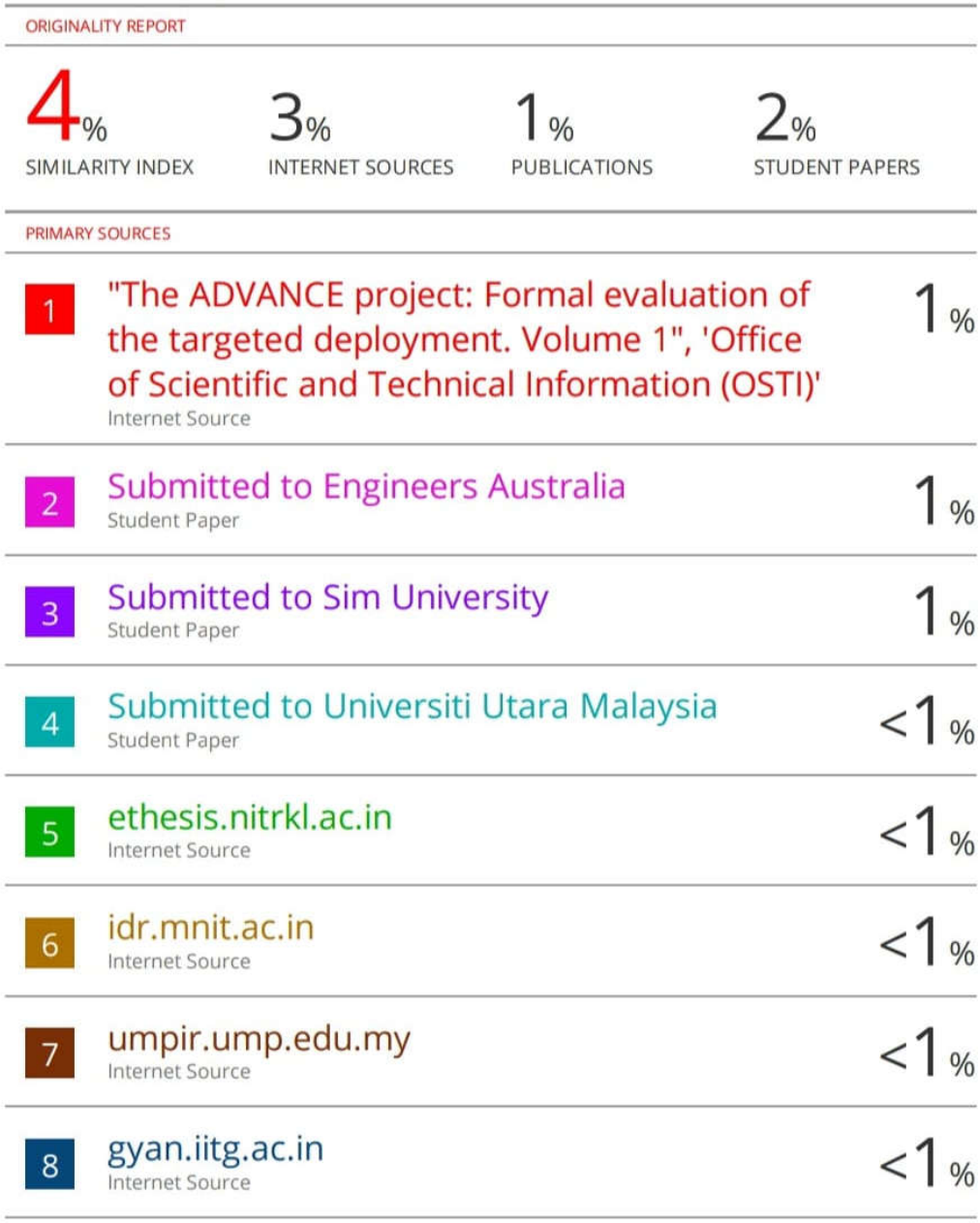
PLAGIARISM REPORT



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PUBLICATION

#567 Stream Data Processing to Guide Drivers in a Real Time Enviornment

With increasing number of vehicles and new drivers on road, the rate of vehicle accidents has considerably increased. There are many reasons that contribute to vehicle accidents such as drowsiness, mechanical failure, missing road signs, missing or skipping signals, abrupt change or drifting lanes, and so on. Multiple studies have confirmed that lane changing or drifting from lanes is one of the major reasons for road accidents. Both novice and experienced drivers are affected by unnoticed drifting of lanes. Novice drivers have lesser control over the car and often don't realize if the car is shifting lanes, while experienced drivers may miss this due to drowsiness. A system is needed in place which would notify the vehicle driver if the vehicle is moving out of their lanes. This would help greatly reduce road accidents and make roads safer for everyone. Current solutions available are expensive and available in only high-end vehicles. The majority of vehicle manufacturers do not add this system to their vehicles to avoid extra costs. A system that can be deployed over and above the current car systems is needed to ensure that all current cars can be equipped with this safety measure. This will help in effectively reducing car accidents due to lane drifting and lane changing.

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Primary Subject Area

Machine Vision

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