

Smart Parking System for Navi-Mumbai Airport

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Abstract -A commercial airport parking system has to deal with many problems such as unnecessary traffic congestion which is mainly caused due to the lack of smart and systematic parking. This eventually causes the time loss of the users while causing unwanted delays in their individual journey. Due to the lack of employees as well as inefficiency in their employment skills, the users again have to face various problems. All these problems ultimately lead to dissatisfaction in the experience of users. Its final capacity will be to handle 90 million passengers. Considering the problems mentioned above, we are providing a designed parking layout which includes a ground floor plan and a typical floor plan with all the basic amenities like washrooms, staircases, waiting areas, elevators, etc. This paper analyses a few parking apps and software and then suggests to build a dedicated app for the airport parking system which will help to counter the problems faced while enhancing the user's experience. The smart features which should be included in the app are license plate recognition, online parking prepayment, parking guidance, vehicle Detection sensors and automated payment stations, unique code for the parking slot of the user's vehicle.

Keywords – applications, airports, mlcp, Smart Parking systems, technologies

1. Introduction

The project intends to make an efficient airport parking system for the Navi- Mumbai airport by using various smart methods and technologies which will make a convenient, comfortable and systematic Process of parking the vehicles in the Multi-Level Car Parking (MLCP) after analysing the data of the existing airport in Mumbai (CSMIA). Some of the advantages are Increase revenue from parking by maximizing occupancy and turnover, Enhance relationships with airline customers by making it easier for their passengers to arrive on time for travel.

Get a clear understanding of parking demand, enabling airports to plan more effectively for future parking infrastructure. The disadvantages are Expensive Construction & Installation, requires regular Maintenance. The parking systems are usually automated, but they require regular maintenance to ensure everything is working smoothly and system breakdown. Due to the insufficiency in existing parking systems, the end users (common public) face issues like consumption of unnecessary time in finding free parking spaces, absence of precise location of user's vehicle, passively affecting airport reputation.

With the help of implementation of smart parking systems, the above problems could be tackled easily while enhancing the user's experience and making it time efficient as well.

2. Literature Review and Objectives

2.1. Literature Review

To address the upcoming parking challenges, a comprehensive two-part plan is proposed. The first part involves reimagining the physical layout of terminal curb side parking areas. The second part of the plan introduces an Autonomous Vehicle-based Traveller Information System (AV-TIS) [1]. The core of this proposed smart parking system involves the deployment of on-site slot modules, each responsible for monitoring and indicating the availability status of individual parking spaces. Additionally, a user-friendly mobile application accompanies the system, enabling end-users to conveniently check the availability of parking spaces and make bookings accordingly [2].

The paper suggests that when a user needs to check the status of their vehicle in the airport parking lot, they log on to the airport's web link using their designated ID and password. Through the IOT infrastructure, they can then view the real-time status of their car in the parking lot [3]. This research project focuses on designing a multilevel car park to alleviate traffic challenges in public areas, drawing from numerous case studies. In the development of such parking systems, various aspects need to be carefully considered. These include the arrangement of decks and ramps, dimensions of bays and aisles, ramp specifications, grid planning, pathways to exit barriers, travel distances from cars to their destinations, security measures, visibility considerations,

camera placement, space allowances, and provisions for lifts [4].

The paper explores the evaluation of existing parking systems utilized at airports and the implementation of Smart solutions within the context of Smart airport operations. The objective of this research paper is to investigate Smart parking as an integral component of the broader Smart airport concept [5]. This paper investigates the problems of car parking system in Malaysia and finally proposed a Wireless Mobile-based Car Parking System using low cost SMS service. This paper demonstrates the design and implementation of Wireless Mobile-based Car Parking System (WMCPS) using SMS services by Breadth First Search (BFS) algorithm in finding the nearest parking space for drivers [6].

2.2. Objectives

This work aims to provide a smart parking system for the Navi Mumbai International Airport. The objectives of the paper are:

- To provide a better and smart parking system for the new airport considering data of existing airport located in Mumbai (CSMIA).
- To provide the general layout of the parking lot of Multi Level Car Parking (MLCP) for the new airport with the new implemented methods.

3. Methodology

The methodology adopted for the research study is described in the form of a flowchart in Figure. 1. The flowchart explains the steps which are followed for the proper explanation of the methodology. As shown below in the figure, the methodology is bifurcated in 4 steps, namely

- Collection of data
- Analysis of data
- Design of parking layout with explanation
- Suggestions of apps and software having smart technologies

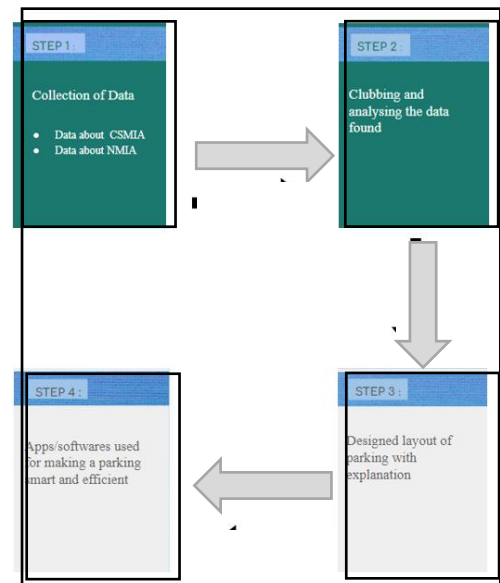


Fig 1: Flow chart of the methodology followed

3.1 Step 1:

3.1.1 Data on NMIA:

The CMO in a statement said that the airport stands on an area of 11.4 km and will have two runways. The first phase will have four terminals that will accommodate 42 aircrafts. There will be a parking space for about 5500 cars. The CMO in a statement mentioned that the airport will accommodate nine crore passengers annually, bringing immense relief to the residents of Mumbai Metropolitan Region.

3.1.2 Data on CSMIA:

CSMIA has a well-planned car parking facility at both domestic as well as international terminals. The car parking capacity as per terminals is as follows:

Domestic Terminal (T1) – 750 car slots.

International Terminal (T2) - 1500 car slots.

Thus, the total number of car parking at the CSMIA comes out to be 2250. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) has registered a strong passenger traffic of around 44 million in the financial year 2022-23. The MLCP (Multi Level Car Parking) at CSMIA evolved into a structure with 10 parking levels including three levels of basement with a total area of 250,000sqm.

3.2 Step 2:

Analysis of data:

Since we couldn't find any information for the area of car parking for NMIA, we considered the parking area of the existing airport i.e. CSMIA which turned out to be 25,000 sq. m. at each level of the MLCP. While looking at the data of CSMIA, the passenger traffic was 44 million and the designed car parking slots was 2250, we noticed an increase in the car parking slots of NMIA, which was 5500, and this was due to

the increase in the estimated annual passenger traffic which is 90 million, almost double of the current annual passenger traffic of the existing airport.

3.3 Step 3:

3.2.1 Design of parking layout with explanation:

Explanation:

The below layouts are proposed for the parking system of Navi Mumbai International Airport. The layouts shown below are designed on the AutoCAD software, these are 2 layouts and one is the ground floor plan while the other one is the typical floor plan. This MLCP of 12 storeys is actually a joint of 4 different buildings which are connected with the RCC structure but works independently as 4 different buildings under one roof and has a total number of 5824 parking slots. These are divided into

4 buildings as mentioned below namely building A, B, C and D. The purpose of making such a design was efficient traffic distribution. With this design, it will be convenient for the users to operate the system, as there are four entry and exit points with a ticket office and with all the basic requirements and amenities like public washrooms, waiting area, 3 stair cases (2 public staircase and one near the waiting area), 2 elevators, parking for the disabled and ducts in each building. The parking slots on the ground floor is 400 out of which there are 18 disabled parking spaces and 452 parking slots out of which 12 disabled parking spaces on each floor (from floor 1 to 12). The required number of parking slots were 5500, but keeping in mind about the future traffic forecast, the parking has additional 324 parking slots. The indication of arrows are for the users to find the path for their respective parking slots guiding all the way from entrance to the exit.

Ground Floor Plan:

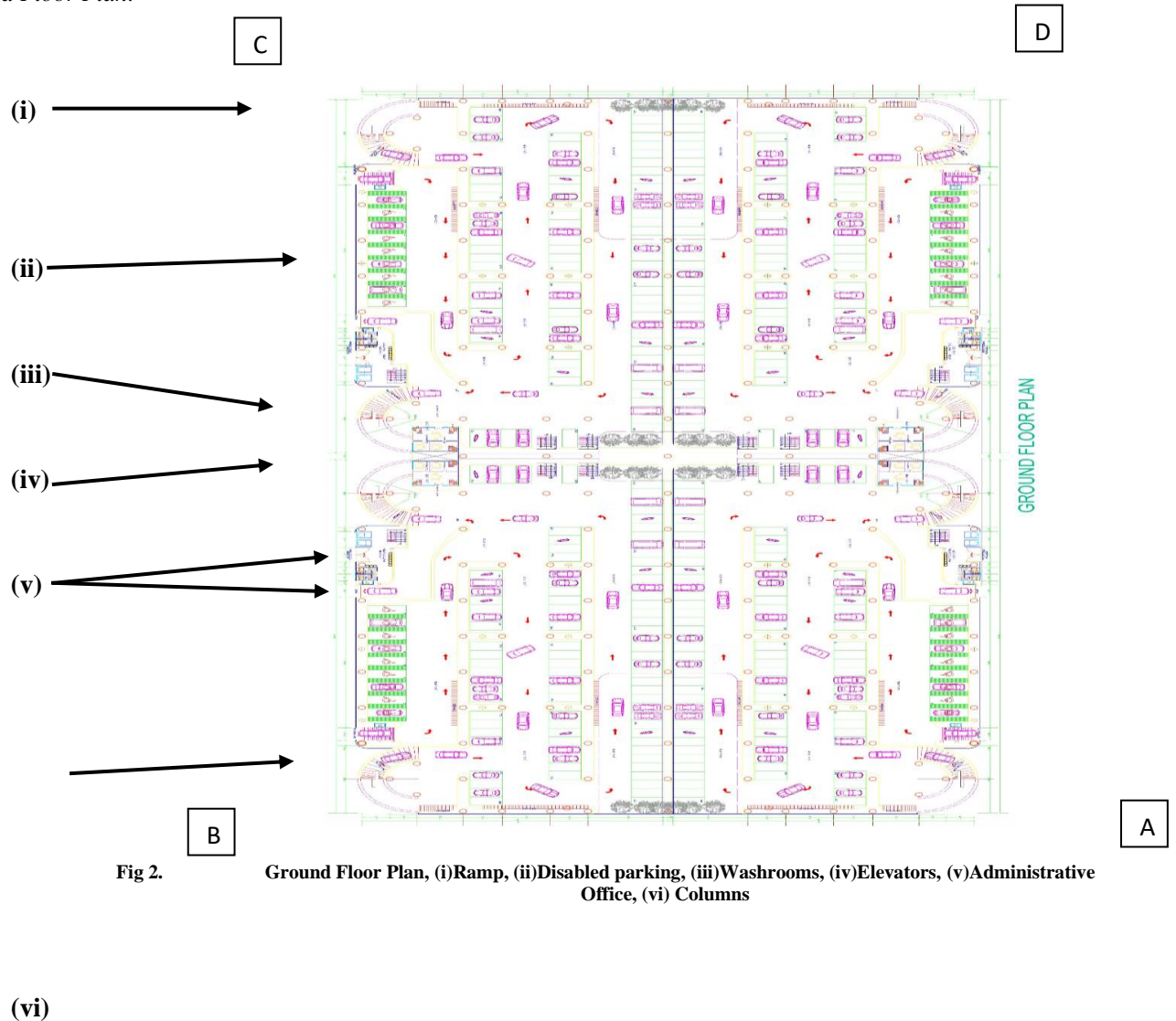


Fig 2. Ground Floor Plan, (i) Ramp, (ii) Disabled parking, (iii) Washrooms, (iv) Elevators, (v) Administrative Office, (vi) Columns

Typical Floor Plan:

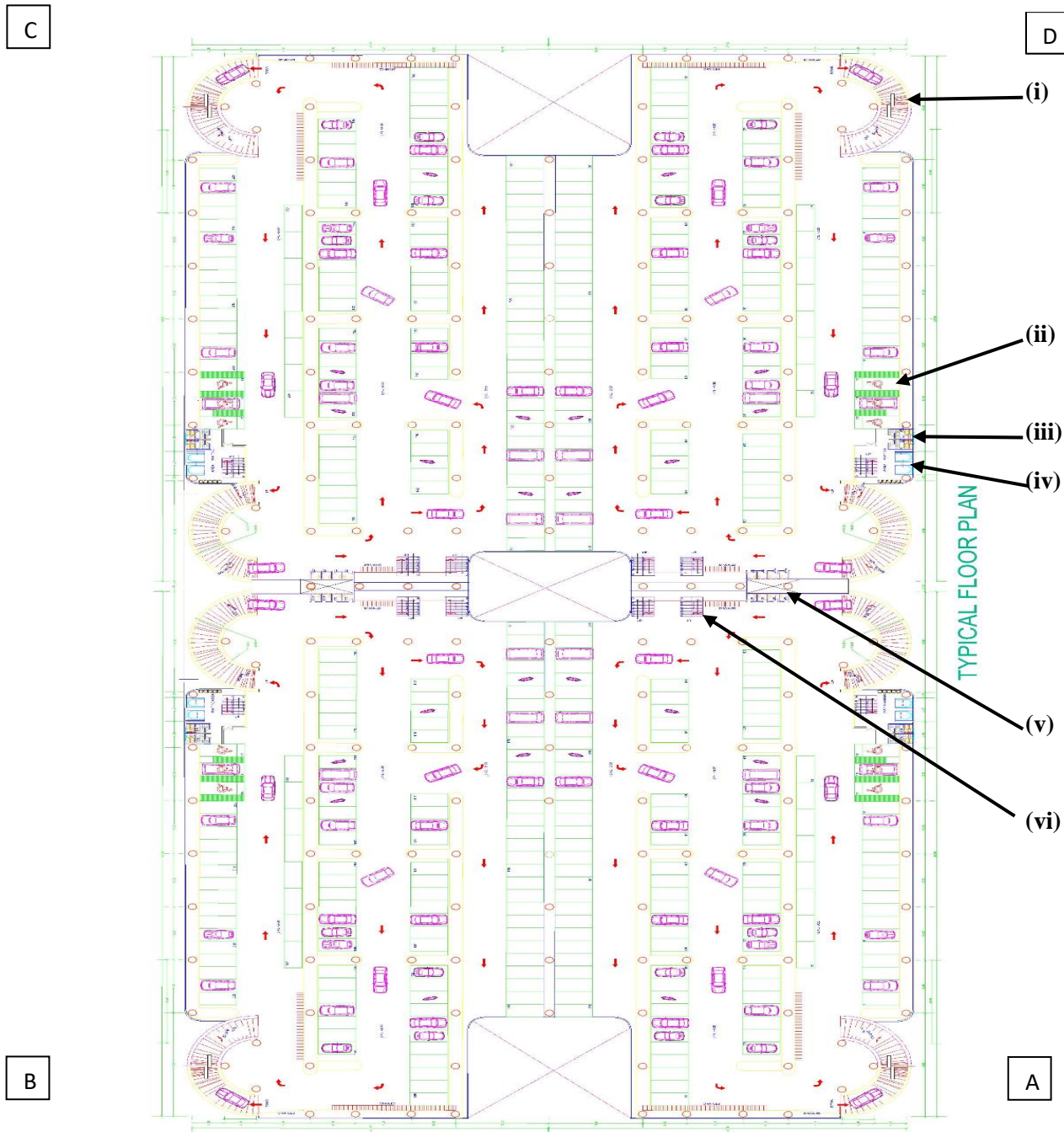


Fig 3. Typical Floor Plan, (i)Ramp, (ii)Disabled parking, (iii)Washrooms, (iv)Elevators, (v) Washrooms, (vi)Staircases

This parking system is not like the existing parking system of CSMIA. The report makes reference to the parking system of CSMIA but various technologies are implemented to make this parking system smart and convenient for the users. The user can check the availability of parking slots on the mobile application of the airport. Once the user comes to know about the parking vacancies beforehand, they can go to the respective buildings (A/B/C/D) whichever is convenient which will directly help the users by saving their time in finding the parking slots.

3.4 Step 4:

Suggestions of apps and software having smart technologies:

3.4.1 Just Park Parking mobile application:

This application offers a smarter way to find guaranteed parking spaces before you leave your destination from the user's place. It depends on the user to book a parking space according to their convenience for a few hours, a day or a

week and even for a month. It even offers the users to monetize their empty parking space by providing it for others to park on a rental basis according to their own convenience.

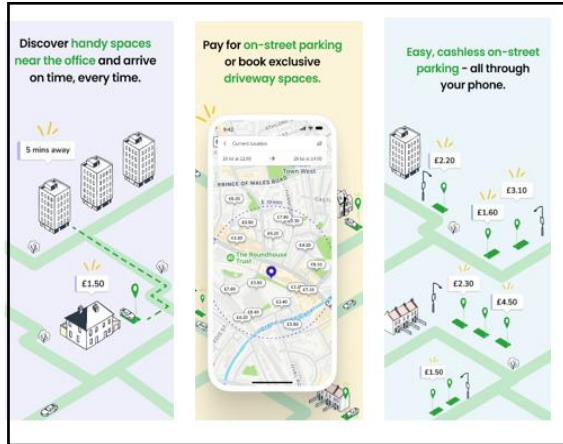


Fig 4. Photos of the apps suggested

3.4.2 YourParkingSpace - Mobile parking application :

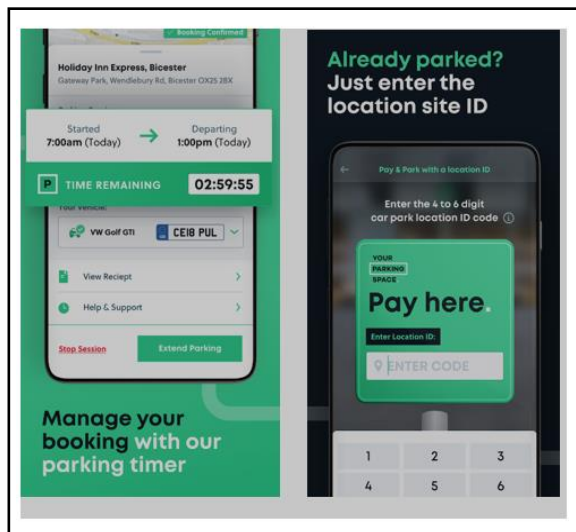


Fig 5. Photos of the apps suggested

This application provides the user with a 4-6 digit car park location ID code. It also helps the users to find its nearest fuel station. It also provides the user to have an option of making a pre-payment or post-payment depending on their time of booking. It depends on the user to book a parking space according to their convenience for a few hours, a day or a week and even for a month.

3.4.3 Airport Parking Reservations mobile application:

This application helps you find the pre-flight airport parking lots as per the user's convenience. It also let you know the empty parking spaces near the airport to avoid the last minute hassle and chaos.

Working of the application:

Select your airport of departure, enter your parking dates, and click SEARCH. The next page will display a list of lots in that area. You can click on the name of each facility to see a summary page that includes hours of operation, shuttle frequency, and other helpful information.

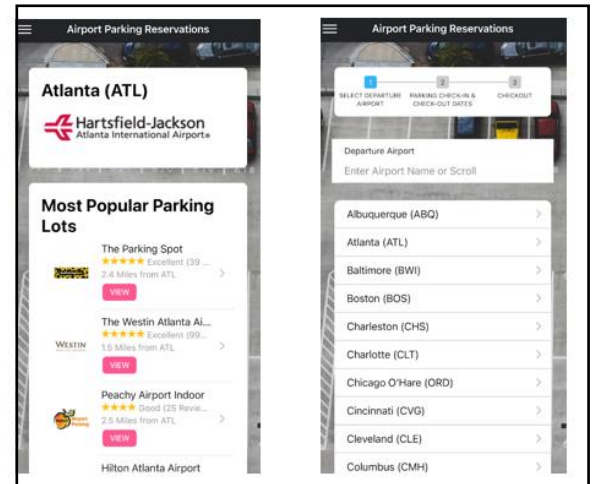


Fig 6. Photos of the apps suggested

3.4.4 Park360 parking software :

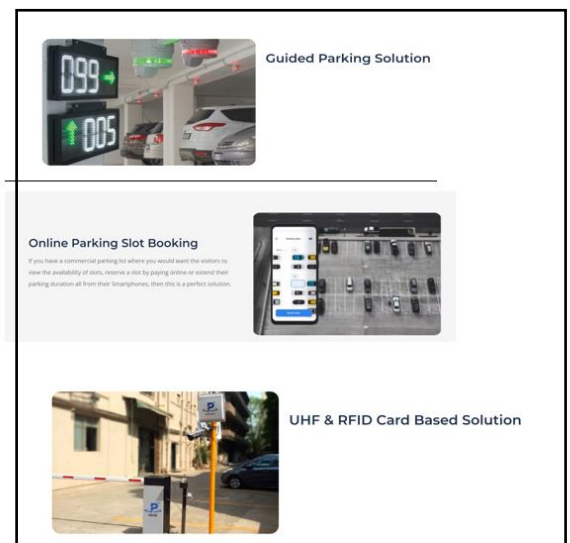


Fig7. Photos of the apps suggested

This software provides ANPR camera based solution (Automatic Number Plate Recognition), pay and park solution, smart QR based solutions, online parking slot booking, guided parking solutions and a UHF & RFID Card Based Solution. The system is built in such a way that there is no requirement of manpower and the user can breeze in or out freely without any physical contact or staff dependency.

- This report suggests designing a mobile application with the reference to the above mentioned existing applications/software.

- The necessary features from all the different apps should be compiled in one mobile application which is to be designed for the new airport.
- This report is constrained till the parking design layout only and it only suggests various technologies used in existing applications which can be used in designing the software for the airport.

4. Conclusion

- After observing various literature reviews, this research paper gets an overview of the problems faced with the existing methods of parking and also an overview of the technologies that should be implemented to make parking smart and efficient.
- After analysing the traffic study and the parking system including the design of the MLCP of the existing airport, the report comes to a conclusion of building a 12 storeyed MLCP with a total parking slots of 5824 including the ground floor and the total area of the MLCP is 20,000 sq. m per floor.
- To explain it further, the report has suggested a typical floor plan and a ground floor plan mentioned in the above section. As specified earlier, the MLCP is a joint structure of 4 individual MLCPs where each MLCP works independently as a separate unit only to solve the purpose of traffic congestion for the users in the process of parking.
- The report also analyses the various mobile applications with specific features used for their individual purposes to make an efficient and smart parking system for the users. On the basis of those applications, the report suggests to build a specific app just for the NMIA parking which includes various features like the user can check the availability of parking slots on the mobile application of the airport and then the user can book their parking slot depending on the vacancies and the users will have a choice to either make a pre or post payment.
- With the provision of the design layouts of MLCP and the technologies that should be implemented in the mobile app together will create a greater impact on the parking system while making it smart, efficient and different from the parking systems in the existing airports.

REFERENCES

- [1] Carlos Sun,(2019),Airport Parking System Design in the Age of Autonomous Vehicles, University of Missouri,pg.2
[\[https://onlinepubs.trb.org/onlinepubs/acrp/docs/UniversityDesign/pdfs/CompetitionWinners/2019-ACRP-Design-Competition_3rd_Management.pdf\]](https://onlinepubs.trb.org/onlinepubs/acrp/docs/UniversityDesign/pdfs/CompetitionWinners/2019-ACRP-Design-Competition_3rd_Management.pdf)
- [2] Anusha, Arshitha M S, Anushri, Geetanjali Bishtannavar, Ms. Megha D Hegde,(2019),Review Paper on Smart [https://www.ijert.org/Review-Paper-on-Smart-Parking-](https://www.ijert.org/Review-Paper-on-Smart-Parking-System) SystemParking System, IJERT, RTESIT - (VOLUME 7 – ISSUE 08),pg. 1 [DOI: 10.17577/IJERTCONV7IS08017] [\[https://www.ijert.org/Review-Paper-on-Smart-Parking-System\]](https://www.ijert.org/Review-Paper-on-Smart-Parking-System)
- [3] M. Suresh , Bannari Amman Institute of Technology, Sathyamangalam, TamilNadu, India; P. Saravana Kumar; T.V.P. Sundararajan,(2015), IoT Based Airport Parking System, International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), pg. 4 [DOI:10.1109/ICIIECS.2015.7193216]
[\[https://www.researchgate.net/publication/308862487_IoT_Based_Airport_Parking_System\]](https://www.researchgate.net/publication/308862487_IoT_Based_Airport_Parking_System)
- [4] Jyotirmayee Sethy,(2020),Multi-level car parking, journal of Shanghai Jiao tong University,ISSN:1007-1172, pg. 656 [DOI:10.13140/RG.2.2.34984.19206]
[\[https://www.researchgate.net/publication/344516127_Multi_level_car_parking\]](https://www.researchgate.net/publication/344516127_Multi_level_car_parking)
- [5] Kristína Kováčiková, Andrej Nováka, Martina Kováčiková, Alena Novák Sedláčková,(2022),Smart parking as a part of Smart airport concept, Transportation Research Procedia 65,11th International Conference on Air Transport – INAIR 2022,pg 7 [DOI:10.1016/j.trpro.2022.11.009]
[\[https://www.researchgate.net/publication/365584978_Smart_parking_as_a_part_of_Smart_airport_concept\]](https://www.researchgate.net/publication/365584978_Smart_parking_as_a_part_of_Smart_airport_concept)
- [6] Soh Chun Khang; Teoh Jie Hong; Tan Saw Chin; Shengqiong Wang,(2010),Wireless Mobile-Based Shopping Mall Car Parking System (WMCPs),2010 IEEE Asia-Pacific Services Computing Conference, pg 4 [DOI: 10.1109/APSCC.2010.116]
[\[https://www.researchgate.net/publication/224217065_Wireless_Mobile-Based_Shopping_Mall_Car_Parking_System_WMCPs\]](https://www.researchgate.net/publication/224217065_Wireless_Mobile-Based_Shopping_Mall_Car_Parking_System_WMCPs)