ISSN: 2321-2152

IJMECE

International Journal of modern electronics and communication engineering

E-Mail
editor.ijmece@gmail.com
editor@ijmece.com

www.ijmece.com

ISSN2321-2152
www.ijmece .com
Vol 12, Issue.2, 2024

AUTOMATIC PARALLEL PARKING

[1]Sudhakar Raju, [2]Sahithi Nemuri, [3]Sravya Bongu

[1]Assistant professor in Department of Information Technology Bhoj Reddy Engineering College for Women

[2,3] UG Scholars in Department of Information Technology Bhoj Reddy Engineering College for Women

Abstract

An innovative Autonomous Parallel Parking System that seamlessly integrates state-of-the-art path is planning, path tracking, and control techniques to enable vehicles to autonomouslyexecuteparallelparkingmaneuversreliablyandefficiently.Thissystemservesasacompellingdemonstration of the transformative potential of artificial intelligence (AI) and robotics in real-world applications, particularly within the realm of autonomous vehicles. Key components of this project include cutting-edge path planning algorithms, precise path tracking mechanisms, and sophisticated control strategies, collectively designed to deliver a robust and efficient parallel parking solution. The seamless integration of these techniques ensures a smooth and reliable parking experience, showcasing the adaptability and precision achievable through the synergy of AI and robotics. This endeavor extends beyond the immediate context of parallel parking, offering valuable insights and techniques applicable to a diverse array of autonomous vehicle scenarios. The project serves as a testament to the scalability and versatility of the developed methodologies, emphasizing their potential integration into broader applications within the field of self-driving cars and other autonomous systems. By presenting this Autonomous Parallel Parking System, we contribute to the growing body of knowledge in AI and robotics, offering a practical and tangible example of howthesetechnologiescanenhancethecapabilitiesofvehiclesinnavigatingcomplexreal-world environments. The findings and methodologies presented in this project provide a foundation for further research and development, opening avenues for advancements in autonomous vehicle systems.

I INTRODUCTION

In an era marked by rapid advancements in artificial intelligence and robotics, the fusion of cutting-edge technologies with real-world applications has become a defining hallmark. This project unfolds against this backdrop, introducing an Autonomous Parallel Parking System that not only showcases the intricacies of modern path planning, path tracking, and

ISSN2321-2152
www.ijmece .com
Vol 12, Issue.2, 2024

control techniques but also stands as a testament to the transformative potential of AI in the domain of autonomous vehicles. The ability to autonomous lynavigate and execute precise maneuver sisal critical milestone in the evolution of self-driving technologies. Parking, particularly in parallel spaces, presents a complex and dynamic challenge, requiring a seamless integration of advanced algorithms and control strategies. Our project delves into this challenge, presenting a comprehensive solution that not only facilitates efficient parallel parking but also extends its implications across a spectrum of autonomous vehiclescenarios.As the demand for autonomous systems continues to grow, the need for robust and adaptable solutions becomes increasingly paramount. This project aims to contribute to this evolving landscape by unveiling a system that goes beyond a singular application. Through the amalgamation of sophisticated path planning, tracking,and control techniques, our Autonomous Parallel Parking System offers a glimpse into the broader possibilities and applications of AI and robotics in there alm of self-driving cars. This introductory overview sets the stage for an exploration into the intricacies of the developed system, emphasizing its significance in the context of autonomous vehicles. The following sections will delve in to the specific methodologies employed, thechallenges addressed, and the insights gained, underscoring the potential impact of this projection the future of autonomous navigation systems.

II LITERATURE SURVEY

In the realm of automatic parallel parking, a considerable body of research has contributed to advancing the capabilities and understanding of this technology. A study conducted in 2018 explored the integration of automated parking systems in commercial vehicles, emphasizing the efficiency gains and safety improvements achievable through autonomous parallel parking maneuvers on a larger scale. Another investigation in 2019delved into path planning strategies specifically tailored for parallel parking, comparing various algorithms to optimize vehicle trajectories during parking maneuvers. In 2020, are search initiative focused on sensor fusion techniques, aiming to enhance the precision of parallel parking in autonomous vehicles by integrating data from multiple sensors. Addressing the human-centric aspect of this technology, a study in 2021 explored the design of user interfaces to improve user acceptance through intuitive interactions and clear visualizations. A subsequent study in 2022 delved into real-time

control strategies for autonomous parallel parking, aiming to enhance responsiveness and adaptability in dynamic parking environments. Additionally, a study in 2023 investigated safety and ethical considerations associated with autonomous parking systems, shedding light on potential risks and ethical dilemmas, particularly in parallel parking scenarios. Together, these works provide a comprehensive view of the technical, user-centric, and ethical dimensions of automatic parallel parking, shaping the trajectory of this evolving field. These studies collectively form a rich tapestry of knowledge that significantly contributes to the ongoing evolution of automatic parallel parking systems. The 2018 research notonlyshowcasedtheviabilityofautomatedparkingincommercialvehiclesbutalsounderscored the broader implications for enhancing safety and efficiency in the transportsector.The2019explorationintopathplanningstrategiesshedlightonthediverseapproaches available, from rule-based methods to machine learning-based techniques, providing valuable insights into then uanced trade-offs and potential areas for improvement. The 2020 study on sensor fusion techniques marks a crucial step forward, recognizing the pivotal role of integrated sensor data in achieving The 2021 investigation, emphasizing human-centric design in user interfaces, delves into the psychological dimensions of user acceptance and trust in autonomous parking. Recognizing that user experience plays a pivotal role in the successful adoption of these technologies, this study introduces an important aspect often overlooked in technical discussions. Following this trajectory, the 2022 study on real-time control strategies adds depth to our understanding of the dynamic nature of parking environments, where responsiveness and adaptability become paramount. As we delve further into the landscape of autonomous parking; these studies underscore the importance of seamlessly integrating human-machine interactions and real-time control mechanisms. Lastly, the 2023 research on safety and ethics brings a critical dimension to the discourse surrounding autonomous parking systems. Beyond the technical intricacies, it prompts thoughtful consideration of the ethical implications, particularly in scenarios such as parallel parking where close proximity to pedestrians and other

ISSN2321-2152
www.ijmece .com
Vol 12, Issue.2, 2024

vehicles demand meticulous attention. By addressing safety and ethical concerns head on, this study contributes to the responsible development and deployment of autonomous parking technologies.Inessence, this collectiveendeavorspropelthefieldofauto maticparallelparkingbeyond mere technological feasibility, guiding it towards a future where safety, user experience, and ethical considerations are integral components of the evolving landscape. In the ever-evolving landscape of automatic parallel parking, the multifaceted research efforts undertaken in recent years collectively weave a narrative that encompasses not only the technical intricacies of the technology but also its broader societal implications. The2018 study's focus on automated parking in commercial vehicles signifies a paradigm shifting transportation, hinting at the potential transformation of entire fleets. By addressing the specific challenges associated with larger vehicles, this research opens avenues for a more comprehensive integration of autonomous parking across diverse vehicular contexts. Building upon this foundation, the 2019 exploration of path planning strategies delves in to the heart of decision-making processes during parking maneuvers. The comparison of different approaches not only highlights the versatility of available methodologies alsoservesasaroadmapforfuturedevelo pments,fostering path planning impacts the efficiency and effectiveness of autonomous parking systems.The2020investigationintosen sorfusiontechniquesaddsalayerofsoph isticationtothediscussion,recognizingt hepivotalroleofintegratedsensordatain achievingheightenedprecisionduringp arallelparking.Thisnotonlycontributes totherefinementofparkingmaneuversb utalsolaysthegroundworkforadvance mentsinsensortechnologies,potentiall yinfluencingbroader applications beyond parking scenarios.

III EXISTING SYSTEM

Now a day's most of the parking areas are manually managed by human manpower and there is no automatic system to manage the parking area efficiently. There is a great analogy that when a driver enters any of the parking lots he must look for some kind of information board that tells him about the status of the parking lot that whether it is fully occupied, partly occupied, or vacant. Most of the time the drivers have to circle the parking area in search of free parking space. This kind of

problem mostly occurs in cities near shopping malls, hospitals, etc., where the number of vehicles is greater as compared to the parking spaces. The process of searching the free parking space is time-consuming and also wastage of fuel. Most of the time the parking spaces remain unoccupied, however, the total occupancy is low because of bad management of the parking lot. This causes ineffective use of the parking area and also results in traffic jams nd congestion near the parking lots.

Searching for a suitable parking space in a populated metropolitan city is extremely difficult for drivers. Serious traffic congestion may occur due to unavailable parking space. The automatic smart parking system is an emerging field and attracted computer vision researchers to contribute to this arena of technology. The traditional or manual car parking system is everywhere in our country but this system is full of problems. They are:

1. We can see in many shopping malls, hospitals huge traffic jams in front of the parking. The parking guard stops the entire vehicle and gives a payment slip, this creates a traffic jam.
2. It is difficult and time-consuming to find out the parking slot which costs extra fuel and wastes time.
3. Security problem is one another problem in manual car parking, people can enter in a parking slot and there snatching, robbery can happen.
4. In manual parking system some guard needs to be appointed for the whole job, it is costly enough.

Drawback in the existing system

- Waste of time
- No security
- Huge traffic jam
- Waste of fuel etc

IV PROPOSED SYSTEM

Automated parking systems require significantly less area and volume for a given number of parking spaces than other parking options. Automated parking systems enable the more profitable use of valuable land for tenants, green space, etc., and provide property developers various options such as: minimizing the area needed for parking to maximizing the number of parking spaces or some optimum point in between the two. In our proposed system we use the Region of interest, Classification algorithm, Otsu's method to detect the free space in the parking area. This paper describes an approach to overcome a situation of monitoring and managing a parking area using a vision-based automated parking system. With the rapid increase of cars, they need to find available parking space in the most efficient manner, to avoid traffic congestion in a parking area, is

ISSN2321-2152
www.ijmece .com
Vol 12, Issue.2, 2024

becoming a necessity in car park management. Current car park management is dependent on either human personnel keeping track of the available car park spaces or a sensor-based system that monitors the availability of each car park space or the overall number of available car park spaces. In both situations, the information available was only the total number of car park spaces available and not the actual location available. In this dynamically growing era, people are facing a new problem on the lack of sufficient parking space. Therefore an automated parking system (APS) with multiple floors is the solution for this problem. An APS is a mechanical system designed to minimize the area required for parking cars. The concept for the automated parking system is driven by two factors; (1) a need for parking spaces and a scarcity of available land. All APS take advantage of a common concept to decrease the area of parking spaces. (2) Removing the driver and passengers from the car before parking. With an APS, the car is driven up to an entry point of the APS and the driver and passengers exit the car. The car is then moved automatically (with some attendant's action required) to its parking space. The primary benefits of automated parking systems compared to conventional multi- story cars parks are:

- Up to 70% less land area needed.
- Up to 50% smaller building volume.
- Up to 12% ROI.
- Up to 85% fewer CO2 emissions generated by driving.

V IMPLEMENTATION

- **Numpy:**

NumPy is a very popular python library for large multi-dimensional array and matrix processing, with the help of a large collection of high-level mathematical functions. It is very useful for fundamental

Scientific computations in Machine Learning. It is particularly useful for linear algebra, Fourier transform, and random number capabilities. High-end libraries like Tensor Flow use NumPy internally for manipulation of Tensors.

- **OpenCV:**

OpenCV is a popular and open-source computer vision library that is focused on real-time applications.Thelibraryhasamodularstructureandincludesseveralhundredsofcomputer vision algorithms. OpenCV

ISSN2321-2152
www.ijmece .com
Vol 12, Issue.2, 2024

includes a number of modules including imageprocessing,video analysis,2Dfeatureframework,objectdetection,cameracalibration,3Dreconstructionand more.

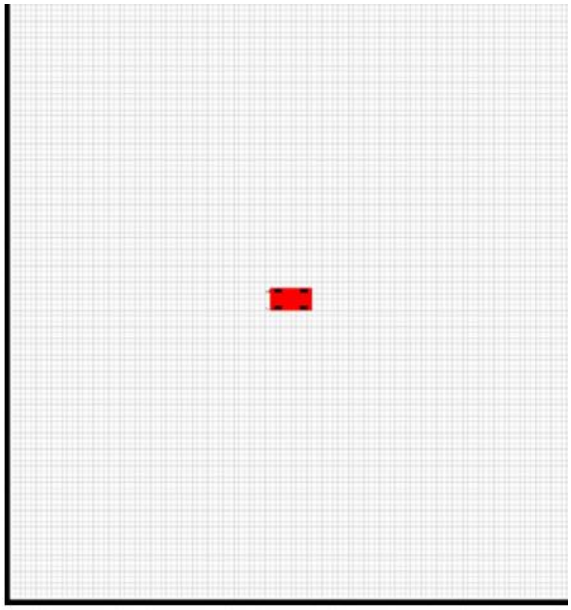
- **Argparse:**

Argparse is a Python module for creating command-line interfaces. It allows you to easily parse command-line arguments and options. Some popular argparse libraries include:

- Argparse (builtin): Part of the Python standard library, it's robust and versatile for most CLI applications.
- Click: A powerful library for building command-line interfaces, known for its simplicity and ease of use.
- Fire: Developed by Google, Fire generates command-line interfaces from Python objects effortlessly.
- Docopt: Rather than defining options and arguments separately, Decoct uses do strings to create CLI interfaces, making it straightforward and easy to understand.
- Typer: A new library inspired by FastAPI and Click, it simplifies the creation of CLIs with type hints and automatic documentation generation.

Each library has its own strengths and use cases, so choose the one that best fits your project requirements and personal preferences

VI RESULTS

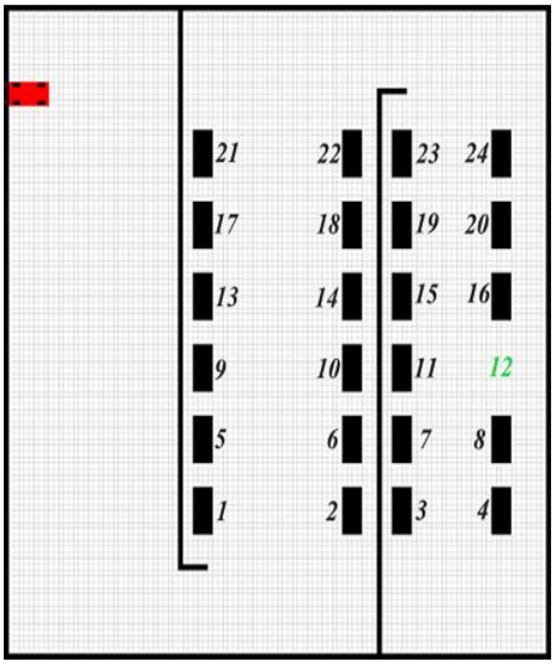


Environment

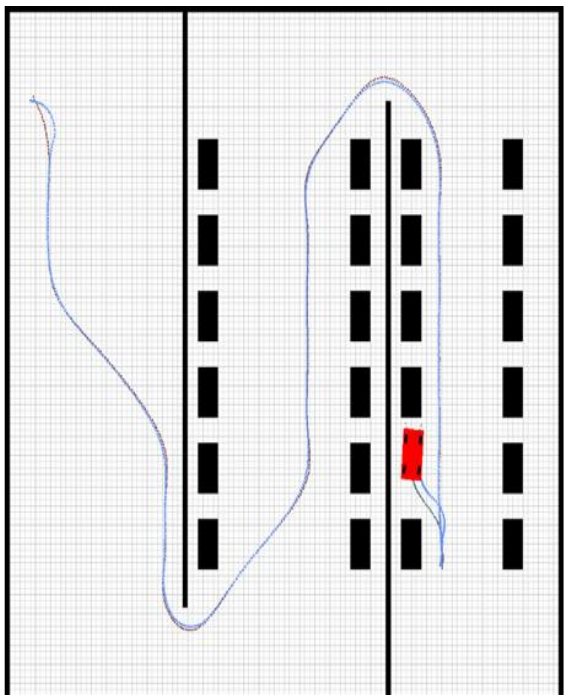
ISSN2321-2152

www.ijmece .com

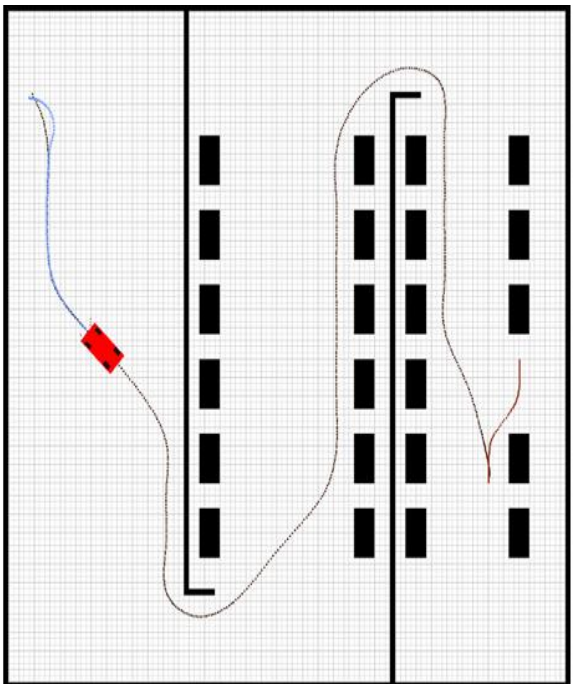
Vol 12, Issue.2, 2024



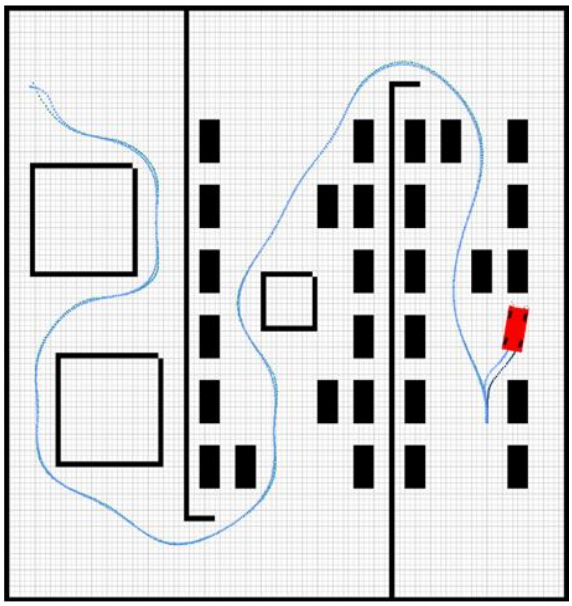
Tracking



Path Tracking2



Path Tracking1

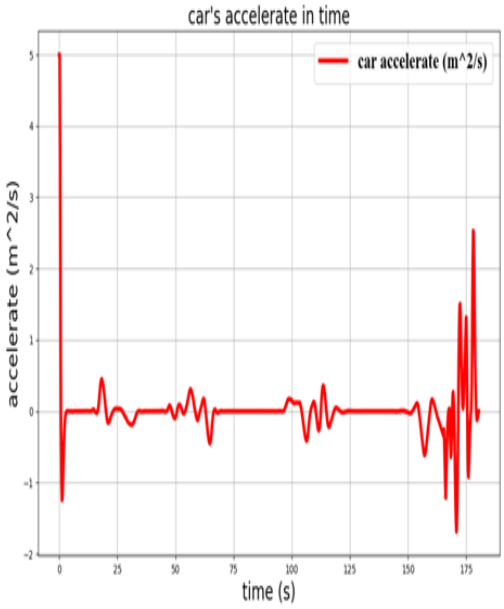


Path Tracking3

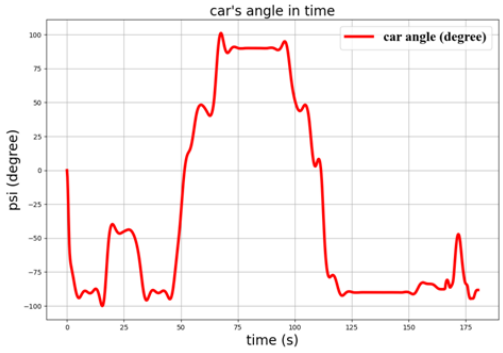
ISSN2321-2152

www.ijmece .com

Vol 12, Issue.2, 2024



Accerlation vs Time



Yaw angle vs Time

VII CONCLUSION

In conclusion, the implementation of the automatic parallel parking system encompasses the utilization of the A* algorithm for optimal path planning and the B-spline algorithm for precise trajectory tracking. The A* algorithm efficiently navigates the vehicle to the designated parking spot by considering factors such as distance, obstacles, and vehicle dynamics, ensuring an optimal and safe route. Additionally, the B-spline algorithm facilitates smooth and accurate trajectory tracking, allowing the vehicle to follow the planned path with precision, even in complex parking scenarios. Together, these algorithms enable seamless and automated parallel parking, enhancing convenience and safety for users while showcasing the efficacy of advanced planning and control techniques in autonomous vehicle systems.

REFERENCES

[1] P. Zips, M. Böck, and A. Kugi, “Optimisation based path planning for car parking in narrow environments,” Robot. Auton. Syst., vol. 79, pp. 1–11, May 2016.

[2] H. Vorobieva, S. Glaser, N. Minoiu-Enache, and S. Mammar, “Automatic parallel parking in tiny spots: Path planning and control,” IEEE Trans. Intell. Transp. Syst., vol. 16, no. 1, pp. 396–410, Feb. 2015.

[3] H. Vorobieva, S. Glaser, N. Minoiu-Enache, and S. Mammar, “Automatic parallel parking with geometric continuous-curvature path planning,” in Proc. IEEE Intell.

Veh. Symp., 2014, pp. 465–471.

[4] H. Vorobieva, N. Minoiu-Enache, S. Glaser, and S. Mammar, “Geometric continuous-curvature path planning for automatic parallel parking,” in Proc. IEEE ICNSC, 2013, pp. 418–423.

[5] D. J. Balkcom and M. T. Mason, “Time optimal trajectories for bounded velocity differential drive vehicles,” Int. J. Robot. Res., vol. 21, no. 3, pp. 199–217, Mar. 2002.

[6] B. Li and Z. Shao, “A unified motion planning method for parking an autonomous vehicle in the presence of irregularly placed obstacles,” Knowl.-Based Syst., vol. 86, pp. 11–20, Sep. 2015.

[7] T. Fraichard and A. Scheuer, “From Reeds and Shepp’s to continuouscurvature paths,” IEEE Trans. Robot., vol. 20, no. 6, pp. 1025–1035, Nov. 2004.

[8] A. Wächter and L. Biegler, “On the implementation of an interior-point filter line-search algorithm for large-scale nonlinear programming,” Math. Programm., vol. 106, no. 1, pp. 25–57, Mar. 2006.