

Proposal

For

**INTEGRATED PARKING MANAGEMENT SYSTEM
(SMART PARKING MANAGEMENT SYSTEM)**

**Kerala Development and Innovation Strategic Council
(K-DISC)**



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1. Organization Profile

K-DISC is a strategic think-tank and advisory body constituted by the Government of Kerala. It aims at bringing out path-breaking strategic plans that reflect new directions in technology, product and process innovations, social shaping of technology, and creating a healthy and conducive ecosystem for fostering innovations in the State. In the sphere of development, K-DISC is promoting and initiating new projects in Emerging Technologies such as Blockchain, Internet of Things, Machine Learning, Artificial Intelligence, Robotics, and soon that would enable transparent and cognitive advances in various departments of the state Government and deliver the ultimate benefit to the citizens. K-DISC would facilitate different government departments that may need any of these technological advances to solve their critical problems and to arrive at the proof of concepts stage with adequate technical and financial resources to promote innovation. Also, K-DISC will ease the implementation by overseeing the same.

Citizen Service-One Department One Idea 2021 (CS-ODOI) is an initiative from K-DISC which is an exclusive platform for the employees of Government Departments and Agencies under the Government of Kerala, to submit Innovative Ideas. The objective of this program is to encourage the unreserved participation of all Government staff to improve the process or product innovations in the respective departments or any Government departments that they interact with.

The Idea "INTEGRATED PARKING MANAGEMENT SYSTEM (SMART PARKING MANAGEMENT SYSTEM)" submitted by **Mr. Pramoj Sankar P.S (Additional Transport Commissioner, Motor Vehicle Department)** was shortlisted as one of the top 12 ideas and is being considered for pilot implementation.

2. Introduction

Road traffic congestion is a major problem with rapid urbanization, increased travel demand, and the use of personal vehicles. In old cities of developing nations, with narrow roads and unmanaged roadside parking, congestion problems require special attention. Finding a parking spot for a car is a practical problem faced by millions of drivers daily. Most of the time this involves anxiety and uncertainty, also considering a threat to the environment, it wastes limited resources which include time, road space, and fuel. Also, drivers roam around in search of free parking spaces. Parking management and pricing, including penalties for illegal parking, can go a long way in reducing the congestion of the city. Apart from this a comprehensive parking solution is the need of the hour as far as the Kerala States urban centers are concerned.

2.1 Need of the Project

As the population increases vehicle population also increases. Vehicle population shows uncontrollable growth with respect to available road infrastructure. It is important to find space for each vehicle getting into an urban area and to manage the parking areas since illegal parking causes various problems that make the traffic system stuck.

The need of the project is to eliminate unorganized parking practices and traffic congestion and help in reducing fuel wastage and carbon emissions occurring due to searching for parking slots.

Around 10% of automobiles that uses the parking facility daily drive around the city looking for a place to park, wasting about 17 litres of fuel. It is estimated that around Rs. 54000 of fuel is wasted by the citizens per month roaming around to find the parking spot which can be saved with the help of the proposed parking management system.

The petrol and diesel vehicles emit around 2.4 kg of CO₂ per litre of fuel. Citizens must travel through the city in search of a parking space, using up to 17 litres of fuel per day and leaving a monthly CO₂ footprint of 1200 kg. With the implementation of the proposed approach, we could decrease CO₂ emissions to an extent.

Considering the present tariff rates, the monthly revenue generated from parking at Gandhi Park is approximately Rs.1.6 lakhs. By adopting the Smart Parking Management System, the monthly revenue could improve to 22%.

Guaranteed parking space & easy transit (to citizens), a Transparent dashboard (to Corporation Authorities) & optimal revenue (to contractors) are the need of the day.

2.2 International/National Scenario

Presently, the integration of smart technologies in parking is gaining serious traction; to improve on-street and off-street parking demands, optimize parking supply, regulate pricing, and enhance customer satisfaction, all of which require hyper-local servicing. And in this regard, geofencing technology has come forward as a revolutionary force.

2.3 Summary of the Proposal

The Pilot implementation aims to build an efficient parking management system by identifying the existing parking infrastructure. The proposal is to notify and bring the available parking facility into a database that helps in minimizing parking-related problems by giving advance information to drivers/users. Smart Parking is a parking strategy that includes smart IoT (Internet of Things) devices in an effort to make parking vehicles much faster, simpler and less time-consuming in a crowded area.

3. Project Objectives

The project objective is to develop an automated parking system using IoT-enabled sensors and ANPR cameras for number plate recognition along with Geofencing and to assist the drivers with ideal parking solutions by collecting information on real-time availability of parking slots and assisting the drivers to get a hassle-free parking experience.

4. Scope of the Project

The scope of the pilot projects includes the following:

- Installation of boom barriers having IoT sensors and Automatic Number Plate Recognition (ANPR) cameras at entry and exit of **Gandhi Park** (East fort, Thiruvananthapuram)
- Development of a web portal for the department and parking agency for smart parking management with the following features:
 - a. Log register – Keeping a record of the vehicles entering and exiting the parking lot.

- b. Security analysis - the surveillance can be upgraded with ANPR systems.
 - c. The Ticketing System can be updated based on the tariff of the parking agency.
 - d. Real-time Count of all vehicles in parking areas can be displayed and this information can be used to allocate parking slots efficiently. Consolidated payment reports are also available.
- Development of a mobile application for the users to book parking slots.
- a. User can register to the mobile application using Mobile number, Vehicle Number and Vehicle type and OTP will be sent to the registered mobile number at the time of registration. Users can book slots in 3 ways:
 - i. A push notification system that alerts users about available parking slots once they enter the limit of the geofence.
 - ii. After getting a notification while within the 1.5 km geofencing radius, they can book a parking spot by paying the minimum charge through the mobile application's UPI facility, with a 15 min. grace period.
 - iii. The booking charges will be refunded to the source if the user didn't turn up at the parking facility within the grace period and that slot is freed for other users to book.
 - iv. Pre-booking can be done from anywhere using the mobile app, and a 15-minute grace period is given to reach the parking facility.
 - v. One can also obtain a parking spot through the parking agency's web application as spot booking, while visiting the facility.
 - b. UPI Integrated Payment System - User has to make the payment with respect to the parking duration via UPI integrated Parking System.
 - c. Booking is only confirmed once the payment is made and amount to be paid will be prompted by the APP based on the predefined tariff.
 - d. If the user is unable to reach the parking facility within the 15 Minutes grace period, the amount will be refunded to the source. If the user parks the car for a longer period of time than the pre-booked duration, the tariff calculation will be done in the App and will be collected in hand or via UPI, while exiting the parking facility.
 - e. Payment collected in hand can be maintained by the parking agency through web application.

4. Location for Pilot Implementation- Gandhi Park (East fort, Thiruvananthapuram)

5. Implementation Strategy

5.1 Technical Approach

The overall architecture of the smart parking management system is depicted below.

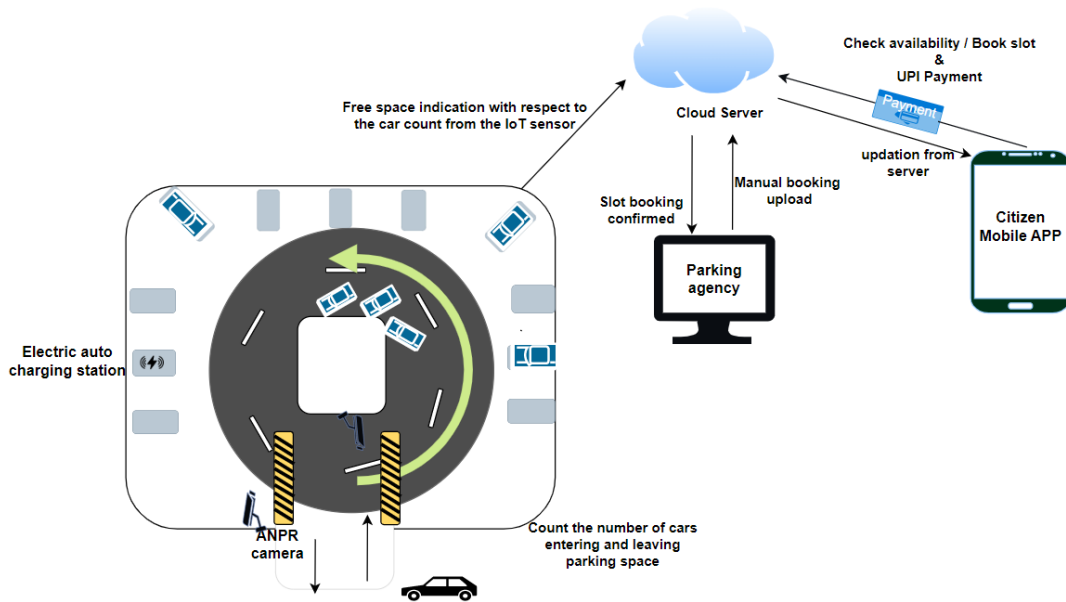


Fig 1: System architecture

5.1.1 Smart Parking Management

The parking-related problems could be minimized if drivers had advance information about vacant parking spots. With specialised ANPR and IoT sensor systems for monitoring parking lot occupancy and reservations, the data can be collected easily. Based on historic data in the system, day of the week, Calendar events as recorded etc.. an AI algorithm can be launched to predict daily hourly demand. Accordingly, a parking space seeker can decide to opt for booking ahead or book just in time. AI based analytics program can also help in “look ahead” prediction of space availability

5.1.2 Crowdsensing using Geofencing for Smart Parking

Geofencing is defined as a location-based service that uses GPS, RFID, Wi-Fi, or cellular data via an application or various other software in order to trigger an already programmed action when a vehicle tries to enter or exit a virtual boundary that is set up around a geographical location, known as a geofence. Depending on the configuration of the geofencing techniques, the software can prompt mobile push notifications, trigger text messages or alerts, send targeted advertisements on social media, or deliver location-based marketing data. The model can also allow tracking of vehicle fleets as well as disable certain technology.

Thus, by implementing geofencing in smart parking facilities, the average time required for users to find parking spots is reduced, and thus reducing the consumption of non-renewable resources. When the smartphone passes through the geofence, the app creates a trigger that sends a notification alerting users of available parking spots, provided the vehicle subscribes for such an alert service.

Assume that To create a list of geofencing objects, the software needs to set the longitude, latitude, radius, and time and trigger action types for each geofence. The trigger action shows all the events that could trigger the geofence, for example when users enter or exit a geofence.

5.1.3 Working of Geofence

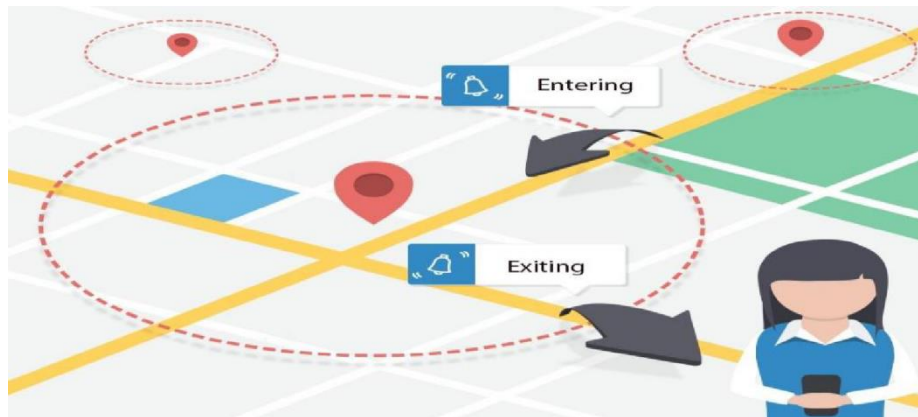


Fig 2: Geo fencing layout

Set the latitude and longitude of the parking facility and add markers on it. Then, with that marker, create a circular area of 1.5km radius and add that circle to the database. Geofence comprises local points on a map with which a virtual fence is set up. Thus, whenever any vehicle enters this geofence, the user can book a slot in the parking facility.

5.2 Process Flow

This is process flow for parking slot booking.

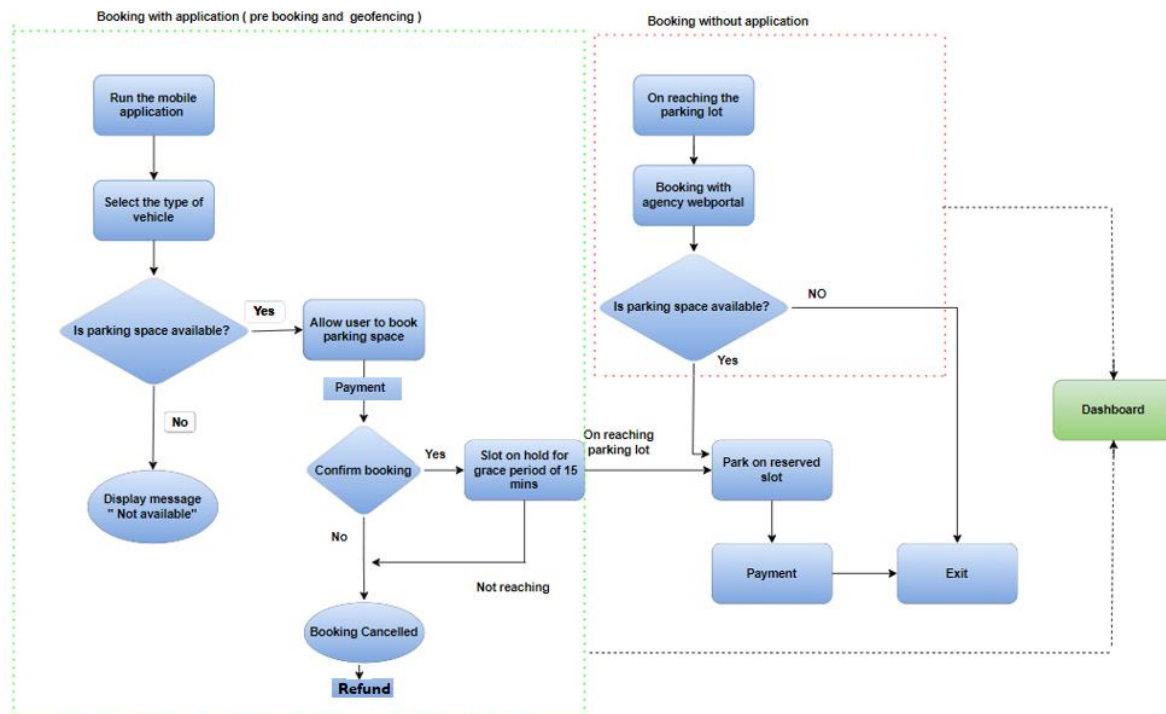


Fig 3: Process Flow

6. Deliverables/Milestones

The deliverable of the project includes:

- I. Managing parking infrastructure by installing boom barrier and ANPR cameras
- II. Web portal for corporation and agency
- III. Mobile application for citizens

7. Key Benefits to be achieved

The Key benefits envisaged for the major stakeholders include:

1. Corporation

- I. Transparent dashboard
- II. Corporation can get the exact number of vehicles parked at Gandhi Park this would support officials to plan for parking infrastructure management, other facilities for the public and Corporation could also get better price discovery.
- III. After IPMS implementation, expected monthly increase in revenue is 22%. This is with optimum utilisation expecting an average of 92% occupancy of the different time slots, from the current 75% as given by Corporation.

1.1 Revenue generation in the Current Scenario

Based on the discussion with the Agency personnel at Gandhi Park, the following information has been obtained on the current scenario and the approximate revenue calculation of **Gandhi Park** is arrived as below :

- They charge Rs. 15 for 4-wheelers, Rs. 10 for 3-wheelers, and Rs. 5 for 2-wheelers for time periods ranging from 0-3 hours.
- They earn roughly Rs.6000 from the total number of parking places offered, including the rent from the nearby Chala market owners and full day Parking (since they have a different tariff).
- Without the rent from Chala market owners and full day parking, the agency makes roughly Rs. 5300 per day.

Accordingly, monthly revenue (Excluding shop owners and daily parking) is approximately Rs. 1,61,208 (Rs.5300*365/12).

Revenue generation after the implementation of IPMS:

Revenue calculation after IPMS												
Timing	4 - Wheeler				2- Wheeler				3- Wheeler			
	occupancy (%)	slot availability			occupancy (%)	slot availability			occupancy (%)	slot availability		
		Approx slots available	occupied	unoccupied		Approx slots available	occupied	unoccupied		Approx slots available	occupied	unoccupied
8 AM - 11 AM	95	66	63	3	95	120	114	6	95	17	16	1
11 AM - 3 PM	95	66	63	3	95	120	114	6	95	17	16	1
3 PM - 6 PM	95	66	63	3	95	120	114	6	95	17	16	1
6 PM - 10 PM	80	70	56	14	80	128	102	26	80	17	14	3
		268	244	24		488	444	44		68	62	6
Approx daily rate for 244 slots @ Rs.15/3hrs		3660			Approx daily rate for 444 slots @ Rs.5/3hrs		2220		Approx daily rate for 62 slots @ Rs.10/3hrs		620	
Approx daily revenue (4-wheeler (3660)+2-wheeler(2220)+3-wheeler(620))					Rs. 6500.00							
Approx monthly revenue(excluding shop owners & Full Day Parking) (6500*365/12)					Rs. 197708.33							

An Increase in revenue of 22% can be expected since the implementation of IPMS will bring in optimum utilization of the parking slots by publishing the information on vacant parking slots and thereby increasing the occupancy to an average of 92%.

Alternatively, it is also possible to keep the same occupancy as the current scenario and hike the charges per 3 hours, for the peak hours (11AM to 3PM & 3PM to 6PM), which can bring additional revenue.

2. Parking agency

- I. With the implementation of Boom barriers and ANPR cameras for regulating vehicle entry and exit would support the contractor to reduce manpower deployment at the premise.
- II. Gradual increase in revenue by providing an online booking facility via a mobile App
- III. Computerized revenue accounting of parking system management both offline and online through the suggested project implementation.
- IV. Parking fees could be collected through UPI-based payment for both online and offline vehicles

3. Citizen

- I. Online booking facility shall provide hassle-free parking of vehicles at Gandhi Park based on the availability of parking space.
- II. UPI-based payment shall support citizens to pay parking fees online.
- III. Hassle-free entry & exit
- IV. It is estimated that around Rs. 54000 of fuel is wasted by the citizens per month roaming around to find the parking spot which can be saved with the help of the proposed parking management system.

The calculation of fuel consumption is shown below:

Avg fuel (Petrol) consumption to travel 1 hour (liters)	3.78
Number of vehicles uses car parking facility (Gandhi park) a day	268
10% of vehicles roam around to find spot	27
Avg time for a vehicle to find a parking spot (minutes)	10
Avg time taken by all the (10%)vehicles to find the parking spot(minutes)	268
Fuel cost/ Liters	106
Approx fuel consumption for a (10%)vehicles to find a parking spot a day(Liters)	16.88
Approx fuel expense for vehicles in a day for finding parking spot(Rs.)	1,789.70
Approx cost for vehicles in a month for finding parking spot(Rs)	54,436.83

- V. It is estimated that around 17 litres of fuel are wasted per day roaming around in search of a parking space and leaving a monthly CO2 footprint of 1200 kg. With the implementation of the proposed approach, we will be able decrease CO2 emissions to an extent.

The calculation of CO2 footprint is shown below

Avg fuel (Petrol) consumption to travel 1 hour (liters)	3.78
Number of vehicles uses car parking facility (Gandhi park) a day	268
10% of vehicles roam around to find spot	27
Avg time for a vehicle to find a parking spot (minutes)	10
Avg time taken by all the (10%)vehicles to find the parking spot(minutes)	268
Fuel cost/ Liter	106
Approx fuel consumption for a (10%)vehicles to find a parking spot a day(Liters)	16.88
Carbon dioxide emission by vehicle /Liter (kg)	2.4
Approx Carbon dioxide emission by a (10%)vehicles to find a parking spot a day(kg)	40.52
Approx CO2 emission by vehicles in a month for finding a parking spot (Kg)	1,232.53

8. Conclusion

The Pilot implementation aims to build an efficient parking management system in Gandhi Park using IoT-enabled sensors and ANPR cameras for number plate recognition along with Geofencing and to assist the drivers with ideal parking solutions by assigning parking slots based on real-time availability. It is expected that optimum usage of parking space can be assured. Time and effort are saved relieving the drivers of the effort of driving around in search of a parking space. The system helps in bringing parking discipline to crowded cities. An Intelligent Parking Management System can generate data that detects the correlation and movement of users. Automation conserves labour costs and resource utilization. As the global population resumes developing and urbanizing, it is essential to execute a well-planned and convenience-driven smart parking solution that can be used globally.