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Intelligent Travel Assistance for Bus Passengers

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ABSTRACT

The 'Intelligent Travel Assistance for Bus Passengers' introduces an innovative approach by integrating AI capabilities to enhance the notification system as passengers enter a predefined geo-fence. Geo-fence is a virtual border which is defined by GPS, which the user's destination is at the center point. Users can have the flexibility to customize the notification range, determining how far in advance they receive alerts. This system employs Geo-Fencing and GPS technologies, accessible through the passenger's mobile phone location. The application, developed in Java and utilizing the Google Maps API for destination and geo-fence determination, ensures a user-friendly interface. Going beyond traditional methods, Passengers, can effortlessly select their bus services along with boarding and dropping points and specify approximate times, are ushered into a journey that prioritizes intuitiveness, security, and tailored convenience. In this project, the integration of AI takes this customization to the next level, learning real-time analysis and analyzing recent historical data to deliver personalized and adaptive travel assistance. The system's proactive approach, fueled by real-time traffic analysis and the ability to navigate route diversions intelligently, ensures that users receive timely and accurate alerts, even in dynamically changing conditions. On the infrastructure front, the project incorporates a PostgreSQL database, offering a robust and reliable foundation for data storage, retrieval, and management. Cloud services from AWS, Azure, and Google Cloud provide scalable and efficient hosting solutions. The Android app leverages background location tracking, ensuring accurate and continuous positioning. This holistic integration of

technologies creates a sophisticated travel assistance system that combines innovation, customization, and reliability.

CHAPTER 1

INTRODUCTION

In the era of extensive urbanization, the challenges faced by bus travelers during long-distance journeys, particularly the struggle to wake up at the correct destination, serve as the focal point for this paper. The intricate nature of navigating unfamiliar territories, exacerbated by the relocation of bus stands to distant locations, poses a genuine concern for passengers. This becomes more pronounced during nighttime travel, leading to the inconvenience of missed stops, additional expenses, and increased complexities. This paper introduces an "Intelligent Travel Assistance for Bus Passengers" to address these issues comprehensively. By incorporating Geo-Fencing and GPS technologies, the system enables real-time tracking of the bus's location, notifying passengers as they approach their destinations. The emphasis on a user-friendly mobile application and customization options empowers passengers to take control of their travel details, enhancing predictability and tailoring the journey to individual needs. The envisioned integration with government transport corporations and private bus services aims to standardize the travel experience, offering seamless retrieval of travel details through Passenger Name Record (PNR) numbers. In conclusion, this paper endeavors to redefine bus travel by leveraging technology to provide an intuitive, secure, and personalized experience for every passenger.

In this paper, we are incorporating AI technologies to create a more intelligent and adaptive "Intelligent Travel Assistance for Bus Passengers". By integrating AI algorithms with Geo-Fencing technology and GPS technologies, this paper aims to enhance the system's ability to predict passenger behavior and dynamically adjust notification strategies. It involves the integration of Geo-fencing technology, establishing a virtual boundary around the user's destination by utilizing geographical coordinates. This virtual boundary is crucial for triggering alerts as the user's mobile phone enters the specified Geo-fence. Complementing this, GPS technology is employed to precisely track and determine the real-time location of the bus. This information is accessible through either the bus's installed hardware or the passenger's mobile phone, ensuring accurate tracking.

The Android application, developed in Java, serves as the user interface, leveraging the Google Maps API for destination setting and Geo-fence determination. Users have the flexibility to select their specific bus, input boarding and dropping locations, and provide approximate boarding and dropping times and dates during ticket booking. This user input and customization contribute to a more personalized and tailored travel experience.This comprehensive approach aims to redefine the bus travel experience through the intelligent use of AI, making it more adaptive, secure, and tailored to the evolving needs of each passenger. Our vision includes seamless integration with various transit networks, enhancing overall convenience through features like AI-driven predictive customization and personalized travel recommendations.

CHAPTER 2

LITERATURE SURVEY

The development of an "Intelligent Travel Assistance for Bus Passengers", especially one enriched with AI capabilities, aligns with the growing intersection of technology and transportation. The literature survey delves into existing research and technologies related to bus travel, location-based services, AI integration, and similar researches.

LITERATURE 1:

K. Hariharan, B. Srimathi, R. S. Kumaran and I. Yamuna, "*Spotting Current Location of the Public Bus with its Destination and Live Details Through Mobile Application,*" 2021

International Conference on System, Computation, Automation and Networking (ICSCAN), Puducherry, India.

Most of the peoples use bus as their mode of transportation to migrate from one place to another. Sometimes timing of the bus is not known to the peoples. To resolve this, a method is proposed to find where the bus is currently coming, the route of the bus and also number of peoples present inside the bus, then the fare details of bus from one location to another location will updated in the corresponding web application. We can able to determine the current location of every bus using GPS, also the fare details for each and every boarding place to dropping place in the route. The IR sensor is employed to count the number of passengers present inside the bus and the details gets updated in the web application where we can know the source and the destination of the bus with its current location along with fare details, passengers count and the approximate arrival time of the bus to its destination place.

LITERATURE 2:

R. Verma et al., "*A Smartphone-Based Passenger Assistant for Public Bus Commute in Developing Countries,*" in IEEE Transactions on Computational Social Systems, vol. 7, no. 2, pp. 465-476, April 2020

Although public transport vehicles such as buses have always been an economical means of commuting in the cities of many developing countries, it is always considered as a secondary mode of transport owing to poor infrastructure, chaotic and reckless driving habits, and absence of any proper information system in buses. Based on rigorous experiments carried out over a period of two years and multiple surveys, we have tried to learn the problems faced by bus commuters. As a solution, in this article, we develop a novel energy-efficient system which would help commuters navigate through their journey safely. Along with making them aware of any upcoming points of concerns (PoCs) such as sudden bumps, sharp turns, and bad roads, we also inform commuters about the expected time of arrival at the destination. We conducted extensive experiments using 25 volunteers over 50 trails. The system showed an average localization error of only 50 m and mean estimated time of arrival (ETA) error of 2.5 mins and a fairly high alert prediction accuracy while consuming significantly less energy when compared to GPS.

LITERATURE 3:

A. Dimitriu and I. Harmati, "*Artificial intelligence based bus routing in urban areas*," 2020 23rd International Symposium on Measurement and Control in Robotics (ISMCR), Budapest, Hungary, 2020.

Public transportation consists mostly of fixed transit systems, which have fixed stations, routes, and schedules. In this paper, a new approach for bus routing in public transportation is proposed, in which buses are traveling unbounded, adapting to passengers (not vice versa) by picking them up at their current location and transferring them to their destinations. Bus routes need to be adjusted to the passenger layout. This problem is close to the Dial-a-Ride Problem (DARP), but the solution is searched on real road-network graphs. The goal is to find a globally optimal set of paths for a given number of buses, such that all passengers are transferred to their destinations while the average travel time is minimal. In this paper, a modified Max-Min Ant System (MMAS) algorithm is utilized.

LITERATURE 4:

S. Bhongale, S. Budhia, R. Singhal, K. Grover, S. Mishra and D. Vora, "*City Glider: A Smart Local Bus System*," 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), Lonavla, India.

This study aims to create a real-time smart bus tracking system that will help to improve the current public bus service system while reducing the burden on the bus management team. Furthermore, passengers get impatient while waiting at a bus stop since they do not know how long they would have to wait or when the next bus willarrive.The main objective of this paper is to give a digital platform to the current public bus service system, where the passengers don't have to worry about the uncertainty of the bus arrival time at the bus stop. The proposed application provides the users a platform, where they can view the live location of the chosen bus, and get an estimate of the time taken by the bus to arrive at their bus stop. The passengers get to choose which bus to take so that they can reach their destination at the earliest, as the proposed model also lets the user know the approximate time taken to reach the destination. The passengers can book tickets as well as monthly passes using the proposed app, in turn saving their time. The proposed application gives the user the advantage of clicking on the emergency button if the user feels unsafe at any given point, which would alert the nearest police station and the emergency contacts of the user, by sending the live location of the user. Flutter has been used to create the frontend of the mobile application, with Firebase as its backend. The use of Google's Distance Matrix API has been made to estimate the arrival time of the bus at the stop and to predict the time taken to reach the destination.

LITERATURE 5:

Ayob, Mohd & Saaid, Mohammad &Dimyati, Khoiri&Maarof, Khairul. (2018). "*Destination alarm notification for public transportation passenger using Geo-Fence in mobile App*." IOP Conference Series: Earth and Environmental Science.

Geo-fence is a non-visible parameter that allows interaction between user of mobile device and point of location in sending and retrieving information. A destination alarm mobile app can help to alert and notify passenger of public transportation on their current location and the destination. An alarm will be triggered once the mobile device enters the geo-fence of the point of destination. Eclipse Kepler is the platform to develop the bus destination mobile app. Using Java language; the mobile app is built compatible for Android User. The process started from drafting storyline and interface, developing coding geo-fence 300m from point of destinations and finally testing the mobile app in real travel journey. The actual locations of alarm triggered were collected by getting the latlong from Google Maps to determine the difference between the distances automatically measured from the actual locations of alarm triggered to the point of destinations. The difference on battery consumption while using and not using the app also taken into consideration. The actual alarm triggered slightly differs from the expected 300m from point of destinations but still acceptable near to the geo-fence. The alarm continuously notify passenger even after exiting the geo-fence until it be denied by the user.

CHAPTER 3
EXISTING SYSTEM

3.1 DISCUSSION

The existing systems presented in the literature surveys offer innovative solutions to address various challenges in public bus transportation. These systems leverage technologies such as GPS, IR sensors, smart phone applications, AI algorithms, and geo-fencing to enhance the overall commuting experience. The system [4] focuses on real-time tracking and information dissemination through a mobile application. Using GPS, it determines the current location of buses, updates route details, counts passengers using IR sensors, and provides fare information on a web application. This approach aims to empower commuters with accurate and timely information.

A smart phone-based passenger assistant system designed to improve safety and provide real-time information to bus commuters has been discussed in [1]. Leveraging landmarks and probabilistic timed automata, the system notifies passengers about upcoming points of concern and estimates the time of arrival. It achieves high accuracy while consuming less energy compared to traditional GPS-based systems.An AI-based bus routing system that adapts to passengers' current locations, similar to the Dial-a-Ride Problem. In [16], using a modified Max-Min Ant System algorithm, the system optimizes bus routes globally, minimizing average travel time. This approach challenges the traditional fixed transit systems by dynamically adjusting routes based on passenger demand.

The City Glider project [13] introduces a real-time smart bus tracking system with a focus on improving the efficiency of public bus services. The application provides users with live bus locations, estimated arrival times, and the ability to book tickets. Additionally, safety features such as an emergency button enhance passenger security and overall satisfaction.A destination alarm mobile app that utilizes geo-fencing technology. The app notifies public transportation passengers when approaching their destination, enhancing the overall commuting experience. Despite slight [14] discrepancies in triggered alarms and actual distances, the system proves effective in providing timely alerts to passengers.

In summary, these existing systems address challenges such as lack of real-time information, inefficient routing, and poor passenger experience in public bus transportation. They employ various technologies and methodologies to enhance tracking, safety, and overall efficiency. The proposed research can build upon these existing systems to develop a more integrated and robust solution for public bus transportation.

3.2 DISADVANTAGES

There are so many countries using lot of technologies in public transports for make people more comfortable while travelling in public transports. But still there is some disadvantages are there. These are as follows:

- Fixed schedules may cause issues when unexpected events disrupt the system.
- If GPS devices on vehicles break or malfunction, it can affect the accuracy of real-time tracking.
- Constant location tracking may raise privacy concerns, needing strong protection for user data.
- Poor network connectivity may cause delays in alerts and updates, affecting system reliability.
- High initial costs to integrate new technology might prevent widespread adoption, especially in financially tight areas.

- Updates and maintenance might cause temporary downtime, disrupting real-time services.
- High setup and maintenance costs could be a financial burden for implementing and maintaining advanced technologies.
- Errors in information may occur due to signal interference, network issues, or inaccurate algorithms.
- Implementing AI-based routing might face challenges adapting to current transportation systems and regulations.
- Users, including passengers and staff, may need training, which could lead to resistance and the need for education.
- Regular updates and maintenance are needed to ensure the system works efficiently; otherwise, it may lose reliability.

CHAPTER 4
PROPOSED SYSTEM

In this proposed system, we are trying to overcome the disadvantages caused by the existing systems. In our proposed system, we are using AI technologies like machine-learning. So the application has been trained to recognize and understand traffic. The AI-based algorithm also informs users about the precise distance and time it will take them to arrive at their destination. It has been trained to calculate this based on the traffic situations.

4.1 PROJECT REQUIREMENTS:

4.1.1 MOBILE PHONE COMPATIBILITY:

The app is designed to function seamlessly on Android devices running Android 8.0 (Oreo) or later versions. These versions provide enhanced background location access permissions, contributing to more streamlined and effective real-time bus and user location tracking.

Considering the device specifications, it is recommended to use devices with a higher battery capacity (3000mAh or above) to support background location tracking without significantly impacting battery life. The processor and RAM play a crucial role in ensuring smooth execution of the application and timely processing of location data; hence, a reasonably powerful processor (quad-core or higher) and sufficient RAM (2GB or more) are preferred.

Reliable internet connectivity, either through mobile data or Wi-Fi, is essential for real-time updates and communication with cloud services. Devices with 4G/LTE capability offer faster data transfer, contributing to the app's responsiveness. Adequate internal storage space (16GB or more) is recommended to accommodate app updates, map data, and user preferences.

4.1.2 TECHNOLOGIES USED:

Java in Mobile App Development

Java serves as a foundational language for Android app development, offering versatility and platform independence. Its object-oriented nature promotes modular and maintainable code, fostering collaboration among developers. Key aspects include Java's compatibility with Android Studio, a robust security framework, and a rich ecosystem of libraries, enhancing the efficiency and functionality of Android applications. The active developer community further contributes to Java's prominence in creating feature-rich and secure mobile apps.

PostgreSQL Database

Choosing a reliable database is crucial for the "Intelligent Travel Assistance for Bus Passengers" app, and PostgreSQL stands out as the preferred solution. As an open-source system, PostgreSQL supports complex queries and transactions, aligning well with the system's requirements. Its relational database model ensures organized storage of user data, facilitating efficient retrieval for personalized notifications.

Cloud Technology for Hosting and Storage

Cloud platforms offer high reliability and redundancy, minimizing downtime and ensuring continuous system availability. Cloud services operate on a cost-efficient pay-as-you-go model, optimizing expenses and directing resources towards system enhancements. Security measures implemented by cloud providers, including data encryption and access controls, ensure the safeguarding of user information and compliance with data protection regulations. Cloud technology seamlessly integrates with AI and machine learning services, allowing the incorporation of advanced algorithms for predictive notifications and adaptive strategies.

4.2 DEVELOPMENT PROCESSES

1. APP DEVELOPMENT

Development of a user-friendly Android application using Java as the primary programming language. The app will serve as the interface for users to interact with and customize their travel preferences. Utilization of Android development tools, such as Android Studio or any other compatible software, to facilitate the creation, testing, and deployment of the Android application.

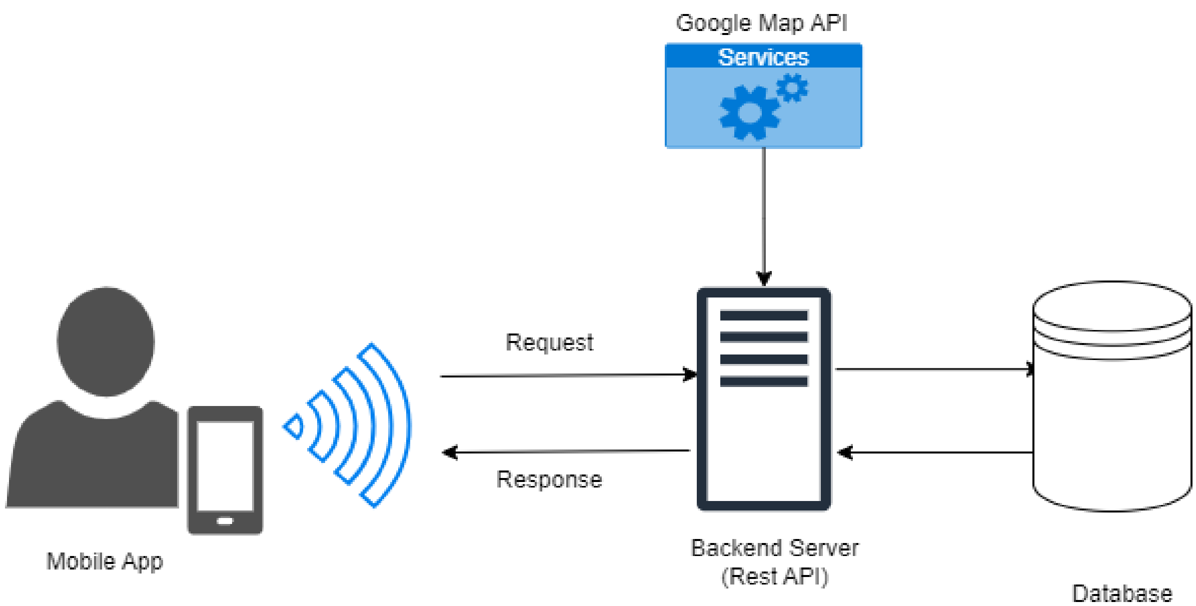

Fig 3.1 Block Diagram of Working of an Android Application

Working of an Android Application

The working principles of an Android application are visually represented in **Fig 3.1** with a block diagram illustrating the intricate components and interactions involved, as outlined in the comprehensive guide on Android application development.

Google Maps API Integration

The Google Maps API enhances destination setting, Geo-Fence determination, and overall mapping functionalities within the Android application.

It provides accurate geographical data for seamless customization and reliable mapping features.

Tools Used: Android Studio is the official integrated development environment (IDE) specifically crafted for Android app development. This sophisticated tool offers a robust set of features to facilitate the entire lifecycle of Android application creation. The IDE boasts an intelligent code editor with real-time error checking and refactoring capabilities, simplifying the coding process. For visual design,

2. GPS and GEO FENCE TECHNOLOGY INTEGRATION

Integration of GPS technology to enable real-time location tracking on users' mobile phones. Implementation of Geo-Fencing technology to create virtual boundaries around user-defined destinations. This functionality is fundamental for triggering alerts as the user's mobile phone enters the specified Geo-Fence which is mentioned in the below **Fig 3.2**.

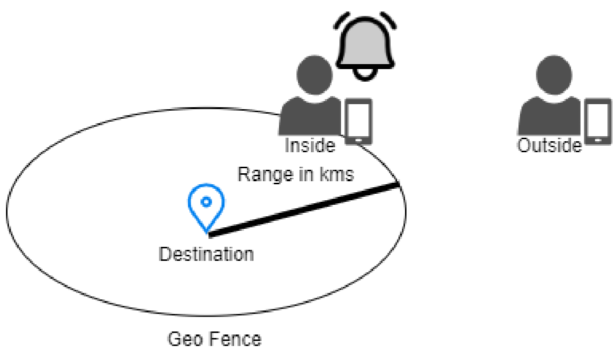

Fig 3.2 Geo Fencing Technology

Integrating Google Maps API into a mobile application involves pivotal concepts. Firstly, a Google Cloud Platform Project needs to be created, with the "Maps SDK" enabled based on the platform of development. Subsequently, an API key must be generated, the API key is then seamlessly integrated into the application to facilitate communication with the Google Maps API.

3. AI TECHNOLOGY - MACHINE LEARNING

Destination Prediction

We have proposed a Bayesian framework for predicting the future trajectory of an agent by estimating its intention to move to a goal region in the environment, and have presented a computationally efficient solution. Our next step is to incorporate our method into motion planning algorithms. It is also important in future work to explore other types of intentions and objective functions, model interaction with other agents, and consider observation uncertainty.

4.3 WORKING

4.3.1 FLOW CHART:

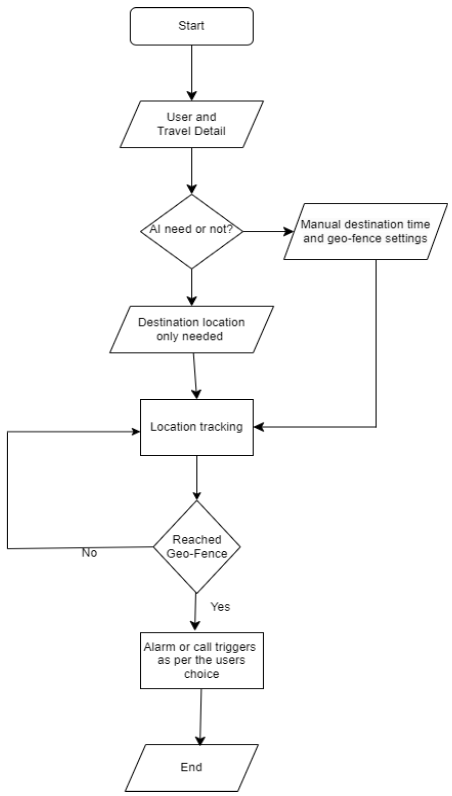

Fig 3.4 Flow chart for our proposed model

4.3.2 DESCRIPTION

The proposed project, titled "Intelligent Travel Assistance for Bus Passengers," represents a groundbreaking advancement in enhancing the safety and efficiency of bus travel. This innovative system integrates Geo-Fencing, GPS, and AI technologies to create a smart and personalized travel companion for users. Through a user-friendly mobile application, passengers can define Geo-Fences around their intended destinations, utilizing Google Maps for precise geographical customization. As the user's mobile phone, equipped with GPS capabilities, enters the specified Geo-Fence, the system triggers intelligent alerts, providing users the option of either an audible alarm or a pre-recorded call, ensuring timely disembarkation. The working flow of the system has been explained in the above flow chart **Fig 3.4.**

CHAPTER 5
RESUT AND DISCUSSION

The implementation of the 'Intelligent Travel Assistance for Bus Passengers' project has yielded promising outcomes, fundamentally reshaping the traditional bus travel paradigm through the incorporation of AI-driven functionalities. The system effectively employs Geo-Fencing and GPS technologies to establish a virtual boundary centered around the user's destination, significantly refining the precision of location tracking. The Android application, meticulously developed in Java and harnessed with the Google Maps API, offers an instinctive and user-friendly interface. This empowers passengers to effortlessly choose bus services, input boarding and dropping points, and specify approximate travel times.

The integration of AI as an augmentative feature profoundly elevates the user experience, providing passengers' unparalleled authority over their journey. Users can intricately customize notification ranges and lead times, tailoring the system to their unique preferences. This customization is further heightened through AI integration, which learns from user behavior and historical data, culminating in a travel assistance experience that is both personalized and adaptive.

SNAPSHOTS:

LOGIN &REGGISTRATION PAGES

Fig 5.1 Login page

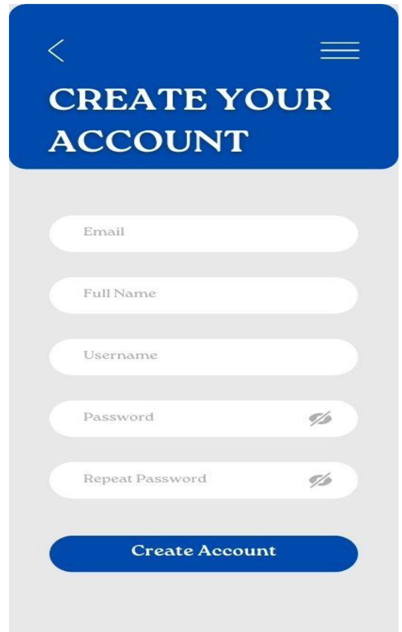

Fig 5.2 Registration page

The login page of the mobile app which is mentioned in **Fig 5.1** is designed for a user-friendly and secure authentication process, requiring users to input their registered email or phone number along with their password. It ensures simplicity and security, incorporating features like secure password input and optional social media logins for added convenience. The page also includes a password reset option for accessibility. Simultaneously, the sign-up page in **Fig 5.2** streamlines the account creation process, prompting new users to enter essential information like full name, email or phone number, and a secure password.

MAIN PAGES

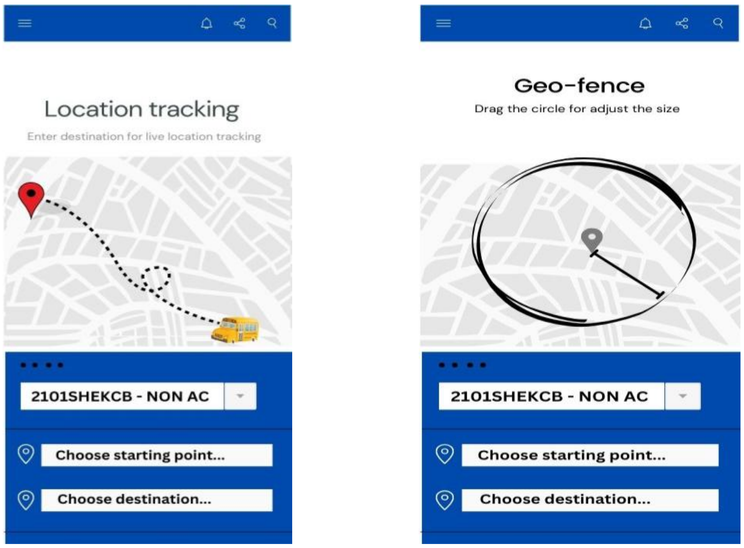

Fig 5.3 Main Pages

The main pages of the mobile app shown in **Fig 5.3** for the 'Intelligent Travel Assistance for Bus Passengers' project is designed as the central hub, providing users with a clean and intuitive interface. The expected content includes prominent features like selecting language preferences, accessing user accounts, and a menu for navigation. A search bar for quick access to routes, bus services, and destinations enhances user convenience. Relevant announcements, promotions, or travel alerts may also be displayed to keep users informed.

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The system's real-time analysis and route diversion capabilities enhance safety and convenience. In conclusion, the project sets a new standard for smart transportation, showcasing the potential of AI-driven solutions in elevating public transit experiences.

POWER OPTIMIZATION:

In line with the Intelligent Travel Assistance for Bus Passengers application, the optimization of battery power consumption is paramount for ensuring a seamless user experience. The application's integration of AI capabilities, particularly within a predefined geo-fence, necessitates a strategic approach to mitigate battery drain. Employing Geo-Fencing and GPS technologies through bus-installed devices or the passenger's mobile phone for live location tracking demands careful battery optimization.

To achieve optimal battery usage, implementing background process optimization is imperative. Minimizing unnecessary activities when the application is in the background and the device operates on battery power is crucial. Additionally, incorporating features like Doze and App Standby Mode can significantly enhance battery preservation, restricting the application's resources based on its current location in App Standby Buckets.

CHAPTER 6
CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION:

The Intelligent Travel Assistance for Bus Passengers project stands as a promising solution to elevate the efficiency, safety, and personalization of bus travel through the integration of advanced technologies. By combining Geo-Fencing, GPS, Google Maps API, and AI-driven Machine Learning, the system ensures precise location tracking, customizable alerts, and real-time traffic analysis, providing users with an intelligent and adaptive travel companion. The user-friendly Android application, developed in Java, serves as the interface for passengers to define preferences, fostering a seamless and secure journey. The project not only addresses the current challenges faced by bus travelers but also represents a significant leap forward in leveraging technology to redefine the travel experience.

6.2 FUTURE SCOPE:

The future of the project extends beyond its initial implementation, opening avenues for further enhancements and integrations. Some potential directions for future development include:

6.2.1. INTEGRATION WITH PUBLIC TRANSPORTATION NETWORKS

Expanding the system's integration with broader public transportation networks, including collaboration with government transport corporations and private bus services, to create a standardized and comprehensive travel experience.

6.2.2. ADVANCED AI FEATURES

Incorporating more sophisticated AI features, such as predictive analytics and personalized travel recommendations, to further enhance the adaptability and intelligence of the travel assistance system.

6.2.3. GLOBAL EXPANSION

Extending the system's availability to a global scale, catering to diverse regions and transportation infrastructures, ensuring its applicability in various cultural and geographical contexts.

6.2.5. USER FEEDBACK INTEGRATION

Implementing mechanisms to gather user feedback and preferences, allowing for continuous refinement of the system based on user experiences and evolving travel patterns.

6.2.6. MULTI-PLATFORM COMPATIBILITY

Expanding compatibility to other mobile platforms, ensuring accessibility to users across different devices and operating systems.

6.2.7. COLLABORATION WITH SMART CITY INITIATIVES

Collaborating with smart city initiatives to integrate the travel assistance system into broader urban planning strategies, contributing to the development of intelligent and interconnected urban transportation systems.

6.2.8. INCORPORATION OF EMERGING TECHNOLOGIES

Exploring the integration of emerging technologies, such as augmented reality (AR) or virtual reality (VR), to enhance the user interface and provide innovative ways for passengers to interact with the system.

REFERENCES

[1] R. Verma et al., "A Smartphone-Based Passenger Assistant for Public Bus Commute in Developing Countries," in IEEE Transactions on Computational Social Systems, vol. 7, no. 2, pp. 465-476, April 2020.

[2] Murugaiyan, Saravanan & Soundarya, S. (2021). Smart System for Preventing Passenger Destination Missing in Bus. Journal of Physics: Conference Series.

[3] Leeza Singla, Dr. Parteek Bhatia "GPS Based Bus Tracking System" IEEE International Conference on Computer, Communication and Control (IC4-2015).

[4] K. Hariharan, B. Srimathi, R. S. Kumaran and I. Yamuna, "Spotting Current Location of the Public Bus with its Destination and Live Details Through Mobile Application," 2021 International Conference on System, Computation, Automation and Networking (ICSCAN), Puducherry, India, 2021.

[5] S. M, G. GS, J. M, A. Suresh and V. A, "Commutator Bus Transit Recommendation by Predicting Dynamic Bus Flow Occupancy Using Machine Learning," 2021 Fifth International

Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, 2021.

[6] Y. Huang, L. Zhao, T. Van Woensel, and J.-P. Gross, "Time-dependent vehicle routing problem with path flexibility," Transportation Research Part B: Methodological, vol. 95, pp. 169–195, 2017.

[7] H. N. Psaraftis, "A dynamic programming solution to the single vehicle many-to-many immediate request dial-a-ride problem," Transportation Science, vol. 14, no. 2, pp. 130–154, 1980.

[8] K.V.Natarajan , "GSM based bus location tracking and passenger density detection system", In proceedings of International Conference in Telecommunication Technology And Applications IACSIT press, vol.5, pp- 192 - 195,Singapore,2011.

[9] Shen, Sheng & Gowda, Mahanth& Choudhury, Romit. (2018). Closing the Gaps in Inertial Motion Tracking.

[10] Eboli, Laura &Mazzulla, Gabriella & Pungillo, Giuseppe. (2016). Measuring Bus Comfort Levels by using Acceleration Instantaneous Values.Transportation Research Procedia.

[11] Verma, Rohit& Ghosh, Surjya & Shrivastava, Aviral & Ganguly, Niloy & Mitra, Bivas & Chakraborty, Sandip. (2016). Unsupervised annotated city traffic map generation.

[12] Zoric, Bruno &Dudjak, Mario & Bajer, Drazen. (2022). Predicting public transport arrival time and congestion based on BLE beacon crowd sourced data.

[13] S. Bhongale, S. Budhia, R. Singhal, K. Grover, S. Mishra and D. Vora, "*City Glider: A Smart Local Bus System*," 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), Lonavla, India.

[14] Ayob, Mohd & Saaid, Mohammad &Dimyati, Khoiri&Maarof, Khairul. (2018). "*Destination alarm notification for public transportation passenger using Geo-Fence in mobile App*." IOP Conference Series: Earth and Environmental Science.

[15] Basu, Debasis& Maitra, Bhargab. (2007). Valuing attributes of enhanced traffic information: An experience in Kolkata. TRANSPORT.

[16] A. Dimitriu and I. Harmati, "*Artificial intelligence based bus routing in urban areas*," 2020 23rd International Symposium on Measurement and Control in Robotics (ISMCR), Budapest, Hungary, 2020.

[17] Petit, Antoine &Yildirimoglu, Mehmet &Geroliminis, Nikolas & Ouyang, Yanfeng. (2021). Dedicated bus lane network design under demand diversion and dynamic traffic congestion: An aggregated network and continuous approximation model approach. Transportation Research Part C: Emerging Technologies.

[18] G. Best and R. Fitch, "Bayesian intention inference for trajectory prediction with an unknown goal destination," in IROS, 2015, pp. 5817–5823.

[19] K. Jiang, N. Yu, and W. Li, "Online travel destination recommendation with efficient variable memory markov model," in ICME, 2013, pp. 1–4.

[20] J. Krumm and E. Horvitz, "Predestination: Inferring destinations from partial trajectories," in UbiComp, 2006, pp. 243–260.

[21] D. Tiesyte and C. S. Jensen, "Similarity-based prediction of travel times for vehicles traveling on known routes," in SIGSPATIAL, 2008, p. 14.

[22] Z. Dong, J. Deng, X. Jiang, and Y. Wang, "RTMatch: Real-time location prediction based on trajectory pattern matching," in DASFAA, 2017, pp. 103–117.

[23] K. Tanaka, Y. Kishino, T. Terada, and S. Nishio, "A destination prediction method using driving contexts and trajectory for car navigation systems," in ACM SAC, 2009, pp. 190–195.

[24] H. T. Lam, E. Diaz-Aviles, A. Pascale, Y. Gkoufas, and B. Chen, "(Blue) taxi destination and trip time prediction from partial trajectories," in ECML/PKDD, 2015.

[25] F. D. N. Neto, C. de Souza Baptista, and C. E. C. Campelo, "A user-personalized model for real time destination and route prediction," in ITSC, 2016, pp. 401–407.