Online Parking Information System

System Request and Feasibility Study / Planning Phase   
(Homework No.1B)

Project team: Team 07

Instructor: Dr. Araz Yusubov

Submitted in partial fulfillment of the requirements of the INFT 2303: Systems Analysis and Design course project.

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# Introduction

This is part of the System Proposal for a hypothetical project “Online Parking Information System” submitted for partial fulfillment of the requirements of the Systems Analysis and Design course in the School of Information Technologies and Engineering at ADA University, Baku, Azerbaijan.

System requests of team members:

* Improved Ambulance System by Orkhan Ismayilov
* Disaster and Emergency Management System (DEMS) by Faraz Baghernehzad
* Restaurant Management System by Emil Hajiyev
* Automated Information System for Medical Facilities by Jamaladdin Talishinskiy
* Online Parking Information System by Lala Mahmudova

After carefully considering all potential ideas and projects proposed by our groupmates, our team has reached a decision to choose the Online Parking Information System as our preferred project. We have engaged in a thorough discussion of the benefits and challenges associated with this system and have collectively determined that it presents the most promising opportunity for our team to successfully complete a high-quality project. The idea of this project seemed relevant enough for all members of the team.

Overall, the main reason for selecting this idea was predominantly based on the issue that drivers face each day, that is, finding areas to park their car. Our team analyzed this problem and realized that there could be a particular information system that could notify drivers about free spaces on parking stands on underground and ground parking spaces with opening barriers through a system that will be developed specifically for monitoring free parking spots and providing payment functions as well. Another factor that influenced our choice was related to the overall complexity of this project which was relatively lower than that of other proposed projects. By complexity, meaning time and size of the project. In addition, the selected system has yet another advantage among other proposed systems, in the sense that in future perspective successful implementation of Online Parking System is capable of high income that might cover the developing expenditures in a relatively short amount of time and even surpass them.

## Definitions

|  |  |
| --- | --- |
| Term | Definition |
| AI | Artificial Intelligence |
| ATM  Automatic License Plate Recognition | An automated teller machine: a type of electronic communications device that allows users to conduct financial transactions.  Technology that uses cameras and software to capture and read license plate numbers from vehicles. |
| BNA | (az. Bakı Nəqliyyat Agentliyi) Baku Transport Agency |
| Break-Even Point (BEP) | The amount of years it takes a company to recover its initial investment in the project through net cash flows. |
| GPS | Global Positioning System |
| QR code | A quick response code: a type of barcode that stores information and can be read by a digital device. |
| Return on Investment (ROI) | Calculation that measures the average rate of return on the money invested in the project. |
| Sensor | A device that produces an output signal to detect physical processes. |
| Terminal | A device which interfaces with payment cards to make electronic funds transfers |

# Overall Description

* Online Parking Information System
* The system with its user-friendly application will enable drivers to find available parking spots near their current location using GPS and location-based services. The sensors will contribute to detecting both availability and absence of a vehicle in a parking spot and update the parking availability in real-time. Cameras with AI will monitor plates while entering and exiting to ground and underground parking spaces and provide valuable insights for optimizing the smart parking system. QR code will be given to each user while entering the parking slots and will be read by existing systems, which will help calculate the overall time that user spent for parking time. System will also allow drivers to pay for calculated parking fees through the application balance, which can be increased both by credit cards and with cash through terminals like E-Manat and MilliÖn.
* The smart parking system will not always guarantee the availability of parking spots or in all locations. It will not be responsible for any damages or theft of vehicles parked in the locations that system involves. It will not share any user data with third-party companies or individuals without explicit consent from the user. The system will not collect any data related to location or payment services from users who do not use the system.

**The primary objectives and goals of the parking spot tracking system are:**

* Enhancing parking availability: The system aims to facilitate the process of finding parking by providing real-time information on available parking spots. This will reduce the time and effort required to locate a parking spot.
* Reducing traffic congestion: The system is intended to help reduce traffic congestion by allowing drivers to quickly locate available parking spots, which will improve traffic flow in busy areas.
* Improving parking management: By providing accurate data on parking usage and occupancy, the system can help parking managers optimize parking resources and minimize waste. It can also identify opportunities to increase revenue.
* Enhancing user experience: The system is designed to provide a seamless and convenient parking experience for drivers, which will enhance user satisfaction and encourage repeat usage.

**The benefits of the parking spot tracking system include:**

* Improved efficiency: The system will enable drivers to locate available parking spots quickly and efficiently, which will reduce the time and effort required to find parking.
* Increased revenue: By optimizing parking resource utilization, the system can help parking managers increase revenue.
* Enhanced security: The system will monitor parking activity and detect violations, which will enhance security and prevent unauthorized access to the parking area.
* Valuable data insights: The system can provide valuable data and insights on parking usage and occupancy, which can be used to optimize the parking spot tracking system and improve overall parking management.

**Business need:**

The business need for this project is to provide a more efficient and user-friendly parking solution for drivers, while also improving revenue for parking lot owners and municipalities. By implementing a smart parking system, parking spaces can be more effectively managed, reducing the time and frustration drivers often experience when searching for a spot. This can also lead to decreased traffic congestion and emissions, which is an added benefit for the environment.

Moreover, this system can generate revenue for parking lot owners and municipalities by reducing the incidence of unpaid parking fees and providing detailed data on parking usage patterns. It can also reduce the need for human intervention, such as parking enforcement officers, which can save significant costs in the long run. Overall, the business need for this project is to provide a win-win solution for drivers, parking lot owners, and municipalities by improving efficiency, revenue, and sustainability in parking management.

**Business requirements:**

* Ease of use: The system must be user-friendly and easy to use for both the customers and the parking lot management. This will help to increase customer satisfaction and reduce the need for extensive training for the parking lot attendants.

* Cost-effectiveness: The system must be cost-effective to implement and operate. The cost of the system should be justifiable based on the benefits it provides, such as increased revenue and improved parking management efficiency.
* Scalability: The system must be scalable to accommodate the increasing number of parking lots, customers, and transactions. This will ensure that the system can handle the growing demand without compromising its performance.

* Security: The system must ensure the security of customer information and payment transactions. This will help to build trust and confidence in the system and encourage customers to use it regularly.

* Integration: The system must be able to integrate with other existing systems such as payment gateways, mobile applications, and customer databases. This will improve the system's efficiency and provide a seamless user experience for customers.

* Customization: The system should allow for customization, including the ability to set different parking rates for different locations, adjust parking availability based on demand, and customize the look and feel of the application to match the branding of the parking management company or municipality.

**Business value:**

The proposed smart parking system offers several potential benefits for businesses and individuals alike. By utilizing sensors, automatic license plate recognition, and a mobile application, the system can significantly improve the parking experience for users. This can lead to increased customer satisfaction, loyalty, and retention for businesses that implement the system. Additionally, the system can generate revenue through parking fees, which can offset the costs of implementation and maintenance.

The system can also benefit individuals by reducing the time and stress associated with finding a parking spot. This can lead to improved productivity and reduced frustration. Additionally, the mobile application allows for convenient payment options and real-time availability of parking spots, which can further improve the user experience.

Overall, the smart parking system has the potential to offer significant business value through increased customer satisfaction, revenue generation, and improved operational efficiency. Additionally, it can provide individuals with a more convenient and stress-free parking experience.

**Special issues or constraints:**

The implementation of this smart parking system will be subject to a number of special issues and constraints that will need to be taken into account throughout the development process. One key constraint is the need to ensure that the system is compatible with the existing parking infrastructure, including any sensors or cameras that are already in place. Additionally, the system will need to be designed with a high level of security and reliability, in order to protect against potential cybersecurity threats or system failures which is common with nowadays most systems. Other issues to consider are the availability of skilled personnel to install and maintain the system, as well as any legal or regulatory requirements that may impact the design or operation of the system. It will be critical to carefully manage these issues and constraints throughout the development process to ensure the successful implementation and operation of the smart parking system.

**General factors that affect the system and its requirements:**

One of the primary factors that will impact the system is the physical environment in which it will be deployed. This includes factors such as the size and layout of the parking lot, the amount of traffic in the area, and the availability of power and network infrastructure. These factors will affect the types of sensors and equipment that can be used, as well as the placement of these components.

Another important factor is the user experience and the system's ability to meet user needs. This includes considerations such as ease of use, accuracy of the system in recognizing license plates and detecting available parking spots, and the convenience of payment options. The system should also be reliable and able to handle high volumes of traffic without experiencing downtime or other issues.

Security and privacy are also critical factors that must be addressed. The system must be designed to protect user data and prevent unauthorized access to sensitive information. It should also be able to detect and prevent fraud, such as the use of fake license plates or attempts to manipulate the system.

Finally, there are economic factors to consider. The system must be cost-effective and provide a good return on investment for the customer. This includes both the initial implementation costs as well as ongoing maintenance and support.

## Product Perspective

The smart parking system is a component of a larger smart city ecosystem aimed at improving the quality of life for citizens. Other related products in the smart city ecosystem include intelligent transportation systems, energy management systems, and smart building systems. The smart parking system integrates with these systems to enhance the overall functionality and efficiency of the smart city ecosystem.

In the marketplace, there are several smart parking systems available that use different technologies to achieve similar goals. Some systems use sensors, while others use cameras and AI to monitor parking spots (Elsonbaty et al., 2020). The main difference between these systems lies in their accuracy and cost. While camera-based systems are more accurate, they tend to be more expensive than sensor-based systems (Parklio, 2019). Additionally, some systems may offer additional features, such as reservation systems or payment methods, that differentiate them from others in the market.

For instance, a similar system application - ParkMobile is a popular mobile payment application for parking that allows users to find and pay for parking spots using their mobile devices. Similarly, the system being specified in this project also uses an application that enables drivers to find and reserve parking spots and pay for parking fees using their mobile devices (Abhishek, 2021). Both systems aim to improve the overall parking experience for drivers by providing them with a convenient and seamless way to locate and pay for parking spots. Additionally, both systems use various technologies - including mobile applications, GPS, and wireless communication networks to track parking spot availability and usage.

However, there are also some differences between the two systems. For example, the system being specified in this project uses sensors to detect parking availability, but it also utilizes a license plate recognition system to identify vehicles and QR codes when entering and exiting for calculating the parking duration, while ParkMobile relies solely on user input to indicate the start and end of parking sessions (Abhishek, 2021). Additionally, our system will also allow users to pay their parking fees through the app, which is a feature that is becoming increasingly popular among smart parking systems. It will offer integrations with other systems and hardware, such as parking meters and garages, ATM’s and payment kiosks for increasing the balance in order to provide a seamless experience for users.

## Product Functions

**The smart parking system will perform the following major functions:**

* **Locate available parking spots through the use of sensors:** The system will use sensors to locate available parking spots and display them to the driver through a mobile application.
* **Plate recognition system:** The system will use a camera to recognize the license plate of the car and identify the driver who has entered and exited to the parking spot.
* **QR code scanner:** The driver will use the mobile application to scan a QR code on the parking stopper to start and stop the timer.
* **Timer:** A timer will start when the driver enters the parking spot, and it will stop when the driver exits the spot. The time will be used to calculate the fee.
* **Payment system:** The driver will be able to pay for the parking fee using the balance in the mobile application.
* **Historical data:** The system will store data on parking usage, including the number of available spots, the number of busy spots, and the average parking time.
* **Administrative dashboard:** An administrative dashboard will be available to the parking management team to monitor and manage the system, including data analytics, reports, and maintenance alerts.

## User Characteristics

Users may utilize the system as a practical tool to locate available parking spots in the city. Drivers will be the system's primary users. Users are likely to be individuals who are comfortable with using technology and have access to internet-connected devices, such as smartphones or computers. They may also have experience using similar online systems, such as e-commerce platforms, and be familiar with online payment systems. Although the system is intended for those who own a car and a driver's license, it can nevertheless be used by those without these elements for a variety of purposes.

To accommodate users with varying levels of technical expertise, the system's user interface should be user-friendly and easy to navigate.

Factors that may impact the design of the system include the location and demographic characteristics of the users. The system is intended for use in Baku which is a city with a high population density, therefore it may need to handle a large volume of users and provide real-time updates to avoid congestion and frustration. Additionally, if the user base includes individuals with disabilities or who do not speak the primary language of the system, the design should incorporate accessibility features and language options.

User Characteristics Values

Role Users of this system

Age 12-65

Gender Male/Female

Education level Secondary education level

Computer skills Basic knowledge

## Constraints

* **Availability of the system for several types of devices:**

System may be accessible on a variety of devices, including computers, laptops, smartphones, and tablets. The system should be optimized for each device, ensuring that users can easily access and interact with the system on any device.

* **Option for reservations of spots:**

System may provide an option for users to reserve a parking spot in advance. This can be useful for events or busy areas where parking spots are in high demand. The reservation system should be integrated with the real-time parking availability system to ensure that the user's reserved spot is still available when they arrive.

* **Availability of online payment:**

System may provide a secure and reliable online payment option for users to pay for their parking. The payment system should be easy to use, accepting a variety of payment methods, and integrated with the reservation and real-time parking availability systems.

* **Online Parking Information System in other regions:**

System may be scalable and adaptable to work in different regions or locations. The system should be able to integrate with local parking regulations and policies, as well as different hardware systems for parking sensors and charging stations.

* **Spots with charging machines for electric cars:**

System may provide information about parking spots with charging machines for electric cars. The system should integrate with the charging infrastructure and provide real-time availability information for these spots. Additionally, the payment system should be able to handle charging fees and integrate with electric vehicle charging networks.

## 

## Assumptions and Dependencies

* **Internet Connectivity:**

The system needs to be available for internet connectivity for the sensors and the application.

* **Payment Integration:**

The system needs to integrate the payment system with local banks and payment gateways.

* **Strong security:**

The system needs the personal information of the user to be saved in the most secure way possible, and the system should be protected from cyberattacks.

* **Proper Location Services:**

Users should give location permission to the system in order to track the exact location of the user.

* **System backup:**

The system needs to have a proper backup and disaster recovery plan in case of system failure or outage.

# Feasibility Analysis

**Technical Feasibility**

* **Familiarity with technology :**

The technology for smart parking system with sensors and a system app has been around for a while and is becoming more widespread. Obviously, developing a smart parking system for this large number of parking spots requires significant expertise and experience. Selection of the right type of sensors, designing a user-friendly app and development of robust data processing are the main steps. Obvious that there are various sensors available for detecting whether a parking spot is occupied or not, and the system app can be developed using various programming languages and platforms. Therefore, in terms of familiarity with the technology, there are many resources available to developers and users**.**

* **Project size :**

The size of the project will depend on the number of parking spots that need to be monitored. A smart parking system with 10,000 parking spots is not a massive undertaking so that it is considered to be at medium risk, and it also requires significant investments in time, money, and resources. The project’s scope will encompass a range of activities, including installing sensors at each parking spot, creating the system app, integrating it with existing parking systems and deploying a centralized server system for data processing and analysis.

* **Compatibility :**

Compatibility is an important consideration when designing a system, and it should not be a challenge for us. The sensors and system app will be compatible with each other, and the app will be compatible with a wide range of smartphones. The system should also be compatible with existing parking infrastructure, including payment methods, and access control system.

**Economic Feasibility**

* **Development Costs**: The development costs would depend on various factors such as the complexity of the application, the number of sensors required, and the technology used for data processing and storage. The type of sensor that is going to be used is a surface-mounted street parking sensor. The number of these sensors will be 10.000 (1 sensor for 1 spot).

Costs of sensors (number of sensors \* price of 1 sensor): 10.000 \* 160 = 1.600.000 AZN

Costs of technology for data processing and storage: ~400.000 AZN

* **Annual Operating Costs**: The annual operating costs would include expenses related to the maintenance and upkeep of the system, including software upgrades, sensor repairs/replacements, data storage, and server maintenance. The annual operating cost is estimated to range from 80.000 AZN to 100.000 AZN.
* **Annual Benefits**: The benefits of the system would include cost savings and increased revenues. The cost savings would come from reduced manpower required for managing parking lots, lower ticketing and enforcement costs, and reduced congestion and emissions from drivers searching for parking spots. The increased revenues would come from parking fees collected through the system. The revenue generated from parking fees would depend on the number of users and the fee charged per hour. Assuming an average fee of 1 AZN per hour and 80% frequency of use of each parking space for at least 1 hour per day, we get:

Number of spots \* fee \* days = 10.000 \* 1 \* 365 \* 80% = 2.044.000 AZN in one year

* **Intangible Benefits and Costs**: The intangible benefits of the system would include improved traffic flow, reduced congestion, and increased convenience for drivers. The intangible costs could include privacy concerns related to the collection and processing of user data.
* **Necessary Calculations**: The table below shows the Overall Cash Flow Projection.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Year 0 | Year 1 | Year 2 | Total |
| Total Benefits | - | 2.044.000 AZN | 2.044.000 AZN | 4.088.000 AZN |
| Total Costs | 2.000.000 AZN | 100.000 AZN | 90.000 AZN | 2.190.000 AZN |
| Net Benefits  (Total Benefits – Total costs) | -2.000.000 AZN | 1.944.000 AZN | 1.954.000 AZN | 1.898.000 AZN |
| Cumulative  Net Cash Flow | -2.000.000 AZN | -56.000 AZN | 1.898.000 AZN |  |

**Return on Investment (ROI):**

**Break-Even Point (BEP):**

Based on the above factors, we can conclude that the proposed parking spot tracking **system is economically** **feasible**, with estimated annual benefits far exceeding the development and operating costs. However, detailed analysis and further research are required to estimate the exact costs and benefits of the system accurately.

**Organizational Feasibility**

* From an organizational perspective, this smart parking system project has moderate risk. The leaders of the organization have shown interest in the project and believe it can enhance the organization's services and customer satisfaction. BNA, the project champion, is a skilled project manager with a history of successful project implementations.
* Users of the system, including parking attendants and drivers, are likely to appreciate the smart parking system's convenience and efficiency. The system will also benefit the organization by improving parking management and decreasing congestion, resulting in a better customer experience overall.
* Other stakeholders, such as local government agencies and nearby businesses, may support the smart parking system due to its advantages. However, concerns may arise regarding the cost and potential interruption during the implementation process.
* The organization has prior experience with technology-based systems, lowering the project's risk. Change management plans will be implemented to ensure a smooth transition to the new system.
* Overall, the smart parking system's organizational feasibility is promising, with strong support from top executives and an experienced project champion in BNA. The system is expected to benefit users and the organization, despite some challenges that may arise during implementation.

# References

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