VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi - 590018

Mini Project Report

on

"TRAFFIC SIGN DETECTION"

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

in

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

by

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Under the Guidance of

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MITE

Invent Solutions

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

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(*A Unit of Rajalaxmi Education Trust®, Mangalore - 575001*)
Affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Badaga Mijar, Moodabidri-574225, Karnataka

2022-23

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CERTIFICATE

This is to certify that Mr. **PRAJWAL U (4MT20AI026),** Mr. **PRASHANTH (4MT20AI028),** Mr. **PRUTHVIRAJ (4MT20AI030)** has satisfactorily completed the mini project entitled "**TRAFFIC SIGN DETECTION**" for the **DIGITAL IMAGE PROCESSING Laboratory with Mini Project (18AIL67)** lab as prescribed by the VTU for 6th semester B.E. Artificial Intelligence and Machine Learning branch for the academic year 2023 – 2024.

…………………………	…………………………
Signature of the Guide	Signature of the HOD
Mrs. RADHA E G	**Mr.Sunil Kumar**

Name of Examiners	**Signature of the Examiners**
1. ………………………….	**…………………………..**
2. ………………………….	**…………………………..**

ABSTRACT

Traffic sign detection plays a crucial role in intelligent transportation systems, aiding in the safe and efficient movement of vehicles on roads. In recent years, advancements in computer vision and deep learning techniques have significantly improved the accuracy and speed of traffic sign detection systems. This project presents a comprehensive study on traffic sign detection using a deep learning approach. The proposed system employs convolutional neural networks (CNNs) to automatically recognize and classify traffic signs from images or video streams captured by onboard cameras or traffic surveillance systems. The project focuses on the development and evaluation of a robust and efficient deep learning model for real-time traffic sign detection. The key steps of the project involve data collection, preprocessing, model training, and inference. A diverse dataset comprising various traffic signs is gathered and carefully annotated for training and testing purposes. Image preprocessing techniques are applied to enhance the quality and reduce noise in the input data. To train the traffic sign detection model, a CNN architecture is designed and optimized to achieve high accuracy and efficiency. The model undergoes an iterative training process using annotated images, where the network learns to extract discriminative features and classify different types of traffic signs. Transfer learning techniques are also explored to leverage pre-trained models for improved performance. The trained model is then evaluated using a separate test dataset to measure its detection accuracy, precision, recall, and computational speed. The evaluation results are analyzed, and potential areas of improvement are identified and addressed. The project also explores practical applications of the developed traffic sign detection system, such as integrating it into autonomous vehicles, traffic monitoring systems, and driver assistance systems. The system's performance is evaluated in real-world scenarios, considering factors like varying lighting conditions, weather conditions, and occlusions. The experimental results demonstrate the effectiveness and reliability of the proposed deep learning-based traffic sign detection system. The project contributes to the advancement of intelligent transportation systems, enhancing road safety and optimizing traffic flow by accurately and efficiently detecting traffic signs.

… **ACKNOWLEDGEMENT**

The successful completion of any significant task is the outcome of an invaluable aggregate combination of different people in radial direction explicitly and implicitly. We would therefore take the opportunity to thank and express our gratitude to all those without whom the completion of the project would not be possible.

We express our thanks to **Ms.Radha E G , Assistant Professor,** Department of Artificial Intelligence and Machine Learning for having provided all the facilities that helped us in timely completion of this report.

We express our sincere gratitude to **Mr. Sunil Kumar, Associate Professor, Head of the Department, Artificial Intelligence and Machine Learning** for her support and guidance.

We would like to thank **Professor Prashanth C M, Principal, Mangalore Institute of Technology and Engineering, Moodabidri** for his support and encouragement.

I express my sincere gratitude to our institution and management for providing us with good infrastructure, laboratory facilities, qualified and inspiring staff, and whose guidance was of immense help in completing this seminar successfully.

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Chapter 1

INTRODUCTION

The World Health Organization (WHO) in 2013 reported that road traffic accidents that result in loss of lives and damages to properties will continue to become a global challenge due to rapid motorization and insufficient action of national governments. The goal of this project is to help solve the problem of drivers neglect and lack of road education. Traffic signs defined by the Department of Public Works and Highways to be recognized must be strategically positioned, clear and fully visible and captured in good weather conditions during daytime.

1.1 Problem Statement

Nowadays, with the rapid development of society and economy, automobiles have become almost one of the convenient modes of transport for every household. Traffic signs occupy an important position in the road traffic system. The main function of the traffic signs is to display the contents that need to be noticed in the current road section, to warn the driver to drive at the prescribed speed, to provide a favorable guarantee for safe driving and also to prevent the road accidents. This study implements a traffic sign detection and recognition system using Python.

1.2 Objective

The main aim is to detect and recognize the road traffic signs then provides information to the driver about the meaning of the signs by using a powerful neural network approach called Convolutional Neural Networks (CNN) which acts as a powerful tool to classify and recognize the traffic signs. Convolutional Neural Network for the recognition stage not only provided the best trade-off between classification accuracy (93.97%).

Chapter 2

REQUIREMENT ANALYSIS AND SPECIFICATION

2.1 Functional Requirements

The System Requirement Specification (SRS) is a document, which describes completely the external behavior of the software as well as the behavior of the hardware. The first and foremost work of the developer is to study the system to be developed and specify the user requirements before going for the designing phase.

It includes a set of use cases that describes all the interaction the users will have with software. Use cases are also known as functional requirements. In addition to use cases, the SRS also contains non-functional requirements. Non-functional requirements are requirements, which impose constraints on the design or implementation.

The functional Requirements are broadly classified into 2 categories :

- Hardware Requirements
- Software Requirements

Hardware Specifications:

Processor	: Intel i3/i5, 1.8 GHz machine or above
Main Memory	: 4GB RAM or above
Hard disk	: 1TB or above

Software Specifications:

Operating system: Windows 7 and above

Programming Language : Python

Platform Used : Anaconda, jupyter, Visual Studio

2.2 Non-Functional Requirements:

Non-functional requirements are requirements that are not directly concerned with the specific functions delivered by the system. The plan for implementing functional requirements is detailed in the system design. The plan for implementing non-functional requirements is detailed in the system architecture. Non-functional requirements are often called qualities of a system. Other terms for non- functional requirements are "constraints", "quality attributes", "quality goals", "quality of service requirements" and "non-behavioral requirements".

Reliability

- Technology: The choice of technology used for traffic sign detection can impact reliability. Systems can rely on computer vision algorithms, machine learning, or a combination of both. More advanced algorithms and machine learning models tend to offer improved accuracy and reliability compared to simpler methods
- Accuracy and False Positives: The reliability of a traffic sign detection system is typically evaluated based on its accuracy in correctly detecting signs and avoiding false positives. High accuracy and a low false positive rate contribute to the system's overall reliability

Consistency

- Handling occlusions: Traffic signs can sometimes be partially obstructed by objects such as trees, buildings, or other vehicles. A consistent detection system should be able to handle such occlusions and still recognize the signs accurately.
- Robustness to environmental conditions: A reliable traffic sign detection system should be able to perform consistently in different lighting conditions (e.g., day and night), weather conditions (e.g., rain, fog), and various road surfaces.

Performance:

- Accuracy: The accuracy of traffic sign detection refers to how well the system can correctly identify and localize traffic signs in an image or video stream. High-performing systems can achieve accuracy rates above 90%, meaning they can accurately detect and classify the majority of traffic signs present in the scene.
- Recall and precision: Traffic sign detection systems are often evaluated based on metrics like recall and precision.

Security:

- Sensor Security: Traffic sign detection systems rely on various sensors, such as cameras, lidar, or radar, to capture and analyze the traffic signs. Ensuring the security of these sensors is crucial to prevent unauthorized access.
- Data Integrity: Traffic sign detection algorithms analyze sensor data to identify and interpret traffic signs. Ensuring the integrity of this data is essential to avoid misleading or maliciously manipulated results.

Chapter 3

SYSTEM DESIGN

System Design process partitions the system into subsystems based on the requirements. It establishes overall system architecture and is concerned with identifying various components, specifying relationships among components, specifying software structure, maintaining a record of design decisions and providing a blueprint for the implementation phase. Design consists of architecture design and detailed design is concerned with the details of how to package processing modules and how to implement the processing algorithms, data structures and interconnections among modules and data structures.

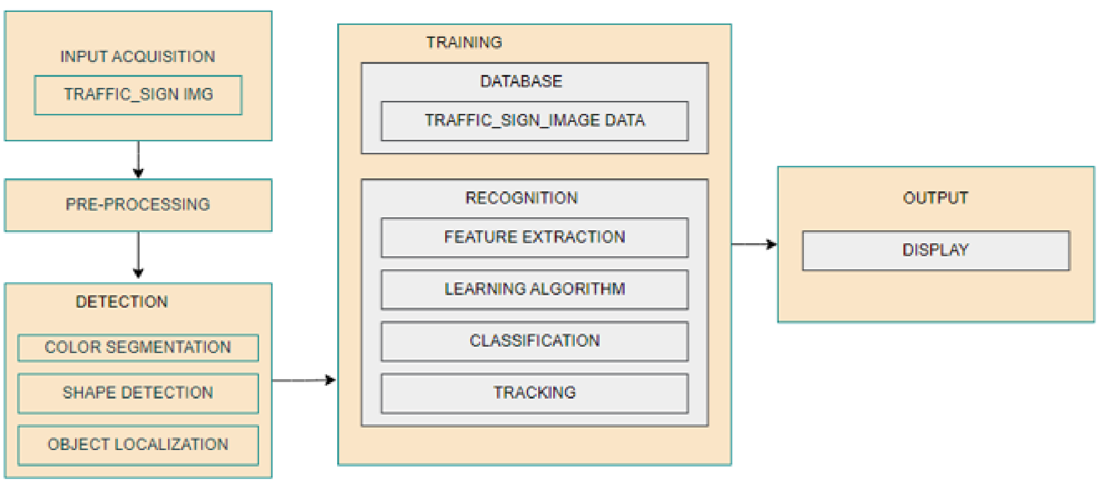

Figure 3.1 Overview Methodology

- **Data Acquisition:** Input traffic data will be acquired by the system using a camera interfaced to the microcomputer. Videos taken will be processed per frame by the system. Some testing processes will make use of traffic images to be stored in the microcomputer.
- **Pre-processing and Detection:** The detection phase is composed of pre-processing, color-based segmentation, shape-based detection and object localization. Methods to be evaluated that use different filtering techniques in different color spaces are RGB Normalized Thresholding with Color Constancy Algorithm.

Chapter 4

TESTING

In the context of traffic sign detection, testing refers to the process of evaluating the performance of a traffic sign detection system or algorithm using appropriate datasets and evaluation metrics. The goal of testing is to assess how well the system or algorithm can accurately detect and classify traffic signs in real-world scenarios.

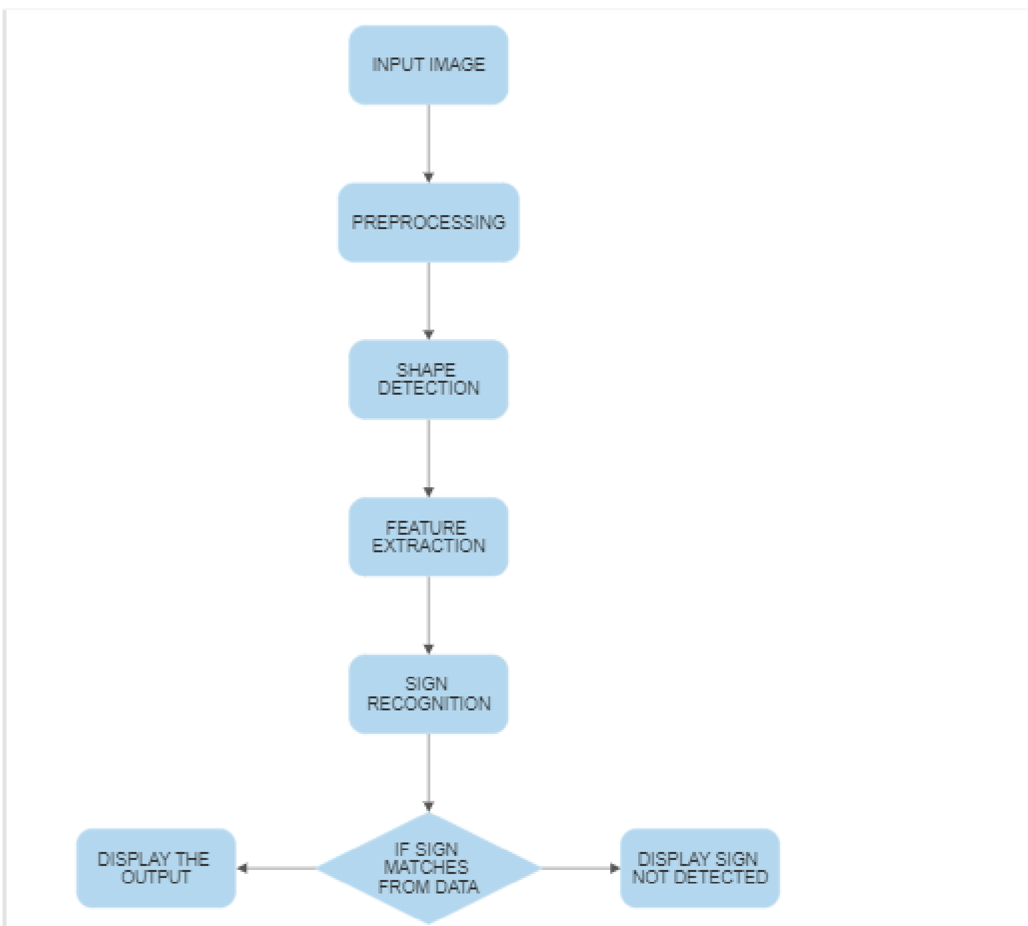

Figure 4.1 Flowchart

- **Input Image:** The input image refers to the image or frame from a traffic scene that is being processed by a traffic sign detection system or algorithm. The input image serves as the primary input data for the detection process.
- **Preprocessing :** Preprocess the dataset if necessary. This may involve resizing images, normalizing pixel values, or applying other transformations to ensure consistency and optimal input for the detection algorithm.
- **Feature Extraction :** Feature extraction in traffic sign detection refers to the process of extracting relevant and discriminative features from the input images or video frames that can be used to distinguish and classify traffic signs. It involves transforming the raw pixel data into a set of meaningful representations that capture the distinctive characteristics.

Software testing is the process used to identify the correctness, security, completeness, and quality of developed computer software. This includes the process of executing the program or applications with the intent of finding errors. An individual unit, functions or procedures of a developed project is verified and validated, and these units are fit for use.

4.1 Testing process

Best testing process is to test each subsystem separately, as we have done in the project. Best done during implementation. Best done after small sub-steps of the implementation rather than large chunks. Once each lowest level unit has been tested, units are combined with related units and retested in combination. This proceeds hierarchically bottom-up until the entire system is tested as a whole. Typical levels of testing:

- Module- package, abstract data type, class
- Sub-system- collection of related modules, cluster of classes, method-message paths
- Acceptance testing- whole system with real data (involve customer, user, etc) Alpha testing is acceptance testing with a single client (common for bespoke systems).

4.1.1 Unit testing

Unit testing is the process of testing individual software components units or modules. Since it needs the detailed knowledge of the internal program design and code this task is done by the programmer and not by testers.

4.1.2 Integration Testing

Integration testing is another aspect of testing that is generally done in order to uncover errors associated with the flow of data across interfaces. The unit-tested modules are grouped together and tested in small segments, which makes it easier to isolate and correct errors. This approach is continued until we have integrated all modules to form the system as a whole. After the completion of each module, it has been combined with the remaining module to ensure that the project is working properly as expected.

4.1.3 System Testing

System testing tests a completely integrated system to verify that it meets its requirements. After the completion of the entire module, they are combined together to test whether the entire project is working properly.

4.2 Test Cases

A Test Case is a software testing document, which consists of events, action, input, output, expected result and actual result. Technically a test case includes test description, procedure, expected result and remarks. Test cases should be based primarily on the software requirements and developed to verify correct functionality and to establish conditions that reveal potential errors.

Test Case No.	Action	Inputs	Expected Output	Actual Output	Status
1.	Launch Application in localhost	localhost/Traffic Sign Classification/	Homepage	Homepage	Pass
2.	Upload Image	Traffic Sign Image	Uploaded image displayed	Uploaded image displayed	Pass
3.	Predict Traffic Sign	Image	Traffic Sign Prediction	Traffic Sign Prediction	Pass

Table 4.2 Test case for various inputs.

Table 4.2 Represents the test case for various actions.

Chapter 5

RESULT & DISCUSSION

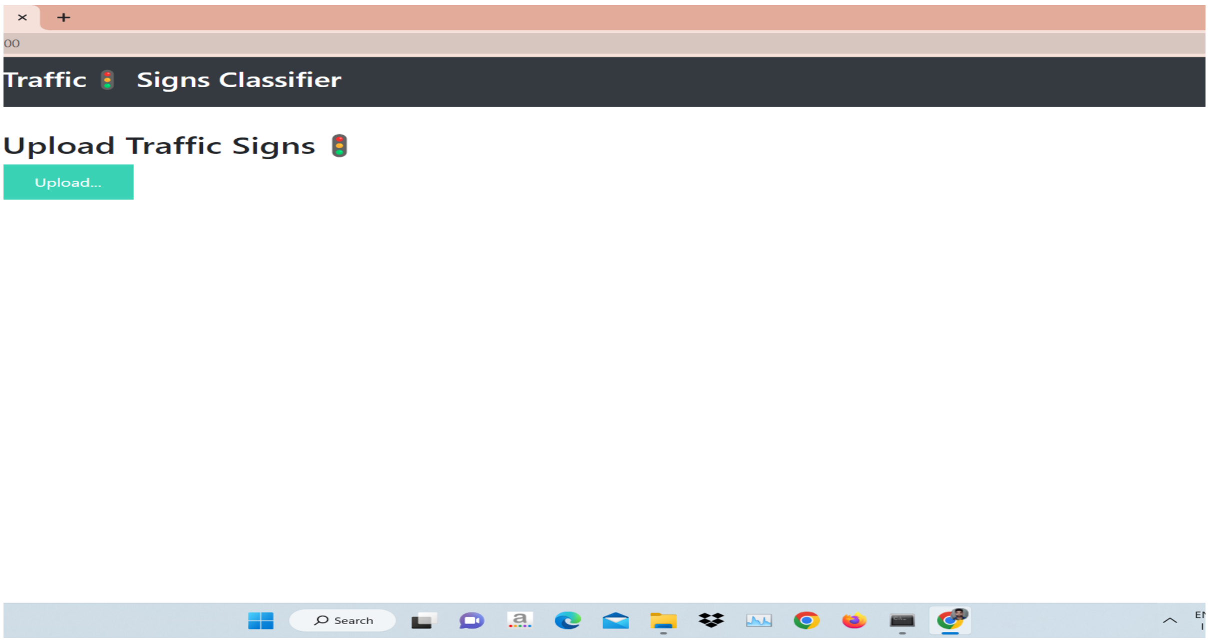

Figure 5.1 Screenshot of Homepage

Figure 5.1 Indicates the home page. This contains an Upload Button, through which you can upload images of traffic signs.

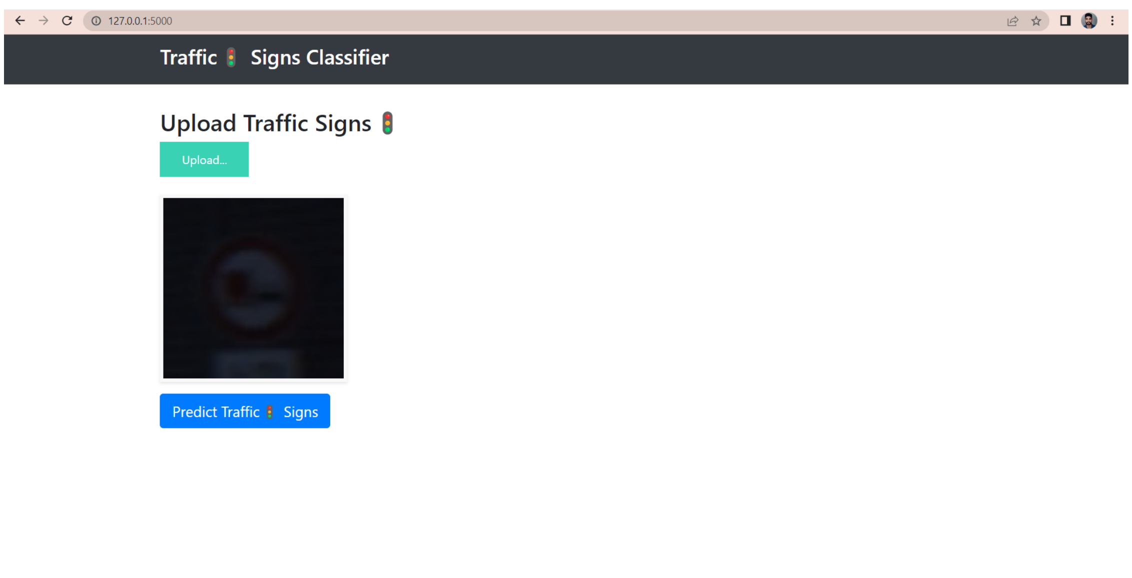

Figure 5.2 Screenshot of Uploaded Image

Figure 5.2 Indicates the uploaded image is displayed on screen providing Predict Traffic Sign Button to predict the Signs.

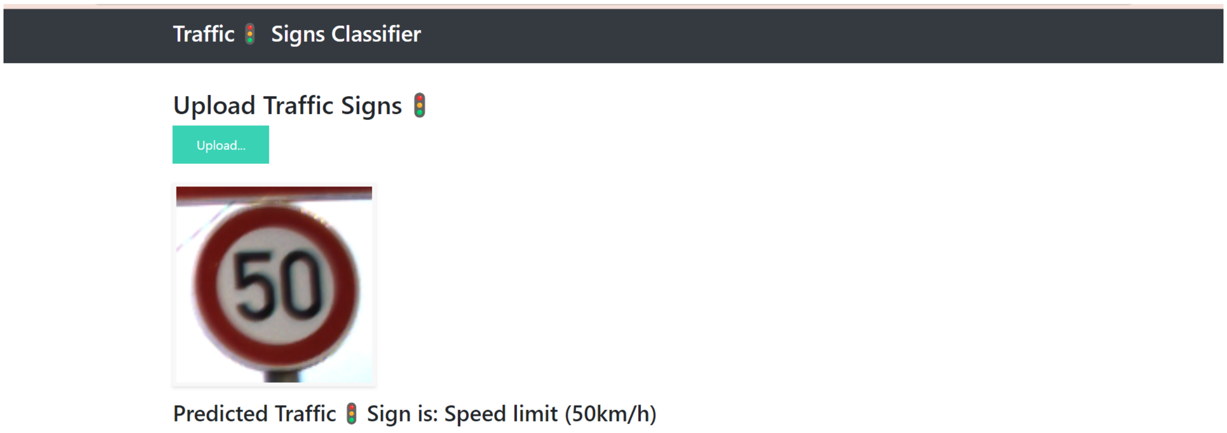

Figure 5.3 Screenshot of Prediction

Figure 5.3 Indicates the Prediction of an uploaded image.Uploaded image is Speed limit (50km/h) and predicted as same.

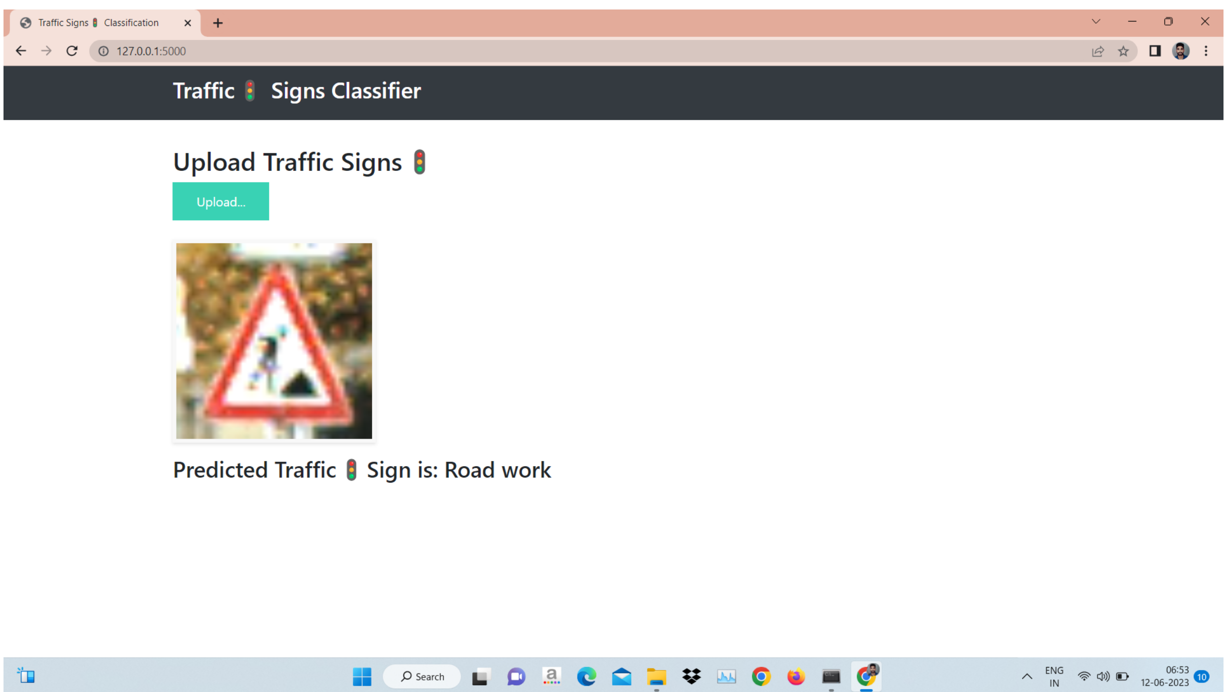

Figure 5.4 Screenshot of Prediction

Figure 5.4 On successful prediction of another uploaded image.

Chapter 6

CONCLUSION

Among the four evaluated pre-processing and detection methods, Shadow and Highlight Invariant method provided the best trade-off between segmentation success rate and processing time due to the less complex image filtering approach. Convolutional Neural Network classifier has the best performance in both accuracy and processing speed among the other algorithms for traffic sign recognition due to the optimization method of the loss function using back propagation and the in-system feature extraction method of the algorithm. In classification, additional class to contain the not targeted traffic signs provides improvement of false detection performance.

FUTURE SCOPE :

- Integration in Autonomous Vehicle
- Integration with Traffic Management System
- Advanced Driver Assistance System(ADAS)
- Pedestrian Safety

Chapter 7

REFERENCES

- KAGGLE DATASET:
  https://www.kaggle.com/datasets/meowmeowmeowmeowmeow/gtsrb-german-traffic-sign/code?select=Train.csv

- PYTHON:
  https://docs.python.org/3/library/

- Feng, "Evaluation of color segmentation algorithms in red color of traffic sign detection", M.S. Thesis, Department of Computer Engineering, Högskolan Dalarna, 2010.

- CNN MODEL(AlexNet):
  https://medium.com/swlh/alexnet-with-tensorflow-46f366559ce8

- Flask:
  https://flask.palletsprojects.com/en/2.3.x/