PROCEEDINGS OF THE INTERNATIONAL CONFERENCE OF GRADUATE SCHOOL ON SUSTAINABILITY (ICGSS)

9th International Conference on Sustainability (ICoS9)
University of Merdeka Malang, November 9th, 2024
https://jurnal.unmer.ac.id/index.php/icgss

E-ISSN:
2721-13988

EVALUATION OF CAPACITY AND PARKING NEEDS IN APARTMENT BUILDINGS

CASE STUDY OF APARTMENT TOKYO RIVERSIDE PIK 2

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Abstract.

Parking is one of the infrastructures that cannot be separated from the transportation system. The design of a proper parking system is crucial in the construction of a building to prevent future parking problems. The existence of infrastructure such as parking facilities is very much needed, one of which is in the building area, or in this study, is an apartment. Tokyo Riverside Apartment PIK 2 North Jakarta is an apartment designed as a residence and office located in Kamal Muara, Penjaringan District, North Jakarta City, Special Capital Region of Jakarta 14470. During the construction of this apartment, careful consideration is given to parking management, ensuring a balance between the need for parking space and the number of existing vehicles. Evaluation of parking space needs planning will discuss parking characteristics, parking space needs (KRP), and Apartment KRP standards. The method used in this study is to conduct a survey of vehicle entry and exit at the comparison building, then calculate the number of parking spaces available at the study building and evaluate the need for parking space against the comparison building and the 1996 Directorate General of Land Transportation parking manual, then determine the design of vehicle circulation in and out, then draw conclusions and suggestions. Based on the results of this study, the minimum Parking Space Requirement that must be provided by the developer is 183 m2/SRP, which is 323 SRP. The Parking Space Requirement planned by the architect or developer is 1454 SRP, so the Parking Space Requirement provided by the developer is sufficient. Technical planning for vehicle circulation in and out is carried out through the south side of the apartment using a one-lane system.

Keywords: characteristics, parking space requirements, 1996 transportation parking manual

1. INTRODUCTION

Advantages of the Location Tokyo Riverside PIK2 is strategically located in the Pantai Indah Kapuk 2 area, Tangerang. This location provides easy access to various public facilities and business centers in Jakarta and its surrounding areas. Its proximity to Soekarno-Hatta Airport and the Jakarta Outer Ring Road tollway makes it an ideal choice for frequent travelers. Available Unit Types: Tokyo Riverside PIK2 offers a variety of unit types that can be tailored to your needs. Starting from studios, one-bedroom, two-bedroom, to penthouses. Each unit is designed with an efficient layout and high-quality materials. Modern Design and Facilities Tokyo Riverside PIK2 is designed with a modern architectural concept that combines beauty

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and functionality. Each unit is equipped with sophisticated facilities, including a 24-hour security system, swimming pool, fitness center, children's playground, and a large green area. Resident Security and Comfort Resident security is a top priority at Tokyo Riverside PIK2. With a 24-hour security system, CCTV cameras in every corner, and card access for its residents, this apartment guarantees comfort and tranquility for all residents.

Parking is one of the infrastructures that cannot be separated from the transportation system. Designing a proper parking system is crucial in the construction of a building to prevent future parking problems. The existence of infrastructure such as parking facilities is very much needed, one of which is in the building area, or in this research, is an Apartment. Tokyo Riverside Apartment PIK 2 North Jakarta is an apartment designed as a residence and office located in Kamal Muara, Penjaringan District, North Jakarta City, Special Capital Region of Jakarta 14470. During the construction of this apartment, careful consideration is given to parking management, ensuring a balance between the need for parking space and the number of existing vehicles. Evaluation of parking space planning needs will discuss parking characteristics, parking space requirements (KRP), and KRP standards for Apartments. The method used in this study is to conduct a survey of vehicle entry and exit in the comparison building, then calculate the amount of parking space availability in the study building and evaluate the need for parking space against the comparison building and the Directorate General of Land Transportation 1996 parking manual, then determine the design of the vehicle circulation in and out, then draw conclusions and suggestions.

Figure 1. Parking Gate

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1.1 Urban Planning and Policy

1.1.1. Urban Planning and Policy Regulatory Frameworks: Many studies examine zoning laws and policies governing parking requirements in multifamily housing. Research highlights that regulations can significantly influence the number of parking spaces mandated per unit, affecting the overall design and density of developments. **Transit-Oriented Development (TOD)**: Literature discusses the integration of parking strategies with public transit accessibility. The effectiveness of reduced parking requirements in TOD areas is explored, indicating potential for decreased car dependency(Simamora & Andrie Gusti Ari Sarjono, 2022).

1.1.2. Design Considerations Space Efficiency: Studies focus on innovative design solutions for parking spaces, such as multi-level parking garages, automated parking systems, and shared parking concepts, which can maximize land use in urban settings. **Aesthetics and Integration**: Research indicates the importance of integrating parking facilities with the architectural design of apartment buildings to minimize visual impact and enhance neighborhood character.

1.1.3. Environmental Impacts Sustainability: Literature explores the environmental footprint of parking facilities, emphasizing the need for sustainable practices, such as permeable pavements, green roofs, and electric vehicle charging stations. Studies suggest that reducing parking supply can lead to a decrease in vehicle emissions. **Impact on Urban Heat Islands**: Some research highlights how large asphalt parking areas contribute to urban heat island effects, advocating for greener alternatives(Effendi et al., 2018).

1.1.4. Social Implications Access and Mobility: Research emphasizes how parking availability influences residents' mobility choices, including reliance on cars versus public transportation or active transportation (walking, cycling). **Equity Issues**: Studies have raised concerns about the inequities related to parking availability, particularly for low-income residents who may not own vehicles but still face higher costs due to parking infrastructure.

1.1.5. Technological Innovations Smart Parking Solutions: Literature discusses the rise of technology in parking management, including apps that help locate available spaces and systems that optimize space usage, potentially reducing the need for excessive parking development(Rocco et al., 2023).
Future Trends: Research points to the implications of autonomous vehicles on parking needs and urban planning, suggesting shifts in how we conceptualize parking spaces.

1.1.6. Case Studies and Empirical Research:
Numerous case studies offer insights into the effectiveness of various parking strategies in apartment complexes across different cities. These studies often highlight the

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correlation between parking availability, resident satisfaction, and overall property value.

2. METHOD

2.1. Classification of parking space detection methods

After collating and summarizing the relevant literature, this paper categorizes parking space detection methods into two main categories: vision-based and non-vision-based methods. Vision-based parking detection methods can be further categorized into two main types: parking space markings and user interface-based methods. Moreover, non-visual-based parking space detection is categorized into two main methods: free-space-based and infrastructure-based methods. According to the reasoning process of effective parking spaces, each method contains several sub-methods(Ma et al., 2021),

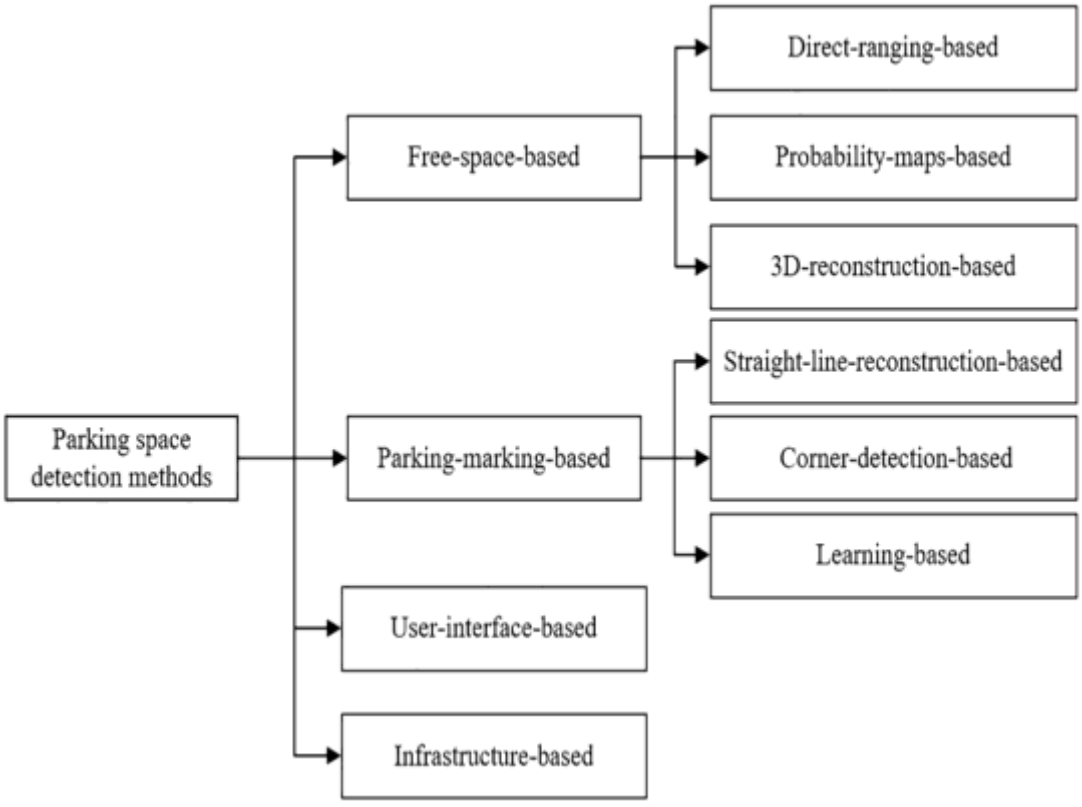

Figure 2. Parking Space Detection Methods

2.2. Free-space-based method

Free-space-based methods are to realize the detection of available parking spaces by identifying the surrounding environment of adjacent vehicles and analyzing the space structure around the vehicles. Among the commonly used sensors are ultrasonic sensors, laser sensors, stereo cameras, depth cameras, and other cameras. These sensors can perceive the environment around the vehicle and provide reliable reference data for

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detecting parking spaces. According to the different discrimination methods for parking spaces, free-space-based methods can be further divided into direct-ranging-based methods, probability-map-based methods, and 3D-reconstruction-based methods (Hou et al., 2018).

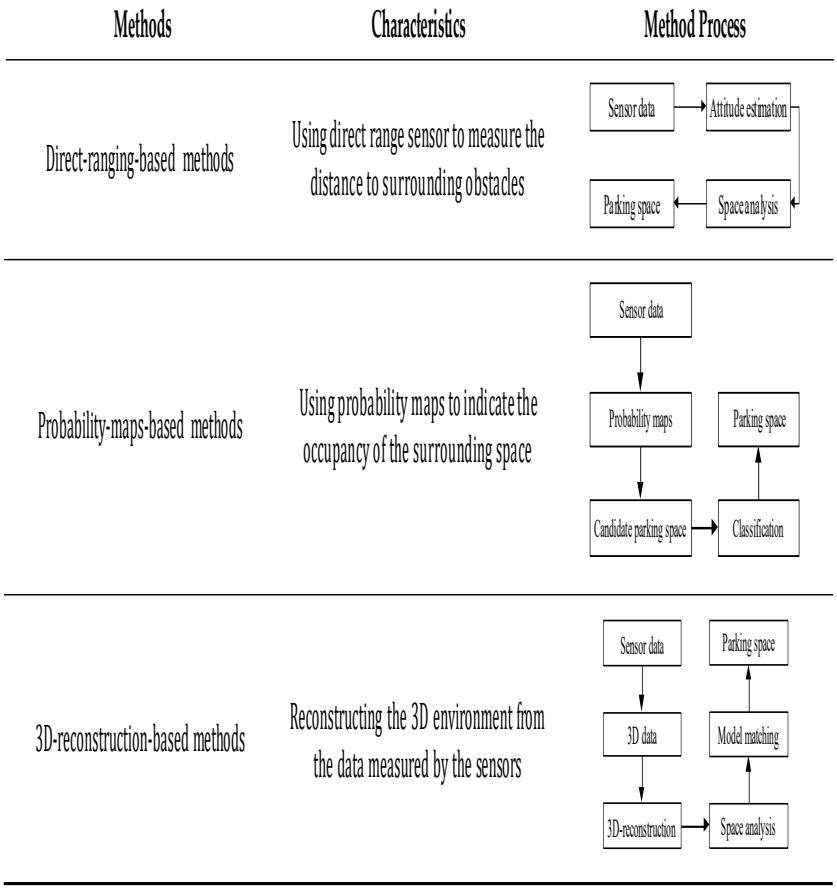

Figure 3. Methods for Parking Spaces

2.3. Direct-ranging-based method

Currently, there are several issues with the direct-ranging-based parking space detection method. Therefore, researchers use map representation methods and mathematical statistics to divide the environment into a series of small grids, each of which is assigned a possible value to express the probability that the grid is occupied. The parking spaces around the vehicle are estimated by the degree of grid occupancy. This method is known as the probability-map-based parking space detection method.

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Figure 4. Ranging-based method

2.4. Occupancy grid map

Proposed a parking space detection method based on a hierarchical three-dimensional occupancy grid, which uses a three-dimensional occupancy grid based on an octree hierarchical data structure to represent the surrounding environment. This is evident in Figure 3. The detailed level of the dynamic control grid divides the intersection between the detected curb boundary and the vehicle boundary into smaller sections. In addition, it determines the size of the parking space by analyzing the maximum vertical distance between the vehicle boundary set and the intersection. It is widely acknowledged that detecting free parking spaces in a two-dimensional dense grid is easy to operate(Dryanovski et al., 2010).

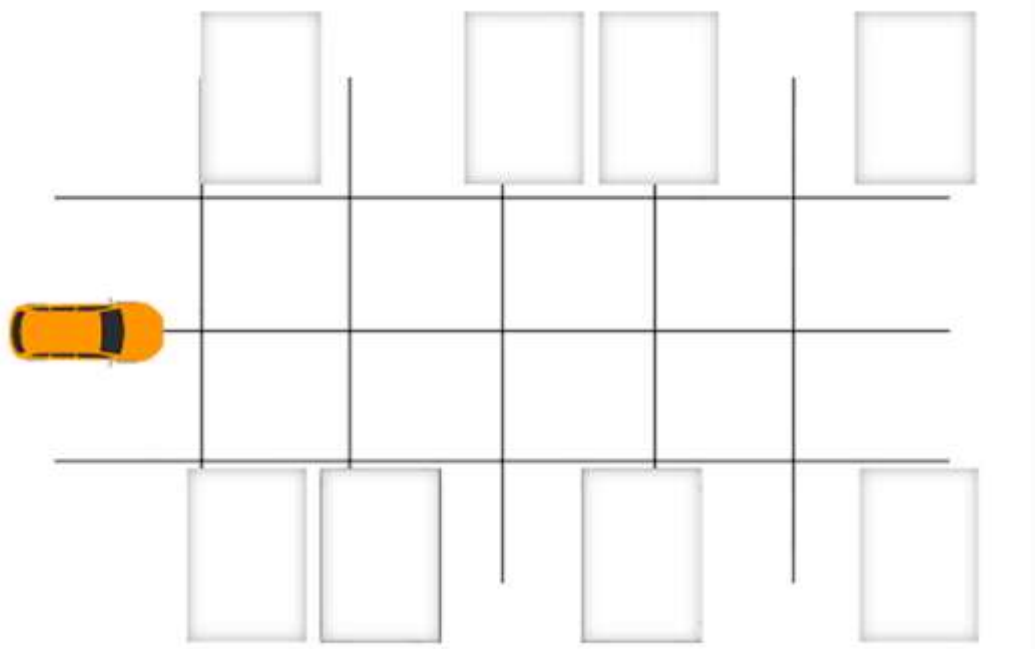

Figure 5. Occupancy Grid Map

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2.5. Hierarchical tree structure of parking space markings

Proposed an effective parking space detection and tracking system, which is divided into three stages. Furthermore, parking space marking detection employed the hierarchical tree structure method proposed by the Reference to identify various types of parking space markings. The occupancy classification stage of parking space uses ultrasonic sensor data to identify the vacancy of the detected parking space. The parking space occupancy rate calculates the probability by treating each parking space area as a single unit occupying the grid(Suhr & Jung, 2016).

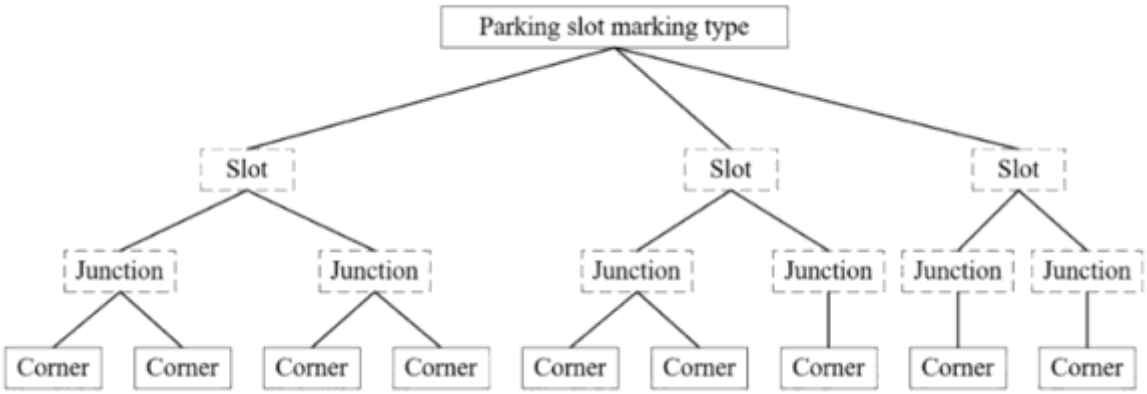

Figure 6. Hierarchical tree structure of parking space markings

2.6. DCNN network structure

Proposed a new parking space detection method based on a Deep Convolutional Neural Network (DCNN), namely DEEPS, which takes surrounding images as input. In DEEPS, there are two key steps: identifying all the marked points on the input image and classifying the partial image patterns formed by the marked points, as shown in Figure 5. Due to the harsh conditions of outdoor parking lots and the high reflection of indoor parking lots, which reduces the reliability of parking space detection, Jang et al. [42] proposed a unified parking space detection method that can simultaneously detect parking spaces composed of multiple structures.

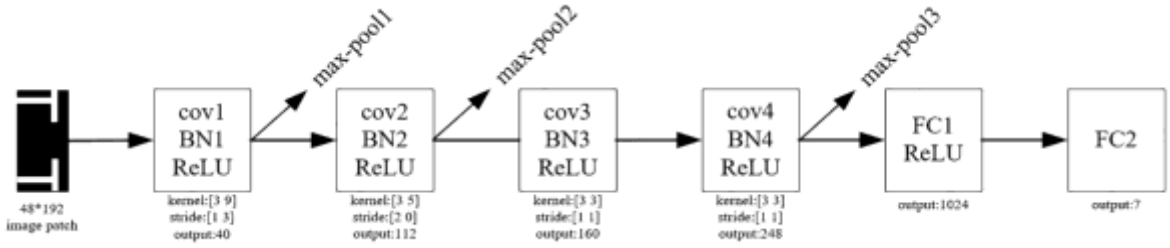

Figure 7. DCNN network structure

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2.7. User-interface-based methods

Free-space-based and parking-space-markings-based detection methods require a tremendous amount of calculation. Therefore, a parking space allocation method based on a user interface is proposed to address this problem. It supports a simple and easy-to-use input method, such as a touch screen. The user can specify a seed point for the target location, and the detection process revolves around this seed point to search, which significantly reduces the scope of detection and the amount of calculation required. The steps of this method are divided into four steps

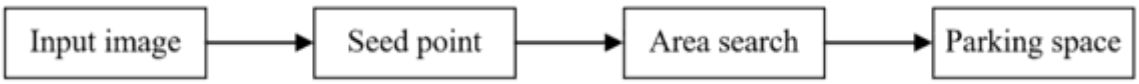

Figure 7. User-interface-based methods

2.8. Infrastructure-based methods

In large-scale parking lot management, the parking space detection method based on infrastructure is highly suitable, as the target location is specified through a local-global positioning system, a digital map, and communication with the parking management system. This method relies on the parking lot's infrastructure and requires distributing various sensor modules and user data communication lines in advance, as well as communicating with the parking lot's management system through the vehicle, to identify the parking space. The specific process

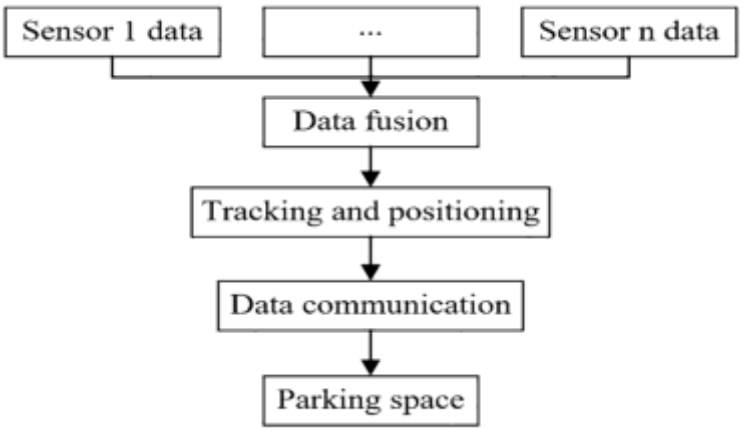

Figure 8. Infrastructure-based methods

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2.9. Summary of parking space detection methods

1. Research on Multi-Sensor-Fusion-Based Parking Space Detection. The algorithms mentioned in this article are all based on the premise of a single sensor.
2. Research on Artificial-Intelligence-Based Parking Space Detection. With the continuous development of artificial intelligence technology, the integration of artificial intelligence into the parking space detection method can enhance the intelligence of the parking space detection process.
3. Research on Parking Space Detection Integrated with Task Requirements. The detection of parking spaces is not the ultimate goal. However, it is necessary to complete diversified tasks by accurately detecting parking spaces, which puts forward higher requirements for detecting parking spaces.

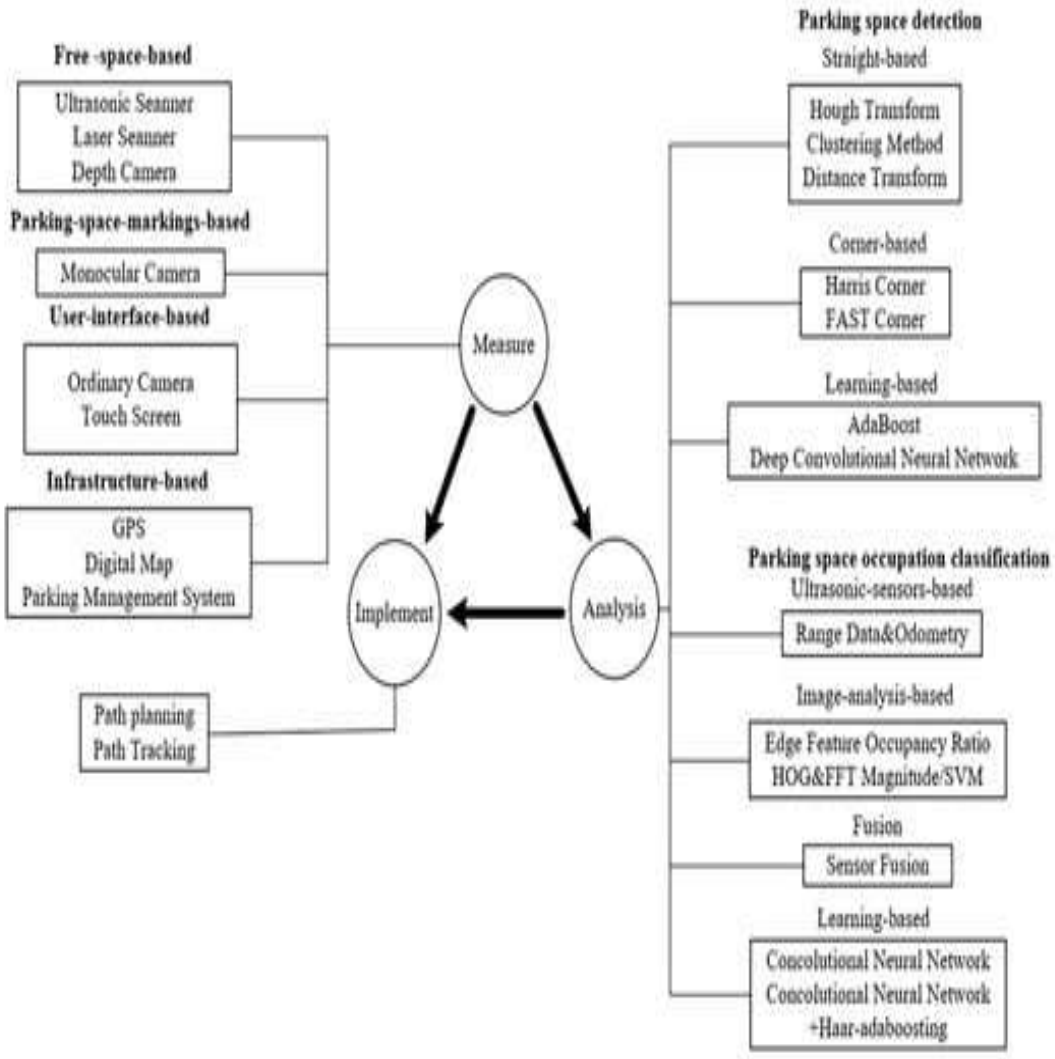

Figure 9. Parking space detection methods

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3. RESULT AND DISCUSSION

3. 1. Over-Provision of Parking and Land Wastage

- **Excessive Space Allocation**: In many urban areas, developers are still required by zoning laws to provide a minimum number of parking spaces per unit. However, in some places, especially in well-connected urban centers or areas with excellent public transport, this requirement can lead to an oversupply of parking. Underutilized parking spaces waste valuable land that could otherwise be used for housing or public amenities(Vanderheiden, 2017).
- **Opportunity Cost**: The land used for parking could be better used for green spaces, more apartment units, or other community-building initiatives, but the regulations in some cities often force developers to build more parking than is actually needed.
- **Financial Implications**: The construction of parking spaces, whether surface lots or underground garages, represents a substantial cost. These costs are often passed down to residents in the form of higher rent or purchase prices, making affordable housing less attainable.

3. 2. Underground and Structured Parking: High Costs

- **Construction and Maintenance Costs**: Underground and multi-story parking garages are more expensive to build and maintain compared to surface parking lots. In addition to the initial construction costs, the maintenance of these parking facilities (including cleaning, repairs, and lighting) can contribute to the overall operating costs of the apartment complex. These costs can be passed on to tenants, contributing to higher rents or homeowners' association (HOA) fees(Gunes et al., 2011).
- **Increased Rents and Affordability Issues**: The higher costs associated with parking can make apartments less affordable, particularly for lower-income residents. In cities where rent control or housing subsidies are already under pressure, these added costs may further exacerbate the affordability crisis.

3. 3. Congestion and Traffic Flow

- **On-Site Traffic Problems**: Parking garages can contribute to congestion within apartment complexes, especially when residents struggle to find available spaces, leading to frustration and inefficiencies. Poorly designed parking layouts can make it hours.
- **Impact on Local Roads**: An oversupply of parking in apartment developments might encourage more car ownership and car use, potentially leading to increased traffic congestion on surrounding streets. In areas that lack adequate transportation infrastructure, this can exacerbate problems related to urban sprawl, road capacity, and environmental pollution(Welde & Tveter, 2022).

3. 4. Environmental Concerns

- **Carbon Footprint of Parking Construction**: The construction of parking facilities adds significantly to a development's overall environmental impact. From excavation

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for underground garages to the use of concrete and steel in multi-story parking garages, parking infrastructure itself contributes to a building's carbon footprint.

- **Surface Parking and Heat Island Effect**: Surface parking lots, common in suburban or low-rise urban developments, can contribute to the "urban heat island effect," where large areas of heat-absorbing materials (asphalt, concrete) increase temperatures in cities. This effect can exacerbate air conditioning demand, air pollution, and overall climate change effects(Onishi et al., 2010).
- **Waste of Land for Parking**: The expansive footprint of parking lots (both surface and structured) takes up land that could be used for more productive purposes. In cities with limited space and growing populations, this becomes an issue of efficiency in land use.

3. 5. Equity and Accessibility Issues

- **Inequitable Distribution of Parking**: Parking is not always equally distributed among residents, leading to inequities in access. For example, lower-income residents may not have access to a parking space, or spaces may be assigned to those who own more expensive vehicles, while others are forced to park on the street or in distant areas.
- **Displacement of Non-Car Owners**: In some apartment complexes, the emphasis on providing parking spaces may come at the cost of amenities that serve non-car owners, such as bike racks, community spaces, or pedestrian-friendly infrastructure.
- **Disabled Parking**: Ensuring that parking spaces are adequately designed for people with disabilities is critical. Insufficiently designated disabled parking spots or poorly designed access routes can create barriers for residents with mobility issues (Gining et al., 2018).

3. 6. Shift Toward Sustainable Transport:

As cities push for more sustainable transport options (public transit, cycling, walking), the traditional model of accommodating parking needs for every resident becomes increasingly outdated and unsustainable. There is a growing recognition that cities need to move toward "car-lite" or "car-free" developments that prioritize public transit and active transportation over private car ownership(Hoogma et al., 2002).

4. CONCLUSION

Research on parking availability and demand in apartment buildings reveals that, although the number of available parking spaces appears sufficient in quantitative terms, there is often a significant discrepancy between availability and residents' actual experiences. Most residents have private vehicles and use parking facilities intensively, but often face difficulties in finding parking spaces, especially during peak hours and at night. Residents' perceptions of the safety and comfort of the parking area are also important factors influencing their decision to use private vehicles. Problems such as inadequate lighting and inadequate supervision can create discomfort and reduce residents' satisfaction. Therefore, it is essential for apartment managers to conduct a thorough evaluation of parking facility management, encompassing not only quantity but also accessibility, safety, and comfort. Recommendations for improvement, such as enhancing parking area design, implementing better monitoring systems, and providing education about alternative transportation options,

E-ISSN:
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should be considered. With these steps, it is hoped that the quality of life of residents can be improved, and parking management can become more efficient and responsive to user needs.

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