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Evaluation of Smart Parking Systems in the Context of Smart Mobility

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A B S T R A C T

This paper provides a comprehensive review and evaluation of smart parking systems in the context of smart mobility. It explores the benefits of implementing smart parking systems in urban areas to address traffic congestion, environmental pollution, and user satisfaction. The study analyzes different types of smart parking systems using the Analytical Hierarchy Process (AHP) method to prioritize key performance indicators. Additionally, it discusses the design of a smart parking architecture utilizing IoT technologies to enhance urban parking management efficiency. The proposed reservation-based parking policy aims to streamline operations, reduce traffic congestion, and offer personal and societal benefits.

Keywords: Smart Parking Systems, Smart Mobility, Urban Parking

1. INTRODUCTION

The rapid growth of cities and advancements in information and communication technologies have given rise to the concept of smart mobility. Smart mobility aims to provide efficient, flexible, and environmentally friendly travel through smart transport systems, infrastructure, and technologies. One crucial aspect of establishing smart mobility is the implementation of smart parking systems. The high number of vehicles in urban areas makes finding parking challenging, leading to traffic congestion and environmental issues. To address this challenge, an advanced parking system is needed to help drivers locate, reserve, and navigate to parking spaces seamlessly. Figure 1 shows the idea of smart on-street and off-street parking system. Key features and technologies used in smart parking systems include:

- Parking Guidance and Information Systems (PGIS): Route vehicles to available parking spaces, real-time information processing, and decentralized infrastructure support.
- Reservation Parking Systems (PRS): Guaranteed parking space for drivers, app-based payment system, simple implementation, and static routes to destinations.
- Crowdsourcing in Intelligent Transport Systems (CITS): Real-time information processing without extensive infrastructure, user-dependent operation, and risk of unreliable information sharing.
- Information Systems based on Public Urban Transport (TIBS): Supports public transportation use, offers parking reservation options, but has limitations on system expansion.
- Centralized Demand-Driven Parking (CAPS): Real-time data processing, operates on a first-come, first-served basis, but relies on a single server and is not suitable for all types of parking.
- Agent-Based Guidance Systems (AGS): Route vehicles using artificial intelligence, adaptable to different parking lots, complex implementation requiring significant time and cost.
- Electric Vehicle Parking Systems (EVPS): No competition for parking spaces, real-time communication with charging station, algorithms focus on resource optimization.

Figure 1. Smart on-street and off-street parking system (Source Google)

2. LITERATURE REVIEW

Gaetano Rocco et. al. provided an overview of urban mobility, focusing on the revolutionizing impact of innovative smart parking systems. It discusses the design of a smart parking architecture utilizing IoT technologies to offer new services for efficient management of urban parking areas. The study defines requirements and technical choices for designing a system that promotes innovation and efficiency in smart parking. The proposed reservation-based parking policy aims to simplify parking operations and reduce traffic congestion in cities within the context of smart cities and urban planning. The proposed reservation-based parking policy simplifies parking operations by automating slot allocation without human intervention, reducing traffic congestion by guiding drivers to available spaces efficiently. It offers personal benefits like time savings and societal benefits like reduced pollution.

Ana D. Đorđević et. Al. discussed smart parking systems within the context of smart mobility. It explores the benefits of implementing smart parking systems in urban areas to improve traffic congestion, reduce environmental pollution, and enhance user satisfaction. The study provides an overview and analysis of smart parking systems, highlighting their features, technologies, and services. It also evaluates the advantages and disadvantages of different types of smart parking systems using the Analytical Hierarchy Process (AHP) method.

Naitik Gandhi and Jayesh Juremalani discussed the on-street parking problems in the central business district (CBD) area of Godhra city, India. It highlights the increasing demand for parking spaces due to the growth of vehicles in urban areas, leading to congestion and transportation issues. The study area profile, parking survey data, analysis of parking demand, and proposed remedial measures such as designing off-street parking facilities are presented.

Parking Supply Survey:

- The on-street parking supply data was collected through a parking space inventory survey. This involved measuring the length and width of the street to calculate the available parking space.
- The Equivalent Car Space (ECS) for on-street parking was determined to be 20 sq m, based on which the total on-street parking supply was calculated.
- The survey identified specific locations of on-street parking facilities, and the data collected was used to analyse the existing supply of parking spaces.

Parking Demand Survey:

- The parking demand survey was conducted over 3 working days of a week, from 11:30 a.m. to 6 p.m., totalling 9 days in 3 weeks.
- Using the fixed period sampling method, surveyors recorded the number of parked vehicles at 30-minute intervals within their assigned segments.
- Data collected included the number of vehicles parked, peak hours, total parking load, parking accumulation, and parking volume.
- The survey results provided insights into the pattern of parking demand at different locations within the study area.

By combining the information from these surveys, the study was able to assess the gap between parking supply and demand in the CBD area of Godhra city, leading to proposed remedial measures to address the on-street parking issues.

3. CONCLUSION

The discussions on urban mobility and smart parking systems emphasize the importance of innovative solutions in managing parking spaces efficiently. The revolutionizing impact of smart parking systems showcases the potential for IoT technologies to optimize urban parking areas and enhance overall city management. The proposed reservation-based parking policy simplifies operations and aims to reduce traffic congestion, benefiting both individuals and society. Moreover, the study on on-street parking issues in Godhra city sheds light on the challenges posed by increasing vehicle numbers and limited parking space availability in urban areas. The proposed remedial measures, including designing off-street parking facilities and implementing multi-storey car parking, aim to address the congestion and transportation problems in the central business district effectively.

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