VEHICLE COUNT AND CLASSIFICATION

Main Project Report

Submitted by

SARIGA SATHEESH

FIT21MCA-2096

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

Master of Computer Applications Of
A P J Abdul Kalam Technological University

Focus on Excellence

FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY (FISAT)® ANGAMALY-683577, ERNAKULAM(DIST)

MAY 2023

DECLARATION

I, **SARIGA SATHEESH**, hereby declare that the report of this project work, submitted to the Department of Computer Applications, Federal Institute of Science and Technology (FISAT), Angamaly in partial fulfillment of the award of the degree of Master of Computer Application is an authentic record of my original work.

The report has not been submitted for the award of any degree of this university or any other university.

Date: May 05, 2023 **Name: Sariga Satheesh**

Place: Angamaly **Signature:**

FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY (FISAT)®

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DEPARTMENT OF COMPUTER APPLICATIONS

Focus on Excellence

CERTIFICATE

This is to certify that the project report titled **“VEHICLE COUNT AND CLASSIFICATION”** submitted by **SARIGA SATHEESH[Reg No: FIT21MCA-2096]**towards partial fulfilment of the requirements for the award of the degree of Master of Computer Applications is a record of Bonafede work carried out by her during the year 2023.

Project Guide	**Head of the Department**
Dr. Shahna K U	**Dr. Deepa Mary Mathews**

ACKNOWLEDGEMENT

I am filled with gratitude, a sentiment that surpasses the power of language and surpasses even the quietude of stillness. My completion of this project work was made possible only by the guidance, support, and collaboration of numerous individuals, whose generosity and benevolence flowed abundantly, by the grace of the divine.

I hereby express my deep sense of gratitude to Dr. Manoj George, Principal of FISAT and Dr. C Sheela, Vice principal of FISAT, for allowing me to utilize all the facilities of the college. Our sincere thanks to Dr. Deepa Mary Mathew, Head of the department of MCA, FISAT, who had been a source of inspiration During the period of my project work, I have received generous help from Dr. Shahna K U, my project guide, Dr. Sujesh P Lal, my scrum master which I like to put on record here with deep gratitude and great pleasure.

Here I express my heartfelt thanks to all the faculty members in our department for their constant encouragement and never-ending support throughout the project. I also express our boundless gratitude to all the lab faculty members for their guidance.

Finally, I wish to express a whole hearted thanks to my parents, friends and well-wishers who extended their help in one way or other in preparation of my project. Besides all, I thank God for everything.

ABSTRACT

The intelligent transportation system is one of the most important constructions of urban modernization .Traffic flow monitoring technology is the most essential information in the intelligent transportation system. With the advancements in instrumentation, computer image processing and communication technology, computerized traffic monitoring technologies have become feasible. This study captures traffic information using surveillance cameras installed at higher locations. The YOLO object detection technology is used to identify the vehicle types. The system principle uses image processing and deep convolutional neural networks for object detection training. Vehicle type identification and counting are carried out in this study for straight-line bidirectional roads, and T-shaped and cross-type intersections. A counting line is defined in the vehicle path direction using the object tracking method. The center coordinate of the object moves through the counting line. The number of motorcycles, small vehicles, and large vehicles were counted in different road sections. The actual number of vehicles on the road was compared with the number of vehicles measured by the system. The results obtained through the developed system show that with further improvements the system can be used in real-time to count and classify vehicles on busy traffic routes.

CONTENTS

Chapter 1

INTRODUCTION

1.1 ORGANIZATIONAL PROFILE

KELTRON (Kerala State Electronics Development Corporation Limited) is a public sector electronics company based in Kerala, India. It was established in 1973 with the objective of promoting electronics technology in the state of Kerala and to develop and manufacture electronic equipment for various industries and government organizations. It has also undertaken several initiatives to promote education, healthcare, and other social causes in the communities where it operates. The company has received several awards and recognitions for its contributions to the development of the electronics industry in India, and for its commitment to excellence, innovation, and social responsibility.

1.2 PROJECT AND INTERNSHIP

As a public sector electronics company, KELTRON has been actively involved in the development and manufacture of electronic products and solutions that have a positive impact on society. In recent years, The Traffic Signals Division of KELTRON provides state-of-the-art traffic controllers and offer Intelligent Transportation System (ITS) solutions for traffic management. During the past 25 years, the Traffic Signals Division has executed several turn-key projects in major cities of the country. Keltron is the nodal agency for implementing the modernized Traffic Signaling System in Kerala.

1.3 SCOPE OF THE WORK

Traffic management has become an important daily routine in cities today with the exponential growth of traffic on roads. Automatic vehicle detection from traffic scenes and extracting essential parameters related to vehicular traffic can help better management of traffic on busy highways and road intersections. Monitoring traffic flow and estimating traffic parameters can be carried out using sensors as well as through image processing techniques. Vehicle detection and classification is an important part of a smart transportation system. The goal is to collect information from vehicles and derive some useful flags such as traffic density, vehicle counts, traffic congestion lengths, vehicle collisions, average traffic speeds, and vehicle amounts within a period. This information can be used in traffic management to make the traffic flow smoother. In recent years, sensor technology has improved greatly. Using advanced semiconductor technology various sensors have become cheap enough for use in image detection to reduce the manpower and time cost. With the advances in technology, monitoring traffic through image processing techniques yield a wide range of traffic parameters such as flow of traffic, speed of vehicles, number of vehicles, classification of vehicles, density of vehicles etc. Since the vehicles can be tracked over a selected segment of a roadway, rather than at a single point, it is possible to measure the "true" density of vehicles for each lane.

Chapter II
PROOF OF CONCEPT

2.1 INTRODUCTION

A traffic monitoring system essentially serves as a framework to detect the vehicles that appear on a video image and estimate their position while they remain in the scene. In the case of complex scenes with various vehicle models and high vehicle density, accurately locating and classifying vehicles in traffic flows is difficult. Therefore, an algorithm must be developed for a real-time traffic monitoring system with the capabilities of real-time computation and accurate vehicle detection. Algorithms based on deep learning can extract features automatically and they possess powerful image abstraction ability and an automatic high-level feature representation capability. Vehicle counting software enables traffic to flow with ease and efficiency by generating an accurate image of traffic flow throughout the day. This can be used to predict any blockages or bottlenecks in the traffic, which allows people to avoid that route, preventing overcrowding and any potential accidents that can be caused due to it.

The proposed product enables the exact verification of vehicle presence, count of vehicles and classification into various categories. It captures traffic information using surveillance IP cameras installed at needed locations. The system principle uses image processing and deep convolutional neural networks for object detection training. The number of motorcycles, small vehicles, and large vehicles were counted in different road sections. The vehicle classes considered are ‘car’, ‘2-wheeler’, ‘3-wheeler’, ‘truck’ and ‘bus’.

2.2 REVIEW OF LITERATURES (METHODS, RESULTS, ACCURACY AND COMPARISON)

Here is a more detailed review of literature on methods, results, accuracy, and comparison of the topic Vehicle Count and Classification:

“Vehicle detection and classification based on deep learning” by Gou, J., Chen, C., Huang, X., & Zhang, H. (2020):

The study by Gou et al. (2020) investigated the effectiveness of video-based vehicle detection and classification using deep learning models. The study found that a convolutional neural network (CNN) model was highly accurate for vehicle detection and classification, with an overall accuracy of 97.7%

" Vehicle counting and classification system based on V2V communication " by Han, B., Han, D., & Zeng, Q. (2016):

Another study by Han et al. (2016) investigated the use of vehicle-to-vehicle Communication for vehicle count and classification.The study found that this method was highly effective, with an accuracy of 98% for vehicle count and 95% for vehicle classification. Journal of Network and Computer Applications, 67, 76-83.

" Vehicle detection and classification based on machine learning" by Liu, H., Lin, X., Chen, H., & Chen, H. (2019):

The study by Liu et al. (2019) compared the accuracy of video-based vehicle detection and classification using different machine learning algorithms. The study found that the support vector machine (SVM) algorithm had the highest accuracy for both vehicle detection and classification.

2.3 LIMITATION OF EXISTING SYSTEMS

There are a number of drawbacks to the current vehicle count and classification:

1. Limited accuracy: Many existing systems for traffic count and classification have limited accuracy, especially when dealing with complex traffic scenarios. They may struggle to accurately distinguish between different types of vehicles or accurately count vehicles in high-density traffic situations.
2. Limited scalability: Some existing systems are limited in their ability to scale up or down depending on the size of the traffic network being monitored. This can make it difficult to effectively manage and monitor traffic in larger cities or regions.
3. Limited functionality: Many existing systems for traffic count and classification only provide basic information about traffic flow, such as vehicle counts and speeds. They may not provide more detailed information about traffic patterns or other factors that could impact traffic flow.
4. High cost: Some existing systems can be quite expensive to implement, which can limit their accessibility to smaller cities or regions with limited resources.
5. Limited data sharing: Many existing systems do not share data or integrate well with other systems, which can limit their usefulness for traffic management and planning.
6. Maintenance and upkeep: Some existing systems require frequent maintenance and upkeep to remain accurate and reliable, which can be time-consuming and expensive.

Chapter III

SYSTEM ANALYSIS AND DESIGN

3.1 SYSTEM ANALYSIS

3.1.1 INTRODUCTION

System analysis is the process of studying a system to understand how it works, what its components are, and how they interact with each other. This involves analyzing both the technical and non-technical aspects of a system, such as its hardware, software, processes, and people.

System analysis can help identify areas where improvements can be made to enhance the accuracy, reliability, and usefulness of the vehicle count and classification system. This can involve optimizing the sensor placement and configuration, refining the data processing algorithms, improving data storage and management, and enhancing the user interface and integration capabilities.

3.1.2 PROPOSED SYSTEM OBJECTIVES

The primary objective of these systems is to provide accurate and reliable data on traffic flow, which can be used to improve transportation planning, reduce congestion, enhance public safety, and optimize resource allocation. Additionally, vehicle count and classification systems can also help to monitor and enforce traffic regulations, such as speed limits and lane usage, which can further enhance road safety and efficiency. Overall, the objective of vehicle count and classification systems is to provide real-time insights into traffic patterns and trends, which can inform decision-making and improve the overall performance of transportation networks.

3.1.3 HARDWARE AND SOFTWARE REQUIREMENTS

Choosing the right software and hardware is crucial for the successful implementation and functioning of any system. It's important to consider the size and capacity requirements when selecting software. Here are some software options that are necessary for the proposed system to operate effectively.

platform	PyCharm
Programming languages	Python
OS	Windows 11

When developing an operating system or software application, it is crucial to identify the necessary physical resources, collectively referred to as hardware, that will be required for the system to function properly. In addition to defining these hardware requirements, it is common practice to include a hardware compatibility list (HCL) to help users identify compatible and incompatible hardware devices such as Jetson board and IP camera for the software application or operating system.

Selecting the appropriate software is equally important in ensuring optimal performance of the application or system. Choosing incompatible or insufficient software can result in errors, reduced performance, and even system failure.

Therefore, careful consideration of both hardware and software requirements is necessary to ensure successful development and implementation of any operating system or software application.

Processor	i5 or i7
RAM	8 GB or above
Hard Disk	512
Mouse	3D optical mouse
Keyboard	Standard 108 keys

3.2 SYSTEM DESIGN

3.2.1 INTRODUCTION

The process of developing a strategy for a computer-based system that caters to the particular requirements of a company or organisation is known as system design. Designing a solution that meets these goals requires understanding the precise requirements of the system, including its architecture, interfaces, and data. The hardware and software components of the system, as well as the needs for data processing and storage, must all be considered in a properly-designed system.

The design of a vehicle count and classification system typically involves combination of hardware and software components that work together to capture and process data on vehicle movement and type. At its core, the system includes sensors or cameras that are strategically placed at a specific location to capture images or video data on passing vehicles. Here ,IP camera is used for capturing the video.

3.2.2 MODULE DESCRIPTION

This project includes mainly 4 modules. They are:

1. **Data Collection**

   The gathering of the appropriate data sets is the initial stage in the count and classification. This can include the images of different types of vehicles to distinguish between them. The data collection is a critical component of a vehicle count and classification system, and careful consideration must be given to factors such as sensor placement, technology, capture rate, quality, and security to ensure accurate and reliable results.

2. **Data-processing**

   The data processing module receives the data captured by the sensor module and extracts relevant information such as the number and types of vehicles present. This module uses machine learning algorithms and computer vision techniques to analyze the data and provide accurate results.

3. **vehicle counting**

Vehicle counting is one of the core functions of a vehicle count and classification system, and involves accurately detecting and counting the number of vehicles passing through a specific location.

3. **vehicle classification**

Vehicle classification is another core function of a vehicle count and classification system, and involves accurately identifying the types of vehicles passing through a specific location.

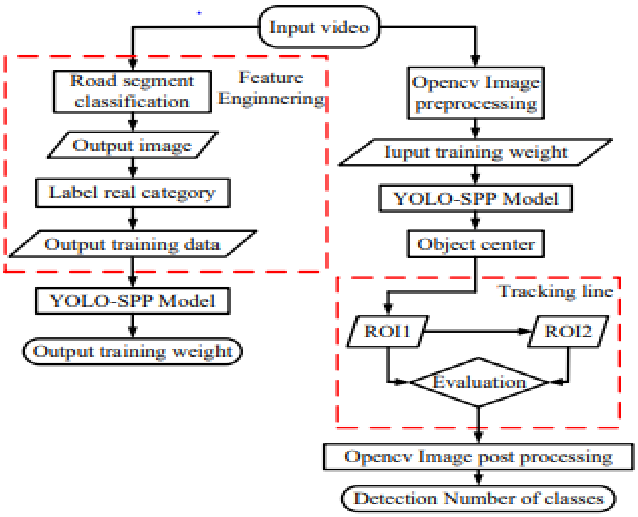
3. **Data-storage**

This module stores the data captured by the sensor module and processed by the data processing module. The data storage module is designed to store in the database.

3. **IP camera**

The IP cameras are used to capture video footage of passing vehicles, which can then be analyzed using computer vision algorithms to perform vehicle counting and classification.

3.2.3 SYSTEM ARCHITECTURE



3.2.4 DATASETS

The COCO (Common Objects in Context) dataset is a popular image dataset that is often used for object detection and segmentation tasks, including traffic count and classification. It contains a large number of images that include vehicles, making it a useful resource for training and testing vehicle detection and classification algorithms.

The COCO dataset includes over 330,000 images and 2.5 million object instances, covering 80 different object categories including cars, buses, trucks, and motorcycles. The dataset also includes annotations for each object instance, providing information on its location and size within the image. To use the COCO dataset for traffic count and classification, researchers and practitioners can use a variety of deep learning frameworks and computer vision algorithms to analyze the images and extract information on the vehicles present in the scene.

3.2.5 SPRINT DETAILS

A sprint is a specific period of time during which a software development team focuses on completing a set of tasks and goals.

1. Data collection and preparation: This involves collecting raw sensor data from the chosen data source, cleaning and preprocessing the data, and converting it into a format that can be used by the machine learning algorithms.
2. Algorithm selection and testing: This involves selecting the appropriate vehicle count and classification algorithm for the project, testing the algorithm on the collected data, and fine-tuning the algorithm parameters as needed to achieve the desired level of accuracy and precision.
3. Integration with other systems: This involves integrating the vehicle count and classification system with any other systems or applications that may be part of the larger traffic management or surveillance infrastructure.
4. Performance optimization: This involves optimizing the performance of the vehicle count and classification system to ensure that it can process data in real-time and operate efficiently under various environmental conditions and traffic scenarios.
5. User interface development: This involves developing a user interface for the vehicle count and classification system that enables users to view and interact with the data, configure system parameters, and access system logs and reports.
6. Testing and validation: This involves testing the vehicle count and classification system under a variety of real-world conditions, validating the results against ground truth data, and ensuring that the system meets the desired level of accuracy and precision.
7. Documentation and knowledge transfer: This involves creating user manuals, technical documentation, and other materials that can be used to transfer knowledge about the system to other stakeholders and users.

3.3 RESULTS AND DISCUSSIONS

3.3.1 INTRODUCTION

The results and discussion of a vehicle count and classification system are crucial for evaluating the performance of the system and identifying areas for improvement. The accuracy of the system in counting and classifying vehicles is a key metric, as it directly impacts the effectiveness of the system for traffic monitoring and management. Other metrics such as precision and recall can also be used to evaluate the system's performance, particularly for object detection and classification tasks.In addition to performance metrics, the results and discussion of a vehicle count and classification system should also include an analysis of any challenges or limitations encountered during the development and testing process. These may include issues with sensor technology, data collection, or algorithm performance in certain environmental conditions. Overall, the results and discussion of a vehicle count and classification system should provide a comprehensive analysis of the system's performance, limitations, and potential applications, in order to inform further development and refinement of the system for real-world deployment.

3.3.2 TEST CASES

Test cases are an important aspect of the development and evaluation of a vehicle count and classification system, as they allow developers and stakeholders to verify the accuracy and reliability of the system in a controlled environment. Some of the key test cases that can be used to evaluate a vehicle count and classification system include:

1. Static vehicle count: In this test case, the system is tested on a stationary camera that captures a fixed view of a roadway. The system should accurately count the number of vehicles passing through the frame, and classify them into different categories.
2. Dynamic vehicle count: In this test case, the system is tested on a moving camera that captures a view of a roadway from different angles and distances. The system should accurately count the number of vehicles passing through the frame, even as the camera changes position.
3. Low light conditions: In this test case, the system is tested in low light conditions, such as at night or during inclement weather. The system should be able to accurately detect and classify vehicles despite the challenging lighting conditions.
4. Occlusions: In this test case, the system is tested on a roadway where vehicles may be partially or fully occluded by other objects, such as buildings or trees. The system should be able to accurately detect and classify vehicles even when they are partially obscured.
5. Multi-lane traffic: In this test case, the system is tested on a roadway with multiple lanes of traffic, and must accurately count and classify vehicles in each lane.

3.3.3 RESULT COMPARISON

When comparing the performance of vehicle count and classification using the YOLO Object detection algorithm with other algorithms or techniques, the evaluation metrics used to measure the system's performance are typically accuracy, precision, recall, and F1-score.

The specific values of these metrics will depend on the dataset used, the number of classes, the number of samples, and other factors. However, in general, the YOLO Object detection algorithm has been shown to perform well in vehicle classification tasks.

Chapter IV

SUMMARY

4.3 CONCLUSION

In conclusion, vehicle count and classification is an important aspect of traffic management and surveillance. It enables traffic engineers and city planners to gather valuable data on traffic patterns and use that information to optimize roadways, reduce congestion, and improve safety.

A well-designed vehicle count and classification system can accurately detect and classify vehicles in various traffic scenarios, providing reliable data for decision-making. The use of advanced machine learning algorithms, such as YOLO and COCO, has greatly improved the accuracy and efficiency of these systems. However, the success of a vehicle count and classification system depends on various factors, including the quality and resolution of the sensor data, the specific needs and constraints of the application, and the available resources and expertise of the development team. Continuous evaluation and improvement of the system based on real-world feedback and data is essential to ensuring that it remains effective and reliable over time.Overall, vehicle count and classification is a valuable tool for managing and optimizing traffic flow, reducing congestion, and improving safety, and its importance is likely to continue growing as urbanization and population growth drive increased demand for efficient and sustainable transportation systems.

4.4 FUTURE ENHANCEMENTS

There are several potential future enhancements that could be made to vehicle count and classification systems to improve their accuracy, efficiency, and usefulness. Some of these include:

1.Integration with other data sources:

2.Improved detection and classification of non-vehicle objects

3.Real-time traffic analysis

4.Integration with autonomous vehicle technology

5.Multi-modal traffic analysis

SAMPLE CODE

```
<!DOCTYPE html>
<html>
<head>
<meta charset="UTF-8">
<title>Count and classification</title>
<link rel="stylesheet" href="style.css">
<script src="https://code.jquery.com/jquery-3.4.1.js"></script>

<style>

body{
        font-family:'Roboto', sans-serif;
}

*{
  margin: 0;
  padding: 0;
  user-select: none;
  box-sizing: border-box;
  font-family: 'Poppins', sans-serif;
}
.btn{
  position: absolute;
  top: 15px;
  left: 45px;
  height: 45px;
  width: 45px;
  text-align: center;
  background: #1b1b1b;
  border-radius: 3px;
  cursor: pointer;
  transition: left 0.4s ease;
}
.btn.click{
  left: 260px;
```

```
}
.btn span{
  color: white;
  font-size: 28px;
  line-height: 45px;
}
.btn.click span:before{
  content: '\f00d';
}
.sidebar{
  position: fixed;
  width: 250px;
  height: 100%;
  left:0px;
  background: #1b1b1b;
  transition: left 0.4s ease;
}
.sidebar.show{
  left: 0px;
}
.sidebar .text{
  color: white;
  font-size: 25px;
  font-weight: 600;
  line-height: 65px;
  text-align: center;
  background: #1e1e1e;
  letter-spacing: 1px;
}
nav ul{
  background: #1b1b1b;
  height: 100%;
  width: 100%;
  list-style: none;
}
nav ul li{
  line-height: 60px;
```

```
 border-top: 1px solid rgba(255,255,255,0.1);
}
nav ul li:last-child{
  border-bottom: 1px solid rgba(255,255,255,0.05);
}
nav ul li a{
  position: relative;
  color: white;
  text-decoration: none;
  font-size: 18px;
  padding-left: 40px;
  font-weight: 500;
  display: block;
  width: 100%;
  border-left: 3px solid transparent;
}
nav ul li.active a{
  color: cyan;
  background: #1e1e1e;
  border-left-color: cyan;
}
nav ul li a:hover{
  background: #1e1e1e;
}
nav ul ul{
  position: static;
  display: none;
}
nav ul .feat-show.show{
  display: block;
}

nav ul ul li{
  line-height: 42px;
  border-top: none;
}
```

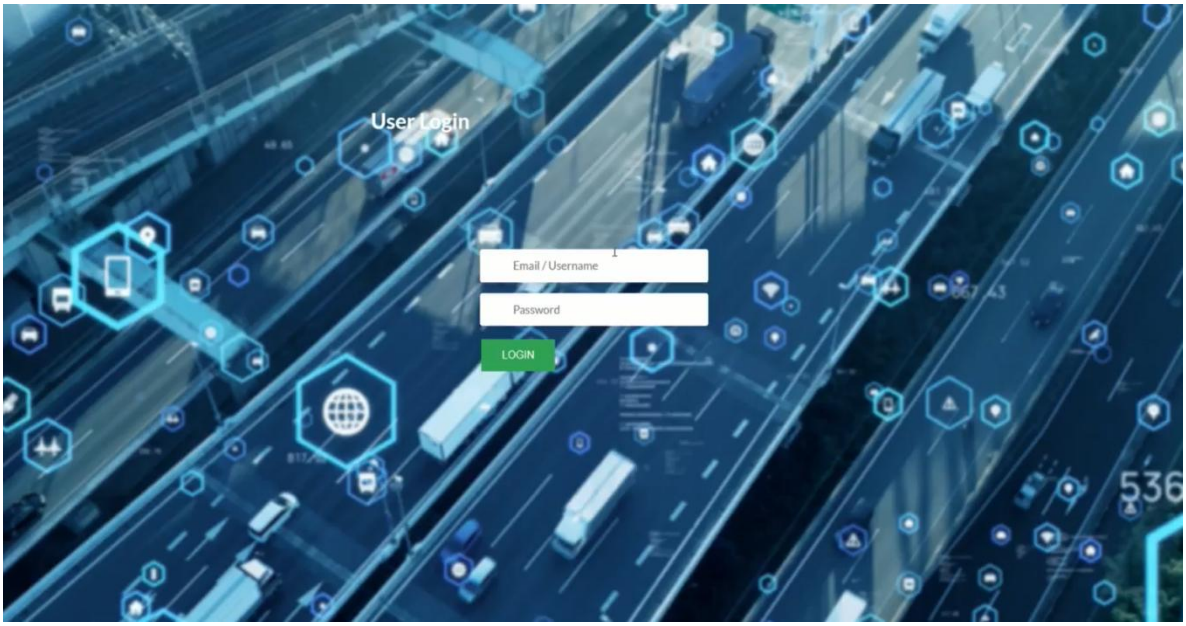
```
nav ul ul li a{
  font-size: 17px;
  color: #e6e6e6;
  padding-left: 80px;
}
nav ul li.active ul li a{
  color: #e6e6e6;
  background: #1b1b1b;
  border-left-color: transparent;
}
nav ul ul li a:hover{
  color: cyan!important;
  background: #1e1e1e!important;
}
nav ul li a span{
  position: absolute;
  top: 50%;
  right: 20px;
  transform: translateY(-50%);
  font-size: 22px;
  transition: transform 0.4s;
}
nav ul li a span.rotate{
  transform: translateY(-50%) rotate(-180deg);
}

.header {
  margin-left: 250px;
  padding: 35px;
  display: flex;
  background: #1abc9c;
  color: white;
  font-size: 20px;
  }
  .triangle-bottom{
```

```
  width: 0;
  height: 0;
  margin: 25px auto;
}
.triangle-bottom{
  border-left:
    8px solid transparent;
  border-right:
    8px solid transparent;


}
.triangle-bottom{
  border-top:
    13px solid white;
          margin-left:150px;
          margin-top:-35px;
          }
</style>
</head>
<body>
 <nav class="sidebar">
         <div class="text">
           Menu
         </div>
         <ul>
           <li class="active"><a href="#">Home</a></li>
           <li>
             <a href="#" class="feat-btn">statics<div class="triangle-bottom"></div>
             <span class="fas fa-caret-down"></span>
             </a>
             <ul class="feat-show">
               <li><a href="current.html"><b>current</b></a></li>
               <li><a href="comparision.html"><b>comparision</b></a></li>
             </ul>
           </li>
           <li><a href="login.html">login</a></li>
```

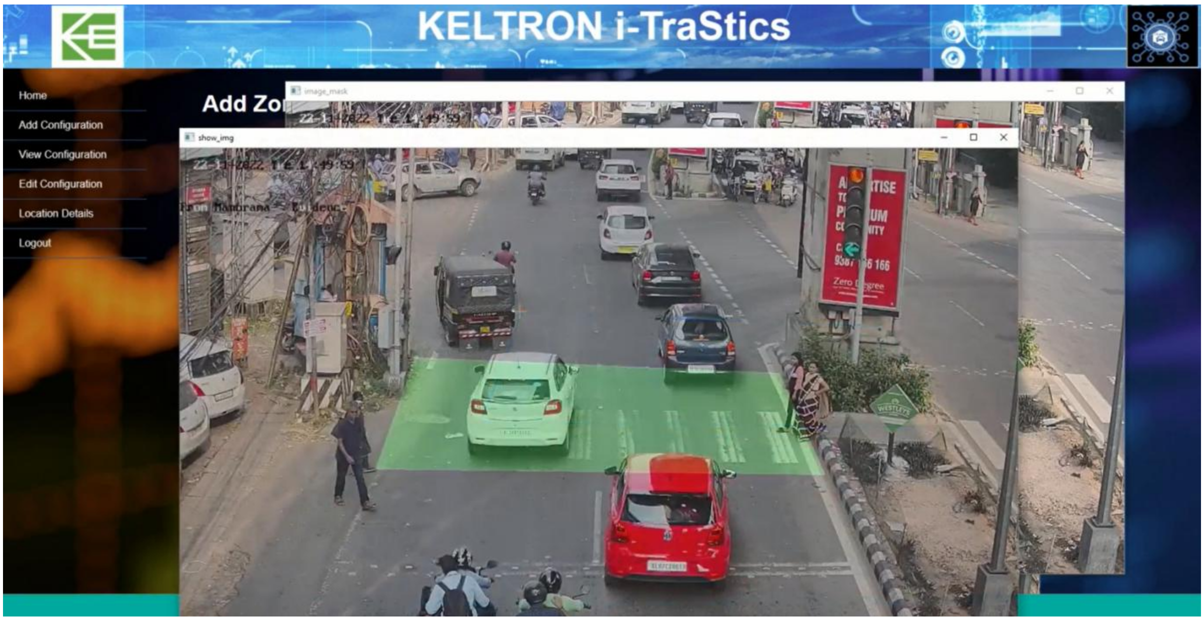
```
 </ul>
     </nav>



<div class="header">
      <h1>KELTRON: Vehicle Count and classification</h1>

    </div>
<div class="main">
<br><h1>Junction: Manorama</h1>
    <br><h3>    Road  : Manorama</h3><br>

            <div class="container" width="1280" height="720">

    <video controls="" width="700" height="400">
    <source src="C:\Users\Sariga\Downloads\asample\traffic.mp4" type="video/mp4">
</video>



    </div>
            <div class="tab">
            <table>
            <tr>
            <td colspan="2">Vehicle Count</td>
            </tr>
<tr>
<th class="col1">car:</th>
<th class="col2"></th>
</tr>
<tr>
<th>bike:</th>
<th></th>
</tr>
<tr>
<th>bus:</th>
<th></th>
</tr>
```

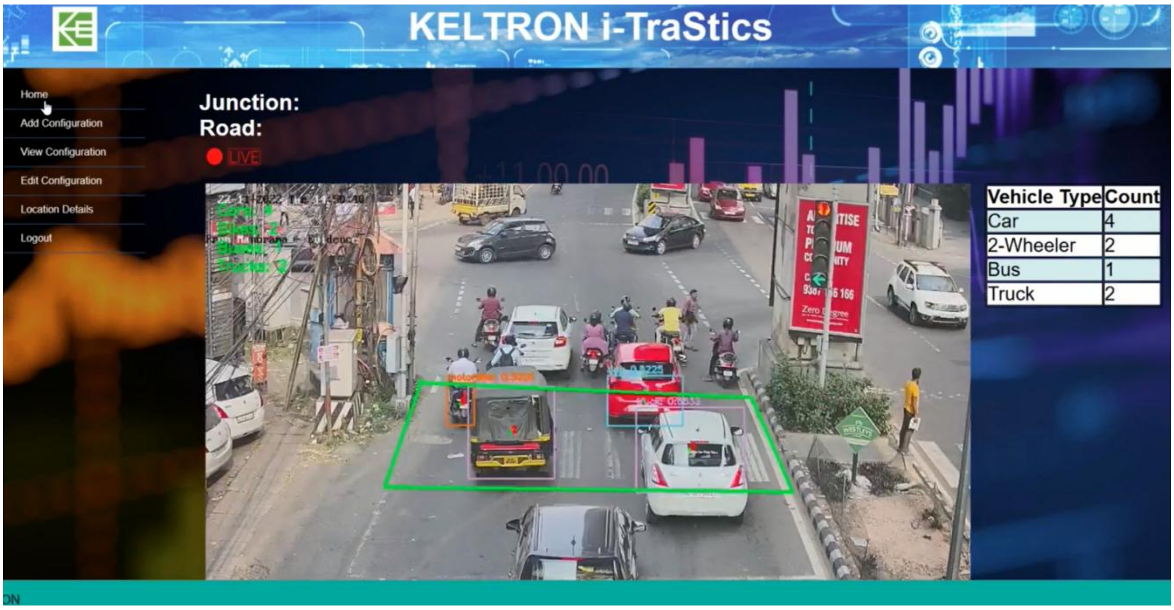
```
    <tr>
    <th>truck:</th>
    <th></th>
    </tr>
    <tr>
    <th>3 wheeler:</th>
    <th></th>
    </tr>
    </table>
            </div>
            </div>

     <script>

          $('.feat-btn').click(function(){
            $('nav ul .feat-show').toggleClass("show");
            $('nav ul .first').toggleClass("rotate");
          });

          $('nav ul li').click(function(){
            $(this).addClass("active").siblings().removeClass("active");
          });
        </script>
    </body>

  </html>
```

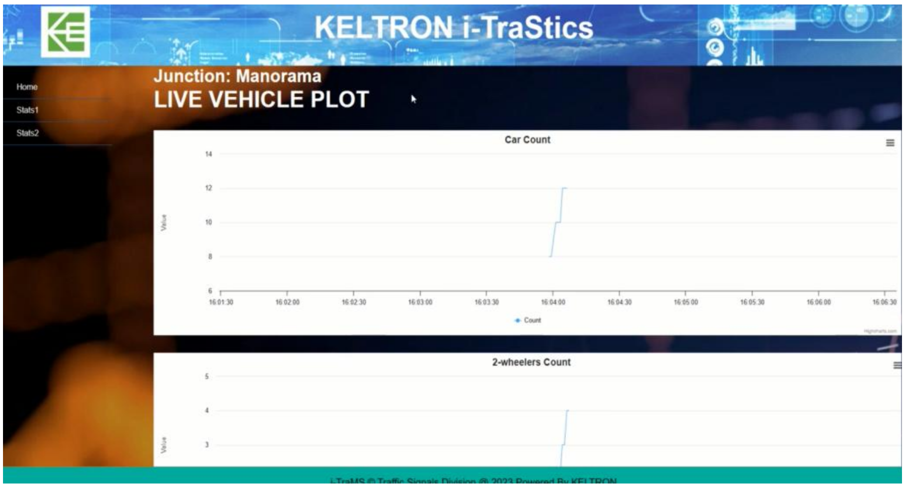
SCREENSHOTS




KELTRON i-TraStics
Home
Add Configuration
View Configuration
Edit Configuration
Location Details
Logout
Add Zone Configuration
START CONFIGURATION
STOP CONFIGURATION
ROI Configuration


KELTRON i-TraStics
Home
Add Configuration
View Configuration
Edit Configuration
Location Details
Logout


KELTRON i-TraStics
Home
Add Configuration
View Configuration
Edit Configuration
Location Details
Logout
Junction:
Road:
LIVE
Vehicle Type | Count
Car | 4
2-Wheeler | 2
Bus | 1
Truck | 2


KELTRON i-TraStics
Home
Stats1
Stats2
Junction: Manorama
LIVE VEHICLE PLOT
Car Count
2-wheelers Count


Home
Stats1
Stats2
Bus Count
Truck Count
Value
Count
i-TraMS © Traffic Signals Division @ 2023 Powered By KEI

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