COMPUTER VISION BASED PARKING SPACE DETECTION

A project report submitted to
MALLA REDDY UNIVERSITY
in partial fulfillment of the requirements for the award of degree of

BACHELOR OF TECHNOLGY
in
COMPUTER SCIENCE & ENGINEERING (AI & ML)

Submitted by

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MALLA REDDY UNIVERSITY
(Telangana State Private Universities Act No.13 of 2020 and G.O.Ms.No.14, Higher Education (UE) Department)

2024

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COLLEGE CERTIFICATE

This is to certify that this is the bonafide record of the application development entitled , "**COMPUTER VISION BASED PARKING SPACE DETECTION"** Submitted by **Tialu Manikanta (2211CS020509) Vavillapally Ashrith (2211CS020529),VindekotiGanesh(2211CS020537),KasireddyHimaBindhu(2211 CS020573) , Vishal Dev Kumar (2211CS020575)** B.Tech II year II semester, Department of CSE (AI&ML) during the year 2023-24. The results embodied in the report have not been submitted to any other university or institute for the award of any degree or diploma

PROJECT GUIDE **HEAD OF THE DEPARTMENT**

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EXTERNAL EXAMINER

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1. INTRODUCTION

1.1 Problem Definition

In developing a computer vision-based parking space detection system, the primary objective is to create a robust solution that automates the monitoring of parking spaces in diverse environments. This entails accurately detecting and classifying parking spaces in real-time, determining whether each space is occupied or vacant. Challenges include ensuring high detection accuracy despite variations in lighting, weather, and occlusions like vehicles or pedestrians. Real-time performance is crucial, requiring the system to process video feeds or images swiftly to provide timely updates on parking space occupancy. Scalability is essential to accommodate different parking lot sizes, configurations, and camera viewpoints, while robustness ensures the system's effectiveness in challenging real-world conditions. Integration with existing parking management systems and providing a user interface for visualizing occupancy status can enhance usability. Constraints include the need for computational efficiency and addressing privacy concerns. Success metrics encompass accuracy, real-time performance, and robustness, ensuring the system's reliability and efficiency in optimizing parking space management.

1.2 Objective of Project

The objective of this project is to develop a computer vision-based parking space detection system capable of accurately detecting and classifying parking spaces in real-time. The system aims to automate the monitoring of parking spaces in various environments, determining whether each space is occupied or vacant.

Key objectives include:

1. **High Detection Accuracy**: Develop algorithms and techniques to achieve high accuracy in detecting the boundaries of individual parking spaces within input images or video frames, even under challenging conditions such as varying lighting and occlusions.
2. **Real-time Performance:** Implement efficient processing methods to enable the system to analyze video feeds or images in real-time, ensuring timely updates on parking space occupancy status.

3. **Robustness and Adaptability**: Design the system to be robust against environmental factors, occlusions, and variations in parking lot configurations. It should adapt to different camera viewpoints, resolutions, and environmental conditions.

4. **Scalability:** Ensure that the system can scale to accommodate parking lots of various sizes and configurations, from small parking areas to large multi-level facilities.

5. **Integration:** Provide seamless integration with existing parking management systems or applications, allowing for easy access to parking space occupancy information by users or administrators.

6. **User Experience Enhancement:** Optionally, develop a user interface to visualize parking space occupancy in real-time and provide alerts or notifications to users regarding available or occupied parking spaces.

7. **Privacy Compliance:** Address privacy concerns by ensuring that the system adheres to privacy regulations and does not capture or store sensitive information beyond the scope of parking space detection.

By achieving these objectives, the project aims to contribute to the optimization of parking space management, enhance user experience, and promote the efficient utilization of parking resources in various urban and commercial settings

1.3 Scope of project

1. **Detection Algorithms:** Develop and implement computer vision algorithms for accurately detecting parking spaces within input images or video frames. This may include techniques such as edge detection, contour detection, and object segmentation.

2. **Occupancy Classification:** Design algorithms to classify each detected parking space as either occupied or vacant based on the presence of vehicles or other objects. Machine learning models such as convolutional neural networks (CNNs) may be employed for this task.

3. **Real-time Processing:** Implement efficient image processing techniques to enable real-time analysis of video feeds or images from parking lot cameras. This includes optimizing algorithms for speed and minimizing computational resources required for processing.
4. **Environmental Adaptability:** Ensure that the system can adapt to variations in environmental conditions, such as changes in lighting, weather, and camera viewpoints. Techniques like image enhancement and normalization may be employed to improve robustness.
5. **Scalability:** Design the system to scale effectively to accommodate parking lots of various sizes and configurations, from small outdoor lots to large indoor parking structures with multiple levels.

6. **Integration with Existing Systems:** Provide integration capabilities with existing parking management systems or applications, allowing for seamless access to parking space occupancy information by administrators and users.

7. User Interface Development: Optionally, develop a user-friendly interface for visualizing parking space occupancy in real-time and providing alerts or notifications to users regarding available or occupied parking spaces. This may include web-based dashboards or mobile applications.

8. Performance Evaluation: Conduct thorough performance evaluation of the system, assessing factors such as detection accuracy, real-time processing speed, robustness under different conditions, and scalability to ensure the system meets desired objectives.

9. Privacy Considerations: Address privacy concerns by ensuring compliance with relevant regulations and guidelines. This may involve implementing measures to anonymize or secure captured data and limit the scope of information collected to parking space detection purposes only.

10. Documentation and Support: Provide comprehensive documentation and support materials for the system, including installation guides, user manuals, and troubleshooting resources to assist users and administrators in deploying and maintaining the system effectively.

By focusing on these key areas within the scope of the project, the computer vision-based parking space detection system can be developed to effectively address the needs of parking management and optimization in various real-world environments.

2. ANALYSIS

2.1 Project planning & Research

Research on computer vision-based parking space detection is a multifaceted field that encompasses various areas of investigation aimed at improving the accuracy, efficiency, and reliability of parking management systems. One significant focus of research lies in algorithm development, where efforts are directed towards creating advanced techniques for detecting vehicles within parking spaces. This involves exploring methodologies such as deep learning, convolutional neural networks (CNNs), and object detection frameworks like YOLO and Faster R-CNN to accurately identify vehicles in parking lot images or video streams. Additionally, researchers delve into image segmentation methods to separate parking spaces from background clutter and occlusions, enabling precise delineation of individual parking spots. Moreover, studies delve into vehicle tracking algorithms to monitor the movement of vehicles within parking lots, facilitating real-time occupancy monitoring and detection of parking violations.

Another crucial area of research revolves around system architecture, where researchers seek to design scalable and distributed systems for deploying parking space detection solutions across diverse parking environments. This involves exploring distributed computing paradigms to handle large-scale deployments efficiently, as well as investigating edge computing approaches to enable real-time processing and analysis of parking lot data at the edge of the network, thereby reducing latency and bandwidth requirements.

2.2 Software requirement specification

2.2.1Software Requirements

Operating System	: Windows 10 or later
User Interface	: HTML, CSS
Client-side Scripting	: Java script
Programming Language	: Python , OpenCV , TensorFlow
Web Technologies	: PHP
Database	: MySQL
Web Server	: XAMPP

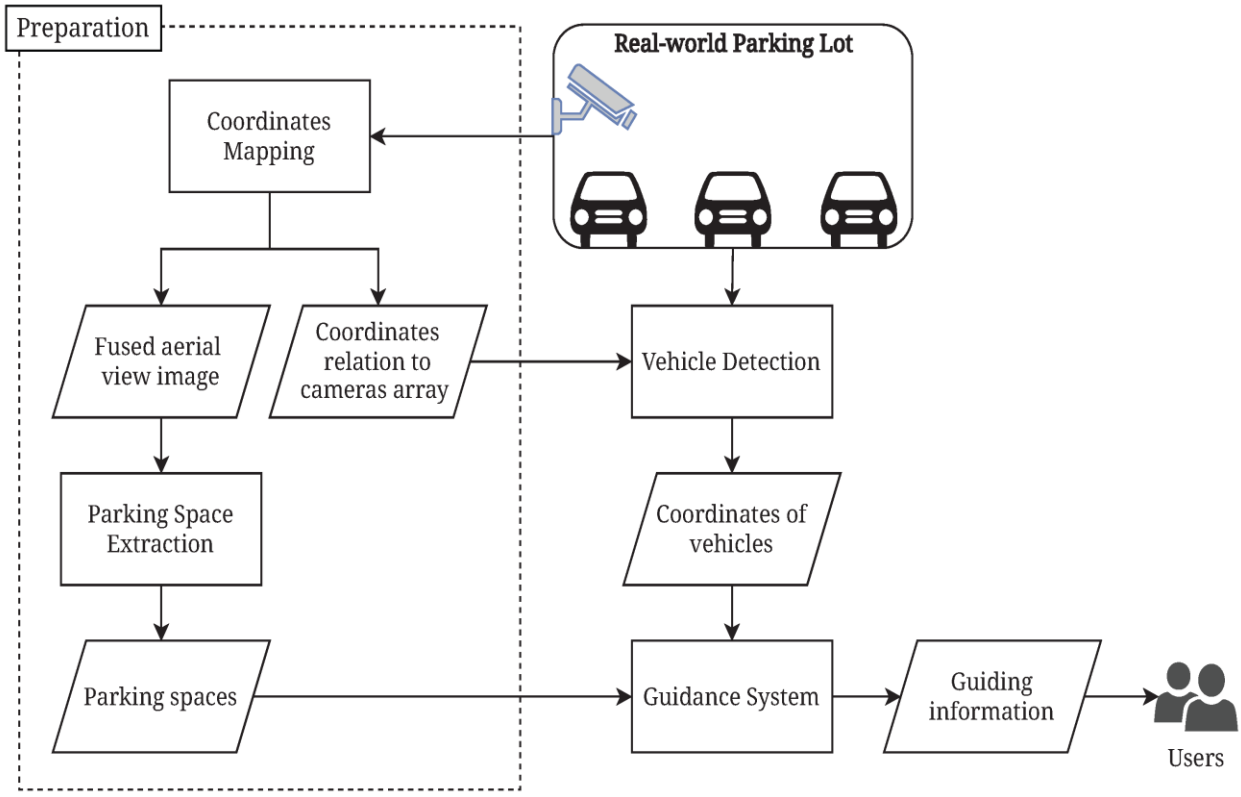
2.2.2 Hardware Requirements

Hard Disk : 100GB

RAM : 4 GB to 8 GB

Processor : Dual core

2.3 Model Selection &Architecture



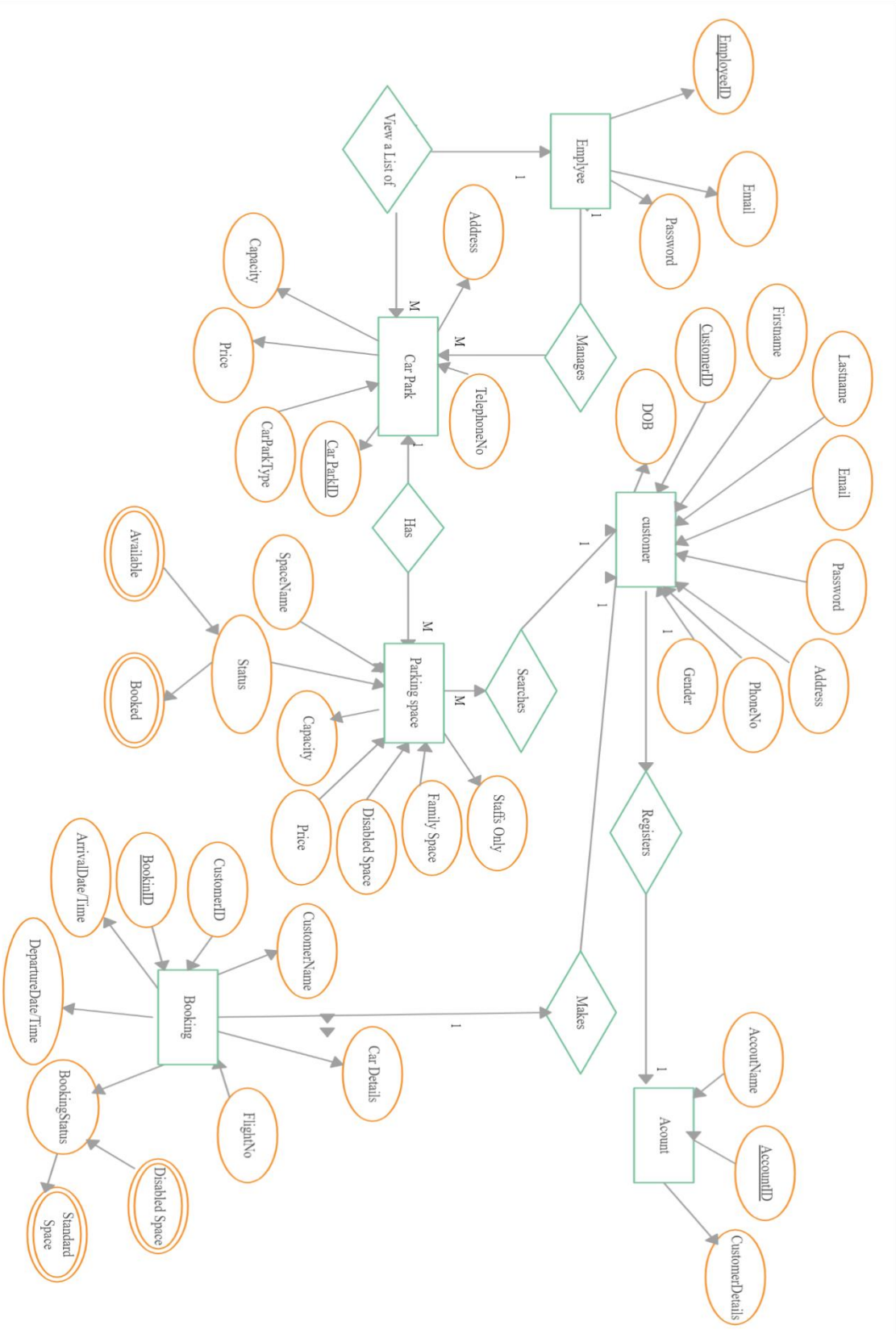
3DESIGN:

3.1 Introduction:

Designing a computer vision-based parking space detection system presents an innovative solution to the challenges of modern parking management. With the proliferation of urbanization and the ever-increasing demand for parking spaces, traditional methods of managing parking facilities have become inadequate. In response, leveraging computer vision technology offers a promising avenue to revolutionize how parking spaces are monitored and optimized.

This introduction sets the stage for discussing the design process of such a system. It highlights the pressing need for more efficient and intelligent parking management solutions and introduces computer vision as a transformative technology capable of addressing these challenges. Additionally, it emphasizes the importance of a systematic and comprehensive design approach to ensure the effectiveness and reliability of the proposed system.

3.2 ER Diagram



3.3 Data set Descriptions:

Dataset descriptions play a crucial role in the development and evaluation of computer vision-based parking space detection systems. Here's how dataset descriptions typically include:

1. Dataset Name: Each dataset is assigned a unique name to distinguish it from others.

2. Dataset Size: The dataset size refers to the total number of images or video frames included in the dataset. This helps researchers understand the scale of the dataset and its suitability for different tasks.

3. Annotations: Annotations provide labels or annotations associated with each image or video frame. For parking space detection datasets, annotations typically include bounding boxes around vehicles and parking spaces, as well as labels indicating whether each parking space is occupied or vacant.

4. Image Resolution: Image resolution refers to the dimensions of each image in the dataset, usually measured in pixels (e.g., 1920x1080). Understanding the image resolution helps researchers assess the quality of the dataset and its compatibility with different computer vision algorithms.

5. Variability: Variability describes the diversity of parking environments represented in the dataset. This includes variations in lighting conditions, weather conditions, parking lot layouts, vehicle types, and occlusions. A diverse dataset helps ensure that the trained model generalizes well to unseen parking environments.

6. Data Collection Method: The data collection method outlines how the dataset was collected and annotated. This may involve using fixed cameras installed in parking lots, capturing images or video frames using drones or vehicles equipped with cameras, or utilizing publicly available datasets.

Overall, dataset descriptions provide researchers with essential information about the content, quality, and usage rights of the dataset, enabling them to make informed decisions when selecting datasets for their research and benchmarking computer vision algorithms for parking space detection.

3.4 Data Preprocessing Techniques

1. Resizing: Resizing images to a consistent resolution helps ensure in the dataset and reduces computational complexity during training. Additionally, resizing can help standardize the input dimensions required by machine learning models.

2. Normalization: Normalizing pixel values to a common scale (e.g., between 0 and 1) improves convergence during model training and helps mitigate issues related to varying illumination conditions. Common normalization techniques include min-max scaling and z-score normalization.

3. Image Augmentation: Image augmentation techniques introduce variations in the training data to improve the model's generalization ability and robustness. This can include random rotations, translations, flips, and changes in brightness or contrast. Augmentation helps prevent overfitting and enables the model to learn from a more diverse set of examples.

4. Color Space Conversion: Converting images from one color space to another (e.g., RGB to grayscale) can reduce the dimensionality of the data and simplify the computational requirements of the model. Grayscale images contain only one channel instead of three (RGB), which can be beneficial for certain tasks while preserving essential information.

5. Histogram Equalization: Histogram equalization enhances image contrast by redistributing pixel intensities to cover a wider range of values. This technique can be particularly useful for improving the visibility of objects in low-contrast images or under challenging lighting conditions.

6. Noise Reduction: Noise reduction techniques, such as Gaussian blur or median filtering, can help mitigate the effects of noise or artifacts present in the images. These techniques smooth out pixel intensities and reduce high-frequency components that may interfere with object detection algorithms.

7. Edge Detection: Edge detection algorithms, such as the Sobel operator or Canny edge detector, can highlight the edges of objects in an image. This preprocessing step can help localize objects and improve the accuracy of subsequent object detection algorithms.

8. Data Augmentation: Data augmentation techniques generate synthetic data samples by applying transformations to existing data. In the context of parking space detection, this may involve simulating variations in vehicle positions, orientations, and lighting conditions to augment the training dataset and improve model robustness.

3.5 Methods & Algorithms

1. Object Detection Algorithms:

- YOLO (You Only Look Once): YOLO is a popular object detection algorithm known for its real-time performance. It divides the input image into a grid and predicts bounding boxes and class probabilities for each grid cell simultaneously. YOLO versions such as YOLOv3 and YOLOv4 have been widely used for vehicle detection in parking lots.
- Faster R-CNN (Region-based Convolutional Neural Network): Faster R-CNN is another widely used object detection algorithm that consists of two stages: region proposal and object classification. It uses a Region Proposal Network (RPN) to generate region proposals and

then classifies objects within those proposals. Faster R-CNN is known for its high accuracy but may be slower than YOLO.

- SSD (Single Shot MultiBox Detector) : SSD is a single-shot object detection algorithm that combines feature maps of different scales to predict bounding boxes and class probabilities. SSD is known for its balance between speed and accuracy and is suitable for real-time applications.

Semantic Segmentation:

- Fully Convolutional Networks (FCNs): FCNs are deep learning models designed for pixel-wise image segmentation. They take an input image and output a segmentation map where each pixel is assigned a class label. FCNs can be trained to segment parking spaces from background clutter in parking lot images.
- U-Net: U-Net is a convolutional neural network architecture designed for biomedical image segmentation but has been adapted for various computer vision tasks, including semantic segmentation. U-Net architecture consists of an encoder-decoder structure with skip connections to preserve spatial information.

3. Feature-based Methods:

- Hough Transform: The Hough Transform is a feature-based method used for detecting lines or shapes in images. In the context of parking space detection, the Hough Transform can be used to detect the boundaries of parking spaces marked by painted lines on the ground.
- Edge Detection: Edge detection algorithms such as the Canny edge detector can be used to identify edges in images, which can then be processed further to detect parking space boundaries.

4. Deep Learning Architectures:

- Convolutional Neural Networks (CNNs): CNNs are the backbone of many computer vision algorithms and have been widely used for feature extraction and object detection tasks in parking space detection systems.
- Siamese Networks: Siamese networks are a type of neural network architecture used for similarity learning. They have been used in parking space detection systems for tasks such as vehicle re-identification and tracking across multiple camera views.

These methods and algorithms can be combined or adapted based on the specific requirements and challenges of the parking space detection task. By leveraging advancements in deep learning and computer vision, researchers and practitioners continue to develop more accurate and efficient methods for detecting parking spaces and vehicles in parking facilities.

4. DEPLOYMENT AND RESULTS:

4.1 SOURCE CODE

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <meta http-equiv="X-UA-Compatible" content="ie=edge">
  <link rel="stylesheet" href="style2.css">
  <title>Sign in/sign up form</title>
</head>

<body>

  <div class="container">
    <div class="container-forms">
      <div class="container-info">
        <div class="info-item">
          <div class="table">
            <div class="table-cell">
              <p>
                Have an account?
              </p>
              <button class="info-btn">
                Log in
              </button>
            </div>
          </div>
        </div>
        <div class="info-item">
          <div class="table">
            <div class="table-cell">
              <p>
                Don't have an account?
```

```
</div>
      </div>
    </div>
    <div class="container-form">
      <div class="form-item log-in">
        <div class="table">
          <div class="table-cell">
            <input name="Username" placeholder="Username" type="text" />
            <input name="Password" placeholder="Password" type="Password" />
                              <a href="index.html" class="btn mt-4">Login</a>
          </div>
        </div>
      </div>
      <div class="form-item sign-up">
        <div class="table">
          <div class="table-cell">
            <input name="email" placeholder="Email" type="text" />
            <input name="fullName" placeholder="Full Name" type="text" />
            <input name="Username" placeholder="Username" type="text" />
            <input name="Password" placeholder="Password" type="Password" />
            <button class="btn">
              Sign up
            </button>
          </div>
        </div>
      </div>
    </div>
  </div>

  <script src="script1.js"></script>
</body>

</html>
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>Find Your Spot</title>
    <link rel="stylesheet" href="style.css" />
    <link
```

```
QWTKZyjpPEjISv5WaRU9OFeRpok6YctnYmDr5pNlyT2bRjXh0JMhjY6hW+AL
EwIH" crossorigin="anonymous">
</head>
<body>
   <div class="navbar navbar-expand-lg bg-body-tertiary">
   <div class="container-fluid">
      <a class="navbar-brand" href="#">Find Your Spot</a>

      <div class="collapse navbar-collapse" id="navbarNavAltMarkup">
         <div class="navbar-nav">
            <a class="nav-link" aria-current="page" href="#">Home</a>

            <a class="nav-link" href="contact.html">Contact</a>
            <a class="nav-link" href="login.html">Sign Up/Login</a>
         </div>
      </div>
   </div>
</div>

<section>
   <div class="right">
      <div class="content" >FIND YOUR SPOT
      </div>
      <div class="Small">
         "Welcome to our smart parking system! We utilize cutting-edge technology
to detect available parking spaces effortlessly. Our system uses sensors to identify
vacant spots, making it easier for you to find parking quickly and efficiently. Say
goodbye to circling around endlessly – with our solution, parking becomes stress-
free and convenient. Simply follow the guidance provided by our system and enjoy a
smoother parking experience."
      </div>

      <br><br><br>

      <button class="btnn"
onclick="window.location.href='http://127.0.0.1:8000/'">Get Started</button>


      <br> <br> <br>
   </div>
   <div class="left">
```

```
<!doctype html>
<html>
   <head>
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <title> Contact Us - Responsive Page Design</title>
   <link rel="shortcut icon" type="image/jpg" href="C:\Users\vavil\Downloads\news2.png"/>
   <style>
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@200&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@300&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@400&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@500&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@600&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@700&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@800&display=swap');
      @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@900&display=swap');
   </style>
   <link rel="stylesheet" href="style1.css">
   </head>
   <body>
      <section>
         <div class="container">
            <div class="contactInfo">
               <div>
                  <h2>Contact Info</h2>
                  <ul class="info">
                     <li>
                        <span><img src="C:\Users\vavil\Downloads\location.png"></span>
                        <span>MALLA REDDY UNIVERSITY<br>
                           MAISAMMAGUDA, SECUNDERABAD<br>
                           501 401</span>
                        </span>
                     </li>
                     <li>
                        <span><img src="C:\Users\vavil\Downloads\mail.png"></span>
                        <!-- <span>Findyourspot_080405@gmail.com</span> -->
                        <span><a href = "mailto:
Findyourspot_080405@gmail.com">Findyourspot_080405@gmail.com</a></span>
                     </li>
                     <li>
                        <span><img src="C:\Users\vavil\Downloads\call.png"></span>
                        <span>7013128225</span>
                     </li>

                  </ul>
               </div>
```

```
href="https://www.facebook.com/share/p/SThis4b4K3UqaQV9/?mibextid=qi2Omg"><img
src="C:\Users\vavil\Downloads\1.png"></a></li>
                <li><a
href="https://www.instagram.com/invites/contact/?i=1o481y4e2mzzk&utm_content=poho4er"><i
mg src="C:\Users\vavil\Downloads\3.png"></a></li>
                <li><a href="https://twitter.com/nassosanagn"><img
src="C:\Users\vavil\Downloads\2.png"></a></li>
                <li><a href="https://www.linkedin.com/in/vavillapally-ashrith-
9823482a1?utm_source=share&utm_campaign=share_via&utm_content=profile&utm_medium=a
ndroid_app"><img src="C:\Users\vavil\Downloads\5.png"></a></li>

            </ul>
          </div>
            <div class="contactForm">
              <h2>Send a Message</h2>
              <div class="formBox">
              <div class="inputBox w50">
                <input type="text" name="" required>
                <span>First Name</span>
              </div>
              <div class="inputBox w50">
                <input type="text" required>
                <span>Last Name</span>
              </div>
              <div class="inputBox w50">
                <input type="email" required>
                <span>Email Address</span>
              </div>
              <div class="inputBox w50">
                <input type="text" required>
                <span>Mobile Number</span>
              </div>
              <div class="inputBox w100">
                <textarea required></textarea>
                <span>Write your message here...</span>
              </div>
              <div class="inputBox w100">
                <input type="submit" value="Send">
              </div>
            </div>
          </div>



    </section>
  </body>
</html>
```

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <meta
      name="description"
      content="EDUINFO is a static website that helps students with the chasing their goal."
    />
    <script
      type="module"
      src="https://unpkg.com/ionicons@5.5.2/dist/ionicons/ionicons.esm.js"
    ></script>
    <script
      nomodule
      src="https://unpkg.com/ionicons@5.5.2/dist/ionicons/ionicons.js"
    ></script>
    <script defer src="script.js"></script>
    <link rel="icon" href="logo.jpg" />
    <link

href="https://fonts.googleapis.com/css2?family=Rubik:wght@400;500;600;700&display=swap"
      rel="stylesheet"
    />
    <link rel="stylesheet" href="style.css" />
    <link rel="stylesheet" href="queries.css" />
    <title>Home - BookQuest</title>
  </head>
  <body>
    <header class="header">
      <a href="#">
        <img class="logo" alt="BookQuest logo" src="logo.jpg" />
      </a>
      <ul class="main-nav">
        <li class="nav"><a class="nav-link" href="#">Home</a></li>
        <li class="nav"><a class="nav-link" href="#contact-me">Contact </a></li>
      </ul>
    </header>
    <section class="search-section">
      <h1 class="heading-primary">Find the perfect book for you...</h1>
      <div class="search">
        <input
          class="search-college"
          type="text
          id="mySearch"
          onkeyup="myFunction()"
          placeholder="Enter your age "
          title="Type in your age"
```

```
<ul id="myMenu" class="search-js">
        <li class="search-list-item">
          <a class="search-list-anchor" href="1-4.html"
            >Age between 1-4</a
          >
        </li>
        <li class="search-list-item">
          <a class="search-list-anchor" href="IITB.html"
            >Age between 5-10</a
          >
        </li>
        <li class="search-list-item">
          <a class="search-list-anchor" href="IITD.html"
            >Age between 11-14</a
          >
        </li>
        <li class="search-list-item">
          <a class="search-list-anchor" href="MIT.html"
            >Age between 15-22</a
          >
        </li>
        <li class="search-list-item">
          <a class="search-list-anchor" href="VIT.html"
            >Age between 23-30</a
          >
        </li>
        <li class="search-list-item">
          <a class="search-list-anchor" href="MRUH.html"
            >Age between 31-39</a
          >
        </li>
        </li>
      </ul>
    </div>
  </section>
  <section class="college-list-section">
    <div class="college-list">
      <a class="college-link college" href="1-4.html">
        <img class="college-logo" src="1-4 -Logo.jpg" alt="I1-4 LOGO" />
        <div class="college-details">
          <p class="college-name">age between 1-4</p>
          <p class="college-location"></p>
        </div>
      </a>
      <a class="college-link college" href="IITB.html">
        <img class="college-logo" src="5-10-Logo.jpg" alt="5-10 LOGO" />
        <div class="college-details">
```

```
    <a class="college-link college" href="IITD.html">
      <img class="college-logo" src="IITD-LOGO.jpg" alt="IITD LOGO" />
      <div class="college-details">
        <p class="college-name">age 10-14</p>
        <p class="college-location"></p>
      </div>
    </a>
    <a class="college-link college" href="MIT.html">
      <img class="college-logo" src="MIT-LOGO.jpg" alt="MIT LOGO" />
      <div class="college-details">
        <p class="college-name">age 15-22</p>
        <p class="college-location"></p>
      </div>
    </a>
    <a class="college-link college" href="VIT.html">
      <img class="college-logo" src="VIT-LOGO.png" alt="VIT LOGO" />
      <div class="college-details">
        <p class="college-name">age 23-30</p>
        <p class="college-location"></p>
      </div>
    </a>
    <a class="college-link college" href="MRUH.html">
      <img class="college-logo" src="MRUH-LOGO.jpg" alt="MRUH LOGO" />
      <div class="college-details">
        <p class="college-name">
          age 31-39
        </p>
        <p class="college-location"></p>
      </div>
    </a>
  </div>
</section>


<!-- ********************************************** -->


<!-- ********************************************************** -->

<footer class="footer" id="contact-me">
  <div class="grid--footer">
    <div class="logo-col">
      <a href="#" class="footer--link">
        <img
          class="footer-logo"
          alt="BookQuest logo"
          src="logo.jpg"
        />
```

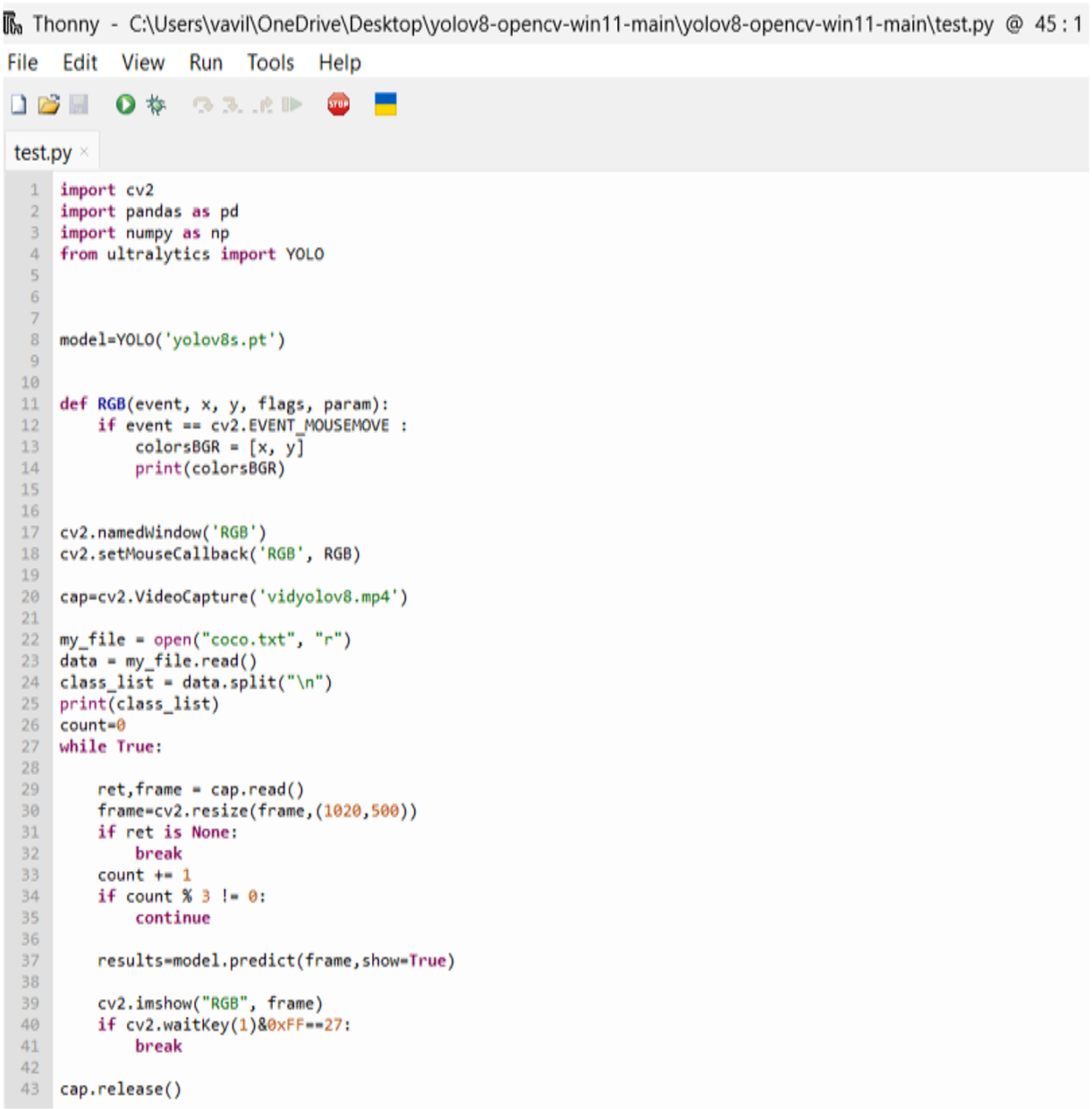
```
</a>
        <ul class="social-links">
          <li class="icon-list">
            <a
              class="footer-link"
              href="https://github.com/ashiishjn"
              target="_blank"
            >
              <ion-icon class="social-icon" name="logo-github"></ion-icon>
            </a>
          </li>
          <li class="icon-list">
            <a
              class="footer-link"
              href="https://instagram.com/aashishjn"
              target="_blank"
            >
              <ion-icon class="social-icon" name="logo-instagram"></ion-icon>
            </a>
          </li>
          <li class="icon-list">
            <a
              class="footer-link"
              href="https://twitter.com/aashiishjn"
              target="_blank"
            >
              <ion-icon class="social-icon" name="logo-twitter"></ion-icon>
            </a>
          </li>
          <li class="icon-list">
            <a
              class="footer-link"
              href="https://www.facebook.com/ashiishjn"
              target="_blank"
            >
              <ion-icon class="social-icon" name="logo-facebook"></ion-icon>
            </a>
          </li>
          <li class="icon-list">
            <a
              class="footer-link"
              href="mailto:BookQuest4365@gmail.com"
              target="_blank">
              <ion-icon class="social-icon" name="mail-outline"></ion-icon>
            </a>
          </li>
        </ul>
```

```
 </div>
      <div class="adress-col">
        <p class="footer-heading">Contact us</p>
        <address class="contacts">
          <p class="address">
            malla reddy university maisamguda kompally, Hyderabad Telangana
          </p>
          <p>
            <a class="footer-link" href="tel:9618607411">+91 9398399385</a>
          </p>
        </address>
      </div>
      <nav class="nav-col">
        <p class="footer-heading">Account</p>
        <ul class="footer-nav">
          <li><a class="footer-link" href="signup.html">Create account</a></li>
          <li><a class="footer-link" href="signup.html">Sign in</a></li>

        </ul>
      </nav>
      <nav class="nav-col">
        <p class="footer-heading">Company</p>
        <ul class="footer-nav">
          <li><a class="footer-link" href="#">About BookQuest</a></li>
          <li><a class="footer-link" href="#">For Business</a></li>
          <li><a class="footer-link" href="#">Careers</a></li>
        </ul>
      </nav>
    </div>
  </footer>
  <p class="copyright">
    Copyright &copy; <span class="year">2022</span> by BookQuest, Inc. All
    rights reserverd.
  </p>
 </body>
</html>
<script>
 function myFunction() {
  var input, filter, ul, li, a, i;
  input = document.getElementById("mySearch")
  if (input !== "") filter = input.value.toUpperCase();
  ul = document.getElementById("myMenu");
  li = ul.getElementsByTagName("li");
  for (i = 0; i < li.length; i++) {
    a = li[i].getElementsByTagName("a")[0];
```

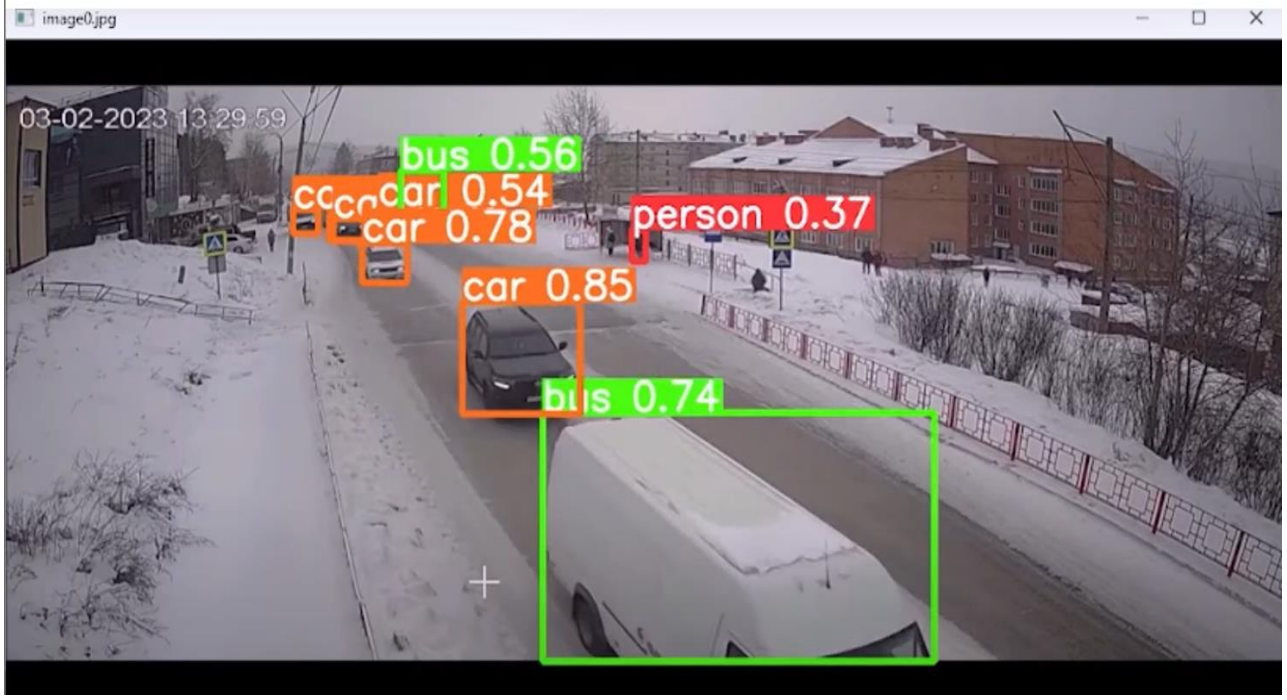
```
if (a.innerHTML.toUpperCase().indexOf(filter) > -1) {
       li[i].style.display = "";
     } else {
       li[i].style.display = "none";
     }
   }
 }
</script>
```

4.2 **MODEL IMPLEMENTATION AND TRAINING**



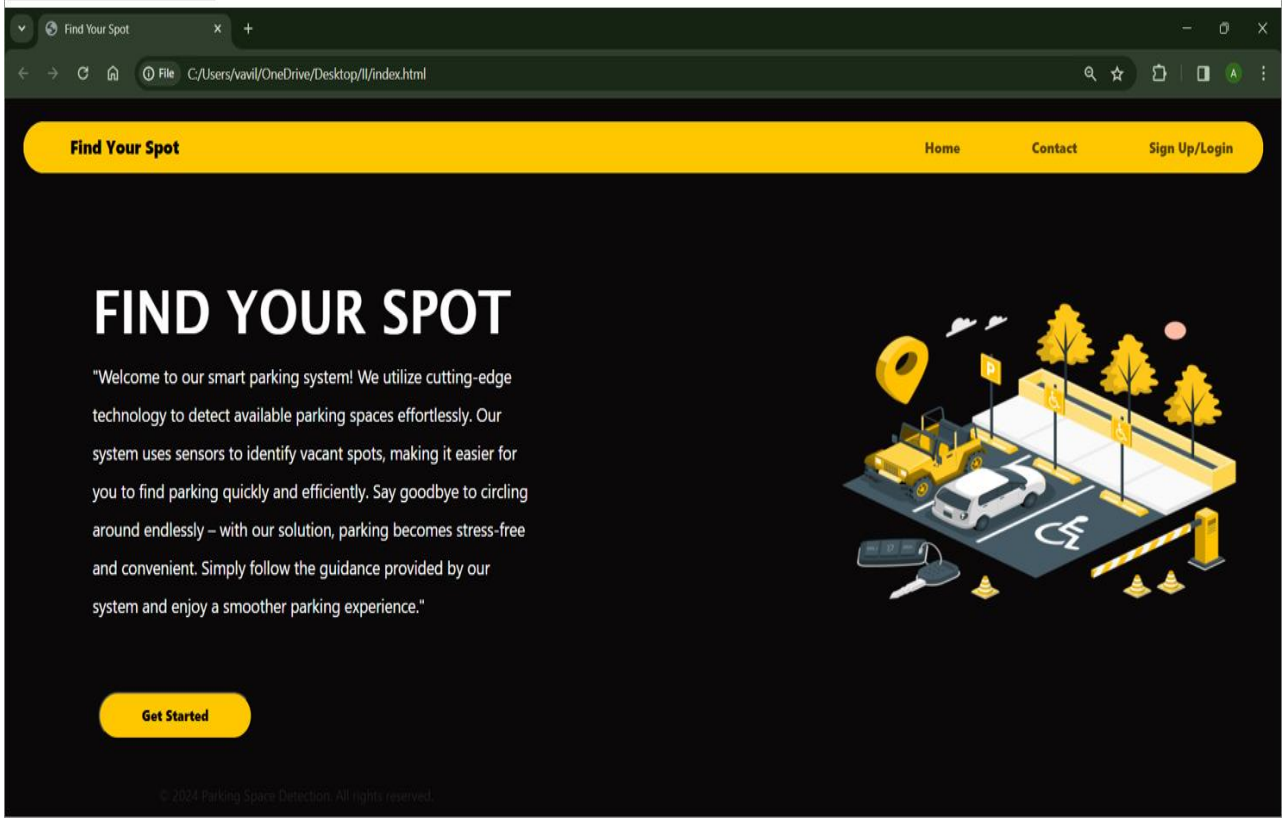
MODEL DEPLOYMENT:

OBJECT DETECTION:



Web GUI's Development & Integration:

GUI SCREEN:



PerfectParking Parking Lots

127.0.0.1:8000/parking-lots

Home Parking Lots Search Sign in Sign up

Parking Lots

Parking Lots

Name	Address	Hours	Is Paid Parking	Latitude	Longitude	Image
Henry Street Left Strip	Henry Street	Paid 09- 17, 2hr limit	True	52.663797090256100	-8.628752240173640	
O'Connell Street	O'Connell Street, Limerick	09:00-17:00	True	52.662742547675100	-8.627915644146310	
Barington Street	Barington Street, Limerick	09:00-17:00	True	52.658504565802500	-8.629324200623040	
Outside St. Johns	New Rd, Limerick, Ireland	09:00-17:00	True	52.663888808578300	-8.616959972127420	
Merchants Quay	Merchants Quay, Limerick	09:00-17:00	True	52.667553203563400	-8.624196369450390	

PerfectParking O'Connell Street

127.0.0.1:8000/parking-lots/2

O'Connell Street

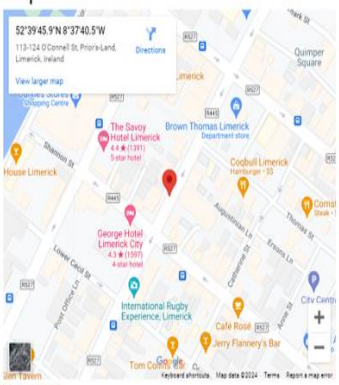
Details

Address
O'Connell Street, Limerick

Hours
09:00-17:00

Total Spaces
12

Map



Images

5 CONCLUSION:

5.1 PROJECT CONCLUSION

In conclusion, our Parking Space Detection project represents a significant step forward in optimizing urban mobility and enhancing the parking experience for drivers everywhere. Through the integration of advanced sensor technologies, real-time data processing, and user-friendly interfaces, we have successfully developed a solution that addresses the perennial challenges of parking space scarcity and inefficiency. Throughout the development process, we have achieved several key milestones. We've implemented robust algorithms capable of accurately detecting and categorizing parking spaces in various environments, from busy city streets to multi-level parking structures. Our system's ability to provide real-time updates ensures that drivers always have access to the most up-to-date information about available parking spots, reducing frustration and congestion. Moreover, our project goes beyond mere detection by offering additional features such as reservation capabilities and seamless navigation to reserved spaces. By empowering users to plan their parking in advance and navigate directly to their designated spots, we're streamlining the entire parking process and making it more convenient than ever before. Looking ahead, we envision further enhancements and potential expansions for our Parking Space Detection project. This may include integration with smart city infrastructure for enhanced connectivity and scalability, as well as the incorporation of machine learning techniques to continuously improve accuracy and efficiency. In summary, our Parking Space Detection project has not only demonstrated the feasibility of leveraging technology to alleviate parking challenges but has also laid the groundwork for a future where finding a parking spot is no longer a source of frustration but rather a seamless and stress-free experience.

5.2 Future Scope

The future of parking space detection is poised for transformative advancements across various fronts. From predictive analytics powered by machine learning algorithms to dynamic pricing models based on real-time demand, the evolution promises to revolutionize how we navigate urban parking landscapes. Integrating with smart city initiatives, parking space detection will become a pivotal component in optimizing traffic flow and reducing congestion. Augmented reality integration offers exciting prospects, providing users with enhanced visual cues for navigating to available spaces with precision. Moreover, the expansion of IoT sensors and connectivity will enable real-time monitoring of parking spots, while multi-modal integration will offer comprehensive mobility solutions. Environmental sustainability will also take center stage, with parking applications encouraging eco-friendly transportation choices and promoting accessibility features for individuals with disabilities. Robust security and privacy measures will ensure the protection of user data, while continuous enhancements in user experience will foster long-term engagement and satisfaction. Together, these advancements will redefine urban mobility, making parking a seamless, efficient, and sustainable experience for all.