AI Enable car parking using OpenCV

Submitted by

Sai thanmay.A (21BCE7877)

Manishwar.K (21BCE7185)

Sai Gopal.P (21BCE8548)

Varshith.C (21BCE7733)

INTRODUCTION

1.1 Project Overview

Most AI-enabled car parking systems parking a car today are still managed by hand. There is no automated monitoring system in place to keep track of how much capacity each parking place contains. In order to find an empty spot, drivers often have to make a circuitoustrip through the parking lot. Where there are more people than parking spots, such problems are especially common near hospitals, malls, schools, and other large gathering places.

1.2 Purpose

The purpose of using AI-enabled car parking systems with OpenCV (Open Source Computer Vision) is to automate and optimize the process of parking vehicles in a parking lot or garage. By employing computer vision techniques and AI algorithms, these systems can efficiently detect and track vehicles, analyze parking space availability, and guide drivers to vacant spots.

2.1 Problem Statement Definition

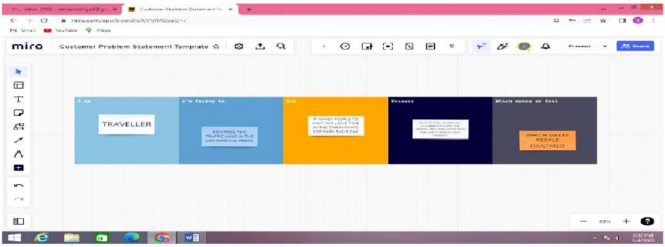
Customer Problem Statement template:

Problem statement 1 :

Consequently, once a car enters a parking garage followed by a parking space, a ping ultrasonic sensor will then be able to determine if a car is parked in the space or not. This information would then be relayed to update the network.

Problem statement 2 :

Avoid excessive parking supply. Use Parking Management to encourage more ef ficient use of existing parking facilities and address any spill over problems that result from pricing. Develop Transportation Management Associations to provide parking management and brokerage services in a particular area.



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Traveller	Control the traffic in car parking	It makes more time	Due to the increased number of cars	Frustrated
PS-2	Traveller	Make the traveller to feel automated	It makes more time	Increased traffic	Frustrated

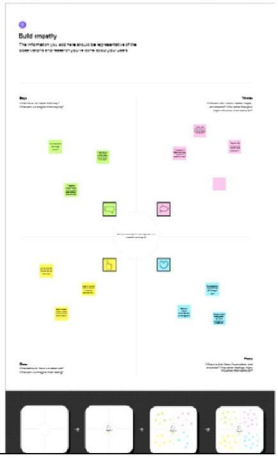
2.2 Empathy Map Canvas

Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understa nd their users.
Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

EXAMPLE:



2.3 Ideation & Brainstorming

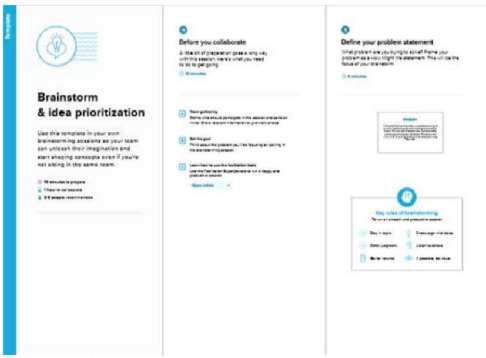
Brainstorm & Idea Prioritization Template:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

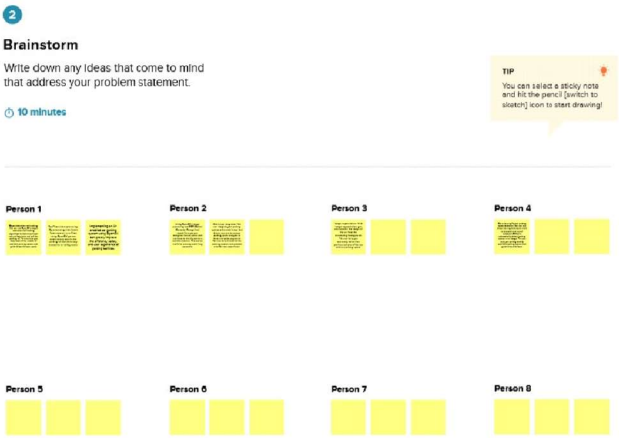
Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Reference: https://www.mural.co/templates/empathy-map-canvas

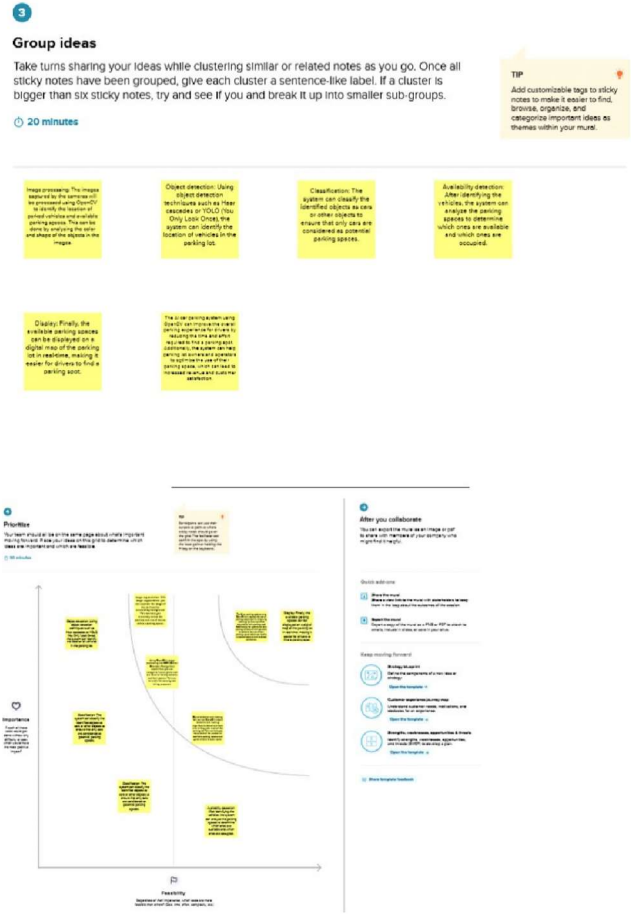
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



2.4 Proposed Solution

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No. Parameter Description

1. Problem Statement (Problem to be solved)

Traditional car parking systems are inefficient and time-consuming. Drivers often have to spend a lot of time searching for an empty parking space, leading to congestion in the parking lot. Additionally, traditional parking systems require manual intervention for ticketing and payment processing, which can lead to long queues and delays.

2. Idea / Solution description The idea behind an AI-enabled car parking system using OpenCV is to leverage the power of computer vision to automate the parking process. By using cameras and image processing algorithms, the system can detect the presence of cars in the parking lot and guide drivers to empty parking spaces. The system can also automate the ticketing and payment processing, making the process faster and more convenient for drivers.

3. Novelty / Uniqueness The use of computer vision technology for car parking systems is a novel approach that can significantly improve the efficiency and convenience of parking. By using OpenCV, the system can accurately detect and track cars, even in crowded parking lots. Additionally, the use of AI algorithms can optimize the parking process by analyzing parking patterns and occupancy rates

4. Social Impact / Customer Satisfaction An AI-enabled car parking system using OpenCV can have a significant social impact by reducing traffic congestion and improving the overall driving experience. By guiding drivers to empty parking spaces, the system can reduce the time spent searching for parking and minimize traffic congestion in the parking lot. Additionally, by automating the ticketing and payment process, the system can improve the convenience and efficiency of the parking process.

5. Business Model (Revenue Model) The business model for an AI-enabled car parking system can be based on a pay-per-use model, where drivers pay a fee based on the duration of the parking. The system can be integrated with a payment gateway to enable online payments, making the process faster and more convenient for drivers. Additionally, the system can generate revenue by collecting data on parking patterns and occupancy rates, which can be used by parking lot operators to optimize the parking process.

6. Scalability of the Solution An AI-enabled car parking system using OpenCV can be easily scaled to accommodate large parking lots and multiple parking locations. By using a centralized database and cloud-based architecture, the system can easily handle large volumes of data and support multiple users. Additionally, the system can be customized based on the specific requirements of the parking lot, making it adaptable to different environments and use cases.

3. REQUIREMENT ANALYSIS

3.1 Functional requirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User authentication	Capture and store user's face image Authenticate user's identity based on face recognition Allow access to parking lot upon successful authentication

FR-2	Parking spot management	Detect availability of parking spots using camera feed Assign parking spot to the user Update parking spot availability in real-time
FR-3	Payment and billing	Calculate parking fee based on parking duration Allow payment via various modes like credit card, mobile wallet
FR-4	Security and surveillance	Monitor parking lot using cameras for suspicious activities Alert security personnel in case of any security breach
FR-5	System maintenance and support	Provide regular maintenance and updates to the system Offer customer support for any issues faced by users

3.2 Non-Functional requirements

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system should be easy to use and user-friendly, providing clear instructions to drivers on where to park and displaying available spots in an intuitive manner.
NFR-2	**Security**	The system should be secure and able to prevent unauthorized access to the parking lot. It should also protect the data collected by the system, ensuring that it cannot be accessed by unauthorized parties.

NFR-3	**Reliability**	The system must be reliable and accurate in detecting and identifying available parking spots. It should also be able to identify and prevent unauthorized access to the parking lot.
NFR-4	**Performance**	The system must be fast enough to detect and identify available parking spots in real-time, allowing drivers to quickly find a parking spot. It should also be able to handle multiple vehicles entering and exiting the parking lot simultaneously.
NFR-5	**Availability**	The system should be compatible with different types of vehicles, including cars, trucks, and motorcycles, and be able to accommodate different sizes of vehicles.
NFR-6	**Scalability**	The system should be able to handle a large number of parking spaces, and be easily scalable to accommodate additional spaces in the future.

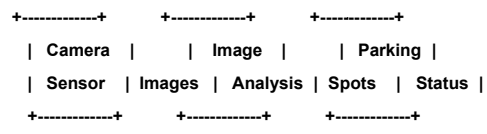
4. PROJECT DESIGN

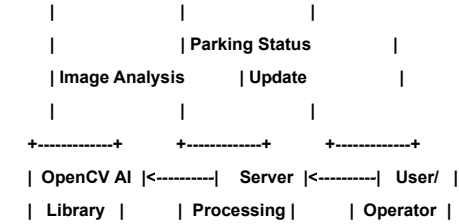
4.1 Data Flow Diagrams

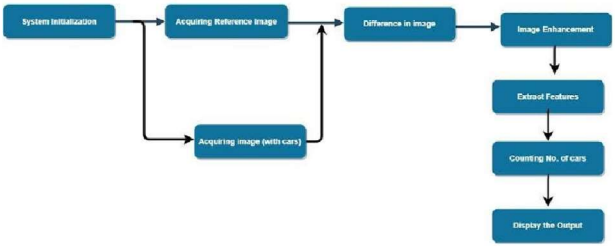
Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system.A neat and clear DFD can depict the right amount of the system requirement graphically.It shows how data enters and leaves the system, what changes the information,and where data is stored.

Example: (Simplified)





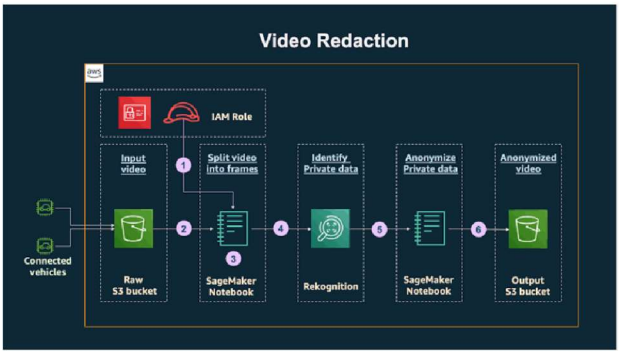


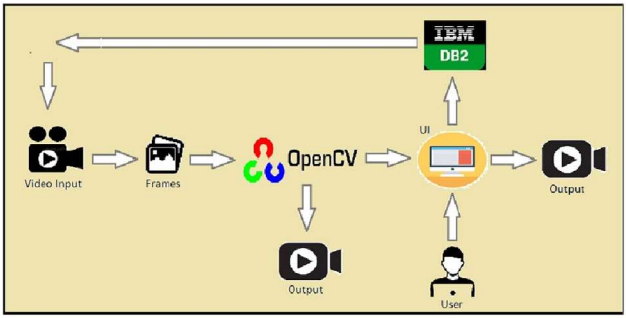
4.2 Solution & Technical Architecture

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.





Example - Solution Architecture Diagram:

Figure 1: Architecture and data flow of the car parking using open cv

4.3 User Stories

User Stories

Use the below template to list all the user stories for the product.

Customer (driver)	Registration	USN-1	As a driver, I want to be able to enter the parking lot and have the system detect a parking space so that I can park my car.	The algorithm can detect empty parking spaces with an accuracy rate of at least 95%.	High	Ragul
		USN-2	As a driver, I want to be able to reserve a parking space so that I am guaranteed a spot when I arrive.	The reservation system can handle multiple reservations at the same time.	Medium	Ragul
		USN-3	As a parking lot attendant, I want to be able to monitor the parking lot in real-time so that I can manage the parking spaces effectively.	The system provides real-time updates of occupied and available parking spaces to the attendant.	High	Ragul
		USN-4	As a parking lot owner, I want to be able to generate reports on parking lot usage so that I can make informed decisions about pricing and capacity.	The reporting system can generate reports on parking lot usage by hour, day, and month.	Medium	Ragul
	Traveller	USN-5	As a parking lot user, I want to be able to pay for my parking spot using my mobile device so that I don't have to use cash or a credit card.	The mobile payment system is secure and uses encryption to protect user information.	Low	Sampath
	Dashboard					
Customer (Web user)						
Customer Care Executive						
Administrator						