

Improving the User Experience with Intelligent and Adaptive Rental Procedures: Internet of Things-Based Vehicle Leasing Solution

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Abstract: This research focuses on the development of an automobile leasing method based on the Internet of Things (IoT). The proposed method leverages IoT technologies to streamline the car rental process, ensuring efficient and user-friendly experiences. The method involves steps such as identity verification, behavioral data analysis, geographical location tracking, quick response code generation, authentication of vehicle identification, and fault management. By integrating user and vehicle authentication, this method offers adaptive, intelligent, and automated rental processes, resulting in simplified procedures, time and energy savings, and an enhanced user experience.

Keywords: Internet of Things, automobile leasing, user authentication, vehicle identification, adaptive rental process, intelligent rental system

Introduction

In today's fast-paced and interconnected world, the Internet of Things (IoT) has emerged as a transformative technology that is revolutionizing various industries, including the automotive sector. The IoT, which refers to the network of interconnected devices and sensors that collect and exchange data, has opened up new possibilities for innovation and efficiency. One such application of IoT in the automotive industry is the development of automobile leasing methods that leverage IoT technologies to enhance the rental process and improve the overall user experience. With the increasing demand for flexible mobility solutions, automobile leasing has become a popular choice for individuals and businesses alike. Traditional car rental processes, however, often involve time-consuming paperwork, manual verification procedures, and inefficient communication channels. These limitations have led to a growing need for innovative approaches that can streamline the leasing process and offer a more user-centric experience.¹

The emergence of IoT technologies has provided an opportunity to address these challenges and transform the way car leasing is conducted. By integrating IoT devices, such as sensors, GPS trackers, and smart contracts, into the leasing process, a new level of connectivity and automation can be achieved. This enables real-time monitoring of vehicle status, accurate tracking of location, remote control functionalities, and seamless communication between all stakeholders involved in the leasing transaction. In this research, we present a novel automobile leasing method based on the Internet of Things. The primary objective of this study is to develop an innovative and efficient approach to car leasing that enhances the user experience and improves operational efficiency. The proposed method encompasses a series of steps that leverage IoT technologies to optimize the rental process and provide a seamless experience for both lessees and lessors. The process of creating an MCP through experimentation began by initially establishing the MCP's specifications. Subsequently, a highly precise prototype was developed based on these specifications. The system configuration can be observed in

Figure 1.⁵

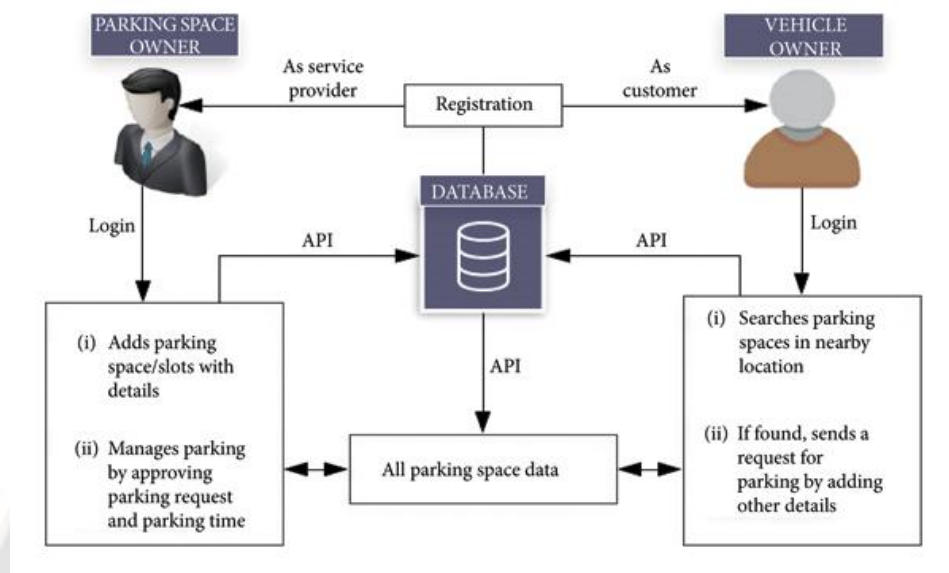


Figure 1 System diagram.

The first step in the proposed method involves the server receiving identity information and behavioural data from the user. This information is then used to determine whether the user intends to hire or return a car. By analyzing the behavioural data, the system can make accurate judgments and proceed accordingly. The next step is to receive the geographical location information of the car rental, which enables efficient tracking and monitoring of the vehicle's whereabouts.⁶

To facilitate the rental process, the system generates a quick response code that serves as a trading certification. This code can be easily scanned and authenticated by the lessee, ensuring a secure and efficient transaction. Furthermore, the method includes the authentication of vehicle identification based on the transmitted vehicle identity information. This step ensures that the rented vehicle is genuine and meets the required standards. In the event of any faults or issues with the rental vehicle, the system is designed to receive fault messages and generate transaction information accordingly. This enables quick and efficient resolution of any problems, ensuring a smooth and hassle-free leasing experience. If the transaction information is confirmed, the lease is considered successful.⁴

By combining user and vehicle authentication, the proposed method offers several advantages. Firstly, it provides an adaptive and intelligent rental mode that adapts to the specific needs and preferences of the users. Secondly, it

simplifies the rental process, eliminating unnecessary paperwork and manual verifications. Thirdly, it saves time and energy for both the lessees and lessors, enabling them to focus on their core activities.²

This research aims to develop an innovative automobile leasing method based on the Internet of Things. By leveraging IoT technologies, the proposed method offers an enhanced user experience, improved efficiency, and streamlined processes. The integration of user and vehicle authentication, along with real-time monitoring and communication capabilities, sets the stage for a new era of smart and connected car leasing systems. This research contributes to the advancement of IoT applications in the automotive industry and paves the way for more efficient and user-centric automobile leasing experiences in the future.

Related Work

Automobile leasing, also known as hiring a car, is gaining popularity as an alternative to car ownership. It is considered a rising industry due to its numerous advantages, such as eliminating the need for handling insurance and yearly maintenance checks. Additionally, car leasing offers the flexibility to replace vehicles as needed, which helps control costs for businesses. This approach is gradually gaining favour among domestic enterprises, institutions, and individual users.¹

However, in today's rapidly advancing technological landscape, various societal operations are becoming more diverse and intelligent. Despite this trend, the process of returning a leased car still typically requires individuals to visit specific rental companies or designated shops. This can cause inconvenience for both the lessee and the rental company. Furthermore, the rental company incurs higher costs, and the leasing process itself can be cumbersome, time-consuming, and labour-intensive. These challenges not only affect the efficiency of the leasing process but also

diminish the overall user experience. To address these issues, there is a growing need for innovative solutions that leverage technology to streamline the car leasing experience. The advancement of digital technologies, particularly the Internet of Things (IoT), provides an opportunity to transform the traditional car leasing process into a more user-friendly and efficient model. By integrating IoT devices and smart systems into car leasing operations, a new era of intelligent and connected car leasing can be realized.

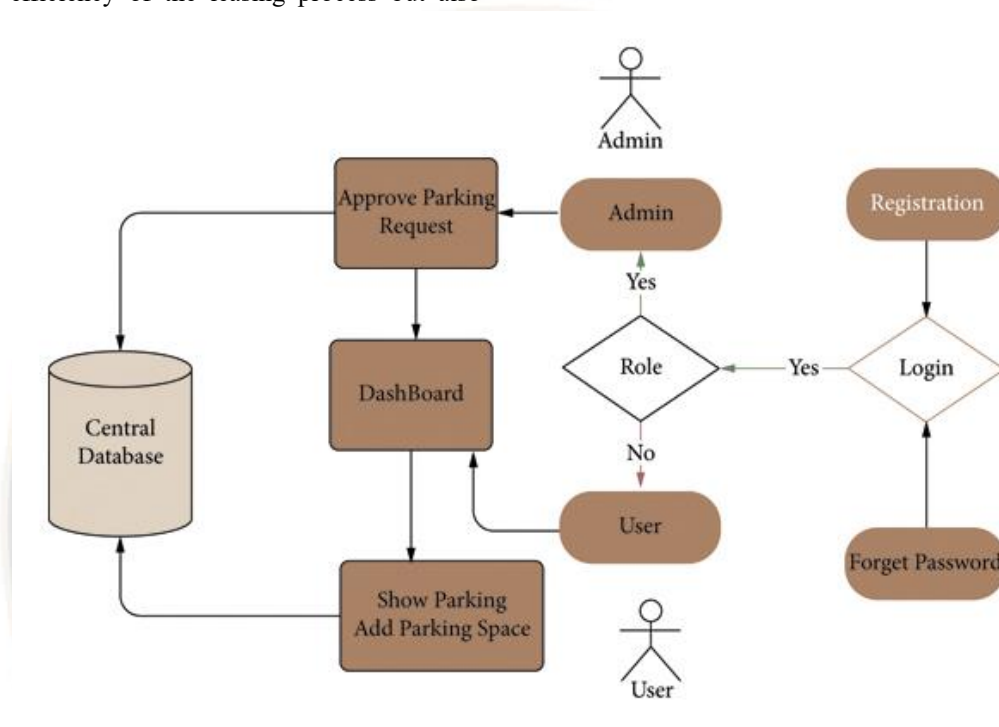


Figure 2. Flowchart of the system.

To utilize the MCP app, users must undergo registration and log in to access its features. The application comprises two distinct user roles: admin and regular users. The admin role is responsible for overseeing the application's backend operations, including approving user and parking addition requests. Admins handle data pertaining to users, parking, and other essential aspects to ensure the smooth functioning of the application. Regular users have dual roles within the app. As car parking owners, they can add their parking spaces to the system. Additionally, as users in need of parking, they can book available parking spaces. The availability of parking is managed by the server, which keeps track of the remaining spaces at each location. Users can park their cars in the designated spaces and collect a ticket for payment. The entire process is illustrated in **Figure 2.**²

The objective of this research is to develop an IoT-based automobile leasing method that improves the overall leasing experience for both users and rental companies. The proposed method aims to simplify the process of returning a leased car by introducing automation and connectivity. By leveraging IoT technologies, such as sensors, GPS tracking, and digital communication channels, the method seeks to eliminate the need for physical visits to rental locations and provide a more seamless and convenient experience for users.⁶

Additionally, the proposed method aims to enhance operational efficiency for rental companies by reducing costs associated with physical rental locations. Through the implementation of IoT-enabled systems, the method seeks to optimize resource allocation, improve vehicle tracking and maintenance processes, and enhance overall management capabilities. The traditional car leasing process faces

challenges related to inconvenience, high costs, and inefficiencies. However, by embracing IoT technologies and developing an innovative automobile leasing method, these challenges can be addressed. The proposed method aims to streamline the leasing process, improve user experience, and enhance operational efficiency for rental companies. By leveraging the benefits of connectivity, automation, and intelligent systems, the research contributes to the advancement of the automobile leasing industry. It sets the stage for a future where car leasing becomes more adaptive, efficient, and user-centric.³

Research Objective

The research objective of this study is to design and implement an automobile leasing method that harnesses the power of Internet of Things (IoT) technologies. The aim is to revolutionize the car rental process and enhance its efficiency and user experience. By incorporating IoT capabilities, the research seeks to combine user authentication and vehicle verification to create a seamless and intelligent rental system. The primary focus of the research is to integrate various steps involved in the car rental process. This includes establishing robust identity verification mechanisms, analyzing user behavioral data, tracking geographical location information, generating quick response codes for transaction certification, and implementing vehicle identification authentication. By combining these steps into a unified IoT-based framework, the research aims to streamline the car rental process and eliminate unnecessary complexities.

The ultimate goal is to develop an adaptive and intelligent car leasing system that adapts to the specific needs of each user. By automating and optimizing key processes, such as identity verification and vehicle authentication, the research aims to simplify the overall rental experience, saving time and energy for both the car hirer and the user returning the car. By leveraging IoT technologies, the research strives to create a comprehensive and user-friendly car rental system. The objective is to provide a seamless and efficient platform that enhances the overall user experience, making the car rental process more convenient, reliable, and enjoyable.

Enhancing User Experience through Adaptive and Intelligent Rental Processes

A new method for leasing cars based on the Internet of Things (IoT) is introduced. This method involves the following steps:

1. The server receives identity information and behavioural data from the user's intelligent terminal. Based

on the user's identity information, the server determines whether the user is a car hirer or a car returner. The behavioural data includes information such as geographical location, vehicle details, and timestamps. For car hirers, the required vehicle information is recorded, while for car returners, the vehicle information is about the returned vehicle.

2. The server receives the geographical location information associated with the car rental from the user who returns the car.

3. The server sends the behavioural data of the user who returns the car, meeting the preset conditions, to the user who hires a car, based on their identity information and behavioural data.

4. The server generates a Quick Response (QR) Code for transaction certification based on the identity information of the car hirer and the user who returns the car. The car hirer scans the QR Code using their intelligent terminal, and the scanning result is uploaded to the server for transaction certification. The authentication result is then issued to both the car hirer and the user who returns the car.

5. Once the transaction certification is completed, the server verifies the vehicle identity information provided by the car hirer using the intelligent terminal. This ensures that the rented vehicle matches the specified details.

6. After the vehicle identity certification is completed, the server receives any fault messages related to the car rental. It then generates Transaction Information based on the fault message. If the car hirer confirms the Transaction Information, the lease is considered successful.

7. The server records the fault message and Transaction Information for future reference after receiving them and confirming the lease success.

8. Finally, the server returns the cash deposit to the selected user who returns the car after a successful lease.

This IoT-based car leasing method improves the leasing process by utilizing advanced technologies. It enhances the accuracy of transactions, enables efficient vehicle identification, and ensures seamless communication between the car hirer and the user who returns the car. The method simplifies the leasing process, reduces manual effort, and enhances the overall user experience.

Conclusion

The research presents a novel automobile leasing method based on the Internet of Things, which effectively combines user and vehicle authentication to optimize the rental process. By leveraging IoT technologies, the method offers adaptive and intelligent features, streamlining the steps involved in renting and returning a car. The proposed

method enhances the user experience by simplifying procedures, saving time and energy, and ensuring a seamless rental experience. This research contributes to the advancement of IoT-based solutions in the automotive industry, paving the way for more efficient and user-friendly car rental systems in the future.

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