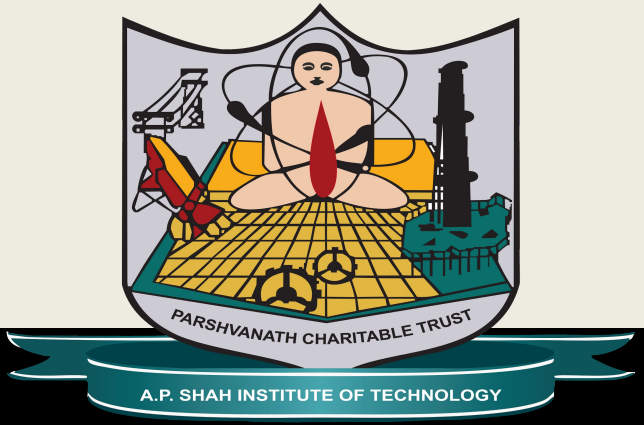

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UNIVERSITY OF MUMBAI

Academic Year 2022-2023

A Project Report on

IoT and ML based Cross Platform Application for Designing Smart Parking

Submitted in partial fulfillment of the degree of
Bachelor of Engineering(Sem-8)
in
INFORMATION TECHNOLOGY

By

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1. Project Conception and Initiation

1.1 Abstract

- The project aims to build a cross-platform smart parking system that can solve parking problems by reducing the time for drivers by searching for vacant positions in car parking lots and also providing efficient parking space utilization.
- It focuses on developing a parking management system based on object detection to detect vacant parking slots in our college premises where automated systems are not installed.
- A smart parking system that involves a camera connected to an application using cloud computing makes use of a less complex Machine Learning model to detect empty positions.
- We train and cross-validate our model using the real-time customized dataset and YOLOv5 algorithm.
- In order to display the reserved spaces based on the data fetched from the model IoT will be used.
- The project for the backend will be using Cloud Services.

1.2 Objectives

- To identify and locate one or more vacant parking slots for vehicles detected through camera.
- To enable drivers to locate any available parking spots and reserve a particular spot through the App GUI.
- To train and test data using YOLO algorithm for maintaining high accuracy.
- To display the count of vacant and reserved parking on OLED dashboard.
- To monitor parking availability based on high precision and detection of parking space using machine learning and image processing.

1.3 Literature Review

Sr. No.	Title	Review
1.	A Multi-storey Garage Smart Parking System based on Image Processing	The Paper state that car drivers and motorcycle riders spend a large amount of time finding an available parking space where slots are spread throughout multiple storeys which causes traffic congestion and long queues. The proposed system design described in the paper uses Python IDLE and the OpenCV library. OpenCV makes use of the combined edge detection and coordinates bound pixel sections in determining whether a parking space in the acquired footage is occupied or not. For the testing of the accuracy and reliability of the parking space identification system, sample videos of actual indoor parking garages were used.

2.	A Camera-based Smart Parking System Employing Low-complexity Deep Learning for Outdoor Environments	The paper state that a smart camera system that consists of a Raspberry Pi 3 attached to a camera utilizes a reduced-complexity deep neural network model to detect vacancy positions. They have trained and cross-validated their model using PKLot-Val dataset and tested the performance of their model using PKLot-Test and SWUpark datasets, accumulating visual information of parking lots at Srinakharinwirot University across several weather conditions. The model has achieved 88% accuracy.
3.	Low Cost Smart Parking System for Smart Cities	The paper state that nowadays the idea of Smart Cities had become very popular. The IoT is addressing the most common problems faced in cities like the availability of car parking and traffic jams, to increase the quality of services offered in cities and to improve the productivity and reliability of urban infrastructure. This paper presents an Internet of Things-based Parking System for Smart Cities. The proposed parking system contains an IoT module deployed on-site for managing the available parking spaces. A platform is provided in the form of a portal for booking parking spaces.

1.4 Problem Definition

- In order to reduce hustle at peak time i.e. time-saving, reduce frustrations, enable accurately sensing vehicle occupancy in real-time, simplify the parking experience, and add value for parking stakeholders.
- This project introduces “IOT and ML based Cross Platform Application for Smart Parking System” using image processing providing a modern & innovative solution for temporary parking places, where no specific approach is used to park a vehicle.

1.5 Scope

The scope for smart parking is significant and continues to expand as cities and municipalities around the world with increasing urbanization and the associated challenges of traffic congestion, air pollution, and parking shortages.

Here are a few areas where the scope for smart parking is particularly promising:

1. Commercial areas
2. Residential areas
3. Public transportation hubs
4. Event parking

1.6 Technology stack

Software -

Frontend : Java

Backend :

- Google Firebase
- Machine learning algorithm - YOLO
- Cloud Platform - Firebase

Hardware -

- IoT - OLED
- CCTV Camera

1.7 Benefits for environment & Society

Smart parking systems have several benefits for both the environment and society, including:

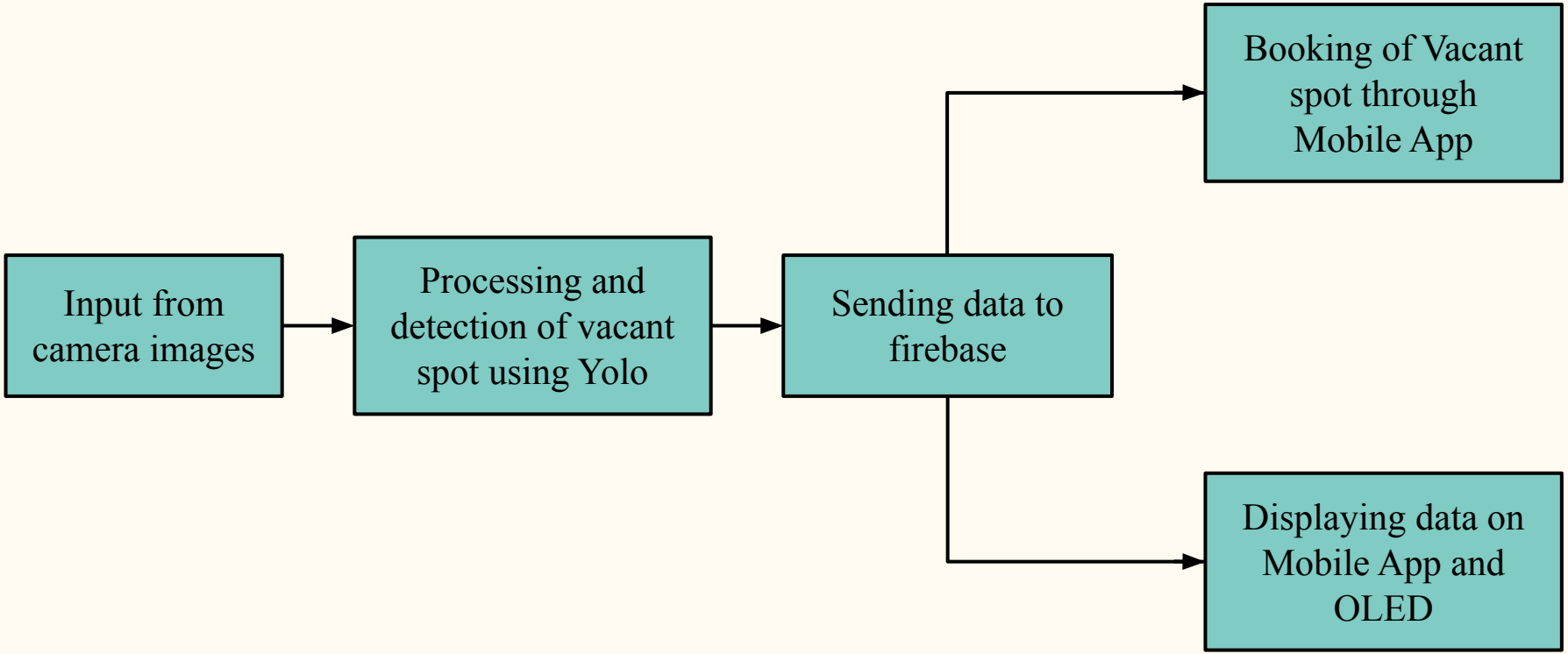
- **Reduced traffic congestion:** Smart parking systems provide real-time information on available parking spots, reducing the amount of time that drivers spend searching for a spot.
- **Improved air quality:** Reduced traffic congestion means fewer idling vehicles, which leads to improved air quality.
- **Increased safety:** Smart parking systems can incorporate safety features such as lighting, cameras, and alarms, which can improve safety for drivers and pedestrians.
- **Enhanced convenience:** Smart parking systems can provide drivers with real-time information on available parking spots, as well as the ability to reserve a spot in advance. This can save drivers time and reduce frustration.

2. Project Design

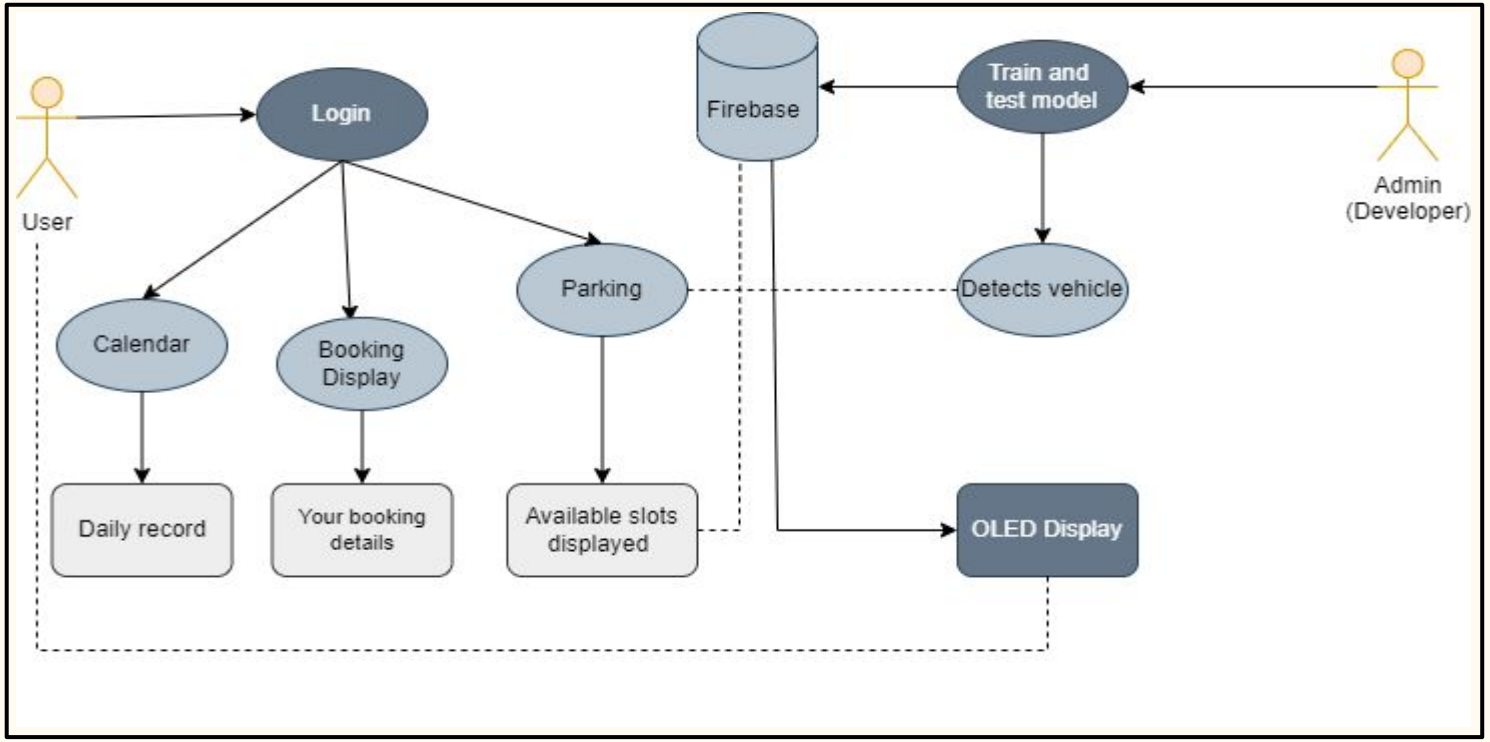
2.1 Proposed System

- The system contains a digital camera installed on the rooftop of our college basement or a few assisting poles at a positive angle where it covers most places of the vehicle parking zone which is being used for taking the input.
- The images received from the camera are then fed to the processing module, which detects the area of interest which includes the place to be included for parking areas.
- A vehicle detection Module uses YoloV5 to track and detect the parking area in an image. The parking area detection module generates the bounding boxes for parking so it can be seen by a person on a vehicle parking app.
- Whenever the user opens the app, he will see the virtual representation of the parking area and the number of vacant areas and reserve a parking spot.

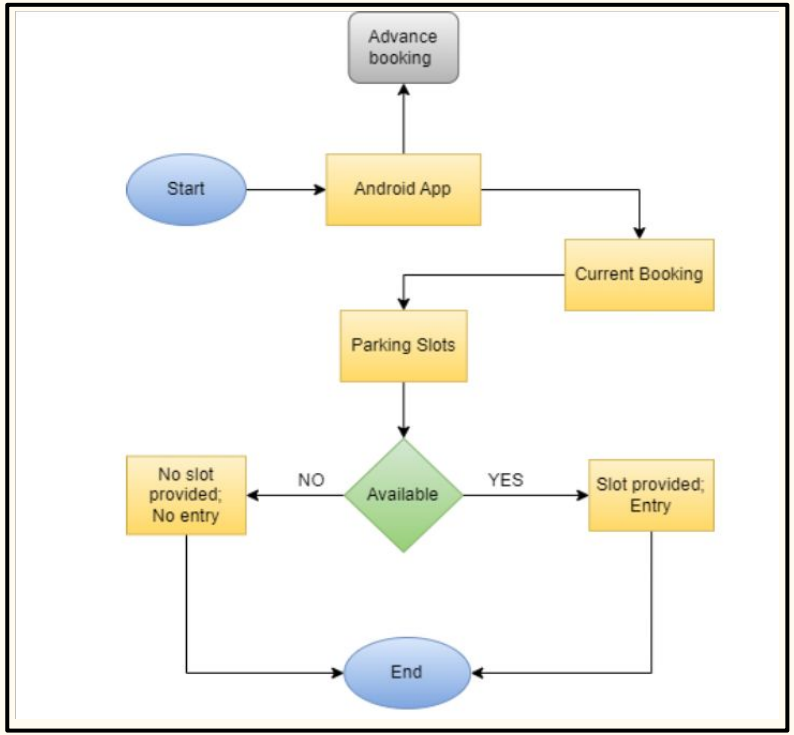
2.2 Design (Flow Of Modules)



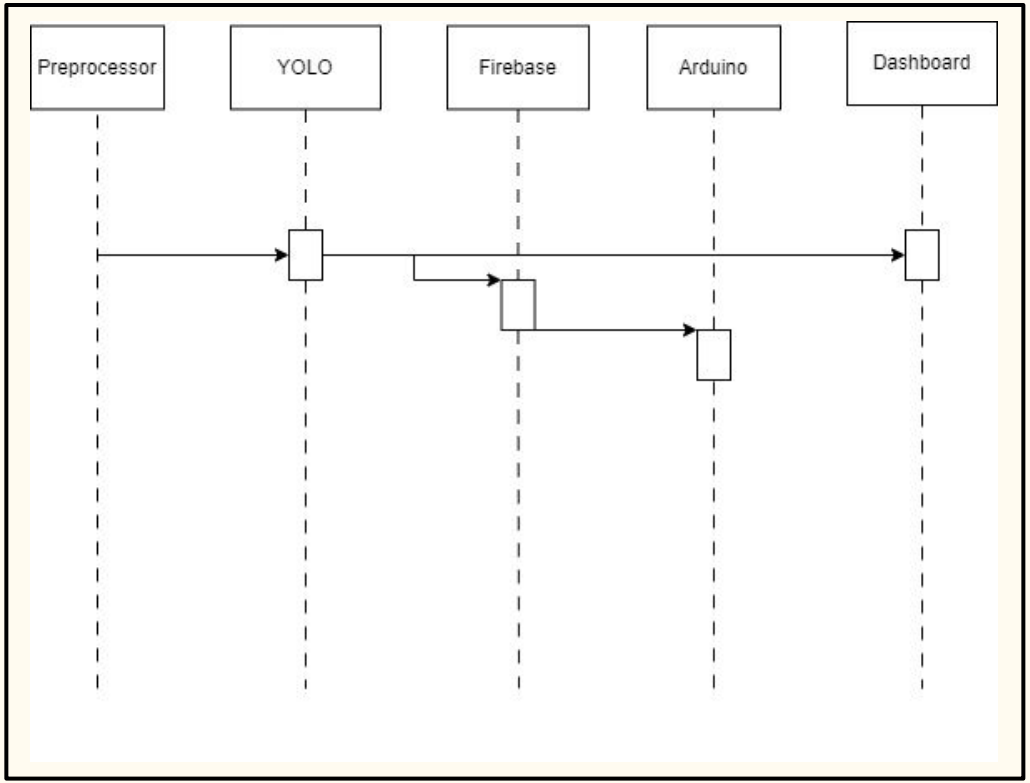
2.3 Description Of Use Case



2.4 Activity diagram

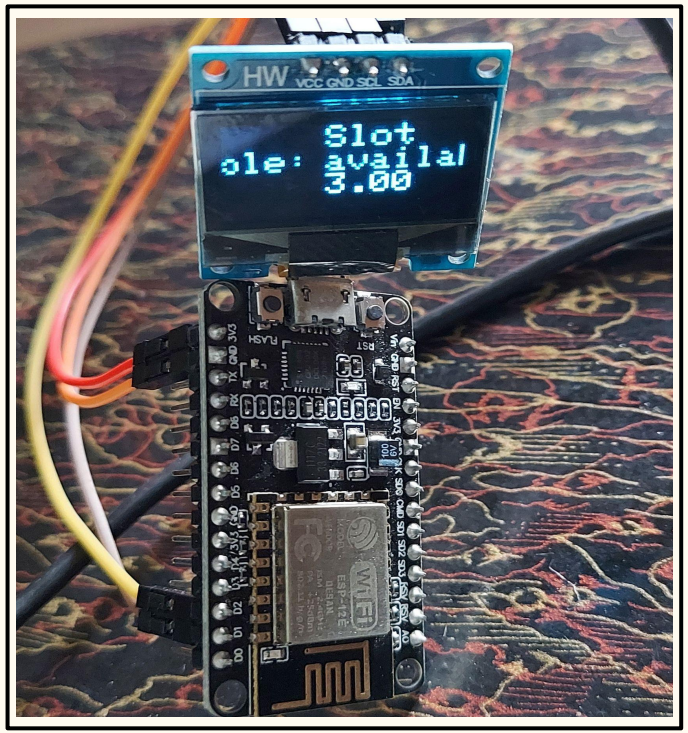


2.5 Sequence Diagram

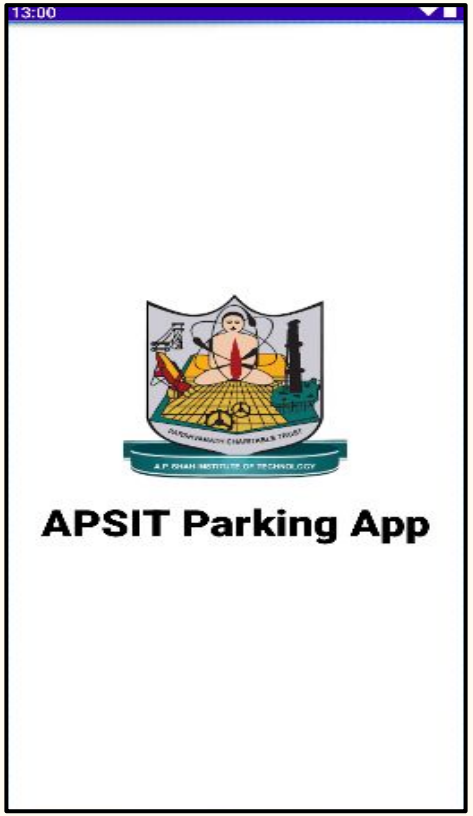


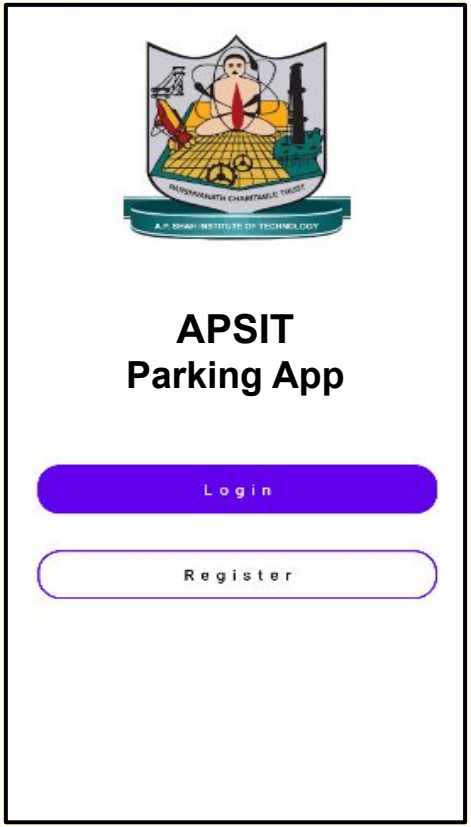
3. Implementation

An organic light-emitting diode (OLED), also known as an organic electroluminescent diode, is a light emitting diode in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current

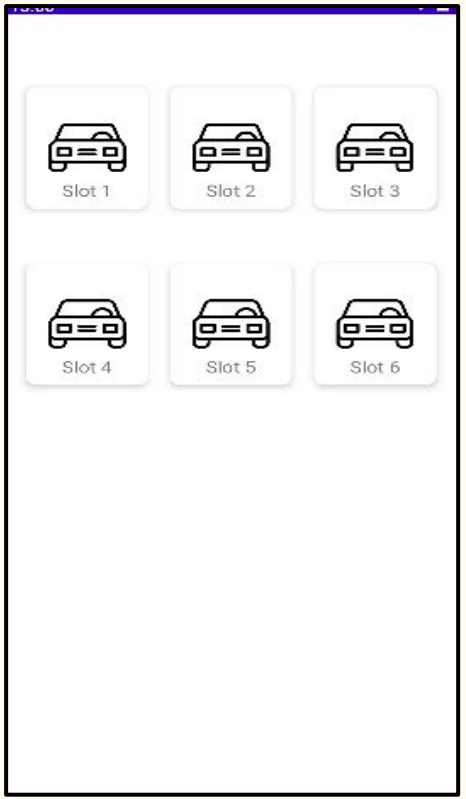


Users can log in by entering his/her email and password and the new user can sign up by clicking on register.

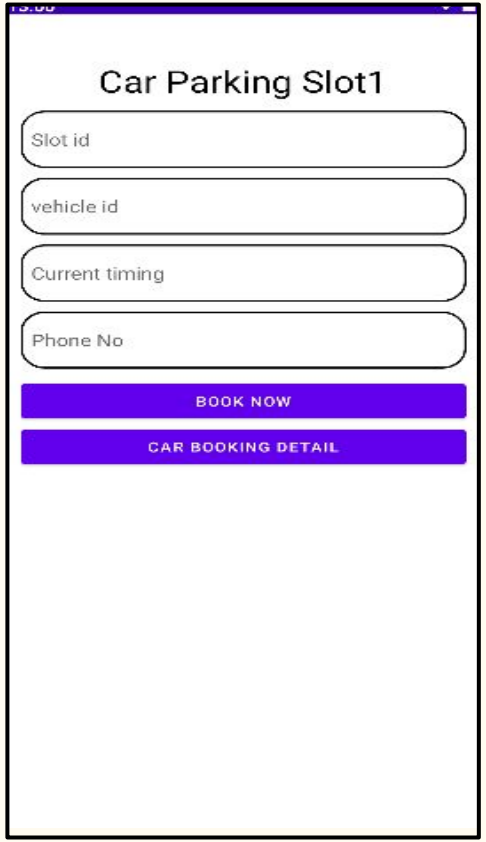


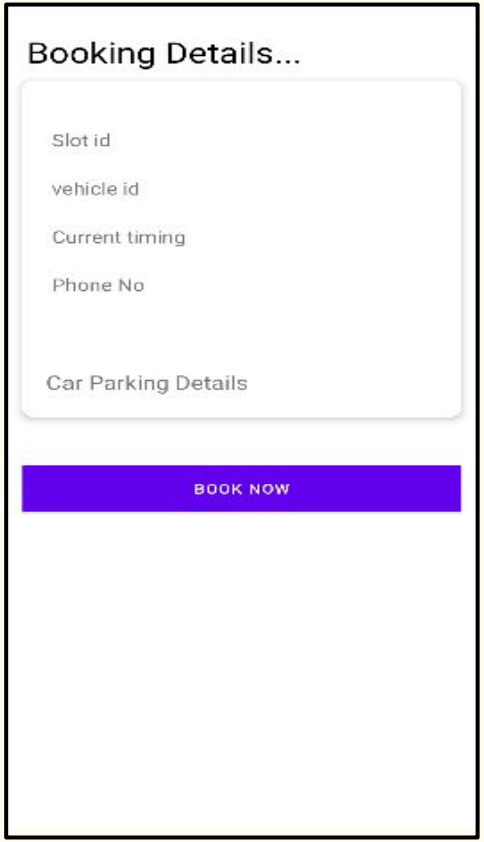


The above figure displays the pages that will be displayed to a user once he logs in to the app using his Login credentials.



The figures below displays the pages where a user can check for available slots and make a booking.





4. Testing

Unit Testing

Unit testing is an important step in the development process, because if done correctly, it can help detect early flaws in code which may be more difficult to find in later testing stages.

Test Cases

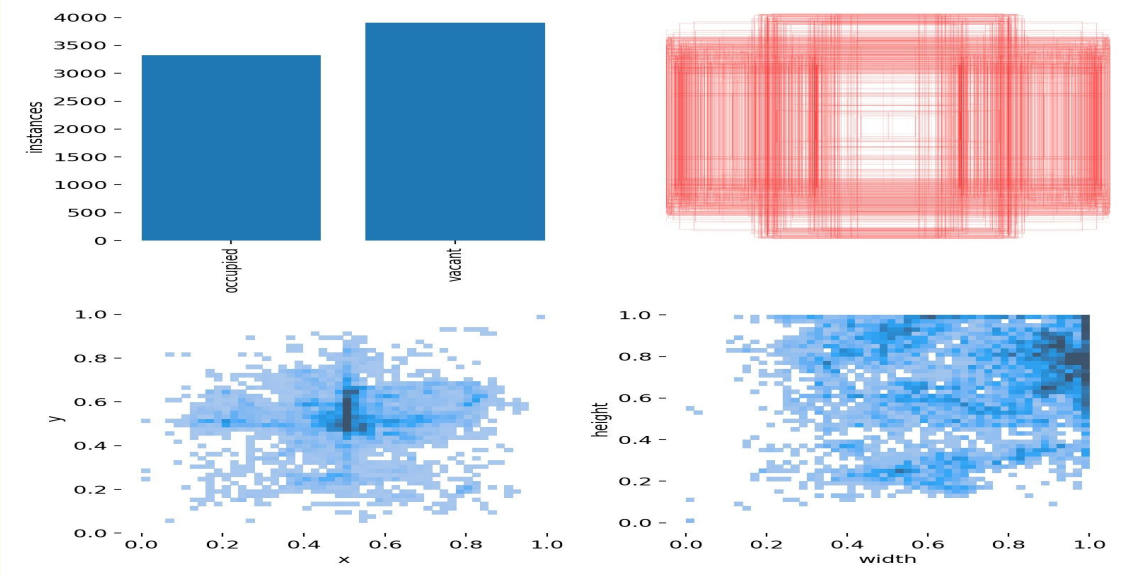
Test Case No.	Test Condition	Test Data	Expected Results	Actual Results	Pass/Fail
1.	Launch App	Application	Launch App	Launching App in environment	Pass
2.	Display count of available or vacant spot on OLED	Output of YoloV5 through Firebase	Display text	Display output received from YOLO	Pass
3.	Display count of available or vacant spot on OLED	Output of YoloV5 through Firebase	Display text	Display output received from YOLO	Pass
4.	Book Parking Spot	User Input	Book App	Booking of vacant Spot	Pass

5. Result

Labels

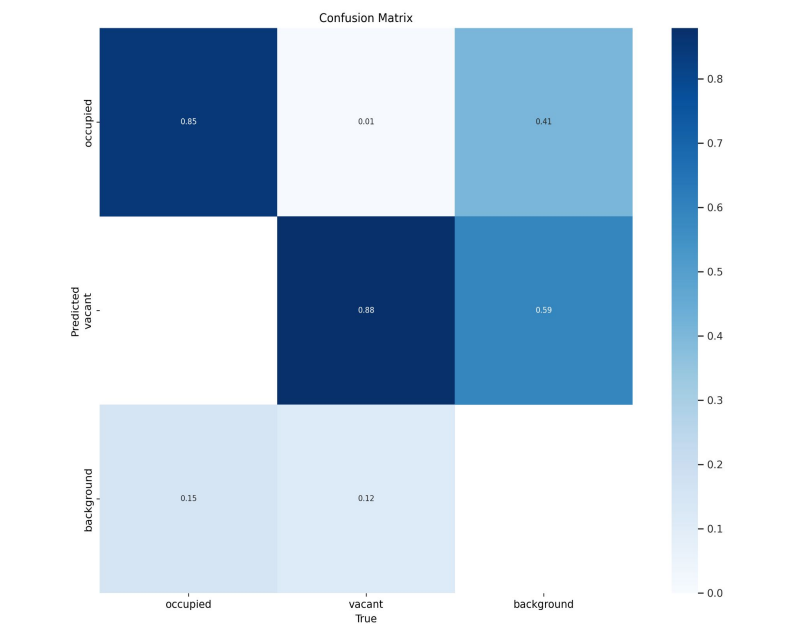
The YoloV5 model was trained with 2 class labels namely occupied and vacant.

The following are the images of the result of the model trained:



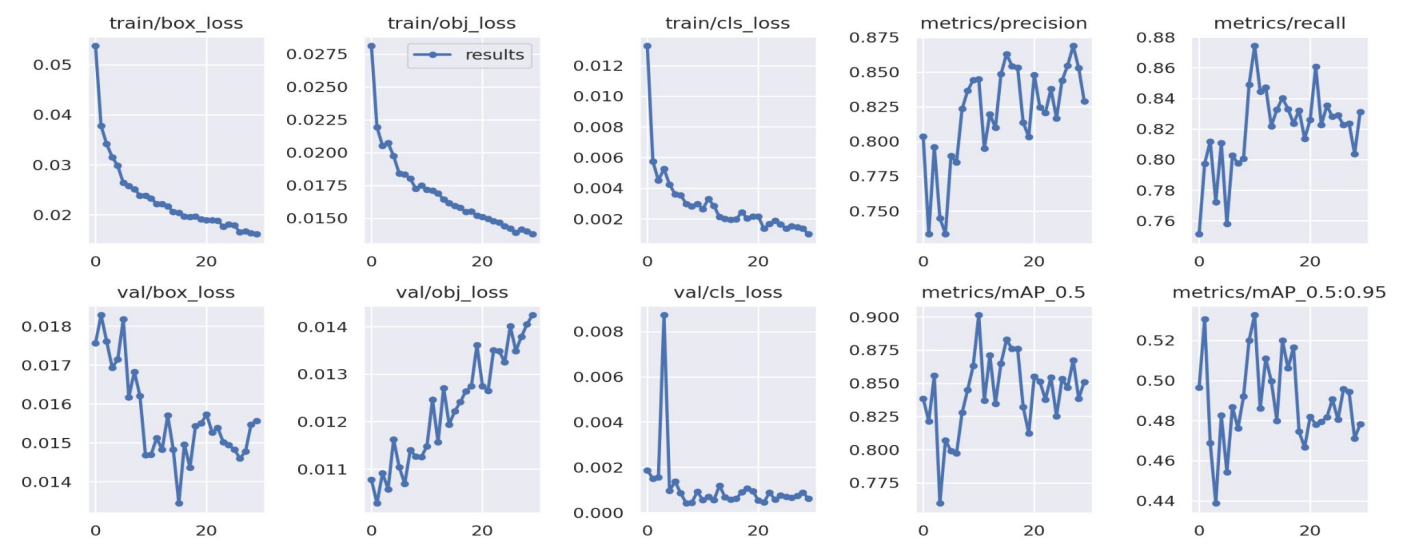
Confusion Matrix

In YoloV5, a confusion matrix is a performance evaluation tool that provides a tabular representation of the model's predictions and the ground truth labels during object detection tasks.



Precision-Recall Curve

The Precision-Recall (PR) curve is a graphical representation of the trade-off between precision and recall in the context of object detection using YoloV5.



6. Conclusion and Future Scope

Conclusion

- The model was trained using the YoloV5 algorithm on a custom dataset with an accuracy of 90 percent as per the evaluation in the stipulated time.
- The proposed design of a Smart Parking System based on Object Detection has been successfully tested and executed using multiple indoor parking area images.
- The user interface was developed using Java and Android Studio.
- The user can get a real-time update on the parking lot to determine whether there are any open spots for them to park their vehicle.

Future Scope

The Proposed design is implemented for a small area of 6 Parking slots in a particular region.

- The proposed idea can be extended for all around the city by providing additional information through the GPS module.
- The parking area can be identified in a particular zone through GSM with a Mobile application.
- The authenticity of the booking can be verified and validated by implementing QR code system.

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2. Chantri Polprasert, Chaiyaboon Sruayiam, Prathan Pisawongprakan and Sirapob Ter Avetchakarn, “A Camera-based Smart Parking System Employing Low-complexity Deep Learning for Outdoor Environments”, IEEE Xplore, 2020-in press.
3. D.Vakula and Yeshwanth Krishna Kolli, “Low Cost Smart Parking System for Smart Cities”, National Institute of Technology, Warangal, Proceedings of the International Conference on Intelligent Sustainable Systems (ICISS), IEEE Xplore, 2017.

Paper Publication

Paper entitled **“IoT and ML based Cross Platform Application for Designing Smart Parking”** is selected to be presented at **“International Conference on Contemporary Challenges in Science and Engineering Applications 2023 (IC3SEA 2023)”** by **“Snehal Shanbhag, Pranjali Shimpi, Akansha Rawat, Prof. Sonal Jain, Prof. Charul Singh and Dr. Kiran Deshpande”** and will be published in Xplore and CSDL.

Thank You