ParkNow: Optimizing Shared Community Parking Spaces with Digital Efficiency

Snehal Kubade[1]
Department of IT,
SSGMCE, Shegaon
Eknath Bhavan, SSGMCE, Shegaon
[1]snehalkubade06@gmail.com

Vedanti Polkat[2] Department
of IT, SSGMCE, Shegaon
Zilla Parishad Nagar, Khadki, Akola
[2]vedantipolkat@gmail.com

Prasad Khadse[3]
Department of IT,
SSGMCE, Shegaon
Balaji Nagar Dabki Road, Akola
[3]khadseprasad281@gmail.com

Kartik Dhande[4]
Department of IT,
SSGMCE, Shegaon
Lonar, Buldhana
[4]kartikpatil0936@gmail.com

Bhavika Jain[5] Department
of IT, SSGMCE, Shegaon
Shivaji Chowk, Shegaon
[5]jainbhavika1111@gmail.com

Amitkumar Manekar[6] Head
of Department of IT,
SSGMCE
Shegaon, India
[6]asmanekar24@gmail.com

Abstract — ParkNow is a community-driven parking platform that allows landlords to profit from their vacant spaces and matches car owners with available spots. This hyperlocal digital solution optimizes space utilization and reduces traffic by leveraging technology to address urban parking challenges. Inspired by Park+ and JustPark, ParkNow enhances the customer experience by integrating safe transactions, AI- powered suggestions, and real-time data analytics. It promotes the shared economy model, which contributes to the sustainability of cities and is consistent with Smart City and Appropriate Technology efforts. The growth, challenges, and impact of ParkNow on the evolution of digital governance and urban mobility are examined in this paper.

Keywords- Traffic Reduction, Sustainability, Public Infrastructure Optimization, Digital Governance, Cloud-Based Platform, Urban Mobility, Service Accessibility, Shared Economy, Government Initiatives, User Experience, Data Privacy, Operational Scalability, Smart Parking, Hyperlocal Services, Real- Time Booking, Online Reservations, Smart City Solutions, Parking Management System, and Online Reservations.

I. INTRODUCTION

ParkNow is an innovative solution that leverages a technology-driven platform to streamline parking management in the quickly evolving field of urban mobility. Due to the increasing number of vehicles on the road and the limited amount of parking available, urban areas confront significant problems such traffic congestion, inefficient space usage, and time-consuming parking searches. ParkNow intends to include digital frameworks and real-time booking procedures to enhance parking accessibility, optimize space usage, and reduce urban congestion.

Using location-based services and cloud-based technologies has become essential as cities strive to improve public convenience and build smarter infrastructure. This change is exemplified by ParkNow, which provides a centralized platform where drivers can conveniently reserve parking spaces and landlords can sign up to profit from their available spots. This hyperlocal approach ensures that parking solutions are efficient, convenient, and beneficial for both individuals and city development initiatives.

ParkNow's primary goal is to eliminate parking-related inefficiencies while offering a transparent, secure, and user- friendly experience. The technology enables dynamic parking space allocation, reduces unnecessary fuel consumption, and promotes environmental sustainability through the use of cloud computing and real-time data analytics. The technology also promotes scalability and flexibility, which makes it easy to combine with existing municipal infrastructure and smart city initiatives.

The architectural layout, technological advancements, and potential impacts on urban mobility of ParkNow are examined in this paper. It also examines implementation-related challenges such infrastructure readiness, data security, user adoption, and regulatory considerations. The discussion also highlights how digital parking management could improve urban traffic flow, reduce emissions, and enhance commuter experiences overall. Through an analysis of case studies and real-world implementations, this paper aims to provide a comprehensive understanding of how ParkNow reimagines parking solutions in order to ultimately promote a more efficient, accessible, and sustainable urban environment.

II. LITERATURE SURVEY

One In urban regions, the necessity for effective parking management systems has increased dramatically due to urbanization and the exponential rise in vehicle ownership. Conventional parking systems frequently fail to fulfill real- time demands, which results in major problems like air pollution, traffic congestion, needless fuel usage, and driver discontent. Ineffective parking has a detrimental effect on the economy and the environment in addition to wasting important time. Smart Parking Systems (SPS), which make use of cutting-edge technologies including the Internet of Things (IoT), cloud computing, computer vision, RFID, artificial intelligence (AI), and optimization algorithms, have been presented by a number of researchers and developers in order to address these issues. This section examines significant contributions, emphasizing significant advancements, successes, constraints, and potential paths forward in the field of smart parking systems.

Zhang W. et al. [1] proposed a smart parking system that combines several YOLO variations with Convolutional Neural Networks (CNN) for vehicle detection using computer vision techniques. Their program achieved an impressive 87% accuracy rate in locating open parking spaces, even in the presence of minor environmental disturbances. However, they discovered that their system's effectiveness drastically decreased in low-visibility conditions, including fog, rain, or dim nighttime illumination, because it depends on high-quality visual input. Kumar and Patel [2] introduced an Internet of Things (IoT)-driven smart parking framework that effectively integrated cloud computing services with mobile applications to enable dynamic slot distribution and real- time parking updates. Their

model reduced automobile parking search times by over 40%, which greatly improved user satisfaction. However, the system's dependence on cloud infrastructure raised concerns about data security and privacy, especially in light of unauthorized access to data.

Sharma and Verma [3] presented a parking control system based on GSM and sensors, with a focus on real-time slot monitoring. Their hybrid system, which combines ultrasonic sensors and GSM modules, achieved 90% detection accuracy across a range of environmental conditions, ensuring dependable performance. However, scalability for large metropolitan installations was limited due to the high cost of installation and maintenance caused by the complexity and volume of technology needed. Park and Choi [4] investigated artificial intelligence (AI)-based smart parking management methods based on reinforcement learning. By introducing dynamic pricing models that adjusted to parking demand in real time, their research improved space usage by 25%. Despite optimizing income generation and space efficiency, this strategy made system maintenance more difficult by requiring constant model retraining to handle changing urban traffic patterns.

Lee and Kim [5] conducted a thorough analysis of current smart parking systems, assessing a number of factors such as system scalability, cost effectiveness, real-time performance, and dependability. Although they came to the conclusion that IoT, AI, and cloud services must be smoothly integrated for SPS installations to be effective, they cautioned that many systems are highly dependent on dependable internet connectivity, leaving them open to disruptions or cyberattacks.

Ahmed et al. [6] proposed a solution that includes a hybrid edge-cloud computing architecture with dynamic pricing. By significantly cutting network latency and lessening the burden on centralized servers, their approach enhanced response times during peak hours. However, because the strategy necessitated large upfront investments in both cloud services and edge technology, it faced challenges for communities with limited resources. Brown and Wilson [7] developed pixel-wise Region of Interest (ROI) selection methods using many generations of YOLO models (YOLOv8 to YOLOv11) in order to advance the field. Their method's improved detection accuracy made it possible to monitor parking spaces in incredibly precise detail. The primary trade-off was the high computational power requirements and expensive GPU resources, which hindered its practical implementation on low-power IoT edge devices.

Khan and Shah [8] concentrated on creating a parking management algorithm that was optimized for the cloud, resulting in quick data transfer and less reliance on local hardware. Although their model showed effective scalability in both large and small parking lots, it was still vulnerable to connectivity problems in places with erratic internet service. Tsai et al. [9] suggested an integrated smart parking system that incorporates mobile apps, cloud-based analytics, and several sensors (ultrasonic, infrared). Their system was commended for its scalability and user-friendliness, despite interoperability problems caused by differences in hardware standards and sensor protocols.

Wang et al. [10] created an Internet of Things (IoT)-based parking management system with an emphasis on environmental impact reduction, automated ticketing, and real-time monitoring. By cutting down on the amount of time drivers had to spend looking for parking, their innovation helped reduce vehicle CO2 emissions. However, having a dependable wireless communication network was essential to the system's success. Kim et al. [11] developed a smart parking system for autonomous vehicle parking that

uses sensor fusion technology to enable cars to find, reserve, and park themselves in public areas. Despite being groundbreaking, this idea was only feasible in high-tech smart city areas because of the challenging infrastructure modifications and higher implementation costs.

Yousif et al. [12] introduced cloud-integrated analytics to enable real-time monitoring and traffic predictions in smart parking solutions. By looking at both past and present data, their program could be able to predict parking availability more precisely in the future. However, a significant issue that may lead to delays was server congestion during peak hours. Zhang, Wu, and Hu [13] developed a smart parking detection system that can detect space occupancy with high accuracy by combining deep learning models with Internet of Things technologies. Although their work advanced automated parking lot management, it required a high level of processing power, so integrating edge computing was crucial for successful scaling.

Hassan et al. [14] created an Internet of Things-enabled system that uses RFID and Wi-Fi to allow user-friendly parking solutions with functions like payment integration and spot reservation. Although their strategy encouraged system scalability, it ran into security issues with RFID- based communications. Elkhodr et al. [15] put out an energy-efficient smart parking model with the goal of extending the life of Internet of Things sensors without sacrificing system functionality. Their answer turned out to be crucial for smart cities that

prioritize sustainability. However, achieving the needed energy efficiency created firmware complexity and demanded extensive system tuning.

Patel and Dhameliya [16] emphasized the use of wireless sensor nodes as a means of getting around complex wiring infrastructure. Despite significantly lowering installation costs, their strategy introduced operational challenges, particularly with regard to battery maintenance for the distributed wireless sensor network. Mutiara et al. [17] used NodeMCU and ultrasonic sensors to construct a low-cost parking module. Their experiment proved that it was possible to implement smart parking solutions on a modest scale at a reasonable cost, especially in poor nations. However, with time, drift problems and sensor calibration could jeopardize dependability.

Fikri and Hwang [18] made a significant contribution by developing a smart parking system specifically for drivers with disabilities that controls accessible parking spaces using smartphone apps. Even if this resolved a major inclusivity issue, the system required frequent manual maintenance to ensure that accessible slots remained available and functional. Perwej A. and Perwej Y. [19] emphasized the potential of IoT technologies in conjunction with big data analytics for predictive parking management. Their approach provided scalable smart city integration by enabling real-time analysis and forecasting. However, there were still issues with managing data storage and the heavy computing load required for real-time forecasts.

Yadav, Kulkarni, and Khairnar [20] greatly reduced vehicle entry and exit times by implementing an RFID-based parking solution. Despite being efficient at increasing throughput, RFID reader mistakes and duplicate tags may interfere with seamless operations, requiring the use of extra error-handling techniques. G. Pradeepini and Amitkumar S. Manekar [21] investigated multi-cloud-based big data computing optimization and offered insightful information for smart parking systems that strive for cost-effective scaling and high availability. Parking operators may be able to optimize infrastructure costs while upholding service level agreements thanks to their resource allocation algorithms. Lastly, Amitkumar S. Manekar et al. [22] conducted a comparative study of metaheuristic optimization algorithms inspired by nature, including Genetic Algorithms and Particle Swarm Optimization, emphasizing their suitability for resolving optimization and parking slot allocation issues. By reducing motorist wait times and optimizing resource usage, these algorithms could greatly increase the effectiveness of future smart parking systems.

III. METHODOLOGY

Through a systematic and organized methodology, this extensive study explores the smart parking system's overall user experience, underlying technological architecture, and operational efficacy. The research attempts to provide a comprehensive picture of how the system operates in actual situations by combining technical studies with user-centered evaluations. The approach used evaluates the system's usability, effectiveness, and end-user satisfaction in addition to closely examining the hardware and software components' performance and dependability. The study also investigates how much the smart parking platform improves digital accessibility, expedites the parking procedure, and advances the more general objectives of smart city development and intelligent urban infrastructure.

Table 3.1 Comparison Table

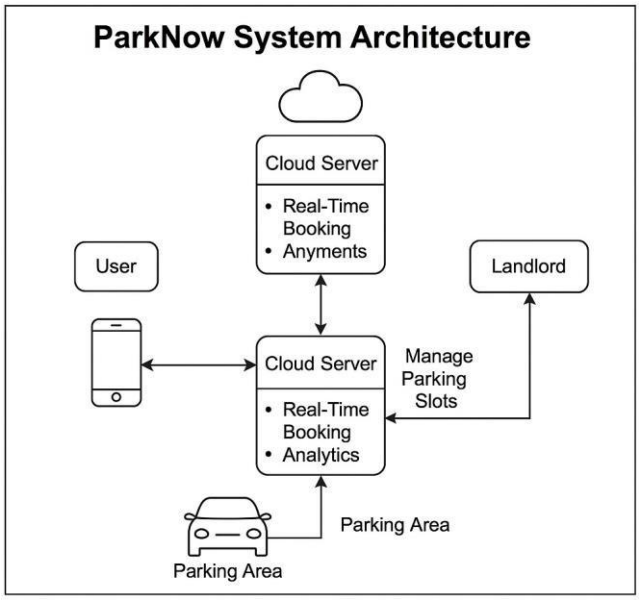
Parameter	**Traditional Parking**	**Smart Parking (ParkNow)**
Slot Availability Info	Manual, Not Real-Time	Real-Time via App
Payment System	Cash-Based	Digital & Secure
Space Utilization	Poor	Optimized with Analytics
Environmental Impact	High CO_2 Emissions	Reduced Fuel Use
User Convenience	Low	High (Live Booking, Alerts)

Table 3.1 outlines the main distinctions between smart parking systems (ParkNow) and conventional parking systems. ParkNow provides digital payments, real-time slot availability, and effective space usage through data analytics, in contrast to manual approaches. Additionally, it improves consumer convenience with features like live booking and alerts and lessens its impact on the environment by using less gasoline.

1. RESEARCH DESIGN

To give a thorough examination of the smart parking system, this study combines descriptive and exploratory research techniques. The study begins with an exploratory phase that entails a thorough examination of the parking issues that are currently prevalent in urban areas and the variety of traditional and novel solutions that are being used to address them [2][4]. This stage aids in creating a fundamental comprehension of the background, requirements of stakeholders, and constraints of current parking systems. It lays the groundwork for determining the opportunities and gaps that contemporary

technology, such as smart parking, may be able to address.



The study moves into a structured descriptive analysis after the exploratory phase. This section focuses on methodically analyzing the smart parking system's architecture, as shown in Fig. 1.1, as well as its technological implementation and the level of user involvement in its operation [1][5]. The descriptive component makes it possible to thoroughly assess how different system elements work together, how users interact with the platform, and how well the solution handles parking inefficiencies and urban congestion.

Fig-1.1 System Architecture

This study guarantees a thorough and nuanced understanding of smart parking systems by combining exploratory and descriptive approaches. In addition to illuminating existing technology frameworks and user experiences, it provides information about prospective developments and tactical enhancements that may influence urban mobility in the future. In the end, this hybrid strategy offers helpful recommendations for maximizing parking effectiveness, minimizing traffic-related problems, and aiding in the creation of smarter, more sustainable communities [4].

Additionally, with an emphasis on sustainability, scalability, and user inclusion, the study highlights the significance of coordinating smart parking technology with larger smart city projects. The research demonstrates how smart parking systems may be customized to match the particular requirements of various urban contexts by examining real- world case studies and taking user feedback into account. It also looks at how supporting technologies like cloud computing, smartphone apps, and Internet of Things sensors might improve the system's functionality and dependability. These results highlight how smart parking has the potential to greatly advance the development of intelligent transportation systems in contemporary cities, in addition to enhancing urban traffic flow and lowering pollution.

2. DATA COLLECTION METHODS

A. PRIMARY DATA COLLECTION

Landlord and User Questionnaires: Both parking space owners and users are given standardized questionnaires to complete in order to assess factors such as transaction reliability, booking ease, and overall system efficacy [2]. To guarantee measurable data collection, these surveys contain both closed-ended and Likert-scale questions. Perceived convenience, app usability, preferred payment methods, and overall experience satisfaction are all recorded in user feedback. Questions about revenue consistency, booking management ease, and technical issues are posed to landlords.

Expert Consultations: To gain a better understanding of future enhancements, scalability concerns, and system efficiency, discussions are held with parking management experts, urban planners, and digital service providers [5][6]. Experts also discuss the adoption of IoT and AI components, the significance of coordinating technology deployment with user behavior patterns and regulatory frameworks, and how smart parking systems can be more effectively connected with smart city infrastructure.

B. SECONDARY DATA COLLECTION

A Case Study Analysis: This involves contrasting the smart parking systems that are now in place in places like Amsterdam, Singapore, and San Francisco that are renowned for their innovative mobility. Finding operational efficiency, best practices in technology, and effective implementation techniques are the goals [2][6]. In order to present a balanced picture of the opportunities and risks, emphasis is also given on comprehending shortcomings or limitations in comparable deployments.

3. DATA ANALYSIS METHODS

A. QUANTITATIVE ANALYSIS

Descriptive statistics: This approach is used to assess numerical data such as average wait times,

transaction success rates, app download and usage rates, and slot occupancy statistics. It facilitates the setting of performance benchmarks and the tracking of system dependability and consistency.

Pattern Analysis: To determine utilization peaks, average session lengths, and consumer behavior - such as favorite booking times or preferred parking zones - booking trends are examined. By using adaptive pricing and improved design, these patterns help forecast demand, allocate resources optimally, and reduce empty parking spaces.

B. Qualitative Analysis

Thematic Analysis: Thematic coding is used to classify the qualitative information gathered from interviews and open- ended questionnaire answers. There include themes including "navigation issues," "technical glitches," "security concerns," and "ease of use." This identifies areas for UX development and helps to find typical user pain points. Comparative Analysis: The attributes of the smart parking system are contrasted with those of other digital alternatives as well as traditional parking systems (manual ticketing, lack of real-time availability). The research provides a clear baseline for the impact of the suggested solution by examining transaction reliability, customer happiness, operational efficiency, and cost-effectiveness.

4. TECHNOLOGICAL FRAMEWORK ANALYSIS

Scalability and Cloud-Based architecture: The backend of the system is dependent on scalable cloud architecture that can manage requests from numerous users in different regions at the same time. The platform's capacity to sustain performance in high-demand situations and during peak hours is assessed using load-balancing strategies, elastic server provisioning, and automated failover procedures.

Security & Data Protection: Safe data handling procedures are examined, such as consistent data backups, two-factor authentication, HTTPS protocols, and end-to-end encryption for transactions. To maintain user confidence and legal compliance, adherence to data privacy laws (such as the GDPR or India's DPDP Act) is also evaluated.

User Experience & Accessibility: UI/UX components including user-friendly layouts, quick loading speeds, few steps required for reservations, and accessible features (such voice input, multilingual support, and color contrast for users with visual impairments) are assessed. To guarantee smooth interaction for a variety of user groups, the system's responsiveness on different devices (such as smartphones and tablets) is also taken into account.

Table 3.2 Description Table

Feature	Description
Real-Time Booking	Live parking space status and reservations
Cloud Integration	Scalable, multi-user support
Digital Payments	Secure transactions and receipts
Data Analytics	Predicts peak usage times
User App Interface	Simplified slot search and navigation

5. ETHICAL CONSIDERATIONS

The study makes sure that strict ethical guidelines are followed during the whole data gathering, processing, and reporting process. In addition to safeguarding participants' rights, ethical compliance is essential for preserving the validity, reliability, and social significance of study findings. The following fundamental ethical standards are strictly adhered to:

Informed Consent: Each participant receives a thorough description of the goals, parameters, and anticipated results of the study before taking part in surveys, interviews, or expert consultations. They are made aware of the procedures in place to guarantee anonymity, the way in which their answers will be utilized, and their voluntary right to participate or to withdraw at any time. To guarantee complete awareness and agreement, consent is legally gained through signed consent papers or digitally through agreements based on apps.

Data Confidentiality and Privacy Protection: All personally identifiable information (PII) gathered for the study is either anonymised or encrypted prior to storage and analysis in order to respect privacy standards. Only aggregated data is given in conclusions, and user data, including booking histories and feedback, is kept in safe, access-controlled systems. The study ensures that individual rights are fully maintained by adhering to best practices for data

protection and complying with current legislation including the General Data Protection Regulation (GDPR) and national data privacy statutes.

Bias Mitigation and Fair Representation: By guaranteeing inclusive involvement from a varied cross-section of users and stakeholders, the research purposefully avoids

demographic, regional, or socioeconomic bias. This encompasses people of various ages, genders, city zones, and occupations (e.g., everyday commuters, older citizens, tech- savvy youth, and landlords). In order to avoid leading or suggestive questions that could distort replies, surveys and interview designs are examined for neutrality in language and tone. The validity and generalizability of the study's findings are strengthened by this impartial and inclusive methodology.

Accountability and Transparency: The study's limits, methods, and processes are all openly acknowledged. A summary of the study's findings is available to participants upon request. To preserve impartiality and scientific integrity, any possible conflicts of interest or affiliations affecting the study are also explicitly declared.

Respect for Stakeholders: The study makes sure that every participant is treated with dignity and that their time, opinions, and contributions are valued. There are feedback systems in place so that participants can express any issues or recommendations about the research procedure. When appropriate, ethical review or monitoring is sought, especially when vulnerable groups or minors are involved.

IV. Conclusion

The smart parking system enhances urban mobility by streamlining parking administration through the use of cloud computing, real-time data processing, and digital payments. Landlords profit from automated reservations, real-time tracking, and increased revenue, while consumers enjoy hassle-free parking, cashless transactions, and real- time slot changes. Obstacles include user acceptance reluctance, data synchronization issues, and payment gateway requirements. Future innovations like mobile apps, QR/RFID-based automatic entry, and dynamic pricing can enhance functionality. All things considered, the system is a scalable and efficient urban solution that maximizes parking, reduces traffic, and saves time. Furthermore, route optimization and parking predictions can be improved through interaction with smart city platforms and navigational aids like Google Maps. Supply and demand could be further balanced with the use of AI-based demand forecasting. Iterative improvements can be guided by regular cycles of user feedback. Such sophisticated systems will be essential to sustainable urban planning and transportation management as cities continue to expand.

References

[1] W. Zhang, et al., "Smart Parking System with Computer Vision," *Int. J. Comput. Vision Appl.*, vol. 12, no. 4, pp. 102–118, Dec. 2024.

[2] S. Kumar and R. Patel, "An Improved IoT Smart Parking System," *J. Internet Things Res.*, vol. 10, no. 3, pp. 89–105, Oct. 2024.

[3] P. Sharma and A. Verma, "A Smart Real-Time Parking Control and Monitoring System," *Smart City Technol.*, vol. 8, no. 2, pp. 55–72, Dec. 2023.

[4] D. Park and S. Choi, "Smart-Parking Management Algorithms in Smart City," *Sci. Rep.*, vol. 12, no. 1, 2022, Art. no. 10076.

[5] J. Lee and H. Kim, "Smart Parking Systems: Comprehensive Review Based on Various Parameters," *Heliyon*, vol. 7, no. 5, May 2021, Art. no. e11531.

[6] M. Ahmed, et al., "Smart Parking System with Dynamic Pricing, Edge-Cloud Computing, and Context-Aware Services," *Sensors*, vol. 20, no. 17, 2020, Art. no. 4899.

[7] L. Brown and D. Wilson, "Smart Parking with Pixel-Wise ROI Selection for Vehicle Detection Using YOLOv8, YOLOv9, YOLOv10, and YOLOv11," *arXiv Preprint*, Dec. 2024.

[8] Khan, M.A, Shah, S.Z., "An Efficient Algorithm for Cloud-Based Parking Systems," *International Journal of Engineering and Advanced Technology*, vol. 7, no. 3, pp. 70, 2018. 2020, 2020, Art. no. 3704852.

[9] Yousif, M., Qadir, Z., & Al-Habib, K., "An Intelligent IoT-enabled Smart Parking System with Cloud Integration," *Journal of King Saud University-Computer and Information Sciences*, 2021

[10] Zhang, Y., Wu, Y., & Hu, C., "Smart Parking System Based on IoT Technology and Deep Learning," *Journal of Ambient Intelligence and Humanized Computing*, vol. 12, no. 3, pp. 3123–3131, 2021.

[11] Hassan, W. A., Omer, F. A., & Yousef, A. M., "Design and Implementation of an IoT-based Smart Parking

[12] System," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 5, pp. 456–463, 2020.

[13] Elkhodr, M., Elmaghraby, A., & Mohsen, H., "An IoT-based Smart Parking System with Energy-Efficient Operations for Smart Cities," *Sensors*, vol. 21, no. 14, 4826, 2021

[14] Patel, D. R., & Dhameliya, S., "Wireless Sensor Node for Smart Parking," *International Journal of Engineering and Advanced Technology*, vol. 7, no. 5, pp. 86–90, 2018.

[15]

[16] Tsai, Y. H., Chen, Y. H., & Liu, T. C., "IoT-based Smart Parking System Using an Integrated Approach," *IEEE Sensors Journal*, vol. 19, no. 9, pp. 3547–3555, 2019.

[17] Wang, G., Zhang, L., Xu, X., & Sun, S., "Design and Implementation of a Smart Parking Management System Using the Internet of Things," *IEEE Access*, vol. 9, pp. 45413–45422, 2021.

[18] Kim, J., Shin, J., & Kim, H., "IoT-based Smart Parking

Management System for Autonomous Vehicle Parking," *Journal of Advanced Transportation*, vol.

[19] Mutiara, F., Arifin, M., & Rahman, A., "Low-Cost Wireless Parking Module Using Ultrasonic Sensor and NodeMCU," *Journal of Engineering Science and Technology*, vol. 14, no. 6, pp. 2695–2706, 2019.

[20] Fikri, R. M., & Hwang, M., "Smart Parking Area Management System for the Disabled Using IoT and Mobile Application," *Proceedings - IEEE International Conference on Internet of Things and Intelligence System (IoTaIS)*, 2019, pp. 172–176.

[21] Perwej, Y., and Perwej, A., "The Smart Parking System for Internet of Things-Based Real-Time Applications in the Era of Big Data," *International Journal of Computer Applications*, vol. 176, no. 17, pp. 29–35, 2020.

[22] Yadav, V. S., Kulkarni, S., & Khairnar, R. S., "IoT-based Smart Parking System Using RFID," *Materials Today: Proceedings*, vol. 46, no. 7, pp. 2150–2156, 2021.

[23] A. Manekar and G. Pradeepini, "Optimizing Cost and Maximizing Profit for Multi-Cloud-Based Big Data Computing by Deadline- Aware Optimize Resource Allocation," 2021, pp. 18–25.

[24] Amitkumar S. Manekar et al., "Comparative Analysis of Nature- Inspired Meta Heuristic Optimization Algorithms," *SSGM Journal of Science and Engineering*, vol. 1, no. 1, pp. 169–173.

[25] P. Sharma and A. Verma, "A Smart Real-Time Parking Control and Monitoring System," *Smart City Technol.*, vol. 8, no. 2, pp. 55–72, Dec. 2023.

[26] D. Park and S. Choi, "Smart-Parking Management Algorithms in Smart City," *Sci. Rep.*, vol. 12, no. 1, 2022, Art. no. 10076.

[27] J. Lee and H. Kim, "Smart Parking Systems: Comprehensive Review Based on Various Parameters," *Heliyon*, vol. 7, no. 5, May 2021, Art. no. e11531.

[28] M. Ahmed, et al., "Smart Parking System with Dynamic Pricing, Edge-Cloud Computing, and Context-Aware Services," *Sensors*, vol. 20, no. 17, 2020, Art. no. 4899.

[29] L. Brown and D. Wilson, "Smart Parking with Pixel-Wise ROI Selection for Vehicle Detection Using YOLOv8, YOLOv9, YOLOv10, and YOLOv11," *arXiv Preprint*, Dec. 2024.

[30] Khan, M.A, Shah, S.Z., "An Efficient Algorithm for Cloud-Based Parking Systems," *International Journal of Engineering and Advanced Technology*, vol. 7, no. 3, pp. 70, 2018.

[31] Tsai, Y. H., Chen, Y. H., & Liu, T. C., "IoT-based Smart Parking System Using an Integrated Approach," *IEEE Sensors Journal*, vol. 19, no. 9, pp. 3547–3555, 2019.

[32] Wang, G., Zhang, L., Xu, X., & Sun, S., "Design and Implementation of a Smart Parking Management System Using the Internet of Things," *IEEE Access*, vol. 9, pp. 45413–45422, 2021.

[33] Kim, J., Shin, J., & Kim, H., "IoT-based Smart Parking Management System for Autonomous Vehicle Parking," *Journal of Advanced Transportation*, vol. 2020, 2020, Art. no. 3704852.

[34] Yousif, M., Qadir, Z., & Al-Habib, K., "An Intelligent IoT-enabled Smart Parking System with Cloud Integration," *Journal of King Saud University-Computer and Information Sciences*, 2021

[35] Zhang, Y., Wu, Y., & Hu, C., "Smart Parking System Based on IoT Technology and Deep Learning," *Journal of Ambient Intelligence and Humanized Computing*, vol. 12, no. 3, pp. 3123–3131, 2021.

[36] Hassan, W. A., Omer, F. A., & Yousef, A. M., "Design and Implementation of an IoT-based Smart Parking System," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 5, pp. 456–463, 2020.

[37] Elkhodr, M., Elmaghraby, A., & Mohsen, H., "An IoT-based Smart Parking System with Energy-Efficient Operations for Smart Cities,"
Sensors, vol. 21, no. 14, 4826, 2021

[38] Patel, D. R., & Dhameliya, S., "Wireless Sensor Node for Smart Parking," *International Journal of Engineering and Advanced Technology*, vol. 7, no. 5, pp. 86–90, 2018.

[39] Mutiara, F., Arifin, M., & Rahman, A., "Low-Cost Wireless Parking Module Using Ultrasonic Sensor and NodeMCU," *Journal of Engineering Science and Technology*, vol. 14, no. 6, pp. 2695–2706, 2019.

[40] Fikri, R. M., & Hwang, M., "Smart Parking Area Management System for the Disabled Using IoT and Mobile Application," *Proceedings - IEEE International Conference on Internet of Things and Intelligence System (IoTaIS)*, 2019, pp. 172–176.

[41] Perwej, Y., and Perwej, A., "The Smart Parking System for Internet of Things-Based Real-Time Applications in the Era of Big Data," *International Journal of Computer Applications*, vol. 176, no. 17, pp. 29–35, 2020.

[42] Yadav, V. S., Kulkarni, S., & Khairnar, R. S., "IoT-based Smart Parking System Using RFID," *Materials Today: Proceedings*, vol. 46, no. 7, pp. 2150–2156, 2021.

[43] A. Manekar and G. Pradeepini, "Optimizing Cost and Maximizing Profit for Multi-Cloud-Based Big Data Computing by Deadline- Aware Optimize Resource Allocation," 2021, pp. 18–25.

[44] Amitkumar S. Manekar et al., "Comparative Analysis of Nature- Inspired Meta Heuristic Optimization Algorithms," *SSGM Journal of Science and Engineering*, vol. 1, no. 1, pp. 169–173.