AI-POWERED SOLUTIONS FOR BREAKDOWN CHALLENGES WITH ELECTRIC VEHICLES

Project ID: TMP-2023-24-117

Project Proposal Report

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Department of Information Technology

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Declaration

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning. To the best of my knowledge and belief, it does not contain any previously published material written by another person except where the acknowledgment is made in the text.

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Date: 25th August 2023

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

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Signature of the Supervisor (Dr. Anuradha Jayakody) Date

Table of Contents

List of Figures

List of Tables

Abstract

This research component addresses the pressing need to enhance emergency assistance for electric vehicle (EV) breakdowns through the integration of machine learning and geolocation technologies. In the context of promoting EV adoption and mitigating environmental pollution, my study focuses on creating an On-Road Breakdown Rescue System that efficiently connects stranded EV drivers with skilled mechanics. The central objective is to reduce the confusion and inconvenience experienced by drivers when faced with breakdowns, particularly in unfamiliar locations.

The study's primary design entails the development of a user-friendly mobile application, catering specifically to registered EV users. In the event of a breakdown, users can promptly request assistance by providing details of the breakdown and their current location. Leveraging natural language processing and machine learning algorithms, the system accurately identifies the breakdown type from the description provided, subsequently matching it with mechanics who possess the requisite skills and services. This intelligent matching considers both proximity and breakdown type, offering users a list of suitable mechanics to select from.

Mechanics are ranked based on proximity and expertise, affording users the flexibility to choose according to their preferences. Users also have the option to broadcast their service request to all available mechanics for immediate assistance. Once accepted, the chosen mechanic can expedite the resolution of the issue, minimizing downtime and inconvenience for the EV owner.

Additionally, the application incorporates mechanisms for users to rate and provide feedback on the service received, fostering accountability and transparency within the repair service industry. It further enhances user convenience by enabling the scheduling of repair service appointments, facilitating proactive vehicle maintenance planning.

This research component contributes significantly to the broader project's mission of reducing environmental pollution stemming from gasoline vehicles by promoting EV adoption in Sri Lanka. By offering an efficient and accessible solution to EV breakdowns, it enhances the overall EV ownership experience, ultimately encouraging more individuals to embrace this sustainable mode of transportation. In summary, our study advances the vital goal of sustainable transportation by addressing the immediate challenges faced by EV owners during breakdowns and reinforces the feasibility and attractiveness of EVs in the Sri Lankan context.

Keywords –

Electric Vehicle (EV) Breakdowns, Machine Learning Integration, Geolocation Technologies, On-Road Breakdown Rescue System, Natural Language Processing, Mechanic Matching Algorithm, Proximity-based Ranking, User Feedback Mechanism, Service Request Broadcasting, Sustainable Transportat

1. Introduction

1.1. Background and Literature Survey

The adoption of electric vehicles (EVs) has been steadily rising, driven by concerns over environmental pollution and the need for sustainable transportation options. As EVs become more prevalent on the roads, ensuring their reliability and providing efficient emergency assistance in case of breakdowns have become pressing concerns. This literature review delves into the existing research and developments in the field of enhancing emergency assistance for EV breakdowns through the integration of machine learning and geolocation technologies, which forms the core focus of this study.

Breakdowns in electric vehicles pose unique challenges compared to traditional internal combustion engine vehicles. EVs rely on complex electrical and electronic systems, making diagnostics and repairs more intricate. Existing studies have highlighted the need for specialized assistance services for EV breakdowns [2]. The integration of machine learning and geolocation technologies offers a promising solution to streamline the assistance process.

Geolocation technology has been widely used in emergency services, such as ambulance dispatch and roadside assistance. It enables precise identification of a user's location, reducing response times and improving the overall effectiveness of the assistance [3]. The incorporation of geolocation into the On-Road Breakdown Rescue System aligns with established best practices in emergency service systems.

Machine learning algorithms, particularly natural language processing (NLP), have shown significant promise in automating breakdown identification based on user descriptions. Research in this area has demonstrated the ability of NLP models to accurately classify and categorize breakdowns from textual descriptions [4]. This capability is crucial for swiftly connecting EV drivers with mechanics who possess the relevant expertise.

Proximity-based service matching, as explored in the proposed study, has been applied in various contexts, such as ride-sharing and food delivery apps. Studies have shown that optimizing service provider selection based on both proximity and service type results in improved user satisfaction and response times [5]. This approach aligns with the goal of reducing inconvenience for stranded EV drivers.

Mechanisms for users to rate and provide feedback on service quality have been instrumental in improving various service industries. This practice encourages accountability and transparency, as well as motivating service providers to maintain high standards [6]. Incorporating these feedback mechanisms into the application is expected to enhance the overall user experience and service quality.

Enabling users to schedule repair service appointments aligns with the growing trend of proactive vehicle maintenance planning. Studies have shown that regular maintenance can significantly extend the lifespan of EV batteries and reduce the likelihood of unexpected breakdowns [7]. This feature enhances the overall convenience and reliability of EV ownership.\

S. Krishna, et al.[1] discusses the development of a Django-based application to assist users when their vehicles break down. The system utilizes the user's location to locate nearby mechanics and garages, displaying them in ascending order of proximity. It employs Dijkstra's Algorithm to find the nearest mechanic shop and provides navigation instructions. The paper also explores related literature on vehicle breakdown services. The proposed system comprises a user interface, logic based on Dijkstra's Algorithm, and a database for storing mechanic shop details. Huang Yan, et al. [8] elaborate on the common/all-view technique used in the Global Positioning System (GPS) for long-distance time and data transfer. Frequently, GPS time transfer involves acquiring data and applying post-processing algorithms to refine its accuracy. This paper introduces an algorithm that squares the measured time periods, particularly for high-frequency time transfers using a multi-channel GPS receiver supported by the EURO-160 GPS board. To ensure accuracy, an experiment involving a common clock in a zero-baseline setup is conducted, utilizing foreign business GPS P3 code measurements. The results demonstrate that the same level of technology is present in real-time GPS acquisitions and those obtained using foreign business GPS P3 code.

Ankush Das and colleagues [9] have conducted research on vehicle tracking assistance, which focuses on a mobile application that enables users to communicate with nearby mechanics whenever needed and provides services through local mechanics in a shorter timeframe. Professor MS Pranita and others [10] have also addressed the issue of vehicle malfunctions during journeys, highlighting the difficulty of finding mechanic shops in unfamiliar locations. To tackle this problem, they proposed the development of a mobile and internet-based assistance system. Sathwik Krishna and team [11] introduced the use of Dijkstra's Algorithm to obtain information about the nearest mechanic service center based on the user's current location.

1.2.Research Gap

While significant progress has been made in the realm of emergency assistance for electric vehicle (EV) breakdowns, there remains a notable research gap in terms of integrating machine learning and geolocation technologies to create a comprehensive and user-centric solution. The literature review highlights several key areas where this research component contributes to filling the existing gap:

1. Integration of Machine Learning and Geolocation for EV Breakdowns:
While geolocation technology has been utilized in emergency services, such as ambulance dispatch, there is limited research focusing on its integration with machine learning algorithms specifically for EV breakdown assistance. The proposed On-Road Breakdown Rescue System seeks to bridge this gap by efficiently connecting stranded EV drivers with skilled mechanics through accurate breakdown identification and intelligent service provider matching.

2. User-Centric Approach to EV Breakdown Assistance:
The literature review underscores the unique challenges posed by EV breakdowns due to their complex electrical and electronic systems. However, existing solutions often lack a user-centric approach that combines proximity-based matching and tailored services. The proposed mobile

application aims to provide a comprehensive solution by allowing users to select mechanics based on their preferences, offering immediate assistance options, and enhancing overall user experience.

3. Real-Time Breakdown Identification and Assistance:
The incorporation of natural language processing and machine learning algorithms to swiftly identify breakdowns from user descriptions is a novel contribution. This real-time identification has the potential to significantly reduce downtime for stranded EV drivers and streamline the repair process.

4. Emergency or Priority Service Request Broadcast:
The function of allowing users to broadcast their service request to all available mechanics for immediate assistance is often referred to as "Emergency or Priority Service Request Broadcast." This feature ensures that the user's request gets the attention of multiple mechanics simultaneously to expedite assistance during urgent situations.

5. Accountability and Transparency in Repair Services:
While user feedback mechanisms have been employed in various service industries, their application to the realm of EV breakdown assistance is limited. By introducing mechanisms for users to rate and provide feedback on the service received, the proposed system addresses the need for accountability and transparency in the repair service industry, potentially driving service quality improvement.

6. Proactive Maintenance Planning for EVs:
The integration of repair service appointment scheduling aligns with the growing trend of proactive maintenance planning for EVs. This feature not only enhances user convenience but also contributes to prolonging the lifespan of EV batteries and minimizing unexpected breakdowns.

	Research A	Research B	Research C	Proposed System
1. Specified for Electric Vehicles	✗	✗	✗	✓
2. Using Geolocation and GPS for locating	✓	✓	✓	✓
3. Using ML and NLP for Real-Time Breakdown Identification and Assistance	✗	✗	✗	✓

4. Proactive Repair Service scheduling	✓	✗	✗	✓
5. Emergency or Priority Service Request Broadcast	✗	✗	✗	✓

Table 1:Research Gap

1.3. Research Problem

The research problem is the lack of an efficient and user-friendly system that can provide rapid and accurate assistance to drivers of electric vehicles (EVs) during emergency breakdown situations, particularly in unfamiliar areas. Traditional breakdown scenarios often lead to confusion and difficulty in locating nearby mechanics, causing inconvenience and delays for drivers. This problem is amplified in the context of EVs, where specialized knowledge and skills are required for repairs, and drivers may not be well-versed in finding suitable mechanics for EV-related issues. Therefore, there is a need for a comprehensive solution that leverages machine learning, geolocation, and natural language processing to quickly identify the breakdown type, match it with skilled mechanics, consider proximity, and facilitate seamless communication and assistance for EV drivers in distress. This research aims to address these challenges and provide an effective system that enhances the overall breakdown rescue experience for EV drivers.

2. Objectives

2.1.Main Objective

The main objective of this research component is to enhance emergency assistance for electric vehicle (EV) breakdowns by developing an On-Road Breakdown Rescue System that integrates machine learning and geolocation technologies. The system aims to efficiently connect stranded EV drivers with skilled mechanics, reducing confusion and inconvenience during breakdowns, especially in unfamiliar locations.

2.2.Specific Objectives

1. **User-Friendly Mobile Application Development**: Create an intuitive and user-friendly mobile application for EV users to easily request assistance during breakdowns.

2. **Real-Time Geolocation Integration:** Integrate geolocation technology to accurately pinpoint the user's location and mechanics' availability, ensuring timely assistance.

3. **Breakdown Type Identification:** Develop natural language processing and machine learning algorithms to accurately identify breakdown types from user-provided descriptions.

4. **Mechanic Skill and Service Matching:** Implement an intelligent matching system that pairs breakdown descriptions with mechanics possessing the relevant skills and services.

5. **Proximity-Based Mechanic Ranking:** Design a ranking mechanism that considers both proximity and expertise, enabling users to choose mechanics based on their preferences.

6. **Broadcast Mechanism for Immediate Assistance:** Create an option for users to broadcast their service requests to all available mechanics, ensuring prompt help when urgently needed.

7. **Feedback and Rating System**: Integrate a feedback and rating system for users to rate the service received, enhancing accountability and transparency in the repair service industry.

8. **Appointment Scheduling:** Enable users to schedule repair service appointments for proactive vehicle maintenance planning, improving convenience.

9. **Mechanic Acceptance and Communication:** Establish a communication channel between users and mechanics, allowing the chosen mechanic to accept the request and coordinate the repair process.

3. Methodology

3.1.System Architecture

The architecture of the On-Road EV Breakdown Rescue System is designed to seamlessly connect stranded EV drivers with skilled mechanics, utilizing React Native, Expo, Python, TensorFlow, and a Node.js server. The architecture includes the following key components:
User Mobile Application: Developed using React Native and Expo, the user app offers an intuitive interface allowing EV drivers to request assistance, communicate with mechanics, and schedule appointments. The app integrates with the Google Geolocation API to provide accurate location data.
Node.js Backend Server**:** The backend, built on Node.js, handles user requests, breakdown type identification using TensorFlow models, mechanic matching, and real-time communication. RESTful APIs facilitate data exchange between the user app and the server.
Database: The database stores user profiles, mechanic details, breakdown history, appointments, feedback, and more. The schema is optimized for efficient data storage and retrieval.

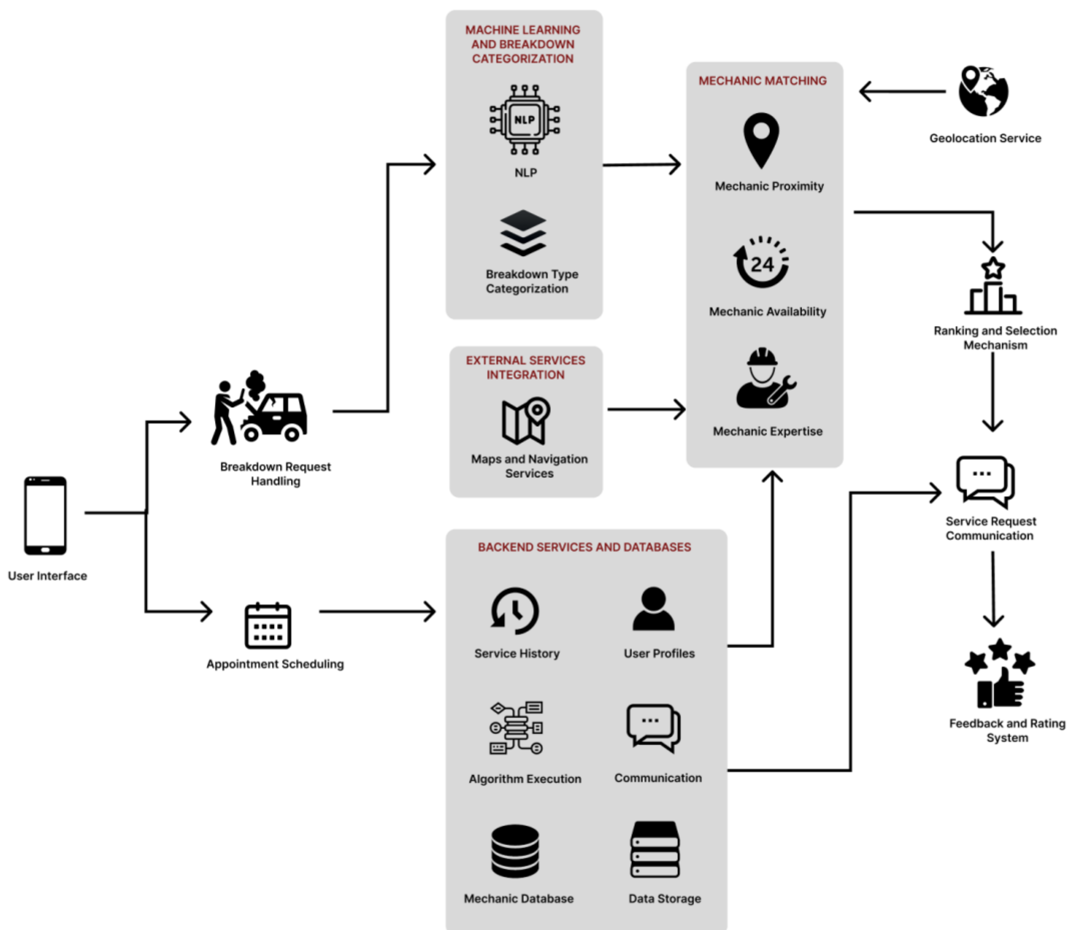

Figure 1: System Architecture Diagram

The On-Road EV Breakdown Rescue System is designed to seamlessly integrate machine learning and geolocation technologies to provide efficient emergency assistance for electric vehicle (EV) breakdowns. The system's architecture can be broken down into several key components, each playing a crucial role in delivering the desired functionality. Here's a clear description of the system architecture:

1. User Interface (UI):
The system's user interface is a mobile application tailored for registered EV users. This user-friendly app serves as the primary interaction point for users to request breakdown assistance, track mechanic availability, and manage their service requests.

2. User Management:
This component handles user registration, login, and profile management. It stores user information, including their contact details and vehicle specifications, which are essential for efficient breakdown assistance.

3. Breakdown Request Handling:
When a user experiences a breakdown, they provide details of the issue through the app. This input could be in the form of text descriptions and/or images. Natural Language Processing (NLP) techniques are employed to analyze the description and categorize the breakdown type.

4. Machine Learning and Breakdown Categorization:
Machine learning algorithms are used to categorize breakdown descriptions accurately. This involves training the system on a dataset of breakdown scenarios and descriptions to enable it to recognize common patterns. The categorized breakdown type is then used for intelligent matching.

5. Geolocation Services:
The app uses geolocation technologies to determine the user's precise location when they request assistance. This location data is crucial for matching users with nearby mechanics and enabling mechanics to navigate to the user's location efficiently.

6. Mechanic Matching:
The system maintains a database of skilled mechanics, including their expertise, availability, and proximity to users. When a breakdown request is made, the system matches the breakdown type and user location with mechanics who are qualified to handle the specific issue and are geographically close.

7. Ranking and Selection Mechanism:
Mechanics are ranked based on proximity and expertise. Users are presented with a list of suitable mechanics along with their ratings and profiles. Users can then choose a mechanic based on their preferences. There's also an option to broadcast the request to all available mechanics for immediate assistance.

8. Service Request Communication:
Once a user selects a mechanic and requests assistance, the system notifies the chosen mechanic about the breakdown details and location. Communication tools such as real-time messaging or push notifications facilitate interaction between users and mechanics.

9. Feedback and Rating System:
After the breakdown is resolved, users have the opportunity to rate and provide feedback on the service received. This accountability mechanism encourages mechanics to provide high-quality service.

10. Appointment Scheduling and Maintenance Planning:
The application offers features for users to schedule repair service appointments in advance, promoting proactive vehicle maintenance planning. This feature ensures that routine maintenance can be planned ahead, reducing the likelihood of breakdowns.

11. Backend Services and Databases:
The backend services manage data storage, communication between components, and the execution of various algorithms. It also handles the mechanic database, user profiles, service history, and more.

12. External Services Integration:
The system might integrate with external services such as maps and navigation services to assist mechanics in reaching users quickly and efficiently.

Technologies	React Native, Expo, Python, TensorFlow, Node Server
Techniques	Text Classification, Entity Extraction, Machine Learning Model, Knowledge Base, Geolocation, GPS, Natural Language Processing,
Algorithms	Recurrent Neural Networks (RNN), Naive Bayes Classifier, Support Vector Machine (SVM)

Table 2: Technologies, Techniques & Algorithms

3.1.1.Software Solution:

The User Mobile Application offers a streamlined breakdown assistance process:

1. Users initiate assistance requests by providing breakdown details and accurate location data.

2. Machine learning algorithms in TensorFlow analyze user descriptions to identify breakdown types.
3. The Node.js backend employs the TensorFlow models to match mechanics based on expertise and proximity, utilizing geolocation data.
4. Users are presented with a list of mechanics along with ratings and distance indicators.
5. Users have the option to select a mechanic or broadcast their request to all available mechanics for immediate assistance.
6. Chosen mechanics can communicate with users in real time through the app's communication features.
7. Users can schedule repair appointments and receive confirmation through the app.
8. After service completion, users can submit feedback and ratings, promoting accountability.

1. Requirement Gathering:

- Requirements were collected through user interviews and discussions with mechanics. EV drivers emphasized the need for an intuitive mobile app, while mechanics highlighted the importance of accurate breakdown identification.

2. Feasibility Study (Planning):

- Technical Feasibility: The selected technologies, including React Native, TensorFlow, and Node.js, are well-suited for the project's technical requirements.
- Operational Feasibility: User feedback indicates a strong demand for a reliable breakdown assistance app, demonstrating operational feasibility.
- Economic Feasibility: Estimated costs align with projected revenue from user subscriptions and mechanic partnerships, suggesting positive returns.

3. Design (System and Software Design Documents):

- Database Schema: Detailed schema design outlining tables for users, mechanics, breakdowns, appointments, and feedback.
- API Documentation: Comprehensive documentation detailing API endpoints, request/response formats, and authentication methods.

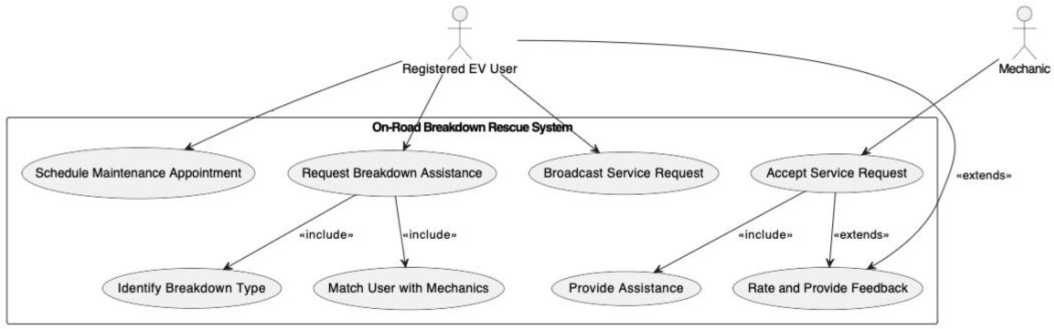

Figure 2: Use Case Diagram

4. **Implementation (Development):**

- User Mobile Application: Developed using React Native and Expo, with integrated Google Geolocation API and real-time communication features for seamless interaction.
- Node.js Backend Server: Implemented to handle user requests, machine learning tasks, mechanic matching, and real-time communication through RESTful APIs.
- Database: PostgreSQL database designed according to the schema, focusing on optimized data storage and retrieval.

5. **Testing:**

- Unit Testing: Components in the app, backend, and algorithms are individually tested to ensure functionality.
- Integration Testing: Interaction between the user app, backend, and database is tested to verify data flow.
- User Acceptance Testing: Real users participate in testing to validate functionality and user experience.
- Algorithm Validation: TensorFlow models' accuracy is validated using a diverse dataset, with iterative improvement as needed.

3.1.2. Commercialization

Future scope

For the future scope of the application will be extended to give the solutions for hybrid vehicles and Internal combustion engine old vehicles. Improve user experience more and more.

Target Audience

- EV drivers
- EV owners
- EV manufacturers
- EV mechanics
- EV spare part shops

Market Space

- No need for advanced knowledge in technology.
- No age limitation for users.
- No need for prior knowledge about electric vehicles.

3. Project Requirements

4.1.Functional Requirements

1. User Registration and Authentication:
   - Users can create accounts using their email or social media accounts.
   - Users must verify their email addresses during registration.
   - Users can log in using their registered credentials.
   - Password reset functionality is provided for forgotten passwords.

2. Breakdown Assistance Request:
   - Users can initiate a breakdown assistance request through the mobile app.
   - Users provide a description of the breakdown and attach relevant media (images, videos).
   - Users grant the app access to their device's geolocation or manually input their location.
   - The system identifies the breakdown type using natural language processing and machine learning techniques.

3. Mechanic Matching and Listing:
   - Mechanics with expertise matching the breakdown type are identified using machine learning.
   - The app displays a list of available mechanics sorted by proximity and expertise.
   - Each mechanic's profile includes ratings, reviews, location, and contact information.

4. Mechanic Communication:
   - Users can select a mechanic from the list and initiate communication.
   - Real-time messaging allows users and mechanics to exchange text, images, and other media.
   - Users can ask questions, provide additional information, and receive updates on the repair process.

5. Mechanic Selection and Confirmation:
   - Users can choose a mechanic from the list or broadcast their request to all available mechanics.
   - Once a mechanic accepts a request, the user receives a confirmation notification.
   - Users can view the accepted mechanic's contact information and location.

6. Repair Scheduling and Appointments:
   - Users have the option to schedule a repair appointment with the chosen mechanic.
   - The mechanic confirms the appointment and the repair date and time.
   - Users receive reminders and notifications about upcoming appointments.

7. Feedback and Ratings:
   - After the repair is completed, users can provide feedback on the mechanic's service.

- Users rate mechanics based on their experience.
- Mechanics can also rate users to enhance accountability.

8. Real-Time Location Tracking:
    - The system continuously tracks the location of mechanics on their way to the user's location.
    - Users can monitor the mechanic's real-time location through the app.

9. Notification System:
    - Users receive notifications about the status of their assistance request, mechanic acceptance, appointment confirmations, and feedback submission.
    - Mechanics receive notifications about new assistance requests, accepted requests, and user messages.

10. User Profile Management:
    - Users can update their profile information, including contact details and vehicle information.
    - Mechanic profiles include details of their expertise, location, and services offered.

12. Security and Privacy:
    - User data is securely stored and transmitted using encryption methods.
    - Users can control the sharing of their location data and personal information.

13. GPS and Geolocation Integration:
    - The system integrates with the Google Geolocation API to accurately pinpoint user and mechanic locations.

4.2. Non-Functional Requirements

1. Performance:
    - The system should respond to user requests within 2 seconds.
    - The app should have a maximum loading time of 3 seconds on user devices.

2. Scalability:
    - The system should be able to handle a minimum of 10,000 simultaneous users.
    - It should scale seamlessly to accommodate increased user demand during peak times.

3. Availability:
    - The system should have an uptime of at least 99.9%.
    - Maintenance and updates should be scheduled during off-peak hours.

4. Reliability:
    - Mechanic-matching accuracy should be above 95%.
    - User data should be backed up regularly to prevent data loss.

5. Security:
    - User data must be stored and transmitted securely using encryption.
    - Mechanic credentials should be protected, and access to user data should be role-based.

6. Usability:
    - The mobile app interface should be intuitive and easy to navigate for both users and mechanics.
    - Mechanic matching and communication features should be user-friendly.

7. Compatibility:
    - The mobile app should be compatible with Android devices (versions 6.0 and above) and iOS devices (versions 10 and above).

8. Data Privacy:
    - User and mechanic data should be handled in compliance with relevant data protection laws.
    - Users must provide explicit consent for location tracking and data sharing.

9. Response Time:
    - Messages sent between users and mechanics should have a response time of less than 1 second within the app.

10. Integration:
    - The system should seamlessly integrate with the Google Geolocation API for accurate location services.
    - It should also integrate with payment gateways for processing service fees.

11. Adaptability:
    - The system should be adaptable to accommodate future technological advancements and updates.

12. Support and Maintenance:
    - Customer support should be available during regular business hours for user assistance.
    - Regular maintenance updates and bug fixes should be conducted to ensure system stability.

13. Performance Metrics:
    - Performance metrics such as response times, user satisfaction, and system uptime should be regularly monitored and reported.

4.3.System Requirements

1. User Authentication and Registration:
    - The system must provide a secure user registration process with email verification.
    - Users must be able to log in using their registered credentials.

2. Breakdown Assistance Request:
    - The system should allow users to submit breakdown assistance requests.
    - Users must be able to provide a breakdown description and attach media (images, videos).
    - The system should capture user location either through geolocation services or manual input.

3. Breakdown Type Identification and Mechanic Matching:
    - The system must use machine learning and NLP techniques to accurately identify breakdown types from user descriptions.
    - Mechanics should be matched based on expertise related to breakdown types and proximity.

4. Real-Time Communication
    - The system should enable real-time messaging between users and mechanics.
    - Users and mechanics must be able to exchange text, images, and other media through the app.

5. Mechanic Selection and Confirmation:
    - Users should have the option to select a mechanic from the provided list or broadcast a request to all available mechanics.
    - Chosen mechanics must be able to accept requests, confirming the assistance.

6. Repair Scheduling and Appointments:
    - Users should be able to schedule repair appointments with chosen mechanics.
    - Mechanics should confirm appointments, specifying date and time.

7. Feedback and Ratings:
    - The system should allow users to submit feedback and ratings for mechanics' services.
    - Mechanics should have the option to rate users based on their behavior and cooperation.

8. Location Tracking and Mapping:
    - The system should integrate with the Google Geolocation API for accurate location tracking.
    - Users and mechanics should be able to view each other's real-time locations on a map.

9. Admin Dashboard:
    - An admin dashboard is required for system administrators to manage user accounts, mechanic profiles, and monitor system activities.

10. Data Privacy and Security:

- User data should be securely stored and transmitted using encryption.
- Mechanic credentials and user data should be protected using role-based access controls.

4.4.User Requirements

1. User Registration:
   - Users should be able to create accounts using their email addresses.
   - Registration should include basic personal information and vehicle details.

2. Breakdown Assistance Request:
   - Users must have the ability to initiate breakdown assistance requests quickly.
   - The process should be straightforward and require minimal effort.

3. Mechanic Selection:
   - Users should receive a list of mechanics matching the breakdown type and nearby locations.
   - Mechanic profiles should display ratings, reviews, and contact information.

4. Real-Time Communication:
   - Users should be able to communicate with chosen mechanics in real time.
   - Communication should be seamless, allowing text and media sharing.

5. Repair Scheduling and Appointments:
   - Users should be able to schedule appointments with mechanics at their convenience.
   - Appointments should be confirmed and notifications sent.

6. Feedback and Ratings:
   - Users should have the opportunity to provide feedback on mechanic services.
   - Ratings should be easy to submit and visible to other users.

7. Location Tracking:
   - Users should be able to view the real-time location of the assigned mechanic.
   - Location tracking should ensure accuracy and privacy.

8. User Privacy:
   - Users must have control over their data sharing preferences and location visibility.
   - User data should be used only for system-related purposes.

5. Description of Personal and Facilities

5.1.Work BreakDown Structure

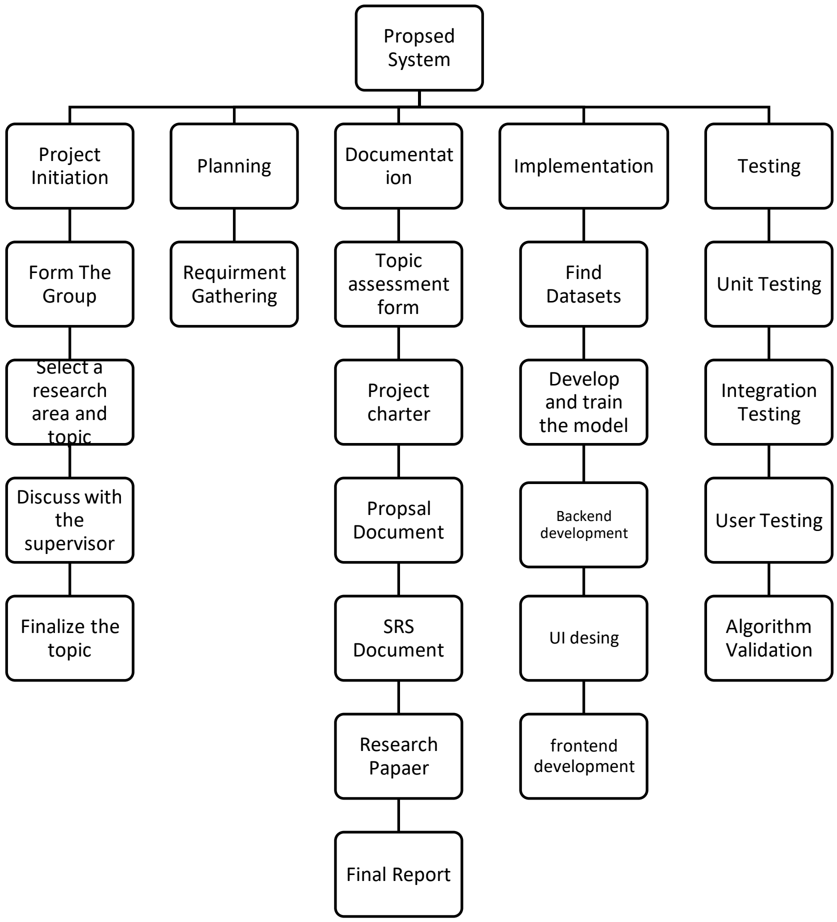

Figure 3: Work Breakdown Chart

5.2.Gantt Chart

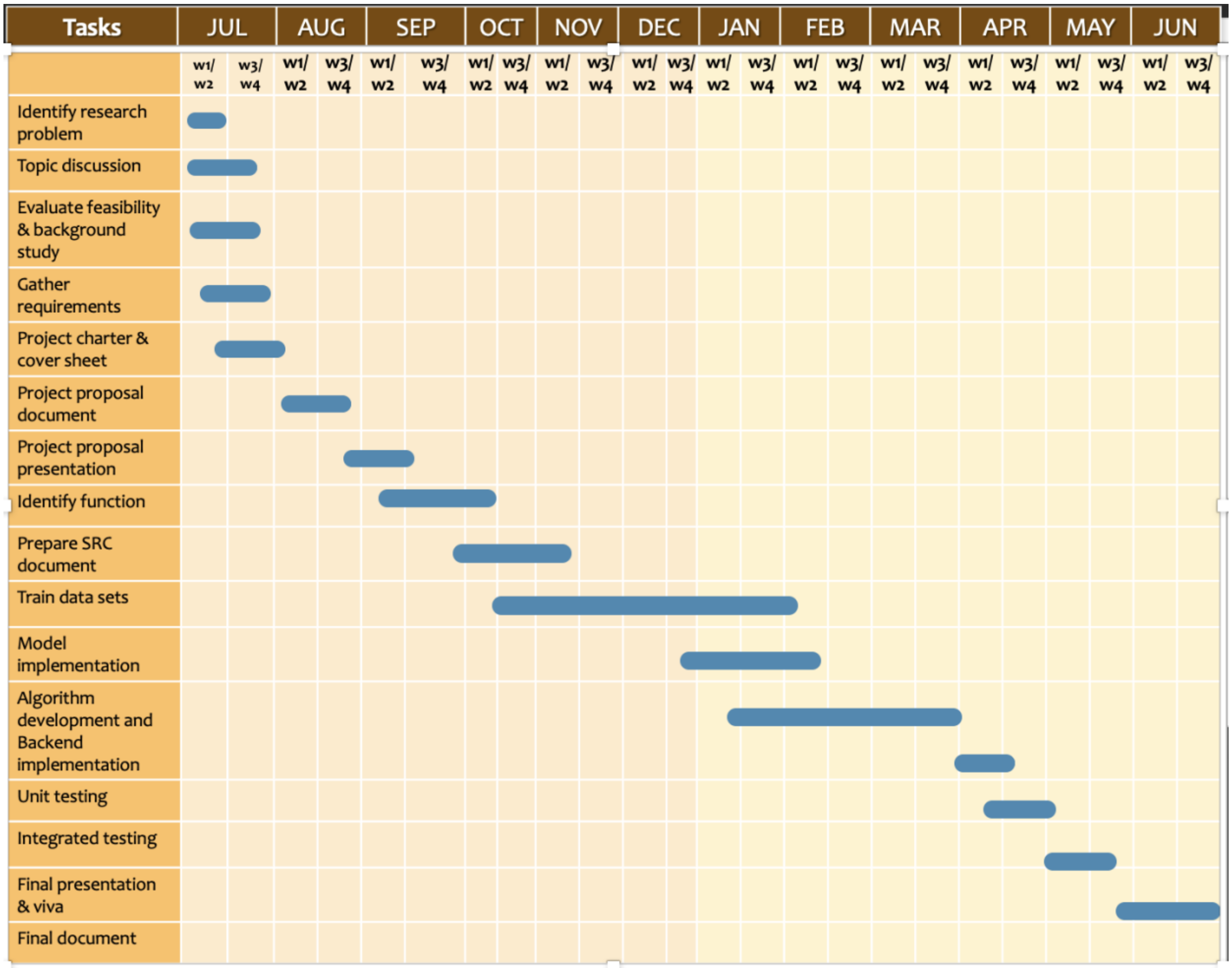

Figure 4: Gantt Chart

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