REVOLUTIONIZING ELECTRIC VEHICLE ASSISTANCE

AI-Powered Solutions for Breakdown Challenges with Electric Vehicles

TMP-2023-24-117

TEAM MEMBERS

Supervisor

Ms.Sanika Wijayasekara

Assistant Professor

Co-Supervisor

Ms.Sasini Hathurusinghe

Assistant lecturer

Perera B.N.H.
IT20096434

Vijerathna A.G.V.K.M.
IT20644826

Sirimanna D.J.T.K.
IT20038328

Madhubhashana A.G.K
IT20038182

INTRODUCTION

- Currently, the world demand for electric vehicles is increasing, but in countries like Sri Lanka, there is a lack of people turning to electric vehicles.
- The reason for this is the lack of knowledge about electric vehicles, the difficulty of finding mechanics when the vehicle breaks down and the difficulty of finding necessary spare parts.
- The purpose of our grant is to provide a successful solution to avoid the hassle and inconvenience that occurs when an electric vehicle breaks down on the road.

RESEARCH PROBLEM

- Lack of knowledge about electric vehicles
- When an electric vehicle breaks down on the road, a successful method is needed to know the fault itself
- When the vehicle breaks down, the driver needs a way to know what actions to take immediately
- It is difficult to quickly find a skilled mechanic to repair the broken down vehicle
- Need a quick way to find spare parts needed for vehicle repairs and find the nearest spare part shops quickly
- The vehicle should be properly maintained and the vehicle owner should be informed in advance about the maintenance work to be done
- There is a need for an efficient system to store the information about the maintenance s carried out

RESEARCH OBJECTIVES

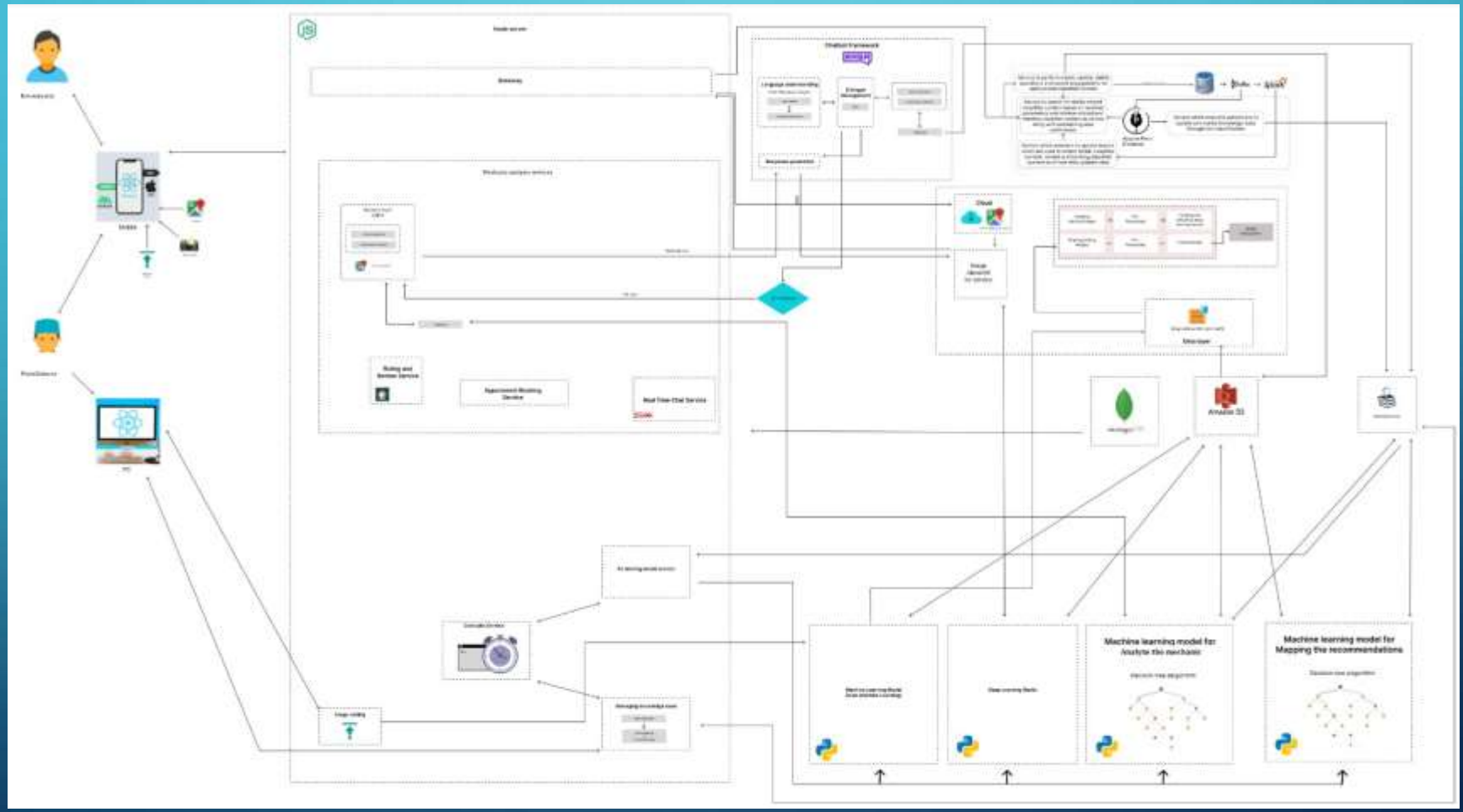
AI chatbot to identify electric vehicle faults and provide solutions

Enhancing User Experience in Vehicle Maintenance with a Smart Digital Monitoring Calendar and Reminder System

Automated Spare Parts Identification and Location System using Image Processing and Computer Vision Techniques

Intelligent Geolocation-based EV Breakdown Assistance with AI based Repair Service Cost Estimation

SYSTEM ARCHITECTURE DIAGRAM



AI Chatbot to Identify Electric Vehicle Faults and Provide Solutions

PERERA B.N.H. | IT20096434
INFORMATION TECHNOLOGY

INTRODUCTION

- Conversational AI Chatbot for Vehicle Breakdown Assistance for electric vehicles.
- Empowers drivers: Provides prompt and accurate information about vehicle faults for informed decisions.
- Leverages extensive datasets: Meticulously developed AI model analyzes breakdown situations and suggests solutions.
- Real-time assistance: Stays up-to-date with the latest electric vehicle models and data for relevant advice.
- Mission: Enhance drivers' safety and efficiency on the road.
- Comprehensive support: Equips electric vehicle users with a powerful tool for quick diagnosis and resolution of breakdown issues.

RESEARCH GAP

- Existing research and solutions focus on traditional internal combustion engine vehicles, leaving a research gap in specialized chatbots for electric vehicles with unique breakdown scenarios.
- Research is needed to develop chatbots that efficiently integrate real-time data on the latest electric vehicle models for accurate assistance.
- Advanced AI models are required to analyze complex electric vehicle breakdowns and provide tailored solutions based on vehicle characteristics.
- Ensuring a seamless user experience and natural language processing in chatbots remains challenging, requiring further research.
- Research is needed to create chatbots that seamlessly connect with emergency services for timely assistance in emergencies.
- Enhancing the trustworthiness and validation of chatbot recommendations is necessary to boost user confidence in relying on AI-powered solutions.

RESEARCH PROBLEM

- When an electric vehicle breaks down on the road, there is currently no way for the driver to know the fault of the vehicle quickly
- There needs to be a way to know what action to take when the vehicle breaks down.
- Conversational AI chatbot with knowledge base
- Proposed solution is cost-effective and personalized.
- Novelty : conversational AI identify electric vehicle faults and provide solutions. It gathers details from drivers, trains an AI model using manufacturer datasets, and builds a knowledge base. The chatbot engages in dialogue, offers solutions, and continuously improves through knowledge base updates.

SPECIFIC AND SUB OBJECTIVES

Main Objectives

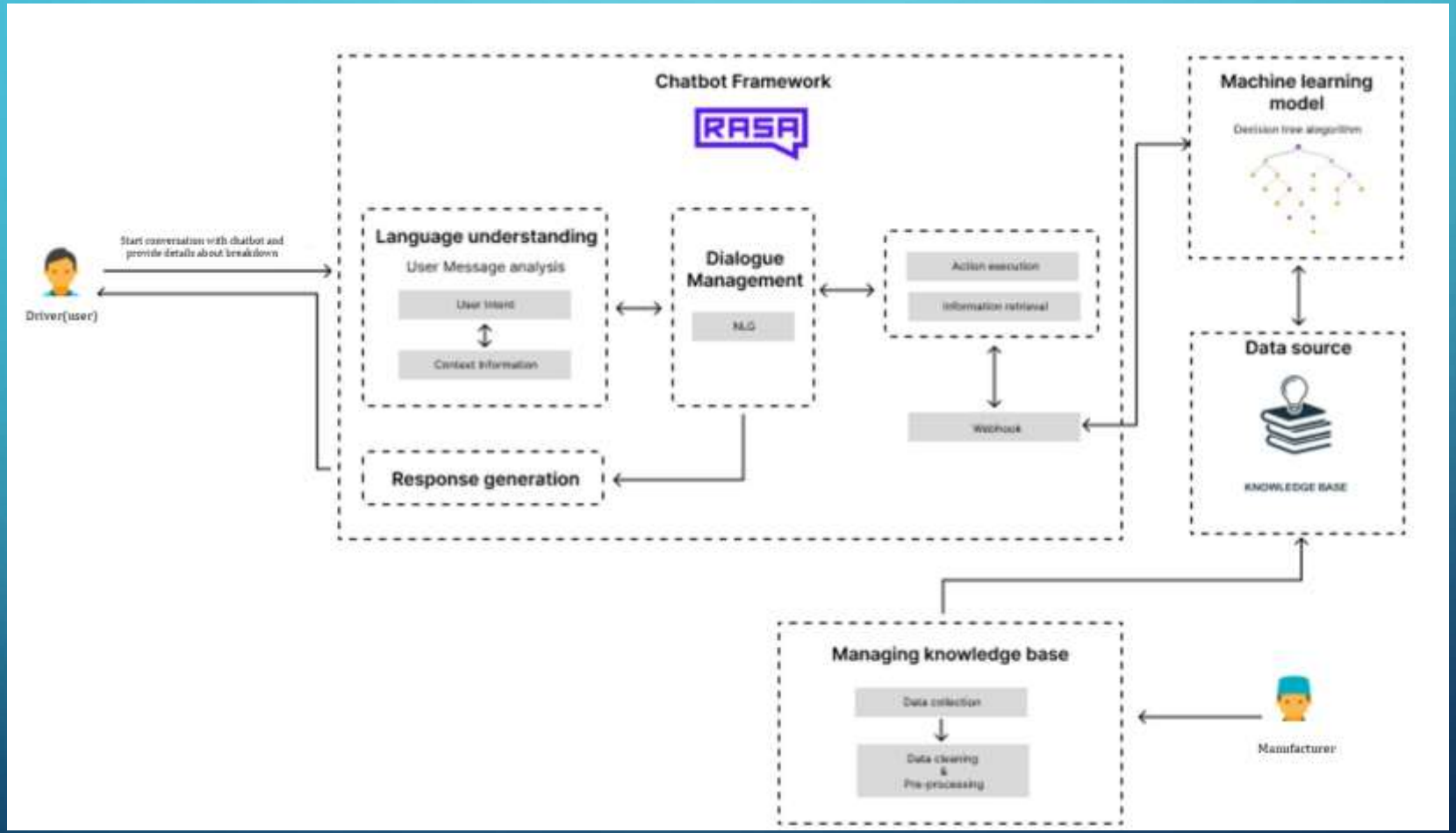
- Electric Vehicle Breakdown Assistance through Advanced AI Chatbot: Empowe Drivers with Real-Time Solutions

Sub Objectives

- Manage knowledgebase.
- ML model
- NLP implementation
  - Dialogue management
  - Intent recognition
  - Named entity recognition

METHODOLOGY

System Architecture Diagram



TOOLS & TECHNOLOGIES

Technology	Techniques	Algorithms	Architecture
• React-native	• Intent recognition	• Decision Tree	• RASA(chatbot teamwork)
• Expo	• Named entity recognition	• Random Forest	
• Python	• Sentiment analysis		
• Node Server	• Text classification		
	• Dialogue management		





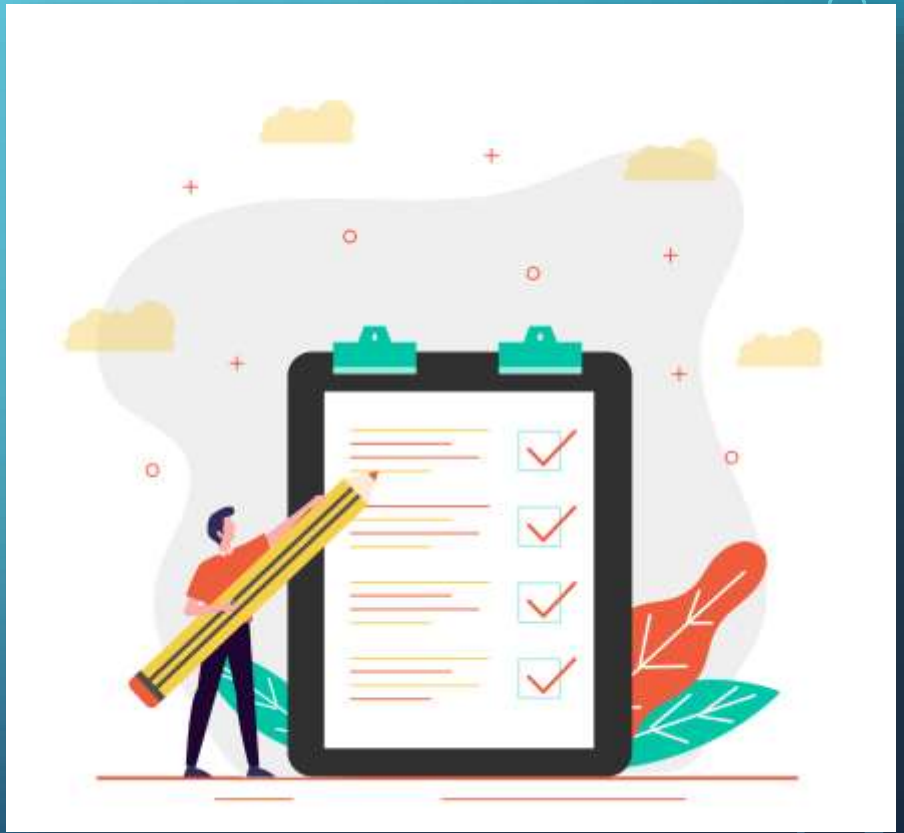
RASA CHATBOT FRAMEWORK

- RASA is an open-source chatbot framework.
- It uses natural language processing (NLP) and machine learning.
- RASA can be used to build AI assistants.
- It allows for customizable dialogue management.
- RASA supports multiple languages.
- RASA has a large and active community.

REQUIREMENTS

Functional Requirements

- Chatbot understands breakdown-related questions.
- Identify conditions based on breakdown.
- Provide suggestions.
- Keep records, provide follow-up advice.
- Recognize emergencies, give appropriate advice.
- User-friendly interface for user interaction.
- Available 24/7 for support.
- Handle multiple conversations to avoid delays.
- Manufacturer can easily update knowledge base.

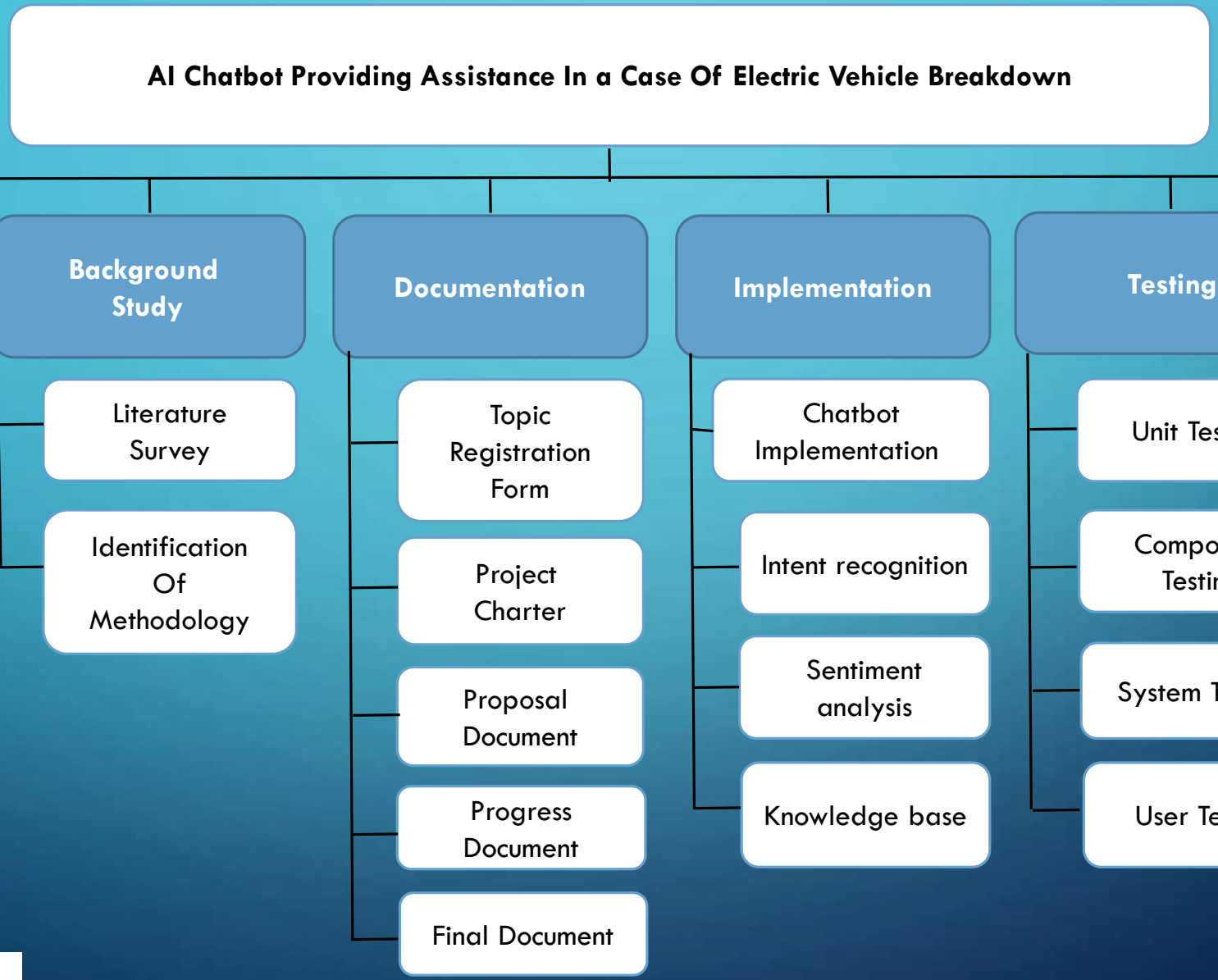


REQUIREMENTS

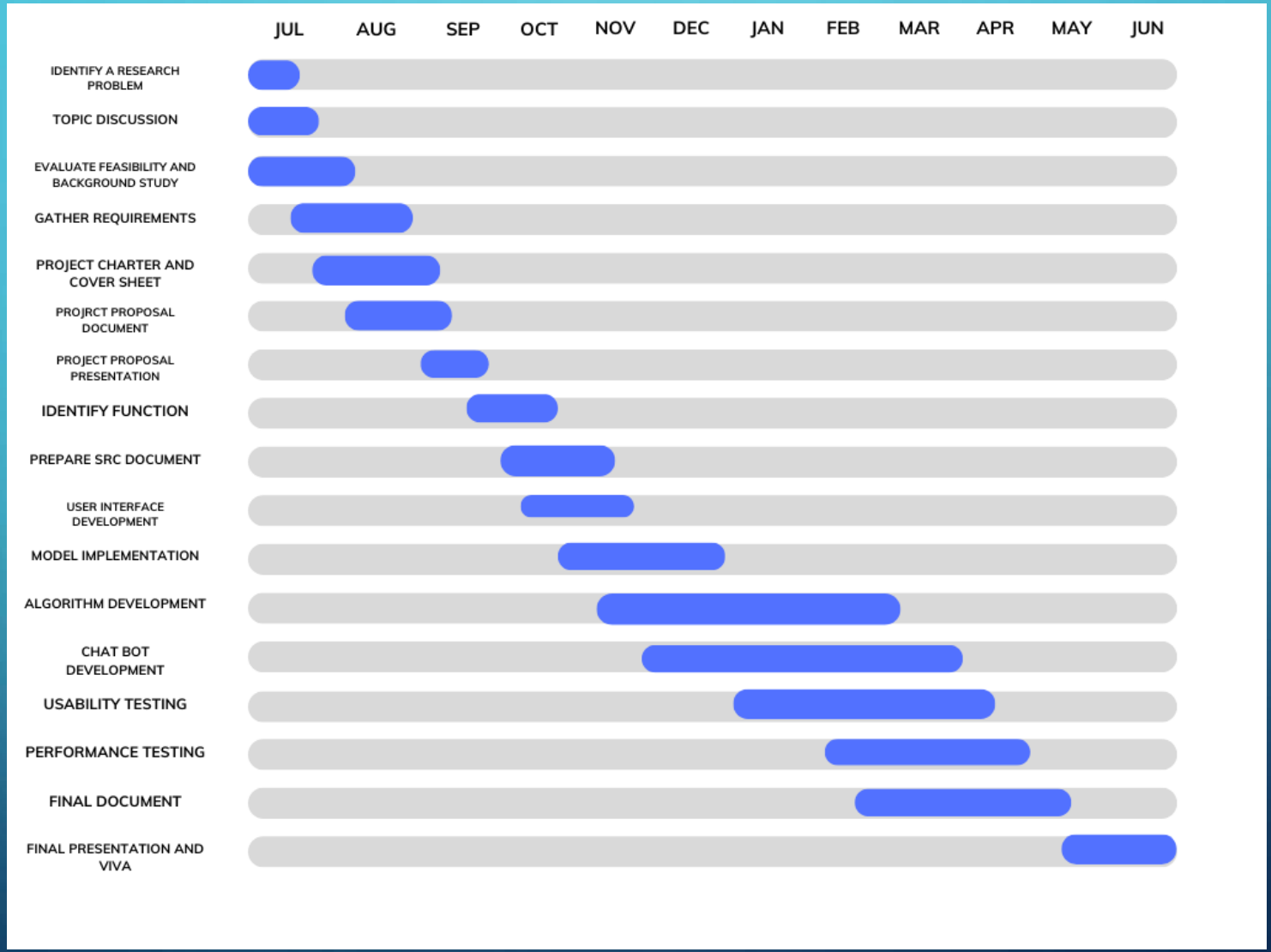
Non-Functional Requirements

- Performance
- Security
- Reliability
- Scalability
- Compatibility
- Performance metrics
- Maintainability
- Usability

WORK BREAKDOWN CHART



GANTT CHART


JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
IDENTIFY A RESEARCH PROBLEM
TOPIC DISCUSSION
EVALUATE FEASIBILITY AND BACKGROUND STUDY
GATHER REQUIREMENTS
PROJECT CHARTER AND COVER SHEET
PROJRCT PROPOSAL DOCUMENT
PROJECT PROPOSAL PRESENTATION
IDENTIFY FUNCTION
PREPARE SRC DOCUMENT
USER INTERFACE DEVELOPMENT
MODEL IMPLEMENTATION
ALGORITHM DEVELOPMENT
CHAT BOT DEVELOPMENT
USABILITY TESTING
PERFORMANCE TESTING
FINAL DOCUMENT
FINAL PRESENTATION AND VIVA

Intelligent Geolocation-based EV Breakdown Assistance with AI based Repair Service Cost Estimation

IT20038328| SIRIMANNA D.J.T.K.

INFORMATION TECHNOLOGY

INTRODUCTION

- System for vehicle breakdown solutions using machine learning and geolocation.
- Connects vehicle owners with registered mechanics for emergency breakdown assistance.
- Allows users to schedule appointments for non-emergency breakdowns or inspections.
- Mechanic rating and feedback system to help users make informed decisions.
- Repair service cost estimation feature to ensure fair pricing and transparency

RESEARCH GAP

- Lack of a comprehensive mobile app that connects vehicle owners and mechanics in real-time.
- Limited use of machine learning and geolocation for quick breakdown solutions.
- Absence of a centralized platform for vehicle repair cost estimation based on market trends.
- Inadequate mechanisms for obtaining user feedback and improving mechanic recommendations.

RESEARCH PROBLEM

- Vehicle owners often face difficulties in finding immediate assistance during breakdowns.
- Mechanics struggle to reach potential customers quickly and efficiently.
- Users lack a reliable source to estimate repair costs and make informed choices.
- Absence of a feedback system hampers the ability to gauge mechanic quality and performance.

SPECIFIC AND SUB OBJECTIVES

Main Objective

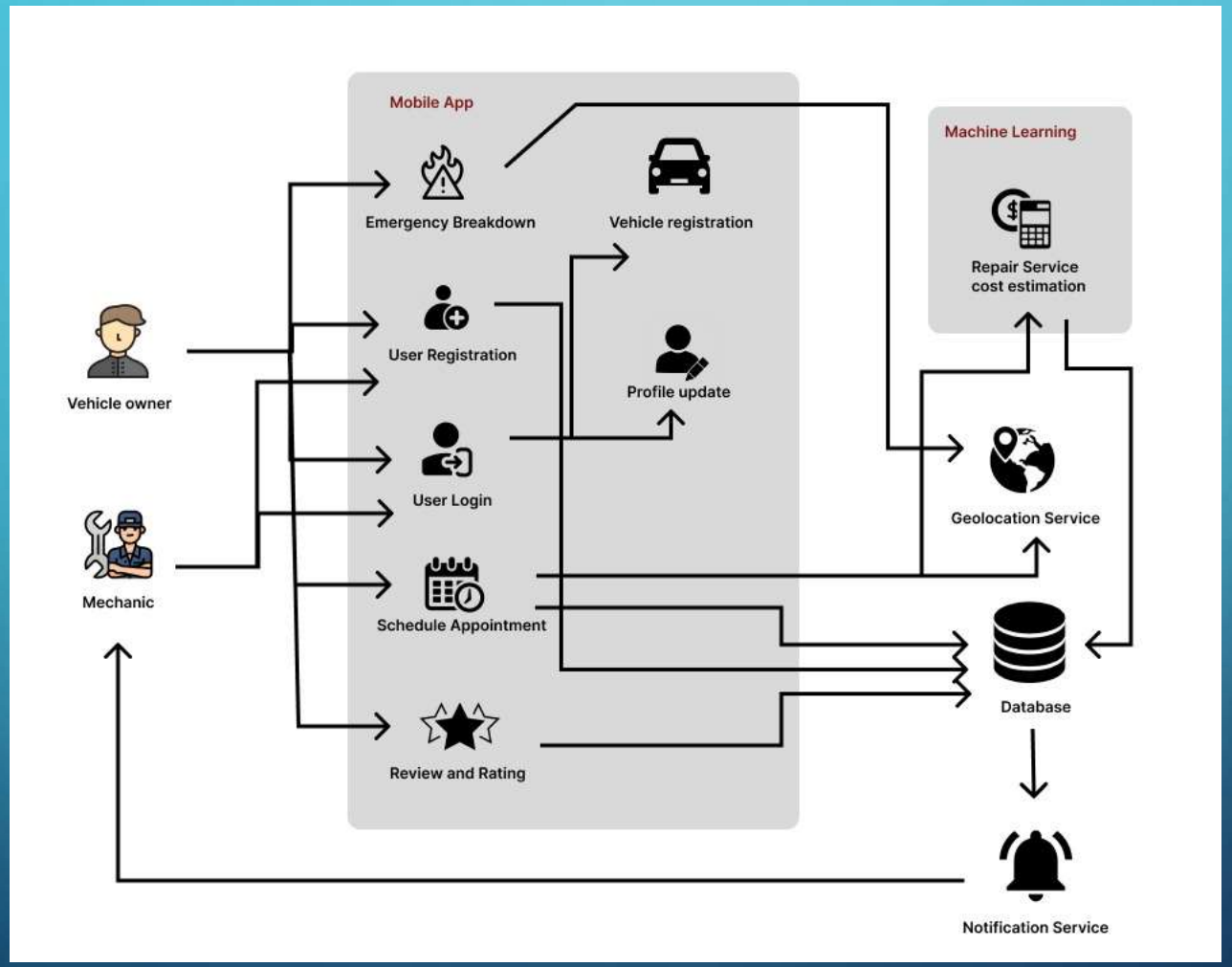
- Create a system that enables vehicle owners to quickly find and connect with suitable mechanics for emergency breakdowns while traveling, and schedule appointments for non-emergencies, while also providing transparent repair service cost estimation.

Sub Objectives

- Implement a geolocation-based system to locate and notify nearby mechanics during emergencies.
- Enable real-time notifications to mechanics based on breakdown type and location.
- Facilitate mechanic acceptance and communication with vehicle owners.
- Provide a seamless appointment scheduling system for non-emergency repairs and inspections.
- Develop a machine learning algorithm to estimate repair service costs, considering current market rates.
- Create a review and rating system to facilitate informed decisions for users and improve the recommendation algorithm.

METHODOLOGY

System Architecture Diagram



TOOLS & TECHNOLOGIES

- Mobile App Development: iOS (Swift) and Android (Java/Kotlin).
- Backend Development: Python, Django framework.
- Geolocation: Google Maps API.
- Machine Learning: Python libraries (e.g., scikit-learn, TensorFlow).
- Database: PostgreSQL.
- User Authentication: OAuth 2.0.
- Cloud Hosting: Amazon Web Services (AWS) or Microsoft Azure.

REQUIREMENTS

Functional Requirements

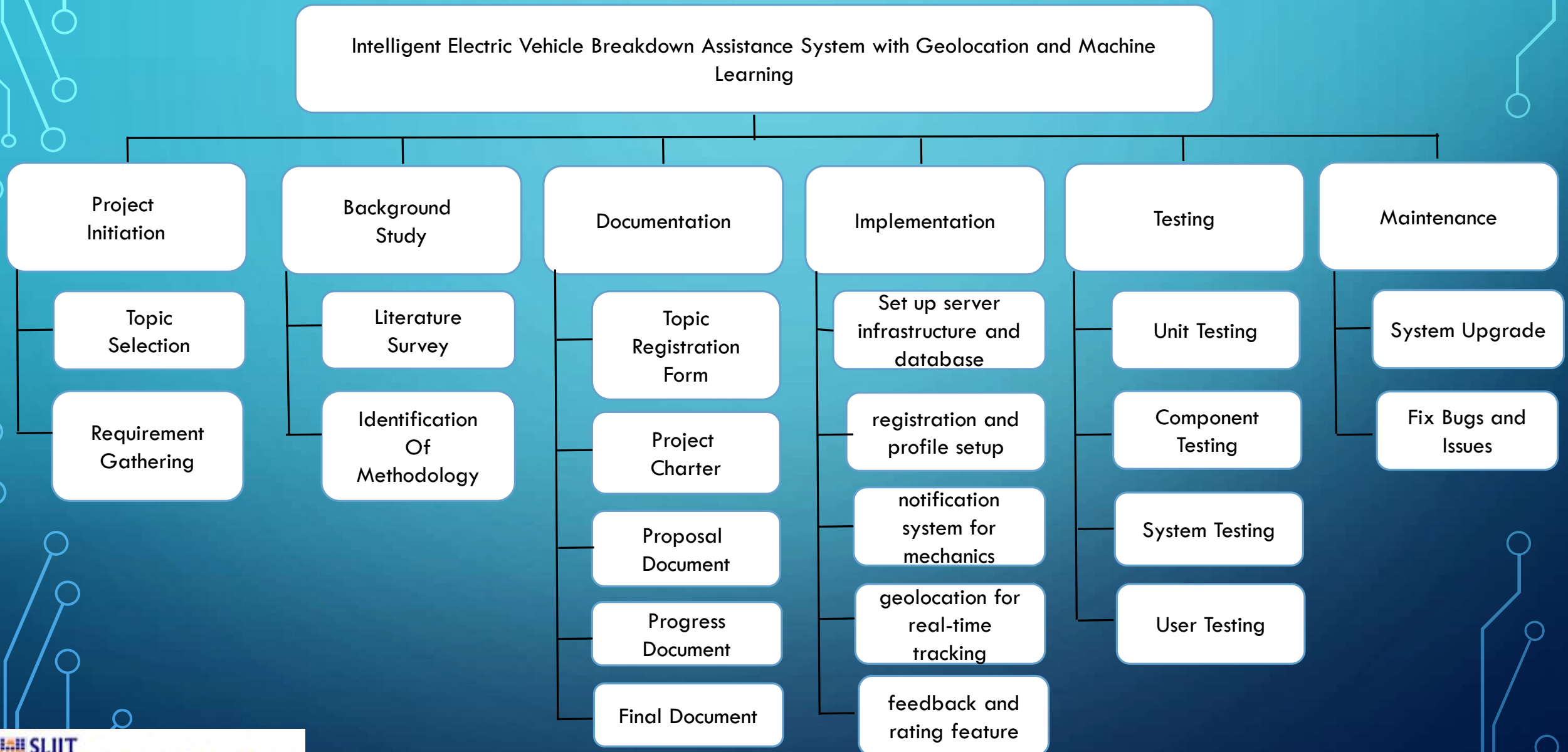
- User registration and profile creation for vehicle owners and mechanics.
- Geolocation services for accurate location tracking of vehicle breakdowns.
- Mechanic skill, location, and fee input during registration.
- Notification system for sending breakdown details to relevant mechanics.
- Appointment scheduling functionality with mechanic/garage selection.
- Real-time market data integration for repair cost estimation.
- Mechanic acceptance/rejection mechanism for service requests.
- Feedback and rating system for users to review mechanics and garages.

REQUIREMENTS

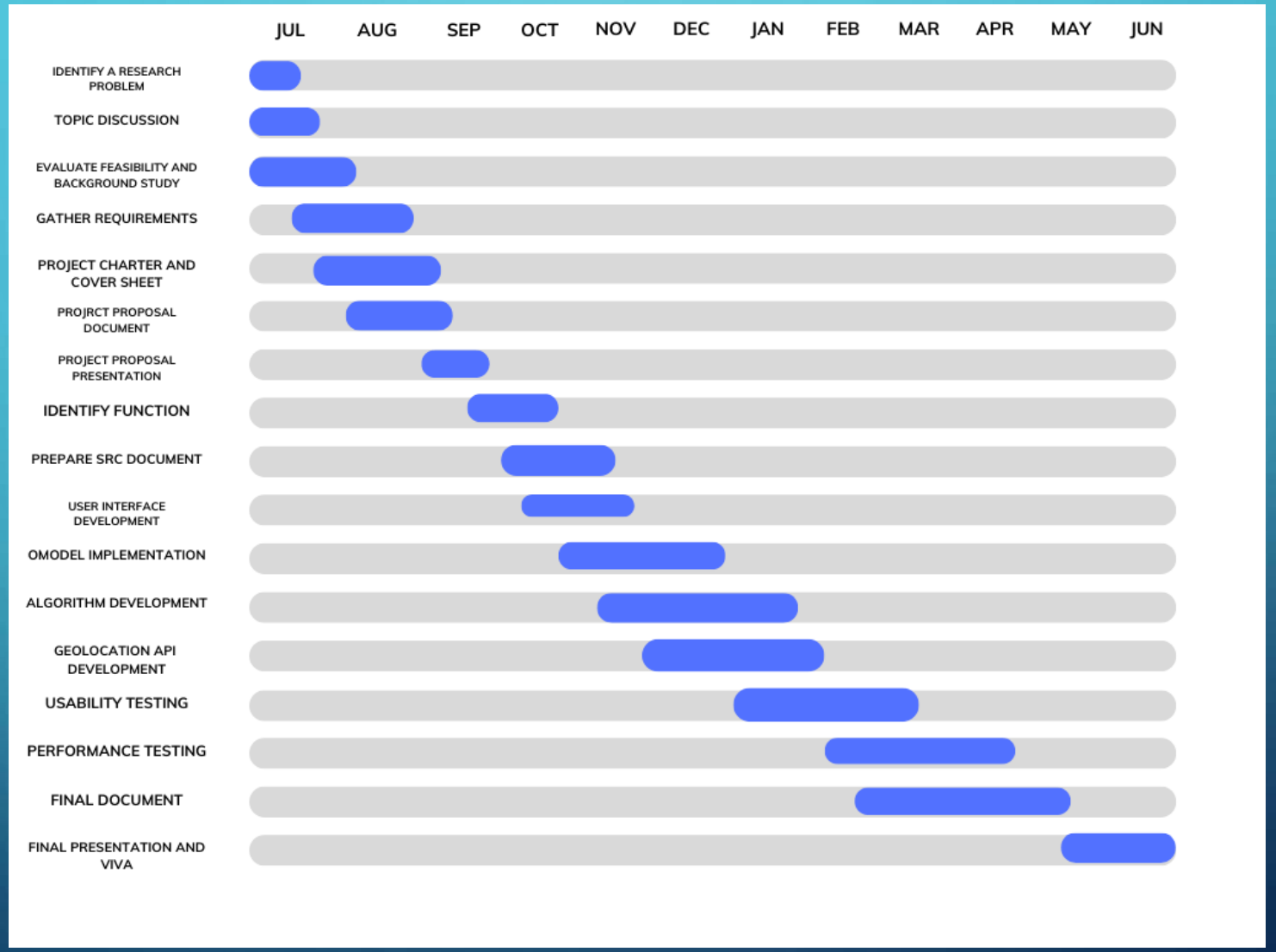
Non-Functional Requirements

- Security: Implement robust data encryption and user authentication mechanisms.
- Performance: Ensure fast response times and smooth user experience.
- Scalability: Design the app to handle a growing number of users and mechanics.
- Reliability: Minimize downtime and system failures.
- Usability: Provide an intuitive and easy-to-navigate app interface.
- Compatibility: Ensure the app works across various mobile devices and operating systems.
- Data Privacy: Comply with relevant data protection regulations to safeguard user information.

WORK BREAKDOWN CHART



GANTT CHART


JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
IDENTIFY A RESEARCH PROBLEM
TOPIC DISCUSSION
EVALUATE FEASIBILITY AND BACKGROUND STUDY
GATHER REQUIREMENTS
PROJECT CHARTER AND COVER SHEET
PROJRCT PROPOSAL DOCUMENT
PROJECT PROPOSAL PRESENTATION
IDENTIFY FUNCTION
PREPARE SRC DOCUMENT
USER INTERFACE DEVELOPMENT
OMODEL IMPLEMENTATION
ALGORITHM DEVELOPMENT
GEOLOCATION API DEVELOPMENT
USABILITY TESTING
PERFORMANCE TESTING
FINAL DOCUMENT
FINAL PRESENTATION AND VIVA

Automated Spare Parts Identification and Location System using Image Processing and Computer Vision Techniques

IT200038182 | MADHUBHASHANA A.G.K.
INFORMATION TECHNOLOGY

INTRODUCTION

- To enhance the convenience and efficiency for electric vehicle owners in finding the right spare parts through image processing and machine learning. By integrating real-time camera functionality, our system allows users to capture photos of the required spare parts.
- These images are then processed using trained machine learning models to accurately identify the parts. The system displays comprehensive details about the spare parts and available shops.
- Through this innovative solution, we aim to empower electric vehicle users with an effortless and reliable method for procuring the right spare parts promptly.

RESEARCH GAP

- Limited Dataset Diversity: Challenge of acquiring diverse datasets with various spare parts in different conditions for training ML models.
- Real-World Accuracy and Robustness: Need for achieving accurate and robust performance in image processing under diverse real-world conditions.
- Integration with Spare Parts Shops: Understanding and overcoming challenges in motivating shop owners to register and maintain up-to-date inventories on the system.
- Privacy and Security Concerns: Addressing user data privacy and implementing robust data protection measures for user trust.
- Scalability and Performance: Optimizing image processing and ML algorithms to handle a growing user base and ensure fast response times.

RESEARCH PROBLEM

- Lack of efficient and accurate solution for spare parts identification for electric vehicle owners through image processing and machine learning.
- Need for an AI-based solution to accurately identify spare parts for repair the vehicles and map the sellers' locations.
- Continual learning and transfer learning techniques can improve accuracy.
- Auto Machine Learning can make the system more accessible for adding new spare parts.
- Therefore, develop an AI-based solution for accurately identifying spare parts and available locations, utilizing continual learning and Auto Machine Learning techniques to improve accuracy and accessibility.

SPECIFIC AND SUB OBJECTIVES

Main Objectives

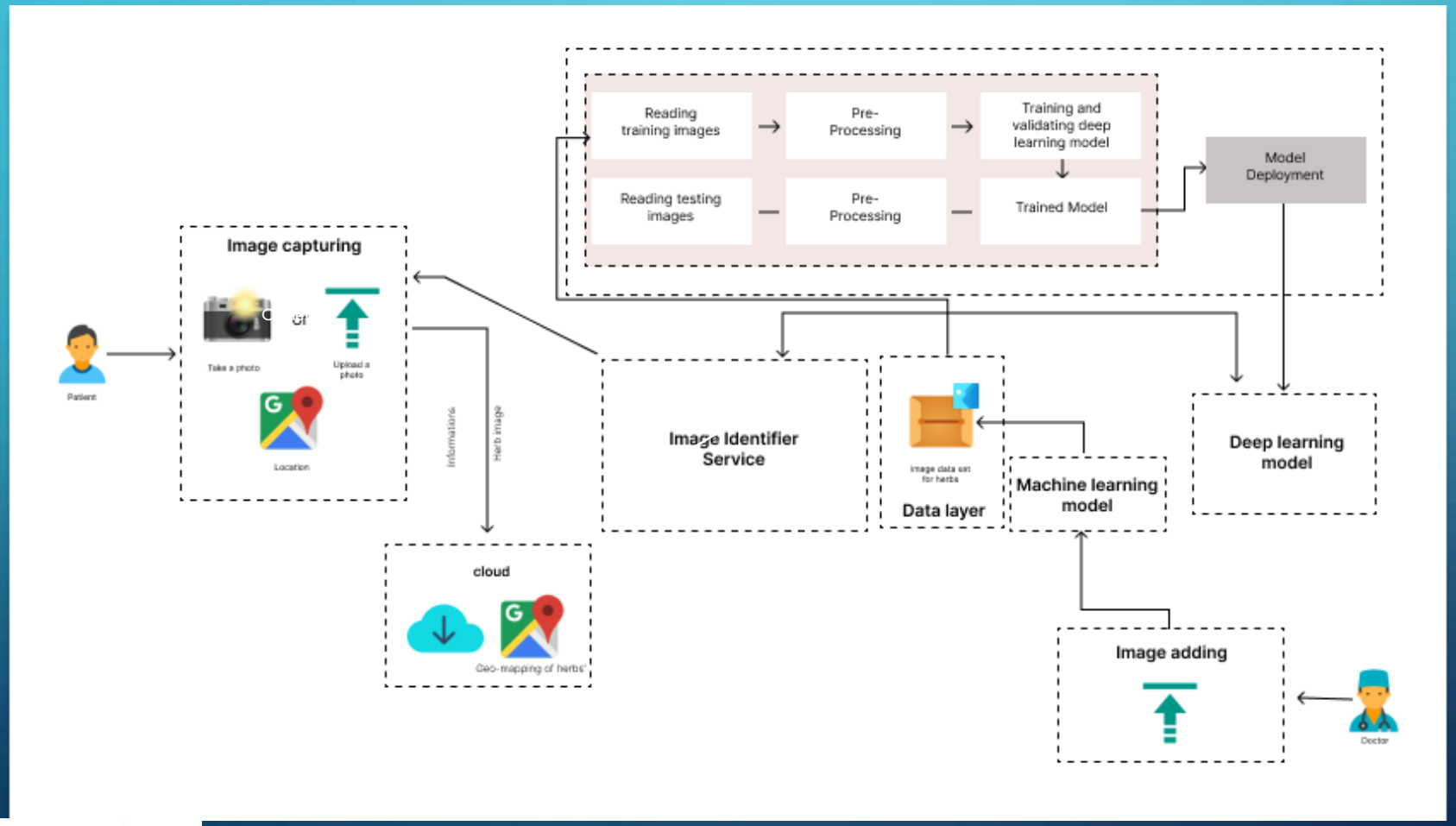
- To provide a comprehensive solution for electric vehicle users, enhancing their ability to handle breakdown situations by identify EV spare parts effectively, improving safety and efficiency on the road.

Sub Objectives

- Pre-processing of the collected images, such as resizing and normalization
- Splitting the data into training, validation, and testing sets.
- Training a machine learning model using pre-processed image data.
- Evaluating the model on the validation set to identify areas of improvement.
- Collecting and processing large amounts of image data to map the shape of spare parts.
- Fine-tuning the model based on the evaluation results.
- Testing the final model on the testing set to measure its accuracy and robustness.

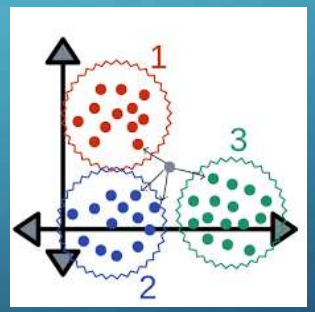
METHODOLOGY

System Architecture Diagram



TOOLS & TECHNOLOGIES

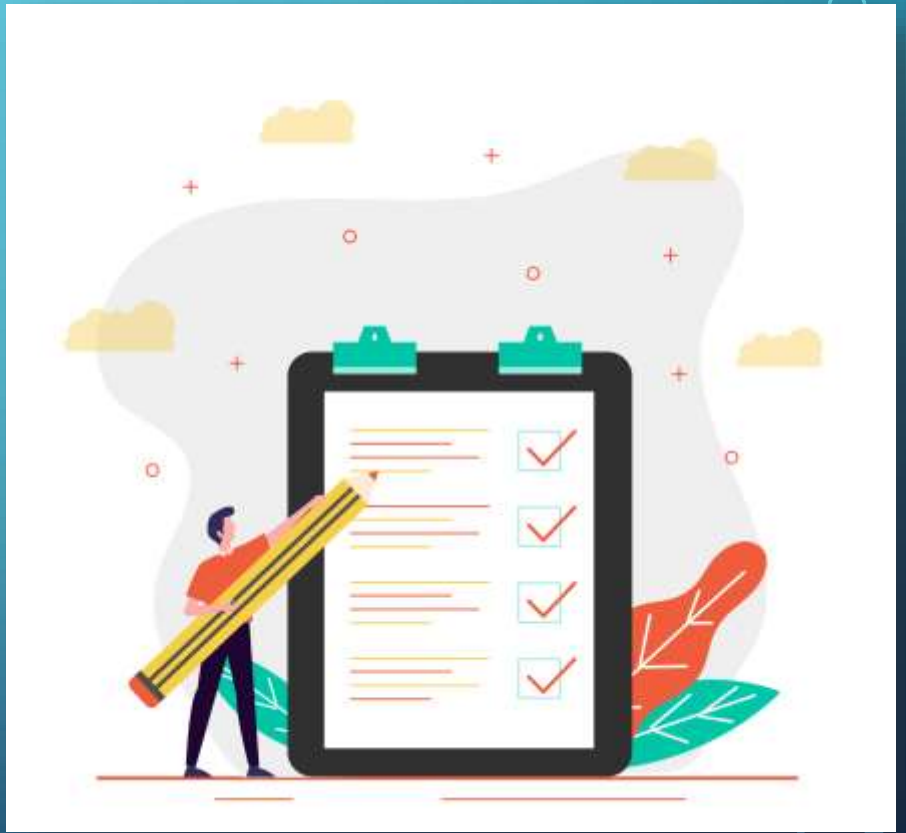
Technology	Techniques	Algorithms	Architecture
• React-native	• Image processing	• K-Nearest	• ResNet
• Expo	• Computer vision	• Naïve bayes	
• Python	• Continual Learning		
• Node Server	• Auto Machine Learning		
Google map			



REQUIREMENTS

Functional Requirements

- Image-Based Spare Parts Identification
- Allow users to capture photos of spare parts using the real-time camera.
- Process the images to identify the type and condition of spare parts accurately.
- Display detailed information about the identified spare parts, including manufacturing details and prices.
- Spare Parts Shop Registration:
- Provide a registration mechanism for spare parts shops to join the system.
- Collect and store shop details, including contact information and inventory.
- Spare Parts Shop Database:
- Maintain an up-to-date database of spare parts and their availability in registered shops.
- Enable seamless integration with registered shops for real-time inventory updates.

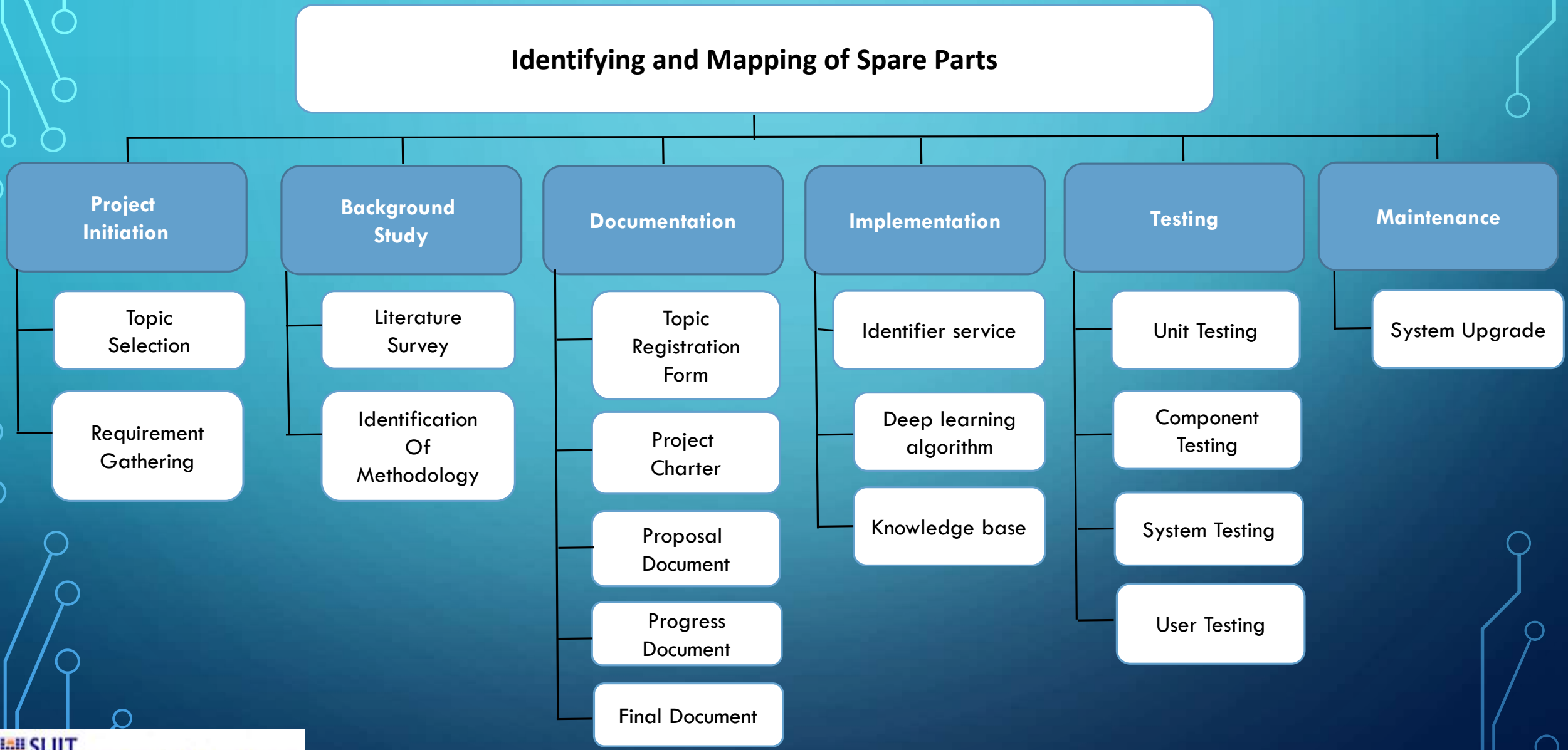


REQUIREMENTS

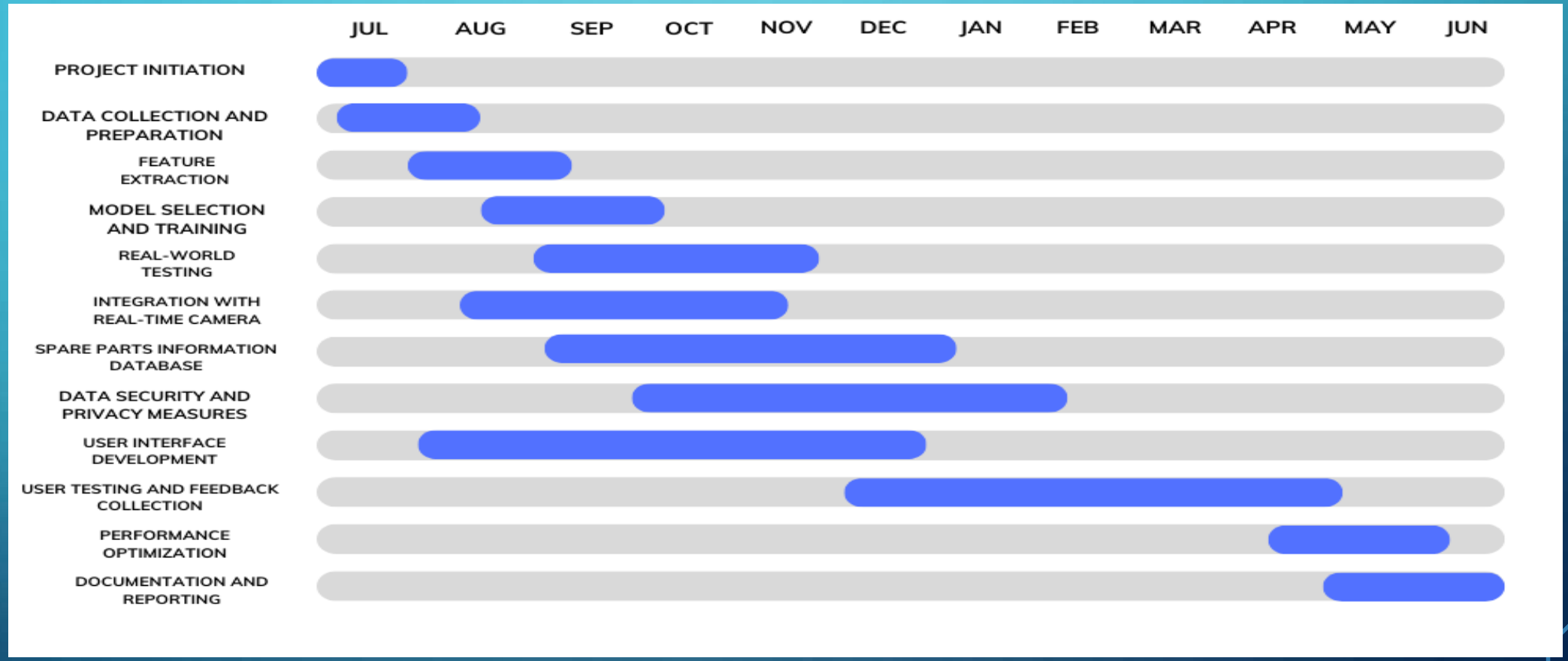
Non-Functional Requirements

- Performance: Able to handle many requests simultaneously, without significant delay or response time degradation.
- Usability: Easy to use and navigate, with clear instructions and feedback provided to the user.
- Reliability: Should be available, with minimal downtime for maintenance or upgrades.
- Security: Should be secure, with appropriate measures in place to protect user data and prevent unauthorized access.
- Compatibility: Be compatible with a range of devices and platforms, be able to operate seamlessly with other software applications.
- Maintainability: The system should be designed and built with maintainability in mind, with clear documentation and easily maintainable code.
- Scalability: The system should be designed to scale up or down as needed, with minimal impact on performance and functionality.
- Regulatory compliance: The system should comply with relevant laws and regulations, such as data protection and privacy laws.

WORK BREAKDOWN CHART



GANTT CHART


JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
PROJECT INITIATION
DATA COLLECTION AND PREPARATION
FEATURE EXTRACTION
MODEL SELECTION AND TRAINING
REAL-WORLD TESTING
INTEGRATION WITH REAL-TIME CAMERA
SPARE PARTS INFORMATION DATABASE
DATA SECURITY AND PRIVACY MEASURES
USER INTERFACE DEVELOPMENT
USER TESTING AND FEEDBACK COLLECTION
PERFORMANCE OPTIMIZATION
DOCUMENTATION AND REPORTING

Enhancing User Experience in Vehicle Maintenance with a Smart Digital Monitoring Calendar and Reminder System

INFORMATION TECHNOLOGY

IT20644826 | VIJERATHNA A.G.V.K.M.

INTRODUCTION

- Why smart digital monitoring Calander providing remainders and recommendations needed?
- What are the drawbacks in traditional approach in vehicle maintenance?
- Importance in smart digital monitoring Calander system.

We know how crucial it is to maintain our vehicles in top-notch condition. **Regular servicing, timely repairs, and accurate record-keeping** play a pivotal role in extending the lifespan of our vehicles and ensuring they run smoothly on the roads. However, the traditional approach to vehicle maintenance can sometimes be **cumbersome, time-consuming,** and prone to oversight. Today, we bring you a holistic and transformative objective that addresses these challenges head-on. Our comprehensive vehicle maintenance **system is designed to empower users with informed decision-making and proactive upkeep,** elevating the way we care for our automobiles to new heights.

INTRODUCTION

key components

- Proactive Monitoring Service
- Record Management
- OCR-Based Bill Capture
- Predictive Algorithms
- Common Issue Identification
- Digital Monitoring Calendar System

Research Problem

- How to avoid breakdowns of Vehicle through proper maintenance and smart digital monitoring Calander system ?

- How to track average maintenance cost based on vehicle type for a period?
- Based on each electric vehicle type how to recognize most occurring issues ?
- How to calculate the time of next service after doing a repair to certain part of a vehicle?

Research Gap

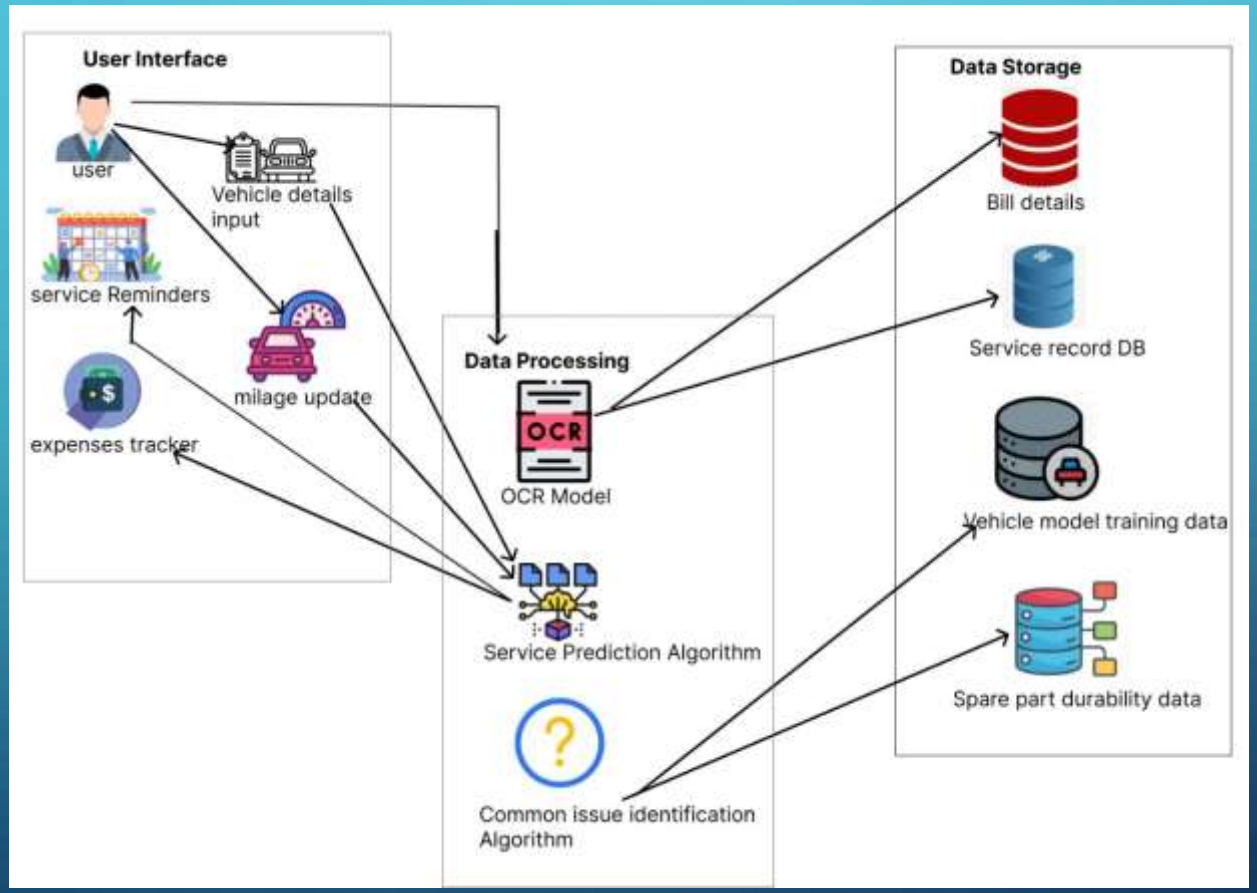
- There is no existing system to track maintenance records and to calculate the maintenance cost through a digital monitoring calendar.
- Lack of personalized maintenance recommendations.
- Limited integration of OCR technology for vehicle maintenance and bill capture.

OBJECTIVES

- Main Objective:
  - **Develop a smart digital monitoring calendar system that revolutionizes vehicle maintenance by offering a comprehensive approach,** integrating proactive monitoring, streamlined service record management with OCR-based bill capture, and identification of common vehicle issues based on historical data.
- Sub Objectives:
  - Research and Data Collection
  - Interface Development
  - Algorithm Development
  - Digital Monitoring Calendar System
  - User Testing and Assessment
  - Software Application Implementation

METHODOLOGY

SYSTEM ARCHITECTURE DIAGRAM



FUNCTIONAL REQUIREMENTS

- User Registration and Vehicle Details Input.
- Users should be able to periodically update their vehicle's mileage.
- Users should be able to upload images of service bills and invoices.
- The system should predict the optimal replacement time for each spare part based on vehicle mileage and historical service records.
- The system should identify common vehicle issues based on historical data and relevant factors.
- Users should be able to input and track maintenance activities, spare part replacements, and relevant data through a digital monitoring calendar.

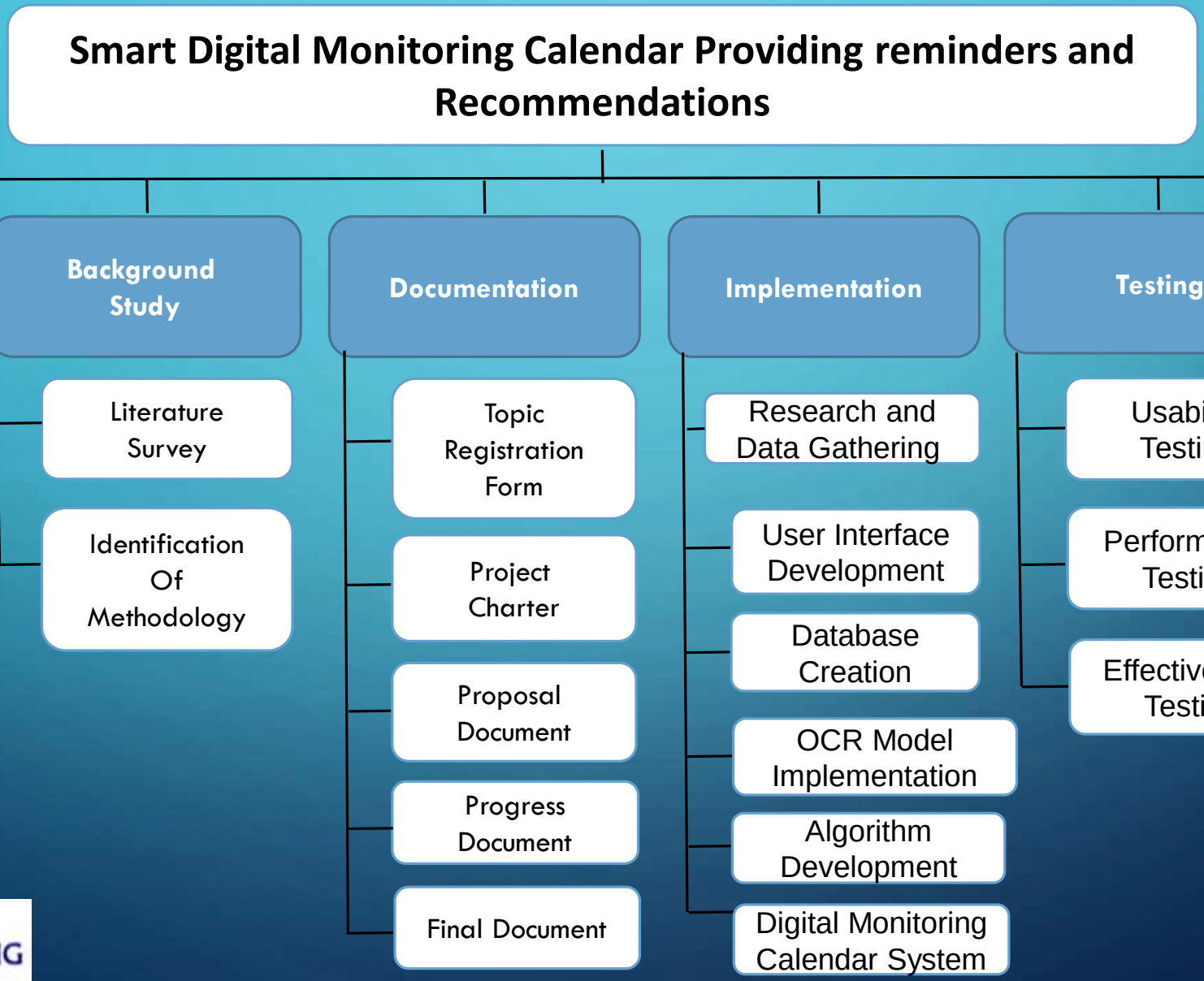
NON-FUNCTIONAL REQUIREMENTS

- Performance
- Security
- Reliability
- Scalability
- Compatibility
- Maintainability
- Usability

TECHNOLOGIES

Technology	Techniques	Algorithms	Architecture
• React	• Image Processing	• Decision Tree	• client-server model
• JavaScript	• Data Scraping	• Optical Character Recognition	
• Python	• Time Series Analysis		
• Node Server	• Machine Learning		

WORK BREAKDOWN CHART



GANTT CHART


JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
IDENTIFY A RESEARCH PROBLEM
TOPIC DISCUSSION
EVALUATE FEASIBILITY AND BACKGROUND STUDY
GATHER REQUIREMENTS
PROJECT CHARTER AND COVER SHEET
PROJECT PROPOSAL DOCUMENT
PROJECT PROPOSAL PRESENTATION
IDENTIFY FUNCTION
PREPARE SRC DOCUMENT
USER INTERFACE DEVELOPMENT
OCR MODEL IMPLEMENTATION
ALGORITHM DEVELOPMENT
DEVELOPING DIGITAL MONITORING CALANDER
USABILITY TESTING
PERFORMANCE TESTING
FINAL DOCUMENT
FINAL PRESENTATION AND VIVA

REFERENCES

[1]M. Monica, "A Car Breakdown Service Station Locator System," INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH, vol. 3, no. 4, pp. 13-16, 2018.

[2] A. Ziebinski, R. Cupek, D. Grzechca, and L. chruszczyk, "Review of advance driver assistance system (ADAS)," DOI: 10.1063/1.5012394, 2017.

[3] K. Haridas, S. Ahmad, Baharudin, Kamal, and karkonasasi, "Automotive Servicing and Breakdown Assistance System (ASBAS): Impact of Perceived Ease of Use (PEOU)and Vehicle Breakdown Servicing Necessity (VBSN) on Vendor's Intention to Adopt ASBAS," 2016.

[4] A. Kumaar, Balakrishna, S. Subha, and K. Harin, "On Road Vehicle Service finder," 2019.

[5] Road Assistance System using GPS, "International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT)."

[6] W. Wang, H. Chen, and M. Bell, "Vehicle Breakdown Duration Modelling," 2005.

[7] S. Zhang, G. Wang, M. Z. A. Bhuiyan, and Q. Liu, "A Dual Privacy Preserving Scheme in Continuous Location-Based Services," IEEE Internet of Things Journal, May 2018.

[8] R. Schlegel, C.-Y. Chow, Q. Huang, and D. S. Wong, "Privacy-preserving location sharing services for social networks," IEEE Trans. Services Comput., vol. 10, no. 5, pp. 811-825, Sep./Oct. 2017.

[9] J. Hua, W. Tong, F. Xu, and S. Zhong, "A Geo-Indistinguishable Location Perturbation Mechanism for Location Based Services Supporting Frequent Queries," IEEE Transactions on Information Forensics and Security, 2018.

[10] A. LaMarca and E. de Lara, "Location Systems: An Introduction to the Technology Behind Location Awareness," 2008. Book Publisher: Morgan & Claypool.