VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JnanaSangama, Belgaum-590018, Karnataka, India

A Project Report on

"Computer Vision and OBD2 Based Driver Assistance and Monitoring System"

in

ELECTRONICS AND COMMUNICATION ENGINEERING

By

1. **Mukul S Prabhu**
2. **Madhur Tripathi**
3. **Juwairiyah Tabassum**
4. **Prarthana Shenvi**

UNDER THE GUIDANCE OF

"Dr. Arun Tigadi"

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

K. L. E. Dr. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY
BELAGAVI– 590008

(2020-21)

K. L. E. Dr. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY
BELGAVI– 590008

Department of Electronics and Communication Engineering

CERTIFICATE

Certified that the Project work entitled **“Computer Vision and OBD2 Based Driver Assistance and Monitoring System”,** is carried out by **Mukul S Prabhu (2KL17EC056), Prarthana P Shenvi (2KL17EC059), Juwairiyah Tabassum(2KL17EC037), Madhur Tripathi (2KL17EC042)** are bonafide students of **Department of Electronics and Communication Engineering, K. L. E. Dr. M. S. Sheshgiri College of Engineering and Technology, Belagavi,** in partial fulfillment for the award of **Bachelor of Engineering** in Electronics and Communication of the **Visvesvaraya Technological University, Belagavi,** during the year **2019-20.** It is certified that all corrections/suggestions indicated have been incorporated in the report and has been approved as it satisfies the academic requirements in respect to **Project** prescribed for the said degree.

Project Coordinator **Guide**

HOD **Principal**

Vision and Mission of the Department of Electronics and Communication Engineering are:

VISION

To be the center of excellence for education and research in Electronics and Communication Engineering

MISSION

1. To achieve academic excellence by encouraging active student-teacher relations.
2. To groom students with high moral and ethical standards.
3. To promote socially-relevant research and development activities.
4. To collaborate with institutions and industries for knowledge sharing, employability and entrepreneurship.
5. To encourage life-long learning in developing innovative products and services.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The educational objectives of the undergraduate program in Electronics and Communication Engineering are:

1. To impact the knowledge and skills to meet the needs of current and emerging technologies in Electronics and Communication Engineering.
2. To enable active pursuance of life-long study in Electronics and Communication Engineering in order to develop innovative technologies for quality products and services.
3. To cultivate the ethical and socially relevant research and development activities.
4. To impact effective communication skills for success in interdisciplinary and multicultural teams.

Program Outcomes: (POs)

1 **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.**Problem Analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.**Design/development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.**Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.**Modern Tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:(PSOs)

1. Demonstrate theoretical and practical knowledge of Electronic and Communication Engineering.
2. Exhibit the technical and soft skills leading to employability.
3. Actively pursue lifelong learning to develop innovative products and services.

K. L. E. Dr. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY

Department of Electronics & Communication Engineering

Project Group No:

Student Name:	USN:	Signature:
Mukul S Prabhu	2KL17EC056	
Prarthana P Shenvi	2KL17EC059	
Juwairiyah Tabassum	2KL17EC037	
Madhur Tripathi	2KL17EC042	
Guide		
DR. Arun S Tigadi		

Mapping of Program Outcomes(POs):

Project Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Computer Vision and OBD2 Based Driver Assistance and Monitoring System												

Mapping of Program Specific Outcomes (PSOs):

Project Title	PSO1	PSO2	PSO3
Computer Vision and OBD2 Based Driver Assistance and Monitoring System			

TABLE OF CONTENTS

1. Abstract

The increasing number of vehicles on the road in contrast with the workforce of Traffic management authorities has made monitoring a challenging task; any compromises might prove to be hazardous. Simultaneously, for a driver of the vehicle, keeping track of the numerous other vehicles, traffic signs, and signals, and various vehicle parameters is tiresome. The solution is a Computer vision and OBD2 based system which can be installed on a vehicle, which would not only be making it self-monitoring but also would assist the driver, thereby bridging the gap between Autonomous vehicles and Human-driven vehicles all while promoting responsible behavior on road even in zones with minimal monitoring.

2. <u>Acknowledgments</u>

This project consumed a huge amount of work, training on necessary technology and dedication. The project would not have been possible without the support of many individuals and organizations for their incredible knowledge. Therefore, we would like to extend our sincere gratitude to all of them. In particular, we would like to take this opportunity to express our honor, respect and deep gratitude to the staff of the **Electronics & Communication** department of **KLE Dr. M.S. Sheshgiri College Of Engineering and Technology, Belagavi** for providing us all the guidance required for completion of the project.

We sincerely would like to thank our guide **Prof. Dr. Arun Tigadi** for guiding us throughout this internship and we would also like to thank our **HOD Dr. Rajashri Khanai** for giving an opportunity for the completion of this project work and giving us a platform to showcase it.

Our sincere thanks to **Dr. Basavaraj Katageri Principal of KLE Dr. M.S. Sheshgiri College Of Engineering and Technology** who has given us the opportunity for completion of this project. Last but not the least we would like to thank all the people who have directly or indirectly helped us in making this project a success.

3. List of figures

4. List of Tables

5. <u>List of Abbreviations</u>

- YOLO- You Only Look Once
- OBD- On Board Diagnostics
- ECU- Electronic Control Unit
- ALDL-Assembly Line Diagnostic Link
- R-CNN-Region Based Convolutional Neural Networks
- API-Application Programming Interface

6. Introduction

Traffic signs are specially designed graphics which give instructions and information to drivers. Many accidents take place when drivers miss signs due to distractions or psychological state of drivers. Although different countries' traffic signs vary somewhat in appearance, they share some common design principles. The current process to determine whether the driver follows traffic rules is expensive. Automated recognition of traffic signs is an important topic for autonomous navigation systems. Such a system has to be fast and efficient to detect traffic signs in real-time context and identify them precisely. Moreover, they have to handle complex problems which can hinder detection and recognition effectiveness. Traffic signs are divided according to function into different categories, in which each particular sign has the same generic appearance but differs in detail. This allows traffic sign recognition to be carried out as a two-phase task: detection and classification. The detection step focuses on localizing candidates for a certain traffic sign category, typically by placing a bounding box around regions believed to contain such a traffic sign. Using the YOLO algorithm, object detection can be achieved. Classification then examines these regions to determine which specific kind of sign is present. Then comes the tracking step wherein, through the OBD2 port, real time status of the subsystems is accessed and data collected through this gets logged into a file. Thus ensuring the driver abides by the rules.

7. Literature Survey

Over the years, traffic sign detection and recognition systems have brought more value to driver assistance when driving, leading to more user-friendly driving experience and much improved safety for passengers. Some of the common challenges faced by the drivers include involvement in a variety of traffic conditions, keeping track of multiple things like other vehicles, lanes, traffic signs etc. leading to losing track of certain rules to be adhered to, resulting in traffic violations or at times even accidents.

The first research on traffic sign recognition can be traced back to 1987; Akatsuka and Imai attempted to make an early traffic sign recognition system. A system capable of automatically recognizing traffic signs could be used as assistance for drivers, alerting them about the presence of some specific sign (e.g. a one-way street) or some risky situation (e.g. driving at a higher speed than the maximum speed allowed). Generally, the procedure of a traffic sign recognition system can be roughly divided into two stages namely Detection and Classification.

YOLO is simple and efficient. It employs a single convolution neural network to predict bounding boxes and probabilities of predicted class of objects. This unified approach has several advantages over the conventional object detection system. YOLO is faster and achieves double the mean average accuracy than the other architectures. YOLO learns how to generalize the representations of various objects, which shows its versatility to newer applications.

After 1960 there was a rapid increase in the number of vehicles in the US. Hence the problem of air pollution arises. To control the air pollution in 1963 congress government passed the Clean Air act. That time several implementations took place to interface the vehicles ECU for control and monitor engine by-product's. The best example is General Motors; they use Assembly Line Diagnostic Link (ALDL). This was the previous version of OBD I.

7.1 Detection

This step aims to detect the precise location i.e. the Regions of Interest (RoI) of the Traffic Signs and verify the hypotheses on the sign's presence. Based on the "Literature for object detection techniques for detecting traffic signs", Histogram of Oriented Gradients (HOG) combined with linear support vector machine and You Only Look Once (YOLO) were selected for illustration in order to find out detection accuracy and processing speed of the algorithm.

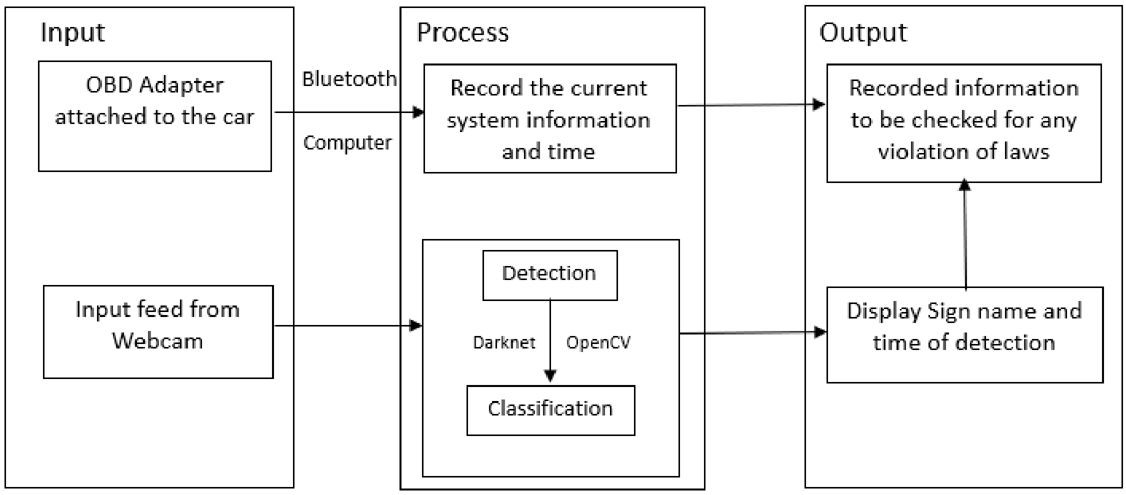
HOG calculates gradients over the image cells using sliding window fashion. Although there exist few feature-based methods such as SIFT, SURF which are powerful and better at detection of region of interest, their computation is very complex making them unrealizable for real time applications.The YOLO algorithm proves to be faster than neural network-based methods like R-CNN and Fast R-CNN while maintaining good detection accuracy.

7.2 Classification

Once the candidate traffic sign regions have been detected, a classification step is performed to make the decision, whether to consider or reject a candidate region of traffic sign. Another group of works has based their identification process on Traffic Signs (TS) model where the TS region is compared to a set of TSs Template Exemplars (models) labeled with discrete class in order to find out the most similar TS class. To perform TSs matching, some comparison metrics are used like the normalized correlation between the templates stored in the database and the potential TS regions.

To ensure follow up on the rules, On Board Diagnosis-II (OBD-II) scanners have been introduced to use a vehicle network (OBD-II) for the diagnosis and checking of a vehicle, which has previously used many devices. OBD system, or called OBD-II, was proposed in 1996 to replace the deficient former system, namely OBD-I. The specifications of OBD-II were recognized by the Environmental Protection Agency (EPA), US, and California Air Resources Board for air-pollution control. Since 1996, all vehicles are required to be equipped with OBD-II under EPA regulation in the USA.

8. Methodology



Traffic Sign Recognition: The recognition of traffic signs is mainly performed using three steps: Detection, Classification and Tracking. The detection step seeks to reduce the search space and indicate only potential regions which could be recognized as possible traffic signs. In the classification step, each of the already detected candidate regions are filtered to decide whether they are a traffic sign or not. As for tracking steps, it helps to reduce the time processing of traffic signs while keeping a continuous focus on the classified traffic sign. Video input will be taken from the web camera. Object detection is a computer vision technique in which a software system can detect, locate, and trace the object from a given image or video. To implement this, we are going to use TensorFlow and OpenCV library functions.

TensorFlow is an open-source library for numerical computation and large-scale machine learning that eases the process of acquiring data, training models, serving predictions, and refining future results. We will be using the TensorFlow Object Detection API which is an open-source framework built on top of TensorFlow that makes it easy to construct, train and deploy object detection models and implement using the YOLO (You Only Look Once) object detection algorithm. Data sets provided by Google open images data set V6 will be used to train and test our model. To detect objects in live video feed we are going to use OpenCV and the camera Module to use the live feed of the webcam to detect objects. The names of the recognised traffic signs will be logged to a file along with the time of its detection for further use. Apart from this we will also be using INI - German Traffic Sign Benchmark dataset. Vehicle Information: For the second part of the project, we will be requiring the current data of the vehicle. We will be acquiring this through the use of the On-Board Diagnostics port also known as "OBD2". On-Board Diagnostics is an automotive term referring to a vehicle's selfdiagnostics and reporting capability. OBD systems give access to the status of the various vehicle subsystems. Modern OBD implementations use a standardized digital communications port to provide real-time data in addition to a standardized series of Diagnostic Trouble Codes, or DTCs, which allows to rapidly identify and remedy malfunctions within the vehicle. Using a Bluetooth enabled OBD2 scanner and connecting to a PC we can access data such as the current speed, check engine light, fuel system status and much more. This data will be logged into a file for further uses, like ensuring adherence to traffic rules. And also log in any unethical behaviour thereby get a step closer to achieving Road Safety Standards.

9. Implementation

For the implementation of Computer Vision and OBD2 Based Driver Assistance and Monitoring System, the components utilized were-

Darknet

Darknet is an open source neural network framework. It is a fast and highly accurate framework for real time object detection. Although the accuracy for custom trained models depends on training data, epochs, batch size and various other factors. The most important reason behind it being fast is that it is written in C and CUDA. Originally, the YOLO algorithm was implemented in the DarkNet framework by Joseph Redmon. It is fast, easy to install, and supports both CPU and GPU computations. You can find the open source on GitHub.

Dash Cam

A Dash cam is an image capturing device or camera, as called in layman's language. A car dashboard is compact, and it can be easily fitted on the dashboard of the car or the windscreen. Dashboard camera records everything in front of the car. Some high-end dash cams even capture the rearview with the help of a rear-facing lens. In other words, a dash cam acts as a 'silent witness'.

Open CV

Open Source Computer Vision Library is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms.

Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

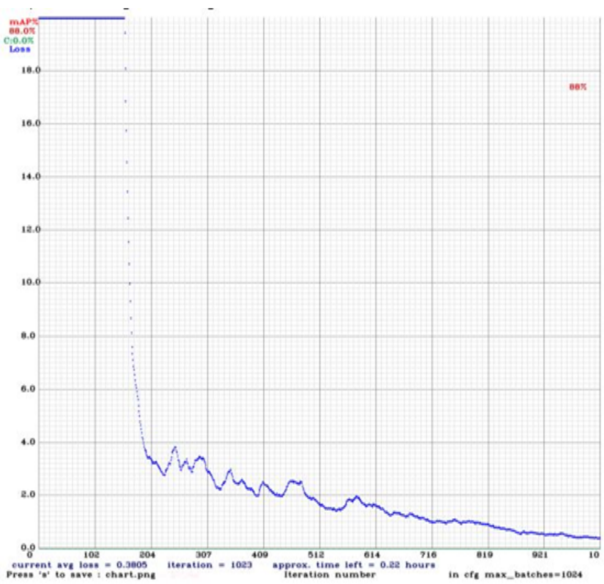
OBD II Scanner

An OBD2 scanner allows you or your mechanic to access vehicle data. The device is often small enough to fit in your hand. Once connected to your car, it can show you essential information, such as your vehicle's VIN number, your car's speed, fuel efficiency, and engine RPM, generic and manufacturer-specific diagnostic codes. Most modern cars contain software that produces on-board diagnostic (OBD) data. Cars have been using OBD data since the early 1980s. Vehicle owners can easily interpret current OBD data.

10. Results

The results from our project is a trained model which could identify different traffic/road/direction signs present and keep a track of vehicle operation and system condition along with its timestamp in log files.

With the help of the log files, it is possible to check if the Driver is properly following the rules and this can be ensured by comparing the generated log file through webcam/dashcam with the standard traffic rules. The data obtained through this will be useful to give tickets to drivers who break the rules. Insurance companies can also make use of this data to prevent car owners from filing false insurance claims. This system will provide assistance to the driver which results in an improvement in the driver's behavior.




```
['speed limit'],Wed Jun 09 19:12:21 IST 2021
['speed limit'],Wed Jun 09 19:12:22 IST 2021
['speed limit'],Wed Jun 09 19:12:23 IST 2021
['speed limit'],Wed Jun 09 19:12:24 IST 2021
"['speed limit', 'speed limit']",Wed Jun 09 19:12:27 IST 2021
['speed limit'],Wed Jun 09 19:12:28 IST 2021
"['other', 'other', 'mandatory']",Wed Jun 09 19:12:33 IST 2021
"['other', 'mandatory']",Wed Jun 09 19:12:36 IST 2021
"['other', 'mandatory', 'other']",Wed Jun 09 19:12:40 IST 2021
"['other', 'mandatory', 'other']",Wed Jun 09 19:12:42 IST 2021
```

```
Wed Jun 09 19:12:21 IST 2021, -97.66247364, 30.48308896, 39.6, 56, 2623.25, 92.54901886, 32.54901886
Wed Jun 09 19:12:22 IST 2021, -97.66247633, 30.48306807, 126.0, 56, 3169.5, 90.98039246, 32.54901886
Wed Jun 09 19:12:23 IST 2021, -97.66247773, 30.4830057, 61.2, 56, 2587.5, 98.4313736, 37.64706039
Wed Jun 09 19:12:24 IST 2021, -97.66254604, 30.48268939, 126.0, 57, 2753, 98.03921509, 39.2156868
Wed Jun 09 19:12:27 IST 2021, -97.66254604, 30.48268939, 54.0, 57, 2957, 96.86274719, 38.82352829
Wed Jun 09 19:12:28 IST 2021, -97.66254604, 30.48268939, 46.8, 57, 3158.5, 97.2549057, 40
Wed Jun 09 19:12:33 IST 2021, -97.66254604, 30.48268939, 115.2, 57, 3430.25, 95.29412079, 40.39215851
Wed Jun 09 19:12:36 IST 2021, -97.66254604, 30.48268939, 79.2, 58, 2927.25, 65.49019623, 16.47058868
Wed Jun 09 19:12:40 IST 2021, -97.66254604, 30.48268939, 93.6, 58, 2267, 77.64705658, 29.41176605
Wed Jun 09 19:12:42 IST 2021, -97.66254604, 30.48268939, 108.0, 58, 2353.75, 93.33333588, 31.76470566
Wed Jun 09 19:12:45 IST 2021, -97.66254604, 30.48268939, 100.8, 59, 2325.75, 94.90196228, 32.15686417
Wed Jun 09 19:12:46 IST 2021, -97.66254604, 30.48268939, 43.2, 59, 2303, 93.72549438, 32.15686417
Wed Jun 09 19:12:48 IST 2021, -97.66254604, 30.48268939, 100.8, 60, 1685.75, 34.11764908, 16.47058868
Wed Jun 09 19:12:49 IST 2021, -97.66254604, 30.48268939, 68.4, 60, 1258.5, 34.90196228, 16.47058868
Wed Jun 09 19:12:50 IST 2021, -97.66254604, 30.48268939, 126.0, 60, 1507.75, 28.23529434, 16.47058868
Wed Jun 09 19:12:52 IST 2021, -97.66254604, 30.48268939, 75.6, 61, 1686.5, 63.52941132, 24.70588303
Wed Jun 09 19:12:54 IST 2021, -97.66254604, 30.48268939, 126.0, 61, 1667, 94.11764526, 28.62745094
Wed Jun 09 19:12:56 IST 2021, -97.66254604, 30.48268939, 122.4, 61, 2378.75, 100, 37.64706039
```

Conclusion

Above project involves detecting, classifying and tracking of traffic signals also ensuring that the driver follows the rules by keeping track of status of various subsystems in the vehicle. Traffic signs are detected using YOLO. At the same time we keep track of traffic signs so as to have a continuous capture of the traffic sign while accelerating the execution time. Status of Vehicle will be in a log file. The data obtained through this will be useful to give tickets to drivers who break the rules. Insurance companies can also make use of this data to prevent car owners from filing false insurance claims.

References

1.H. Akatsuka and S. Imai, “Road signposts recognition system”, SAE transactions, Vol 96, No. 1, pp. 936-943, Feb. 1987.

2.Baek S H and Jang J W 2015 Implementation of Integrated OBD-II Connector With External Network Inf. Syst. 50 pp 69–75.

3.N. B. Romdhane, H. Mliki, M. Hammami, “An Improved Traffic Signs Recognition and Tracking Method for Driver Assistance System”.

4.INSTITUT FÜR NEUROINFORMATIK (INI) - German Traffic Sign Benchmak. Available:<http://benchmark.ini.rub.de/?section=gtsrb&subsection=dataset>

5.J. Redmon, S. Divvala, R. Girshick, and A. Farhadi. You only look once: Unified, real-time object detection. In 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pages 779–788, June 2016.

6.M. Amarasinghe, S. Kottegoda, A. L. Arachchi, S. Muramudalige, H. M. N. D. Bandara, A. Azeez, “Cloud-Based Driver Monitoring and Vehicle Diagnostic with OBD2 Telematics”, Department of Computer Science and Engineering, University of Moratuwa.

7.Chengji L., Yufan T., Jiawei L., Kai L., Yihang C., “Object Detection Based on YOLO Network”, School of Mechanical Electronic and Information Engineering, China University of Mining and Technology .

8. S. K. More, “Comparative Study of HOG and YOLO for Traffic Sign Detection Systems”.

Appendix