IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

EcoRide: Car Sharing Platform for Efficient and Affordable Commuting

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Abstract: *The present paper represents an in-depth review of several studies concerned with multifold aspects of ridesharing. These show advantages of ride sharing, starting with economic savings and efficiency in decongesting traffic, to reducing pollution by transforming the urban transportation system and fostering sustainable development. Logistic and social hindrances of carpooling are also discussed, proposing solutions. Thirdly, technological and design developments in carpooling are sampled, from dedicated lanes to sophisticated matching algorithms, reflecting the speed of innovation within this field. All these studies combine in varied dimensions of carpooling in different perspectives, emphasizing its transforming impact and adaptability for solving urban transportation challenges. This study, therefore, has been a critical review of the current researches on the concept of ride sharing*

Keywords: Carpooling, Urban Sustainability, Reduction of Traffic, Ride-sharing, Fuel Efficiency

I. INTRODUCTION

The situation on modern city streets has reached record congestion, especially in such cities that grow rapidly. This has made finding new ways of moving around increasingly vital. One such innovative way is carpooling. While the concept of carpooling is not new, it is one of the major ways out for the solution of our present transportation problems.

Historically, carpooling came into being during European oil crises as a pragmatic solution whereby people shared rides to conserve fuel, thus greatly easing resource demand. However, carpooling today is focused on much more than cost savings; rather, it focuses on reducing congestion on the roads and alleviating environmental impacts.

While technology is ever-improving, so is the carpool landscape. What was previously informal between friends has now turned into sophisticated mobile applications that have made ride-sharing easy [5]. Other than ease, these platforms guarantee safety and reliability [9]. Furthermore, a focus on the addressed challenges of stop-based rides, in much the same way as traditional bus stops, has pushed innovation even farther in this space [6]. This research paper reviews the complex structure of carpooling. The objective of this paper is to give an in-depth analysis of the diverse benefits associated with carpooling economically, environmentally, and socially. By going into fine details regarding carpooling, we want to bring forth how this practice can be a game-changer in providing travel solutions. We intend to strengthen policy-making and decision-making from which valuable findings are presented that would lead toward sustainable and livable urban environments.

II. METHODOLOGY

The process of creating the application for carpooling "**Ecoride**" was elaborate and comprised of a number of key stages:

Carrying out Research and Gathering Requirements:

- In-depth detailed city mobility study focusing on limitation of traffic and enhancing the use of environmental friendly means of transport like carpools.
- Both qualitative and quantitative aspects were researched into through the market and the existing applications of car were studied in order to find out what was missing and what gaps could be filled.
- User requirements were gathered through surveys and interviews on aspects wearing comfort, safety of the rides, privacy etc.

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System Design:

- Developed an approach for composing system architecture in a modular manner where, one is for passengers, the other one for drivers, and the latter for all other processes.
- Prepared the comprehensive use case diagrams, activity diagrams, data flow diagrams and ERD of the system to illustrate the system processes.
- The mapping of location services incorporated Google Maps API whereas user data and data synchronization storage incorporated Firebase.

Technology Selection:

- Flutter enabled the development of the mobile application for this project which is a cross-platform application development framework that works on Android and iOS platforms.
- To provide secure user login and data protection, Fire base Authentication was incorporated with the application for user management. Additionally, Firestore was used as the database to contain the ride and user profile information.

Agile Development:

- The need for iterative development and active user involvement led to the adoption of an Agile software development approach SDLC model. The project was developed stage by stage for a very short period of time before the next stage with incorporation of suggestions from the users previously.
- Ensured functionality, performance and usability of the system by integrating unit, integration and acceptance testing within every sprint.

Implementation:

- Designed and built the complete application's main functionalities that consist of creating and searching for rides, and monitoring the rides location via GPS in real time.
- Developed a stop-based system to increase users' safety while joining the rides without revealing their precise locations for the ride's start and end.
- Made improvements in the application allowing notifications to be sent in real time concerning changes regarding the ride and enabled the communication of drivers and passengers easily.

Testing and Evaluation:

- Testing was carried out thoroughly as all aspects functional, performance, and security assurance were covered to guarantee the application's strength.
- User testing was carried on the application to check the usability of the user interface (UI) and user experience (UX); modifications were made to the application after the user testing based on the results obtained.

Deployment and Future Enhancements:

- The application was deployed successfully on both Android and iOS operating systems while ensuring it considered issues related to scalability and performance.
- Improvement of advancements in the application includes linking the system with existing public transport systems implementing surge pricing environmental impact monitoring tools.

III. LITERATURE REVIEW

Machine Learning Based Personality Classification for Carpooling Application

M. Anas& et al…[1]presented the work "Machine Learning Based Personality Classification for Carpooling Application" at the 2023 International Conference on Intelligent Systems for Communication, IoT and Security (ICISCoIS). The research aims to study the effectiveness of machine learning techniques in classifying users who share their opinions on Twitter based on different personality traits. The use of user personality traits to facilitate better

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carpooling matching was emphasized in the study so as to enhance the entire process of ridesharing. The present study used natural language processing (NLP) to scrutinize the user tweets and machine learning algorithms to categorize their personalities. The results revealed that there is a possibility of real-time application of NLP and machine learning technologies in system such as carpooling where compatibility of the users is a prerequisite of the success of the system.

Carpooling Systems for Commuting among Teachers

Rey-Merchán MDC& et al…[2] conducted a comprehensive study titled "Carpooling Systems for Commuting among Teachers: An Expert Panel Analysis of Their Barriers and Incentives" published in the International Journal of Environmental Research and Public Health. This particular research sought to explore the views and perceptions of teachers in Andalusia, Spain on carpooling as a means of transport. In the results section, it was revealed that despite the fact that teachers relatively do not carpool especially for short distances, it was however cost effective related to the use of fuel for the teachers who carpooled. In addition, there were issues raised by the female teachers about the concerns on their attitude towards males when carpooling, which created another social barrier. Issues such as these have led the study to offer recommendations such as the use of different cars for men and women. Additionally, the authors argue for the creation of organizational carpooling systems to improve the matching systems and cut down some logistical stressors such as meeting points for commuters and even preferences due to gender. The present research makes a contribution to the practical aspects of the problem of carpooling especially for teachers, making their systems more functional and efficient.

Potential of Carpool for Network Traffic Management

Yu (Marco) Nie & et al…[3] in their study titled *"Potential of Carpool for Network Traffic Management,"* investigate the role of carpooling in mitigating network traffic in a highly idealized futuristic scenario. In this research, a carpool model is developed to evaluate the available options between the discomfort of carpooling and the benefits accrued from reduced travel expenses. Considering a scenario with minimal congestion effects, the authors place their focus on both single Origin-Destination (O-D) pairs as well as cross O-D pairs. The results indicate that for a single O-D pair and when costs associated with the inconvenience are less than the median trip value, a carpool platform can almost achieve a very high level of matching, which is beneficial to commuters. In high inconvenience cost cases positive results can be obtained even though it may not be possible to attain a perfect match. However, cross O-D matching costs more incurring more inconveniences and leads to more congestion. Also, several drawbacks are discussed in the research paper, including unrealistic assumptions and a certain type of network structure, which are not representative of the actual state. Furthermore, the authors highlight that more advanced elements like traffic dynamics and one-to-many matching should be added in further exploration.

Company-Wide Carpooling for Long Distance Commuting

Lee, JB …[4] in the paper *"Company-Wide Carpooling for Long Distance Commuting in South Korea and Its Effects on Reducing Transportation Problems,"* examines a carpooling initiative launched by the Korea Land & Housing Institute, specifically targeting long-distance commuting. After reviewing data on carpooling and the associated satisfaction surveys over a period of three years, the current study has established that most users of the program are employees in their 40s and 50s. Most participants, however, scavenged for rides to work in informally operated vehicles less than two times in a month. Facilitated carpooling records indicated that almost 30 of the users engaged in carpooling three or more times in a month. Over the period of the study, the average number of carpool trip made by drivers was 11.8 and high satisfaction levels were experienced by all the users. Notably, the analysis showed that the number of passengers was two-fold compared to the number of drivers; this, in particular, showcases the convenience of carpooling when there is no access to or it is challenging to use public means of transport. Finally, in order to reduce traffic congestion, the authors believe that the use of car pooling encouraged by traffic management policies could also achieve other goals, such as reduction of vehicular emission and energy use which makes car pooling strategy applicable to long distance driving where commuting is inevitable.

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Ucarpooling: Decongesting Traffic through Carpooling

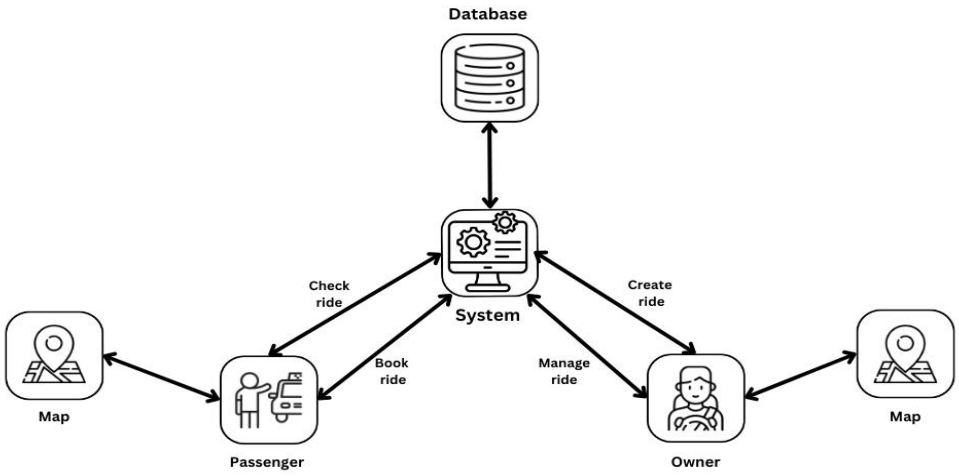
A. Lugo& et al…[5] presented a study titled *"Ucarpooling: Decongesting Traffic through Carpooling using Automatic Pairings"* at the 2020 XLVI Latin American Computing Conference (CLEI) in Loja, Ecuador. The concept of dynamic carpooling has been proposed by the authors in a bid to suggest a new way of reducing traffic and its effects on the environment through shared road usage. Through the use of smartphone applications and websites, Ucarpooling allows users traveling to the same place to meet easily which creates convenience and low cost in travel since the expenses are shared. The app has a lot of other extras like real-time tracking of the car, payment options, among others, which ensures safety, convenience and transparency to the users. However, the rating of the clients and the drivers is an additional aspect that encourages clients and drivers to be accountable even
in the sharing economy. Given the challenges of increasingly mobile urban populations, Ucarpooling is also a viable sustainable option that advances principles of sustainability which help to minimize GHG emissions with minimal energy use. This has the capability to revolutionize urban transport since it encourages maximized use of vehicles and promotes ride sharing, hence building a smarter, greener and more connected world.

Carpooling Algorithm with the Common Departure

X. Xia& et al…[6] explore the *"Carpooling Algorithm with the Common Departure"* in their paper presented at the 2019 IEEE International Conferences on Ubiquitous Computing & Communications (IUCC) in Shenyang, China. The authors tackle a particular issue in carpooling named the Common Departure (CCD) problem, which deals with finding the best pairing that incurs the least travel cost for the carpoolers. This problem is of utmost importance to big organizations who wish to institute a working carpool system for their employees. Enhancing these matchings, the algorithm in the paper has the capability of deriving significant economic and environmental advantages such as reduced consumption of energy and traffic congestion. Results stress the importance of the algorithmic methods in improving the carpool systems in terms of effectiveness and sustainability.

III. SYSTEM ARCHITECTURE

The architecture of Ecoride is divided into two main user types: driver and passenger. Users need to login to the system in order to access the functionalities of the system. User can create the carpool if he/she is driver or else can request for the carpool if he/she is passenger of a carpool. Users will enter all his/her details during this, like route details which will be further stored into database. All these process are easy to use through graphical user interface and it is linked with database of system.



After we collect both driver and passenger details, passengers choosing the “find a ride” option are taken to the Activity page where a list of drivers whose routes match the passenger entered source and destination are shown. Passengers can then look at the options available to them and send a ride request to the driver they select. Drivers on the other hand,

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can accept or decline such requests. Note that communication between driver and passenger is possible only if the driver has accepted the ride request.

IV. CONCLUSION

The Carpooling System is a mobile application (developed using Flutter for the front-end and Firebase for the back-end) that aimed at reducing fuel consumption and traffic congestion by encouraging car-sharing. This mobile application system is superior to existing systems for its exclusivity to cars; this makes it easier for developers to develop as the application server handles table definitions and allows developers to write a better database schema since there are no other vehicles or modes of transport to consider. Better accessibility, higher performance, and more efficient resource utilization are some of the key features of this system. The round-the-clock, in-app support, as well as the easy-to-use app interface, make this mobile application very effective. By reducing fuel emissions with vehicle sharing, this project helps contribute towards global sustainability and also helps combat global warming.

V. ACKNOWLEDGMENT

We sincerely thank all the researchers and scholars for their great works and insights in carpooling and sustainable transportation, which significantly improved both the quality and depth of this paper. It is your work that lays a solid foundation for our research. We would like to show heartfelt appreciation to your dedication and contributions.

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