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# MOBILE APP SHOWING FEATURES AND ANALYSIS OF NEARBY PARKING LOTS

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**Summary--** This is an innovative project designed to help users quickly find parking through a geographic information system that displays the nearest parking options on a map, along with up-to-date information on capacity, availability (using detection technology), features, accessibility, hours, and price. With advanced customization features, the app allows users to set preferences, such as the type of parking (covered, open-air, secure) and the price range they are willing to pay. Parking lot owners manage the information for their facilities. The goal is to provide excellent customer service by optimizing the time spent searching for, finding, and reaching a parking spot, while offering parking lot owners excellent profits and enabling sustainable long-term growth nationwide. The app allows users to view statistics and information through descriptive, diagnostic, and predictive analytics to improve decision-making and profitability. It facilitates the search for parking, reduces the time spent finding a spot, encourages the use of public spaces, and helps alleviate traffic congestion. It improves the parking experience, thereby promoting more efficient and sustainable mobility in cities and enhancing citizens' well-being. The mobile app integrates real-time database management systems, information and communication technologies (ICT), data analysis, the Internet of Things, and cloud computing to offer an optimal user experience and efficient management of parking information. The methodology employed is sequential (cascading), and the results will provide detailed knowledge of parking lot characteristics and the ability to locate them quickly in real time. In conclusion, the main innovation of this product is that customers will be satisfied using it and will think of and choose GUI-PARK every time they need parking, while parking lot owners will achieve a very high occupancy rate.

**Keywords--** Parking, App, Mobile, Speed.

**Abstract--** This is an **innovation project** designed to help users find parking quickly through a **geographic information system** (GIS) that maps nearby options with real-time updates on capacity, availability (using sensing technology), features, accessibility, hours, and pricing. With **advanced**

personalization features, the app allows users to set preferences such as parking type (covered, outdoor, secure) and price range.

Owners manage their own facility data. The goal is to provide **excellent customer service** by optimizing the time spent searching for and reaching a parking spot, while offering owners high profits and **long-term sustainable growth** nationwide. The app provides statistics and insights through **descriptive, diagnostic, and predictive analysis** to improve decision-making and profitability. It simplifies the search, reduces parking time, encourages the use of public spaces, contributes to **traffic decongestion**, and enhances the overall experience—promoting **efficient and sustainable urban mobility** and citizen well-being. The mobile application integrates **real-time database management systems**, ICT, data analytics, **IoT**, and **cloud computing** to deliver an optimal user experience. The project follows a **sequential (waterfall) methodology**, aiming to provide detailed parking insights in real time. In conclusion, the core innovation is ensuring **customer satisfaction** so that **GUI-PARK** becomes the top choice for users while maintaining high occupancy rates for owners. **Keywords—**Parking, Application, Mobile, Speed.

## INTRODUCTION

Over the past 10 years, the number of vehicles in Mexico has increased from 18 million to 55 million (INEGI), according to INEGI data, and there are approximately 9,000 public and private parking lot owners in Sinaloa (INEGI). Population growth and the increase in vehicles in cities have led to a shortage of available parking spaces, making it difficult to find a spot quickly and efficiently. This challenge affects both individual drivers and traffic management in general, causing congestion, wasted time, and stress for users.

Drivers lack up-to-date information on the availability, capacity, features, and prices of nearby parking lots, which makes it difficult to decide where to park; meanwhile, parking lot owners often lack efficient tools to manage their business and optimize the occupancy of their spaces. GUI-Park helps users find parking quickly, displays the nearest options on a map along with up-to-date information on their features, and provides parking lot owners with data on their spaces, demand trends, and usage patterns to improve decision-making. The mission is to provide a comprehensive and technologically advanced solution that improves the parking experience for

GUI-PARK serves users, promotes efficient and sustainable mobility in cities, and provides value to both users and parking lot owners. Its vision is to become a leading national app that simplifies the parking experience for drivers by offering innovative, safe, and accurate solutions to help users save time. GUI-PARK aims to provide excellent customer service so that users can find parking in real time, and so that parking lot owners are satisfied with the high occupancy of their lots, thereby generating excellent profits. The app also seeks sustainable long-term growth nationwide, which is why it will be continuously updated to consistently resolve customer issues.

# DEVELOPMENT

## Theoretical Framework

The theoretical foundations upon which the project is based are:

Flutter is an open-source framework developed and supported by Google that uses the Dart programming language, which features a simple syntax that is easy for developers to learn. Google Firebase is a cloud platform for developing web and mobile applications. Apache, an open-source web server.

Flutter is an app development framework that uses the Dart programming language. Dart is an open-source language optimized for creating user interfaces, enabling developers to build native apps for iOS and Android from a single codebase. (Co., 2024)

Features of Dart in Flutter: Null safety: Helps detect common errors related to null values, reducing maintenance time. JIT and AOT compilation: Uses Just-In-Time (JIT) compilation for development and hot reloading, and Ahead-Of-Time (AOT) compilation for production builds.

The primary programming paradigm in Dart is object-oriented programming (OOP), as Dart is a language that allows code to be organized around objects, with features such as classes, inheritance, polymorphism, and encapsulation. However, Dart is also flexible and supports functional programming by including features such as anonymous functions and the ability to mix approaches to build applications productively.

Object-Oriented Programming (OOP): Classes and Objects: Dart uses classes to create objects, which are instances that encapsulate data (variables) and related behavior (methods). Inheritance:

Allows a class to inherit properties from another, creating class hierarchies. Polymorphism: Enables objects of different types to be treated as objects of a common type, primarily through method overriding. Encapsulation: The ability to group data and methods that operate on that data within a single unit (the class). Mixins: A feature specific to Dart that allows code to be reused across different class hierarchies without the need for traditional inheritance.

Firebase: It is a Backend-as-a-Service (BaaS) platform that offers a comprehensive suite of tools for app development, including a database, authentication, cloud storage, error reporting, and much more.

Why use Firebase with Flutter? Efficiency: It allows developers to focus on the user interface (UI) and user experience without worrying about server infrastructure. Scalability: Firebase services automatically adapt to the app's growth. Acceleration: It provides ready-to-use tools that streamline the development process, such as user authentication or file storage.

The open-source Apache web server is free software that processes HTTP requests and serves web content to users' browsers, including HTML pages, images, and files. Maintained by the Apache Software Foundation, it is known for its reliability and stability, and has been instrumental in the growth of the Internet since its launch in 1995.

Functionality and Features

Request Processing: Apache listens for incoming HTTP requests from browsers and, in response, sends the requested files and data to the browser so that the user can view the web page. Content: It serves all types of web content, both static (such as HTML files and images) and dynamic.

Open source: It is free and open source, allowing users to view, modify, and distribute its source code freely.

Flexibility and customization: It is highly configurable and customizable thanks to its modular architecture and the ability to use different modules to adapt its functions to the needs of each project.

Compatibility: It is compatible with a wide range of operating systems and platforms, including the popular LAMP framework (Linux, Apache, MySQL, PHP).

Stability and security: It has earned a reputation for being secure and stable, with regular updates to address vulnerabilities and improve performance.

**Methodology and**

**Procedure**

The mobile app integrates real-time database management systems, information and communication technologies (ICT), data analytics, the Internet of Things, and cloud computing to deliver an optimal user experience and efficient management of parking information.

The growing trend in the parking industry toward the use of mobile apps for payment and efficient space management has been notable. Examples such as Waze (WASE, 2006), which provides real-time availability of nearby parking spaces, and apps like Parkimeter (GOOGLE, 2014), EasyPark (EASY, 2011), and Parkimovil (GOOGLE, 2014), which simplify the search for and payment of parking spaces, demonstrate the importance of technology in this sector. In addition, tools such as SpotAngels (GOOGLE, 2014), ParkWhiz (GOOGLE, 2014), and ParkMe (INRIX, 2011) optimize space management through geolocation technology and sensors. In this context, GUI-Park stands out as a comprehensive tool for improving the efficiency and profitability of parking facilities. By offering descriptive, diagnostic, and predictive analytics to owners, we aim to simplify the search experience and provide forward-looking insights for making informed strategic decisions. Despite the indirect competition posed by these applications, we differentiate ourselves by offering a comprehensive approach that spans from space management to detailed data analysis, thereby optimizing the overall performance of the parking facility.

**Table 1**. *Comparative chart of the features of each of the parking management-related products*.

| Funciones | Waze | Parkimeter | EasyPark | Parkimovil | SpotAngels | ParkWhiz | GUI-Park |
|---|---|---|---|---|---|---|---|
| Recordatorios | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mapa | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Descripción de lugares | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Notificaciones | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Analítica de datos | X | X | X | X | X | X | ✓ |
| Programa viaje | ✓ | X | X | X | X | ✓ | ✓ |
| Muestra estacionamientos | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ |
| Muestra de tarifas | X | ✓ | X | X | ✓ | ✓ | ✓ |

These strategies focus on electromobility and the development of smart cities, in line with the Sustainable Development Goals (SDGs), specifically SDG 11: Sustainable Cities and Communities of the 2030 Agenda (UN Mexico, 2023), to achieve a positive impact on roadways. GUI-Park aligns directly with this goal by facilitating access to sustainable transportation systems and promoting the development of smart and livable cities for all.

Strategies for positive impact: We will implement a more efficient and personalized parking search by reducing the time spent looking for parking; our solution promotes more efficient and sustainable mobility in urban environments:

1.- Increasing access to information technology: We will develop an intuitive and user-friendly interface; the app allows users to customize their parking experience according to their specific needs and preferences, ensuring it is accessible to everyone.

2. Development of analytical tools for parking lot owners: To provide parking lot owners with advanced analytical tools that enable them to optimize the management of their facilities and improve their efficiency and profitability.

**Results**

This project contributes to a solution for finding parking quickly and securely. Compared to other parking apps that offer standard information such as map locations, GUI-Park stands out for its ability to adapt to each user's individual needs by displaying useful decision-making information, such as payment methods, which significantly improves the customer experience and satisfaction, thereby increasing customer loyalty. It helps reduce traffic congestion and parking shortages in cities: By enabling a more efficient and personalized search for parking, users can quickly find a spot that suits their needs (covered, outdoor, secure) and set an acceptable price range. By facilitating the sharing of parking spaces and reducing the time spent searching for parking, GUI-Park promotes more efficient and sustainable mobility in urban environments, ensuring users find an available spot while saving fuel.

Improved Profitability: By implementing measures based on predictive analytics (data analysis and business intelligence), owners can maximize revenue and minimize operating costs, leading to greater long-term profitability. It also promotes the use of information and communications technology in vehicle fleets.

## CONCLUSIONS

The main innovation of this product is that you can find a parking spot in real time, obtain relevant and detailed information about the parking lot, and do so safely and without wasting time at any time of year. The app is advertised on social media, in department stores, or through direct outreach.

The GUI-Park project combines technologies such as Flutter, Firebase, and the Internet of Things to address traffic congestion and optimize parking management. The app stands out from other solutions due to its comprehensive data approach, offering descriptive and predictive analytics for both users and property owners. The project aligns with Sustainable Development Goal 11 of the 2030 Agenda, promoting smart mobility and sustainable growth.

The key factor is that it offers business owners very good profits and consistent, excellent growth, since, by providing good service, customers will return to use the app and also recommend it to others.

GUI-Park offers its customers the best solution for saving time when searching for parking and, once they find it, the peace of mind that their vehicle is safe. Users value their time, so they will use the app on a daily basis and be very satisfied with it.

Finally, we can note that users are free to search for parking with advanced custom features, and the app offers options such as outdoor or covered parking, high-security facilities, and a wide range of prices to suit their budget.

## FUTURE WORK

To ensure the relevance and continued growth of GUI-PARK, the following future development paths are proposed:

Integration with Autonomous Vehicles and Smart Cars: Develop application programming interfaces (APIs) that allow the platform to communicate directly with the navigation systems of smart vehicles. This would enable the car to automatically reserve and navigate to an available space without manual intervention from the driver.

Implementation of Automated Payments and Blockchain: Incorporate an integrated payment gateway that uses contactless technology or crypto-assets to streamline entry and exit from facilities, eliminating the use of physical tickets and ensuring secure and transparent transactions for owners.

Artificial Intelligence Algorithms for Demand Forecasting: Refine predictive analytics models using machine learning to anticipate demand spikes in specific areas based on local events, weather, or traffic, enabling owners to implement dynamic pricing that optimizes their revenue. Expansion into Intermodal Transportation: Evolve the app so that it not only manages parking but also suggests intermodal routes (for example, parking the car near a public transit station or bike-sharing stations) to promote even more sustainable urban mobility.

Gamification and Loyalty System: Create a rewards system for frequent users that offers discounts or benefits for using eco-certified parking lots or for vacating spaces in record time, thereby improving customer retention.

Low-Cost, High-Precision Sensors: Research and deploy new low-power IoT sensor architectures (such as those based on LoRaWAN technology) to enable even small parking lots or public spaces to integrate into the network at minimal cost.

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