ADA University, School of Information Technology and Engineering

Senior Design Project

FINAL REPORT

SıgortaHub (SığortaHub)

Murad Huseynli
Hajar Naghiyeva
Saida Zarbiyeva
Anar Bayramov

Supervisor: Assistant Professor, Jamaladdin Hasanov

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ABSTRACT

The traditional car insurance claim and repair processes in Azerbaijan are fraught with inefficiencies that prolong the post-accident recovery period, creating frustration and operational delays. SigortaHub is a groundbreaking digital platform designed to address these issues by digitalizing the entire claims cycle, from accident reporting to repair management. This platform enables car owners to submit accident reports swiftly, facilitates a competitive bidding environment for repair services, and integrates seamlessly with existing insurance protocols. With its introduction, SigortaHub aims to significantly reduce response times, enhance service quality, and improve customer satisfaction. The project is distinctively tailored to meet local market needs, positioning it as a pioneering solution in Azerbaijan's insurance sector.

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1. INTRODUCTION

1.1 Definition

Addressing the inefficiencies inherent in traditional car insurance claim handling and repair processes in Azerbaijan is the cornerstone of our initiative. The current approach makes car owners often suffer from the annoying wait after an accident. They need to arrange for an insurance agent to come out, assess the damage, and then begin the long process of getting repair approvals and settling claims. There is an obvious need for our comprehensive digital solution SigortaHub that enhances transparency and expedites the entire claims cycle. Our digital and optimized system eliminates these inefficiencies and delays to improve the claim handling process and make it more efficient for all parties involved: the insurance company and its agents, the car repair company and its agents, and the insured customers.

1.2 Purpose

The primary purpose of our SigortaHub project is to streamline and enhance the efficiency of the car insurance claims and repair process, firstly, in Azerbaijan through the implementation of a robust digital platform. This platform is designed to automate the traditionally manual and time-consuming tasks associated with post-accident procedures, from initial reporting and damage assessment to repair management and final claim settlement. By digitalizing these processes, we aim to significantly reduce the wait times for car owners, facilitate competitive and transparent service biddings from repair companies or persons, and integrate seamlessly with existing insurance protocols to ensure swift and effective claims handling. This initiative will not only improve the overall customer experience but also drive operational efficiencies for insurance and repair companies.

1.3 Project Objectives, Significance, Novelty

Project Objectives

The objectives of our SigortaHub project include:

1. Bringing Claim Handling and Repair Processes into the Digital Era: Our objective is to develop an intuitive application that transforms the car repair and insurance claims landscape in Azerbaijan, enabling digital reporting, assessment, and repair management.

2. Minimizing Response and Repair Times: We aim to significantly reduce the waiting time from the initial accident report to the completion of the car repair.

3. Introducing a Competitive Bidding Environment: We want to establish a transparent platform that invites multiple repair shops to submit bids, granting insurance companies the autonomy to select services based on a variety of vital factors, such as repair quality, as well as cost and time efficiency.

4. Ensuring Seamless Insurance Integration: Our objective is to create a system that integrates flawlessly with existing insurance company protocols, ensuring rapid claims processing and prompt repair commencement.

Significance

This project targets the protracted and cumbersome nature of the post-accident car insurance claim handling process and repair workflow. Currently, this involves a drawn-out cycle of evaluations by insurance agents, obtaining multiple repair company quotes, and extensive back-and-forth communication, all of which contribute to a stressful and inefficient experience.

By introducing a digital platform, our project seeks to revolutionize these processes. Designed to expedite and simplify the claims and repair cycle, it benefits individual car owners by reducing the time and frustration traditionally associated with such experiences. Insurance companies will see improved efficiency in claims processing, and car repair businesses will be provided with an expanded customer base, fostering a transparent and competitive marketplace.

The primary beneficiaries of SigortaHub are car owners who will experience a more streamlined process following an accident, insurance companies who will realize operational savings and customer satisfaction improvements, and car repair businesses that will gain increased visibility within the market. Ultimately, our platform is set to redefine the integration of technology within the insurance and vehicle repair industries, heralding a new era of digital-led customer service.

Novelty

For our project, the novelty lies in creating a localized, comprehensive system SigortaHub that integrates all stakeholders—insurance companies, repair companies, and customers—in Azerbaijan, tailored to the specific market needs and regulations. Even though we have Lemonade as our competitor in the global market, there is not any company or product doing what we are planning to implement in the local market.

1.4 Problem Statement

In the traditional car insurance claim and repair landscape in Azerbaijan, customers frequently endure prolonged and frustrating delays following an accident. The process typically involves waiting for insurance agent assessments, securing repair approvals, and navigating a complex network of communications among multiple parties. These inefficiencies lead to significant time wastage and customer dissatisfaction. Moreover, the lack of a centralized digital system results in vague procedures and inconsistent service quality. There is a clear need for our comprehensive digital solution SigortaHub that addresses these challenges by digitalizing the entire claims and repair cycle, thus providing a streamlined, transparent, and efficient service that benefits all stakeholders involved in the post-accident recovery process.

2. LITERATURE REVIEW

The insurance sector is undergoing a significant transformation driven by digitalization, significantly impacting how companies interact with customers and manage operations. This shift is necessitated by the evolving customer expectations for faster, more transparent, and responsive services. Digital transformation in insurance, particularly in car insurance claim handling, is reshaping the landscape by introducing advanced technologies that streamline processes and enhance customer satisfaction (Deloitte, 2021; McKinsey, 2024).

Digital Technologies and Their Impact on Car Insurance Claims

The adoption of digital technologies in car insurance claims processing is marked by the integration of various innovative solutions. These include AI, machine learning, automation, and smart analytics, which collectively contribute to the automation of routine tasks, enhancement of data analytics capabilities, and acceleration of service delivery. Such technologies facilitate real-time data processing and claims tracking, significantly reducing the time from claim initiation to resolution. This shift not only improves operational efficiency but also affects core aspects of customer interactions and claims management (Arxiv, 2022; EY, 2023; BCG, 2024).

Enhancing Customer Experience through Digital Channels

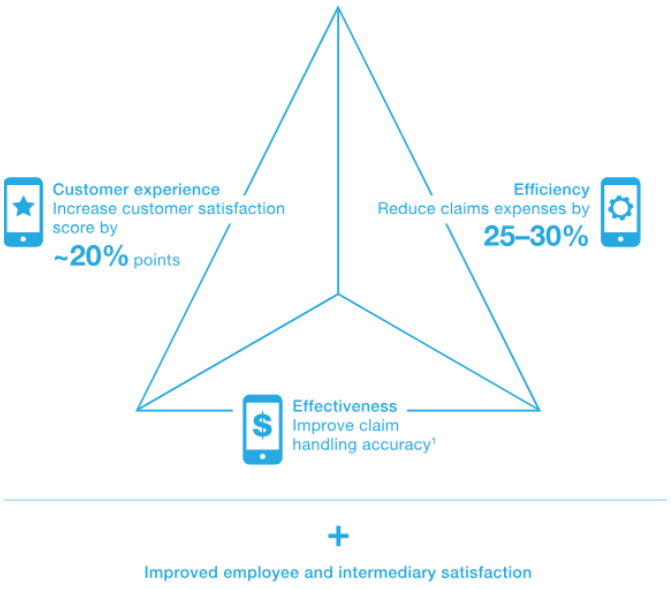
Digital channels are crucial in modernizing customer interactions. They offer platforms for instant communication and provide tools for customers to manage their claims autonomously. This level of self-service capability, supported by real-time updates provided via mobile apps and online dashboards, fosters a sense of control and transparency among policyholders, thereby enhancing trust and satisfaction (Emerald Insight, 2022).

Regulatory Challenges and Data Security

As digital adoption deepens, regulatory compliance and data security emerge as significant challenges. Insurance companies must navigate a complex landscape of global and local regulations regarding data protection and privacy. Implementing robust cybersecurity measures is crucial to safeguard sensitive customer information and maintain compliance with these regulations (EPAM, 2023).

Competitive Advantage in the Digital Era

Companies that effectively leverage digital technologies can gain significant competitive advantages. These include improved efficiency, cost reduction, and the ability to offer tailored insurance products that meet the specific needs of different customer segments. However, maintaining this competitive edge requires continuous innovation and adaptation to rapidly changing technology trends (McKinsey, 2024).



Future Trends and Innovations

Looking forward, the insurance industry is poised to adopt more sophisticated technologies such as blockchain, advanced predictive analytics, and Internet of Things (IoT) integration. These technologies promise to further enhance claim processing efficiency, improve the accuracy of risk assessment, and reduce fraud. The future of car insurance claims will likely be characterized by an even greater reliance on technology to drive decision-making and customer engagement (IJARCCE, 2022).

Research Gap in the Industry

Despite significant advancements, a critical gap remains in the broad integration of digital solutions tailored to local markets, particularly in developing regions. Many existing digital innovations in car insurance claims management primarily target large, established markets, often neglecting the unique regulatory and operational needs of smaller markets. This oversight provides a unique opportunity to develop and implement digital solutions that are specifically designed to meet local requirements and can later be adapted for global scalability.

Proposed Solution and Its Novelty

Our project seeks to address this gap by developing a comprehensive digital system for car insurance claim handling that is initially focused on the Azerbaijani market. While our system includes features, such as automated data processing and enhanced user interfaces for claim submissions, the emphasis is on creating a platform that integrates all key stakeholders—insurance companies, repair companies, and customers—into a streamlined, efficient workflow. This integration is designed to improve operational efficiency and customer satisfaction by making the claims process more transparent and accessible. The project's novelty lies in its localized approach, which considers the specific regulatory and market conditions of Azerbaijan. By tailoring our solution to fit these local needs, we aim to provide a proof of concept that can be adapted and scaled to other markets, addressing similar gaps worldwide. This strategy ensures that the technology is robust and versatile enough to handle various global market demands once it is ready for broader deployment. The digital transformation in car insurance claim handling represents a dynamic journey that is reshaping the landscape of the insurance industry by integrating comprehensive digital solutions designed to meet specific local needs. This strategic focus not only addresses significant gaps in current market offerings but also enhances the industry's capability to adapt to broader trends within the financial services sector. By positioning our project at the forefront of these transformations, we set the stage for future scalability and global market penetration. The successful implementation of such innovative solutions could serve as a model for similar initiatives in other regions, potentially revolutionizing car insurance claim handling worldwide. Insurance companies that embrace these changes and continuously invest in technology, focusing on customer-centric innovations, are best positioned to utilize emerging opportunities and meet future challenges. This approach is key to achieving long-term success in an evolving landscape, ensuring that the industry remains resilient and responsive to the needs of its customers.

3. DESIGN CONCEPT

3.1 Alternative Solutions/Approaches/Technologies

Traditionally in Azerbaijan, when a vehicle is damaged, the insurance claim process involves several steps that are both time- and resource-consuming. Initially, the insurance company sends its employees to physically inspect the damage to the vehicle. This manual process is necessary to estimate the repair costs. Then the insurance company employee prepares a report that is used to process the claim. This process not only requires a large number of workers, but it also costs money for travel and slows the process of claims. Moreover, the evaluations are frequently arbitrary and can differ greatly among adjusters, which causes irregularities in the way claims are handled and discontent among clients.

Digital Solutions

Comparing SigortaHub with other digital solutions in the insurance sector, most platforms focus primarily on simplifying the claim filing process. For example, certain applications let users submit pictures of the damage, which insurance professionals can examine from a distance. Nevertheless, a bidding system is usually not supported by these platforms. Without competitive bidding, insurance companies might still rely on a limited network of repair shops, which will potentially lead to higher costs. Additionally, current systems frequently lack the comprehensive tracking of the repair process and real-time updates that are essential for improving customer satisfaction and transparency. Additionally, we are planning to implement the functionality of automatic car damage assessment (repair price regression utilizing computer vision and deep learning). To that end, insurance firms that cooperate with SigortaHub's platform will work together to improve the machine learning model's capabilities. These businesses will be urged to submit images of the cars before damage, along with the associated expenses of repairs. With a more complete dataset for AI model training, this data will offer a useful starting point for comparing the pre- and post-accident conditions of automobiles. Insurance firms that cooperate with SigortaHub's platform will work together to improve the machine learning model's capabilities. These businesses will be urged to submit images of the cars before damage, along with the associated expenses of repairs. With a more complete dataset for AI model training, this data will offer a useful starting point for comparing the pre- and post-accident conditions of automobiles.

In addition to that, the AI algorithms will be continuously improved with the help of the repair cost data (labeling and supervision) and photographs that are sent to the system from active claims. The model's accuracy will be improved through this iterative improvement process, thereby increasing the dependability of the automated evaluations.

The AI's predictive powers will advance with the size of the database, lowering errors in cost and damage assessment and significantly streamlining the claims handling process.

SigortaHub makes sure that the system adapts to changing car models, repair methods, and cost fluctuations by continuously adding fresh data to the model. This helps the system stay accurate and relevant in the ever-changing automotive and insurance landscape.

3.2 Detailed description of Solutions/Approaches/Technologies of choice

SigortaHub's main interface is a user-friendly iOS mobile application (developed) and Android (yet to develop), designed to provide a seamless experience for iOS and Android users. This platform allows the submission of insurance claims through photos and lets users monitor the progress of their claims in real time.

Users of the software can post high-quality photos straight from their iPhones because this method allows for batch uploads, users can take pictures of the damage from different perspectives for a more thorough evaluation. Users get notifications that update them on the status of their claims, enhancing user engagement and keeping them with up-to-date information each time they enter the app. This interface where users can view their accident reports, compare prices, and select repair bids from a list of rated repair shops, promotes transparency. For the backend, Django, a high-level Python web framework, is selected to fulfill the data processing, security, and API requirements of the application. This solid architecture facilitates both efficient development and clear, practical design. Django is ideal for handling sensitive insurance data and user transactions. It provides secure user authentication, data protection, and scalable app management. Creating APIs that mobile apps may use requires the use of the Django REST framework. These APIs enable seamless data flow and functionality by facilitating interactions between the server and the iOS mobile interface (which has been developed). User data, claim records, and bid information may be efficiently stored and retrieved thanks to Django's ORM (Object-Relational Mapping), which allows for smooth database operations.

Applying PostgreSQL as the database management system provides a powerful, open-source solution that supports complex queries, large datasets, and transactional integrity, which are essential for handling diverse data types and volumes generated by SigortaHub.

3.3 Engineering Standards

SigortaHub developers follow established engineering standards to guarantee the software's performance, security, and dependability. The IEEE Software Engineering Standards and the guidelines for RESTful APIs are the two main sets of standards that have been thoroughly followed and utilized throughout the development process. These standards serve as the reference point for SigortaHub's implementation. SigortaHub guarantees excellent quality and dependability throughout the whole software development process, by adhering to these criteria, from original planning and design to deployment and maintenance. In addition to this, throughout the whole project development process, we have been following an Agile-based software development methodology, Scrum. As such, all the steps of the software development life cycle (SDLC), such as requirement analysis, design, development, testing, and maintenance, are completed following this approach. The IEEE standards help in organizing the development process to avoid typical mistakes, such as scope creep, underestimating the required resources, and problems with the scalability and maintainability of software. Additionally, these guidelines guarantee comprehensive and methodical software testing with the goal of finding and resolving defects early in the development cycle, improving the application's overall stability and usability.

SigortaHub's backend makes use of RESTful API concepts to provide efficient communication between the server and the mobile interface. The architectural paradigm known as REST, or Representational State Transfer, utilizes a stateless communication protocol, usually HTTP, to facilitate simple and effective scaling of client-service interactions. The modular, scalable, and maintainable design of SigortaHub's APIs is achieved by following REST principles. Updating and maintaining the backend services is made easier by their modularity, which permits autonomous development and upgrades without impacting the mobile interface side. Statelessness, which reduces the requirement for the server to keep track of user sessions, allows for scalability by ensuring that every request from the client contains all the information required for the server to process that request. Furthermore, RESTful APIs are known for their dependable and quick performance which are critical to the responsive functioning of mobile applications, such as our SigortaHub. In addition to ensuring that developers can readily understand and utilize the API, the usage of standard HTTP methods, such as GET, POST, PUT, and DELETE also promotes best practices in API creation and integration.

Through the incorporation of these technical principles into its development process, SigortaHub guarantees a high degree of customer satisfaction by offering a reliable, effective, and easy-to-use application, while also improving its operational excellence. In order to create a dependable and secure platform that satisfies user demands and maintains its competitiveness in the quick-paced world of mobile applications, a dedication to quality standards is essential.

3.4 Research Methodology and Techniques

During the early phases of SigortaHub's development, an extensive amount of research was done to comprehend the state of the market and to identify the unique requirements and problems faced by end users and insurance companies. The application's functionality and design were greatly influenced by this research, which helped to guarantee that it adequately addressed the difficulties encountered by all parties involved in the insurance claims processing ecosystem.

Our team carried out an extensive review of the procedures and systems that insurance companies now use to handle insurance claims. To perform this analysis, the software solutions, procedures, and techniques currently in use by insurance firms to evaluate car damage, project repair costs, and handle claims were examined. Finding gaps, inefficiencies, and pain points in the current procedures was the goal of gathering important information for the SigortaHub development. Through comprehension of the weaknesses of the existing systems, the team created a solution that improved the workflow for processing claims while addressing these shortcomings. Our team conducted stakeholder interviews with employees from different insurance organizations in addition to conducting market analysis. First-hand knowledge of the real-world difficulties and problems encountered during the claim's adjustment procedure was gained from these interviews. The team was able to acquire important insights into the particular problems, and inefficiencies in the claims processing workflow. These perceptions had a pivotal role in molding the features and structure of SigortaHub, guaranteeing that it successfully tackled the practical requirements and difficulties encountered by insurance firms in their daily activities.

3.5 Architecture, Model, Diagram description

Presentation Layer (Currently, iOS; Android will soon be deployed as well)

An iOS application (Android application soon as well) is used to implement SigortaHub's presentation layer and functions as the main user interface. The Android version will also be available soon. To ensure that users can explore and interact with the app with ease, this layer has been carefully built for accessibility and usability. It has an easy-to-use design that is both clear and intuitive, making for a seamless and enjoyable user experience (insured and uninsured customers and car repair company employees). All user interactions are managed by the iOS app (Android soon as well), from inputting information, such as pictures of vehicle damage to getting updates on the status of claims and repair estimates. It uses HTTPS to transport data securely and encrypt all user data during transmission while interacting with the backend server through secure RESTful APIs.

Layer of Logic (Django Backend)

The logic layer, which is powered by Django, is the backbone of the application. It processes data and applies the business logic necessary to enable SigortaHub's primary capabilities. To validate data, make decisions, and carry out operations based on user inputs and interactions obtained from the display layer, this layer is essential. manages all company policies and choices, including authorizing users and controlling user sessions. controls the data flow between the presentation layer and the data layer by processing requests from the iOS app (Android soon as well) and responding with the appropriate information.

Data Layer (PostgreSQL)

All application data is safely stored and managed by the data layer using PostgreSQL, a strong and capable relational database management system. This configuration, which is managed by Django's Object-Relational Mapping (ORM), enables sophisticated queries and effective data handling, both of which are necessary for SigortaHub's dynamic and data-intensive activities. Additionally, large amounts of data are safely kept, such as user profiles, claim information, car photos, repair estimates, and various logs (e.g., transactions).

Cloud-Based Systems

Contabo's cloud services are utilized by SigortaHub for hosting and infrastructure management. This option offers a scalable, dependable, and reasonably priced way to implement the application. The strong server solutions provided by Contabo provide the high availability and scalability requirements of contemporary applications. The application and database are hosted on Contabo's servers, which guarantee continuous system uptime and accessibility. Additionally, resources can be easily scaled to meet variations in demand, such as higher loads during periods of high insurance claims, thanks to the cloud architecture.

3.6 Economic analysis

SigortaHub aims to bring innovation and disruption to the traditional insurance industry by bringing novelty concerning functionality and user experience. Strategic analysis helps to understand the competency-based positioning of SigortaHub.

Strength: Core strength is about bringing a wave of innovation to the traditional insurance claim industry. Firstly, enhanced user experience designed towards iOS users (already developed application) and Android users (yet to develop) enables smooth functionality and higher user satisfaction. Additionally, the usage of cutting-edge ML algorithms

helps to harvest the power of predictive technologies which will automate the claim procedure. Additionally, robust technological infrastructure incorporating using of an innovative tech stack coupled with the usage of cloud technologies with strong security guarantees a distinct advantage over existing solutions.

Weakness: Currently, the app is being deployed and served to iOS users only, thus, limiting the market where Android users are staying out of access. Additionally, technology adoption across the traditional insurance industry will require some time to convince the industry players to embrace the new technologies. Also, usage of the latest ML technologies would require some degree of oversight and maintenance which will put pressure on the cost side.

Opportunity: Possible expansion into the Android market will widen the customer pool which together with rapid geographic expansion into neighboring regions will boost the long-term presence of SigortaHub. Additionally, ongoing advancements in AI will provide the app with positive leverage which can be harnessed to improve the functionality of the app further. On top of it, incorporating other types of insurance claims can significantly boost the product coverage of SigortaHub.

Threats: The biggest threat can be when big industry players take action to build their in-house solutions by leveraging their existing industry footprint and know-how. Additionally, economic conditions will put pressure when it comes to the movement within and innovation across the insurance industry. Furthermore, reliance on 3rd party solutions can put the business model and technological ecosystem in jeopardy.

3.7 Social and environmental impact

Social Impact

The improvement of the insurance claim processing user experience is the main social benefit of SigortaHub. The software makes the process of filing and settling claims much faster by digitizing and streamlining it. This effectiveness builds a higher degree of trust between insurance businesses and their clients in addition to improving consumer happiness. SigortaHub brings a level of transparency that is both welcome and essential in a sector that is sometimes chastised for its cumbersome and opaque procedures.

In addition, handling auto accidents can be extremely distressing for people. Typically, this tension can be increased by the additional strain of a drawn-out and intricate insurance claim procedure. SigortaHub relieves these stresses by offering a simple and quick claim-handling process. Customers' worries are calmed by the ease with which they can submit pictures of the damage and get updates on the status of their claims. Enhancing the customer experience has a significant effect on users' general well-being in addition to increasing client retention rates.

Environmental impact

SigortaHub has environmental advantages that are just as noteworthy. The platform eliminates the need for insurance adjusters to physically visit the scene of an accident, hence reducing the need for physical travel. This cut in travel not only cuts operating expenses but also significantly reduces carbon emissions related to the claims procedure. These advancements are consistent with international efforts to mitigate climate change in a world where carbon footprints are becoming more and more noticeable.

Furthermore, because SigortaHub is digital, every step of the claims process—from submitting a claim to receiving the final settlement—can be completed online. Because it minimizes trash creation, paper consumption, and the insurance industry's total environmental impact, this move away from paper-based operations is beneficial for environmental sustainability. SigortaHub helps the larger environmental objective of lowering deforestation and pollution related to paper production and disposal by encouraging digital transactions and records.

4. IMPLEMENTATION

4.1 Hardware Design

Hardware for Insurance Companies

Specification: Insurance companies require high-performance computers capable of running the administrative interface efficiently. These computers should have adequate processing power, memory, and storage to handle the database operations, user interface functionalities, and communication processes smoothly.

Rationale: Insurance employees need reliable and fast computers to manage a wide range of administrative tasks including adding, deleting, or updating insurance policies, creating and tracking accident bids, and managing comprehensive documentation. A robust system ensures they can handle these tasks without system lags, ensuring efficiency and accuracy in high-stakes environments.

Mobile Devices for Car Repair Companies

Specification: Smartphones or tablets with good processing capabilities and internet connectivity that can run the mobile application effectively. These devices need to be robust and capable of handling the outdoor working conditions of repair companies' environments or individual repair persons.

Rationale: For car repair companies, mobile devices are sufficient as their primary tasks involve reviewing bids and submitting offers. The portability of smartphones allows them to manage their operations on the go, which is essential in a dynamic work environment such as car repairs.

Mobile Devices for Customers

Specification: Customers use their personal smartphones to interact with the platform. The application should be optimized for both major operating systems, iOS and Android, to ensure wide accessibility.

Rationale: Customers need a convenient way to access their insurance details, browse deals, and submit accident reports. A mobile application enables them to perform these tasks from anywhere, making the insurance process more user-friendly and accessible.

4.2 Software Design

Backend Design

Architecture: The backend is developed using Django, a high-level Python web framework that encourages rapid development and clean, pragmatic design. This choice supports a robust, scalable application architecture capable of handling complex data operations and user management.

APIs: RESTful APIs are implemented to facilitate communication between the mobile applications and the backend server, ensuring seamless data exchange and functionality across different platforms.

Frontend (Mobile) Design

Mobile Application: Developed using SwiftUI for iOS, the design focuses on providing a responsive, intuitive user interface. This allows for a seamless experience for users when submitting accident reports or interacting with insurance policies.

Admin Interface: The administrative web interface for insurance companies is developed using Django templates, providing a powerful, scalable solution for handling real-time data and complex workflows.

4.3 Essential Components of the Project

Digital Reporting and Management System

Functionality: This component is essential for enabling the digital submission of accident reports, handling claims, and managing the bidding process from repair companies. It includes user authentication, data validation, and secure data handling.

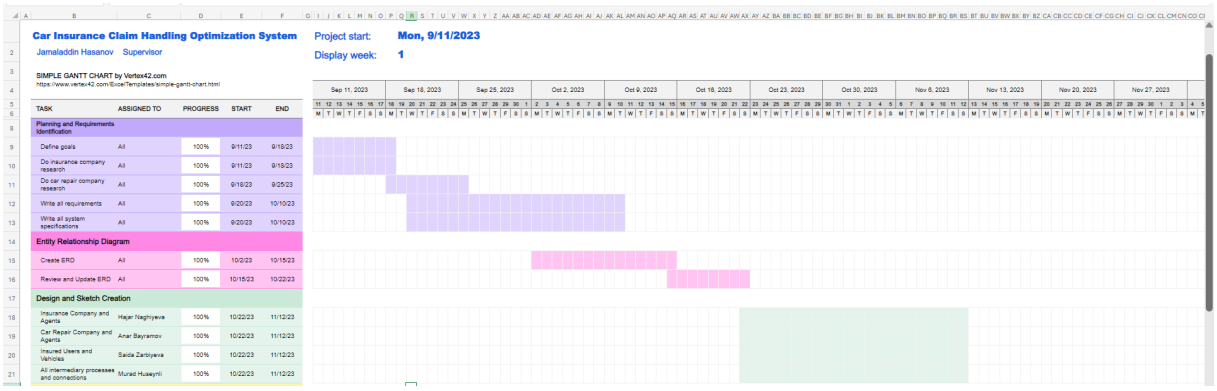
Real-time Bidding Platform

Functionality: A core feature that allows car repair companies to place bids on repairs, which are then reviewed by insurance companies. This fosters a competitive environment, potentially lowering costs and improving service quality.

Seamless Insurance Integration

Integration: The system is designed to integrate smoothly with existing insurance databases and protocols, ensuring that the transition from traditional methods to the digital platform is seamless for insurance companies.

4.4 Timeline or Gantt chart



22	**Development Phase**				
23	Database Creation and Integration	Saida Zarbiyeva	100%	11/13/23	SDPII
24	Frontend Development	Anar Bayramov, Murad Huseynli, Hajar Naghiyeva	100%	11/13/23	SDPII
25	Backend Development	Hajar Naghiyeva, Murad Huseynli, Saida Zarbiyeva	100%	11/13/23	SDPII
26					

SDP1 & SDP2 _ Progress Timeline

4.5 Testing/Verification/Validation of the results

Backend Testing

Admin Panel Testing:

Functional/Acceptance Testing: This involved checking all functional aspects of the admin panel to ensure that it can handle tasks such as managing user data, processing insurance claims, and overseeing the bidding process without errors.

Security Testing: Tests were conducted to ensure that the admin panel is secure from unauthorized access and data breaches. This included testing for SQL injections, XSS vulnerabilities, and ensuring that authentication and authorization mechanisms are robust.

Performance Testing: To assess the system's responsiveness and stability under different load conditions. This included stress testing and load testing to simulate multiple users accessing the system simultaneously.

API Testing:

Unit Testing: Individual API functions were tested to ensure they perform expected operations under various conditions. This included testing all CRUD operations associated with insurance claims, user management, and bidding processes.

Integration Testing: This tested the interactions between APIs and other system components, such as the database and the admin panel, to ensure they work together seamlessly.

Validation Testing with Postman: Using Postman, the APIs were tested to ensure they return the correct responses to requests and handle errors properly. This included checking the APIs for correct status codes, response formats, and error handling capabilities.

UI Interface Testing

iOS Application Testing:

User Interface Testing: This ensured that the application is intuitive, aesthetically pleasing, and provides a responsive user experience. This included testing layout, graphic elements, and interactive components for both customer and car repair company interfaces.

Usability Testing: We conducted it separately for customers and car repair company employees' interfaces to ensure that the application is user-friendly, and that each user group can navigate through the app and use its features without difficulties.

Functional Testing: Each function within the iOS app was tested to verify that it performs as expected. For customers, this included submitting accident reports and viewing insurance policies. For car repair company employees, functionalities such as viewing accident bids and submitting repair offers were tested.

TestFlight Testing

Uploading and Distribution: The latest build of the iOS application was uploaded to TestFlight, Apple's platform for testing beta versions of apps. This allowed us to distribute the app to a controlled group of external testers (mainly, our teammates) and stakeholders without releasing it on the App Store.

Feedback Incorporation: Feedback from TestFlight users (mainly, our teammates) was collected, analyzed, and used to make necessary adjustments to the application. This iterative process helped refine the app before its final release.

5. CONCLUSION

5.1 Discussion of results

In our project development, significant milestones have been achieved, particularly in the completion of the backend and mobile interfaces of SigortaHub. The backend, constructed with Django, has been meticulously developed to handle complex data operations and user management efficiently, ensuring a robust platform for real-time processing. The mobile application, designed using SwiftUI for iOS, has been tailored to enhance user interaction, providing a seamless and intuitive interface for both car owners and repair service providers. Comprehensive testing phases have played a crucial role in refining the platform; functional tests confirmed the robustness of the administrative panel and user interfaces, while security tests ensured the platform's resilience against potential breaches. Performance testing further validated the system's capability to sustain operational stability under varying loads. The integration testing between the backend and mobile application through RESTful APIs demonstrated flawless connectivity and data exchange, ensuring that the application performs optimally across different user scenarios. Notably, the app has been uploaded to TestFlight, allowing us to extend testing to real-world users. This beta testing phase has been instrumental in gathering valuable feedback, which has led to successive refinements in the platform's functionality and user experience. The overall results from these testing stages are promising, indicating that SigortaHub is well-equipped to revolutionize the car insurance claim process by significantly reducing processing times and enhancing customer satisfaction. These achievements mark a pivotal advancement in our project, setting a solid foundation for future enhancements and full-scale deployment.

5.2 Future work

It is important to mention that in addition to our core technology stack, the project will include advanced AI-based computer vision algorithms and networks, such as ConvNets and ResNets, to automate vehicle damage cost estimation - a vitally important aspect of

the insurance claims process. Although this feature is already under development (using PyTorch stack), due to some research-related constraints in terms of time, we may not be able to integrate it fully into the application by the time of presentation – to that end, it has been added to this section of the paper.

These state-of-the-art CNNs (Conv and Res – Nets) are famous for their outstanding performance in image recognition (He, Zhang, Ren, & Sun, 2016; Krizhevsky, Sutskever, & Hinton, 2012) and will be used to analyze the extent of damage to vehicles based on images uploaded by end users. By training these networks on a comprehensive dataset of vehicle damage images with repair costs, the algorithms will be able to estimate repair costs for new vehicle damage incidents. It is important to mention that although this feature is already under development, due to some research-related constraints in terms of time, we may not be able to integrate it fully into the application by the time of presentation – to that end, it has been added to this section of the paper. To further improve our computer vision capabilities, segmentation methods, such as U-Net or Mask R-CNN will be used to isolate specific areas of damage in images (He, Gkioxari, Dollár, & Girshick, 2017; Ronneberger, Fischer, & Brox, 2015). This segmentation is necessary to conduct detailed analysis and obtain accurate damage estimates needed to accurately estimate the cost of repairs.

This seamless integration of artificial intelligence and computer vision technologies into the application's server architecture ensures a high degree of automation of the damage assessment process. These components will work in harmony with our existing technology stack, which includes image ingestion from a Swift-based front-end, processing through a Python-based backend, and interaction with a Postgres database to retrieve and store data. By implementing these sophisticated technologies, our initiative aims to not only improve the accuracy of damage assessments but also significantly reduce the reliance on manual checks, thereby speeding up the entire claims process, as well as potentially reducing the associated expenditures. This AI-driven methodology positions our project at the forefront of technological advancement in the insurance sector, promising a transformative impact on the industry.

Further research can be oriented towards optimizing our approach, as well as considering the integration of other AI techniques to reduce the involvement of humans in the process of claim handling.

H. Abbreviations

1. SDLC - Software Development Life Cycle
2. ERD - Entity Relationship Diagram
3. WBS - Work Breakdown Structure
4. AI - Artificial Intelligence
5. API - Application Programming Interface
6. HTTPS - Hypertext Transfer Protocol Secure
7. ORM - Object-Relational Mapping
8. REST - Representational State Transfer
9. UI - User Interface
10. ML - Machine Learning
11. CNN - Convolutional Neural Network
12. U-Net - A type of convolutional neural network used for image segmentation

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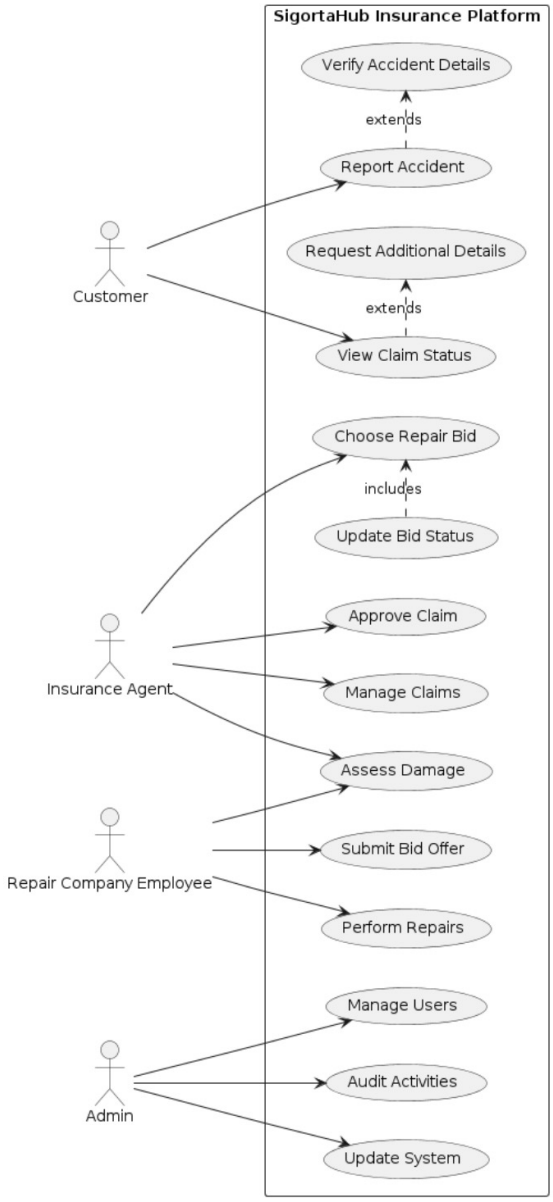
J. APPENDICES

Work Breakdown Structure (WBS)

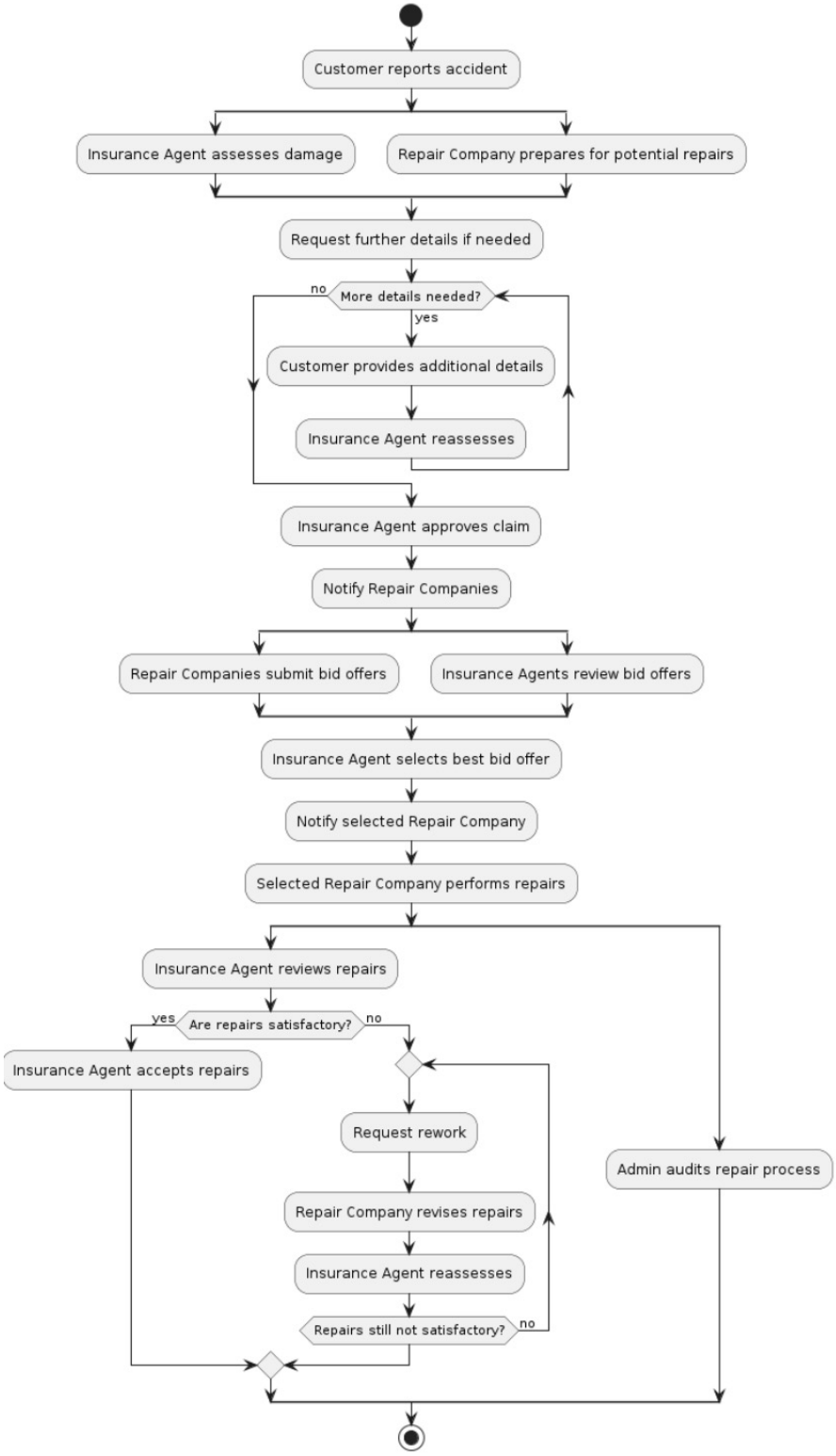
ID	Completion Status	% Work Complete	Task Name	Duration (Days)	Start	Finish	Assigned People
1	○	84.01%	Insurance Claim Handling Optimization System Development	283	7/27/2023	5/5/2024	HN, MH, SZ, AB
2	✓	100.00%	Project Planning	31	7/27/2023	8/27/2023	HN, SZ
3	✓	100.00%	Project Initiation	14	7/27/2023	8/10/2023	HN, SZ
4	✓	100.00%	Developing a system request	7	7/27/2023	8/3/2023	HN, SZ
5	✓	100.00%	Conducting a feasibility analysis: technical, economic, organizational	7	8/3/2023	8/10/2023	HN, SZ
6	✓	100.00%	Project Management	283	7/27/2023	5/5/2024	HN, MH, SZ, AB
7	✓	100.00%	Developing a work plan	31	7/27/2023	8/27/2023	HN, SZ
8	✓	100.00%	Staffing the project	101	7/27/2023	11/5/2023	HN, MH, SZ, AB
9	✓	100.00%	Controlling and directing the project	283	7/27/2023	5/5/2024	HN
10	✓	100.00%	Analysis	50	7/27/2023	9/15/2023	HN, SZ
11	✓	100.00%	Requirements Gathering	50	7/27/2023	9/15/2023	HN, SZ
12	✓	100.00%	Initial research and problem understanding	9	7/27/2023	8/5/2023	HN, MH, SZ
13	✓	100.00%	User roles identification: insured user, insurance company, and car repair company	7	8/3/2023	8/10/2023	HN, SZ
14	✓	100.00%	Defining the requirements of the system for each user role (use-case specifications)	28	8/3/2023	8/31/2023	HN, SZ
15	✓	100.00%	Final discussions with the supervisor and his review	0	9/1/2023	9/1/2023	HN, SZ
16	✓	100.00%	Making necessary adjustments and final check by the supervisor	14	9/1/2023	9/15/2023	HN, SZ
17	✓	100.00%	Design	71	9/20/2023	11/30/2023	HN, MN, SZ, AB
18	✓	100.00%	Entity Relationship Diagram	48	9/20/2023	11/7/2023	HN, MN, SZ, AB
19	✓	100.00%	Identifying entities and relationships	10	9/20/2023	9/30/2023	HN, SZ, AB
20	✓	100.00%	Outlining attributes for each entity	10	9/20/2023	9/30/2023	HN, SZ, AB
21	✓	100.00%	Defining the associations between the relations	10	9/20/2023	9/30/2023	HN, SZ, AB
22	✓	100.00%	Reviewing with the supervisor and optimizing relationships	0	9/30/2023	9/30/2023	HN, SZ, AB
23	✓	100.00%	Making necessary adjustments after the feedback	11	10/1/2023	10/12/2023	HN, MN, SZ, AB
24	✓	100.00%	Finalizing ERD design	31	10/7/2023	11/7/2023	HN, MH, SZ, AB
25	✓	100.00%	Documenting the ERD with descriptions on GitHub	16	11/14/2023	11/30/2023	SZ
26	✓	100.00%	Developing System Design	43	10/18/2023	11/30/2023	HN, MH, SZ, AB
27	✓	100.00%	Initial Sketching based on ERD	27	10/18/2023	11/14/2023	HN, MH, SZ, AB
28	✓	100.00%	Researching design best practices	5	10/18/2023	10/23/2023	HN, MH, SZ, AB
29	✓	100.00%	Sketching user flow diagrams for each of three roles	18	10/27/2023	11/14/2023	HN, MH, SZ, AB
30	✓	100.00%	Creating low-fidelity wireframes for each page	12	11/14/2023	11/14/2023	HN, MH, SZ, AB
31	✓	100.00%	Refining Sketches	16	11/14/2023	11/30/2023	HN, MH, SZ, AB
32	✓	100.00%	Discussing the design with the supervisor and getting feedback	0	11/14/2023	11/14/2023	HN, MH, SZ, AB
33	✓	100.00%	Refining prototypes based on the supervisor's feedback	13	11/14/2023	11/27/2023	HN, MH, SZ, AB
34	✓	100.00%	Finalizing the visualization of the system design for all three roles	3	11/27/2023	11/30/2023	HN, MH, SZ, AB
35	○	36.05%	Implementation				
36	○	72.50%	Database Management	112	12/25/2023	4/15/2024	
37	✓	100.00%	Database Schema Creation	7	11/28/2023	12/5/2023	SZ
38	✓	100.00%	Writing SQL scripts for schema creation	7	11/28/2023	12/5/2023	SZ
39	✓	100.00%	Implementing constraints	7	11/28/2023	12/5/2023	SZ
40	✓	100.00%	Containerization of Database	14	12/10/2023	12/24/2023	HN, MH, SZ, AB
41	✓	100.00%	Installing Docker	10	12/10/2023	12/20/2023	HN, MH, SZ, AB
42	✓	100.00%	Configuring Docker (Dockerfile and yml)	10	12/10/2023	12/20/2023	HN, MH, SZ, AB
41	✓	100.00%	Installing Docker	10	12/10/2023	12/20/2023	HN, MH, SZ, AB
42	✓	100.00%	Configuring Docker (Dockerfile and yml)	10	12/10/2023	12/20/2023	HN, MH, SZ, AB
43	✓	100.00%	Testing Docker's Image	2	12/20/2023	12/22/2023	MH, SZ
44	✓	100.00%	Pushing Docker to GitHub	2	12/22/2023	12/24/2023	MH
45	○	17.50%	Iteratively Updating Database Schema throughout Development				
46	○	25.00%	Registration of Each of the Three Roles	15	2/5/2024	2/20/2024	MN, HN, SZ
47	○	25.00%	Ensuring that passwords are securely stored, such as using hashing and salting techniques	15	2/5/2024	2/20/2024	MN, HN, SZ
48	✗	0.00%	Utilizing memory and time efficient data structures for data retrieval				
49	○	12.50%	Login of Each of the Three Roles	15	2/5/2024	2/20/2024	MN, HN, SZ
50	○	25.00%	Setting up queries to retrieve and verify user credentials	15	2/5/2024	2/20/2024	MN, HN, SZ
51	✗	0.00%	Designing and implementing the database schema for storing session data or tokens if they are not stored client-side				
52	✗	0.00%	Implementing a structure to log login attempts for security and auditing purposes (also for the account lockout mechanism)				
53	○	25.00%	Handling the storage and verification of 2FA codes	15	2/5/2024	2/20/2024	MN, HN, SZ
54	○	25.00%	Personal Information Management for the Insured User	15	2/5/2024	2/20/2024	MN, HN, SZ
55	○	25.00%	Implementing security measures for personal data	15	2/5/2024	2/20/2024	MN, HN, SZ
56	✗	0.00%	Setting up CRUD procedures for user profile (e.g., database triggers for profile updates)				
57	✗	0.00%	Insurance Policies Management for the Insured User				
58	✗	0.00%	Implementing procedures for managing insurance records				
59	○	25.00%	Accident Reporting for the Insured User	15	2/5/2024	2/20/2024	MN, HN, SZ
60	○	25.00%	Implementing data structures for storing accident photos and other responses to the questions	15	2/5/2024	2/20/2024	MN, HN, SZ
61	✗	0.00%	Implementing indexes for efficient accident data retrieval				
62	✗	0.00%	Creating views for accident history				
63	○	6.07%	Backend Development	112	12/25/2023	4/15/2024	
64	○	14.21%	Registration Logic for Three Roles (User, Company A, Company B				
65	○	25.00%	Ensuring all the registration form inputs are validated on the server side for correctness and preventing malicious data entry	15	2/5/2024	2/20/2024	MN, HN
66	○	25.00%	Developing registration endpoints for the user, company A, and company B (admins and agents)	15	2/5/2024	2/20/2024	MN, HN, SZ
67	○	25.00%	Implementing role-based access control	15	2/5/2024	2/20/2024	MN, HN
68	✗	0.00%	Integrating email authentication for the insured user, insurance company, and car repair company				
69	✗	0.00%	Integrating social media authentication for the insured user only				
70	✗	0.00%	Implementing company approval workflow for the insured users to be approved by the insurance company				
71	✗	0.00%	Implementing company approval workflow for the insurance and car repair companies to be approved by us				
72	✗	0.00%	Integrating official email domain verification for the insurance company				
73	○	25.00%	Implementing password hashing to securely store user passwords in the database	15	2/5/2024	2/20/2024	MN, HN
74	○	25.00%	Creating a verification token that will be used to verify the email address or phone number (or social media) of the registered users	15	2/5/2024	2/20/2024	MN, HN, SZ
75	✗	0.00%	Constructing and dispatching a verification email or SMS containing the verification token or link				
76	✗	0.00%	Developing logic to handle the user's response to the verification email/SMS				
77	✗	0.00%	Upon successful verification, instantiating a user session to log the user in automatically				
78	✗	0.00%	Recording the registration event in the system logs for auditing purposes				
79	✗	0.00%	After successful registration and verification, sending a welcome email to the user				
80	○	40.00%	Developing comprehensive error handling for scenarios where registration fails	19	2/5/2024	2/24/2024	
81	○	40.00%	Ensuring that the registration process complies with relevant data protection and privacy regulations	19	2/5/2024	2/24/2024	
82	○	40.00%	Providing a system to give the user feedback if registration is successful or if there are issues that need to be resolved	19	2/5/2024	2/24/2024	MN, HN, SZ
83	○	25.00%	Ensuring that the backend registration logic is fully integrated with the frontend interface, matching the workflow outlined in the sketches	19	2/5/2024	2/24/2024	
84	○	16.15%	Login Logic for Three Roles	19	2/5/2024	2/24/2024	MN, HN
83	○	25.00%	Ensuring that the backend registration logic is fully integrated with the frontend interface, matching the workflow outlined in the sketches	19	2/5/2024	2/24/2024	
84	○	16.15%	Login Logic for Three Roles	19	2/5/2024	2/24/2024	MN, HN
85	○	25.00%	Developing the backend endpoints for each role that will handle the login request and response	19	2/5/2024	2/24/2024	
86	○	25.00%	Implementing the logic to verify the user's credentials against the stored data in the database	19	2/5/2024	2/24/2024	
87	○	25.00%	Once the user is authenticated, generating a secure session token or JWT (JSON Web Token) that will be used to maintain the user's session	19	2/5/2024	2/24/2024	MN, HN
88	✗	0.00%	Adding logic to temporarily lock an account after a certain number of failed login attempts to protect against brute-force attacks				
89	✗	0.00%	Generating and managing session tokens to keep users logged in and differentiate between user sessions				
90	○	20.00%	Depending on the role of the user logging in, redirecting to the appropriate dashboard or home page	19	2/5/2024	2/24/2024	MN, HN
91	○	25.00%	Creating clear and secure error messages to inform users of unsuccessful login attempts without revealing sensitive information	19	2/5/2024	2/24/2024	MN, HN
92	✗	0.00%	Introducing rate limiting to prevent excessive login attempts which may indicate automated attacks (optional; if have time)				
93	✗	0.00%	Keeping track of successful and unsuccessful login attempts for security monitoring (optional; if have time)				
94	○	40.00%	Ensuring login procedures comply with security policies and legal requirements	19	2/5/2024	2/24/2024	MN, HN
95	○	25.00%	Implementing and linking to account recovery options for users who have forgotten their credentials	19	2/5/2024	2/24/2024	
96	✗	0.00%	Establishing a secure timeout policy for user inactivity and automatic logout (optional; if have time)				
97	○	25.00%	Ensuring that the backend login logic is fully integrated with the frontend interface, matching the workflow outlined in the sketches	19	2/5/2024	2/24/2024	MN, HN, SZ
98	✗	0.00%	Personal Information Management for the Insured User				
99	✗	0.00%	Developing endpoints for user profile creation and editing	1/15/1900	2/13/2024	2/28/2024	MN, HN
100	✗	0.00%	Implementing authentication and authorization checks	1/15/1900	2/13/2024	2/28/2024	MN, HN, SZ
101	✗	0.00%	Creating data validation logic for personal information	1/15/1900	2/13/2024	2/28/2024	MN, HN
102	✗	0.00%	Insurance Policies Management for the Insured User				
103	✗	0.00%	Developing endpoints for managing insurance records	1/15/1900	2/13/2024	2/28/2024	MN, HN
104	✗	0.00%	Integrating business logic for policy validation	1/15/1900	2/13/2024	2/28/2024	MN, HN
105	✗	0.00%	Accident Reporting for the Insured User				
106	✗	0.00%	Ensuring all the accident reporting form inputs are validated on the server side for correctness and preventing malicious data entry	1/15/1900	2/13/2024	2/28/2024	MN, HN
107	✗	0.00%	Developing endpoints for accident report submission	1/15/1900	2/13/2024	2/28/2024	MN, HN, SZ
108	✗	0.00%	Implementing logic for accident history retrieval	1/15/1900	2/13/2024	2/28/2024	MN, HN
109	✗	0.00%	Creating sorting and filtering logic for accident reports	1/15/1900	2/13/2024	2/28/2024	MN, HN, SZ
110	○	29.57%	Frontend Development	112	12/25/2023	4/15/2024	
111	○	55.00%	Registration Interface for Three Roles				
112	○	75.00%	Designing registration forms for each of the three roles (insurance company and car repair company have both admin and agent)	19	2/5/2024	2/24/2024	AB
113	○	50.00%	Implementing form validation before submission to the backend (e.g., checking that an email address is in the correct format)	19	2/5/2024	2/24/2024	AB
114	○	75.00%	Creating user role selection	19	2/5/2024	2/24/2024	AB
115	○	25.00%	Connecting with backend services	19	2/5/2024	2/24/2024	AB
116	○	50.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
117	○	32.50%	Login Interface for Three Roles	19	2/5/2024	2/24/2024	AB
118	○	75.00%	Creating the visual components of the login page, such as the input fields for the username/email and password, login button, and links for "forgot password" and "sign up"				
119	○	25.00%	Implementing secure practices for transmitting the login data, such as using HTTPS and possibly adding CAPTCHA to prevent automated attacks	19	2/5/2024	2/24/2024	AB
120	○	10.00%	Providing informative error messages for login failures, such as incorrect username/password and account lockout notifications	19	2/5/2024	2/24/2024	AB
121	○	10.00%	Developing the frontend logic to handle session tokens or cookies that are returned upon successful login for maintaining the user's logged-in state	19	2/5/2024	2/24/2024	AB
122	○	25.00%	Connecting with backend services	19	2/5/2024	2/24/2024	AB
123	○	50.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
124	○	39.00%	Personal Information Management Interface for the Insured User				
125	○	70.00%	Designing user profile form interface	19	2/5/2024	2/24/2024	AB
126	○	50.00%	Implementing frontend validation for profile form	19	2/5/2024	2/24/2024	AB

	A	B	C	D	E	F	G	H
121	119		25.00%	Implementing secure practices for transmitting the login data, such as using HTTPS and possibly adding CAPTCHA to prevent automated attacks	19	2/5/2024	2/24/2024	AB
122	120		10.00%	Providing informative error messages for login failures, such as incorrect username/password and account lockout notifications	19	2/5/2024	2/24/2024	AB
123	121		10.00%	Developing the frontend logic to handle session tokens or cookies that are returned upon successful login for maintaining the user's logged-in state	19	2/5/2024	2/24/2024	AB
124	122		25.00%	Connecting with backend services	19	2/5/2024	2/24/2024	AB
125	123		50.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
126	124		39.00%	**Personal Information Management Interface for the Insured User**				
127	125		70.00%	Designing user profile form interface	19	2/5/2024	2/24/2024	AB
128	126		50.00%	Implementing frontend validation for profile form	19	2/5/2024	2/24/2024	AB
129	127		0.00%	Building edit profile functionality	19	2/5/2024	2/24/2024	AB
130	128		25.00%	Connecting with backend services				
131	129		50.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
132	130		0.00%	**Insurance Policies Management Interface for the Insured User**				
133	131		0.00%	Designing insurance listing interface	19	2/5/2024	2/24/2024	AB
134	132		0.00%	Creating interface for adding and editing insurances	19	2/5/2024	2/24/2024	AB
135	133		0.00%	Connecting with backend services	19	2/5/2024	2/24/2024	AB
136	134		0.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
137	135		21.36%	**Accident Reporting Interface for the Insured User**				
138	136		50.00%	Creating wireframes for accident report form	19	2/5/2024	2/24/2024	AB
139	137		50.00%	Developing high-fidelity mockups for form	19	2/5/2024	2/24/2024	AB
140	138		0.00%	Coding dynamic form fields				
141	139		20.00%	Integrating date and time pickers	19	2/5/2024	2/24/2024	AB
142	140		20.00%	Implementing form validation logic	19	2/5/2024	2/24/2024	AB
143	141		20.00%	Integrating media capture or upload mechanism	19	2/5/2024	2/24/2024	AB
144	142		0.00%	Developing thumbnails and preview for uploaded images				
145	143		0.00%	Creating submission status messages				
146	144		0.00%	Implementing toast notifications for immediate user feedback				
147	145		25.00%	Connecting form with backend services	19	2/5/2024	2/24/2024	AB
148	146		50.00%	Performing frontend testing and debugging	19	2/5/2024	2/24/2024	AB
149	147			**Presentation**				
150	148			**Research Paper**				
151	149			**Reports**				
152	150							
153	151							

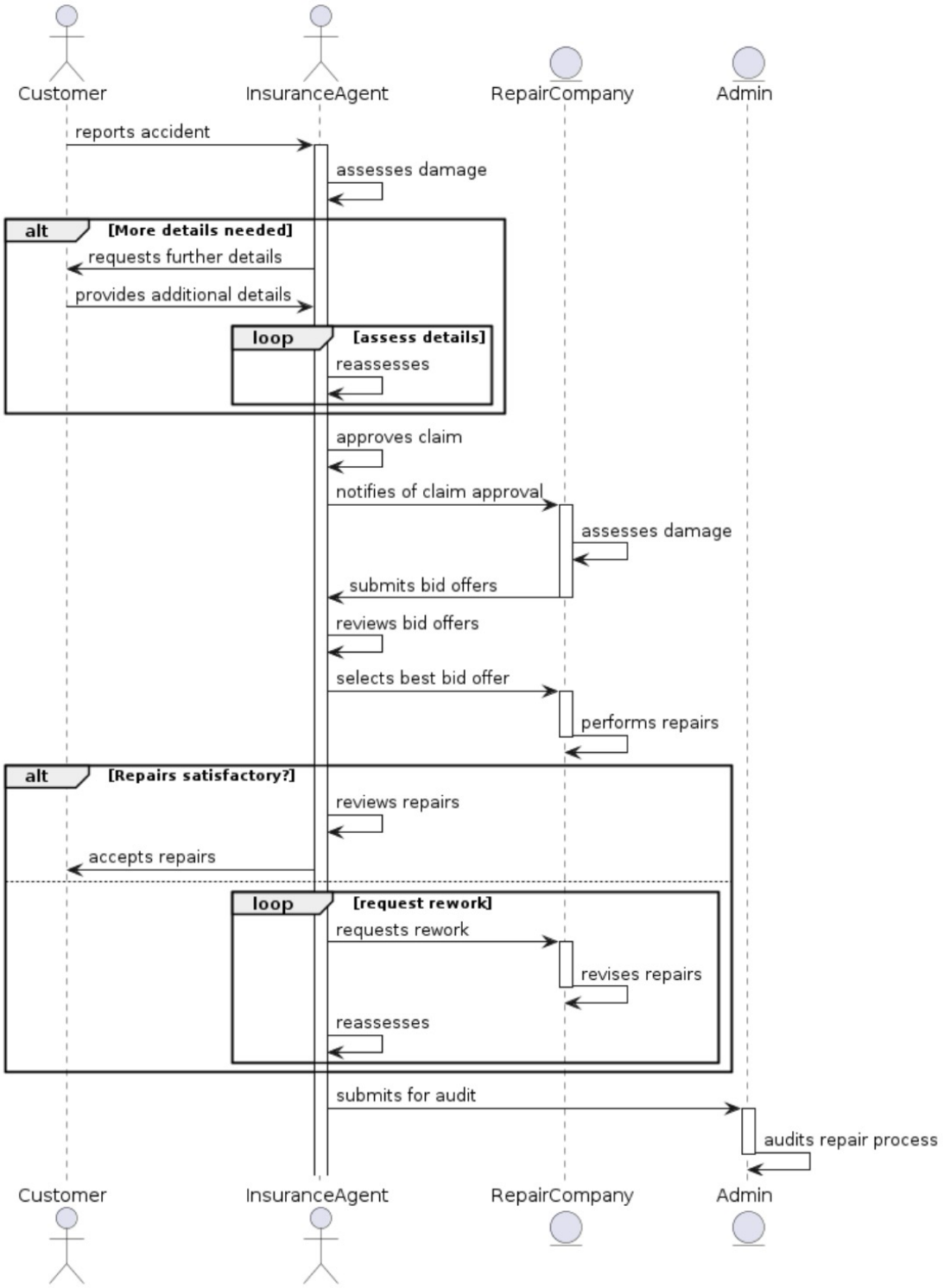
UML Use Case Diagram



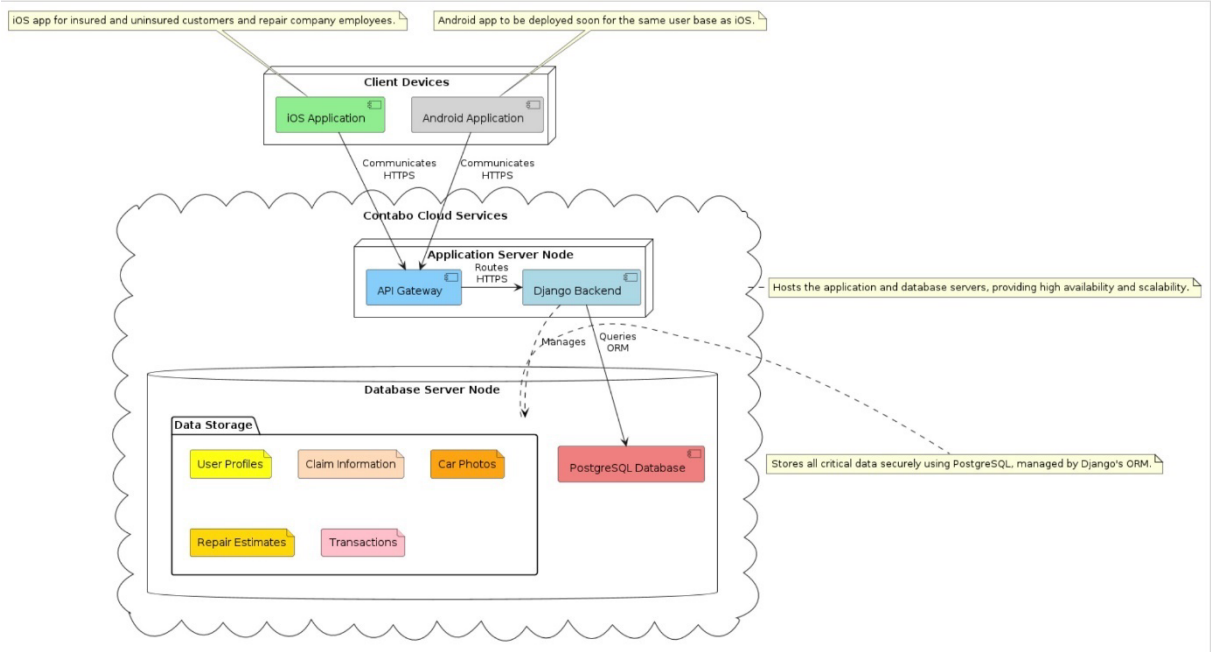
UML Activity Diagram



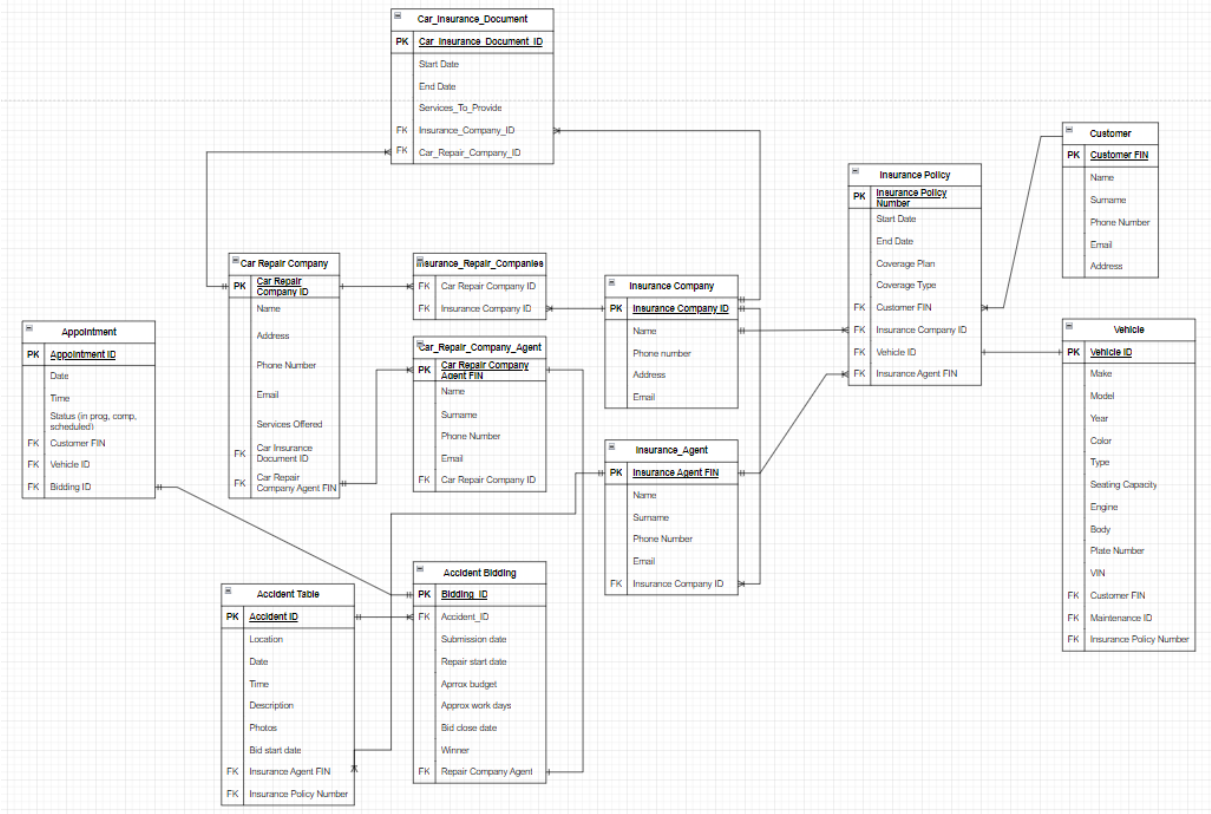
UML Sequence Diagram



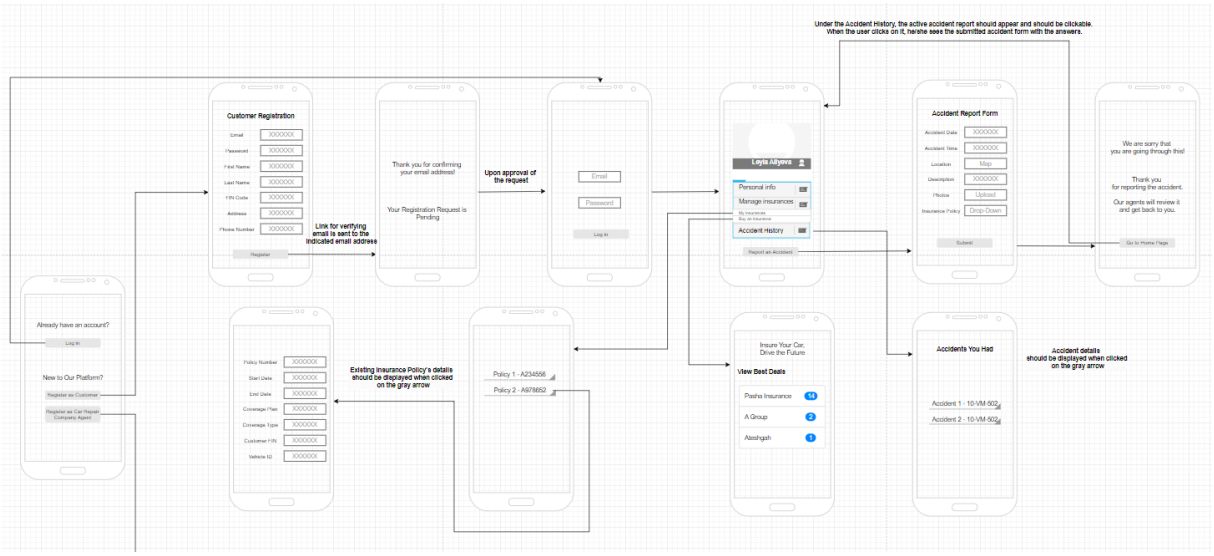
UML Deployment Diagram

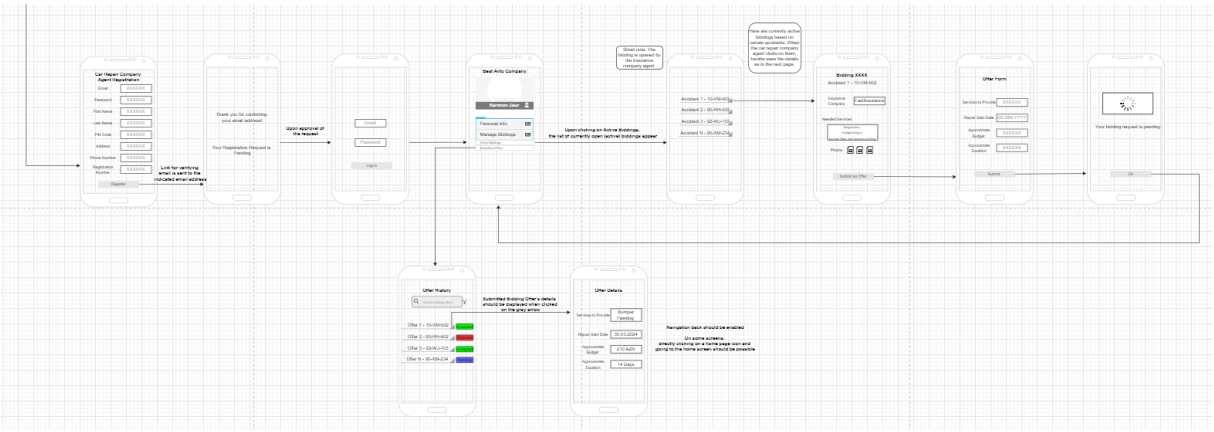


Entity Relationship Diagram (ERD)

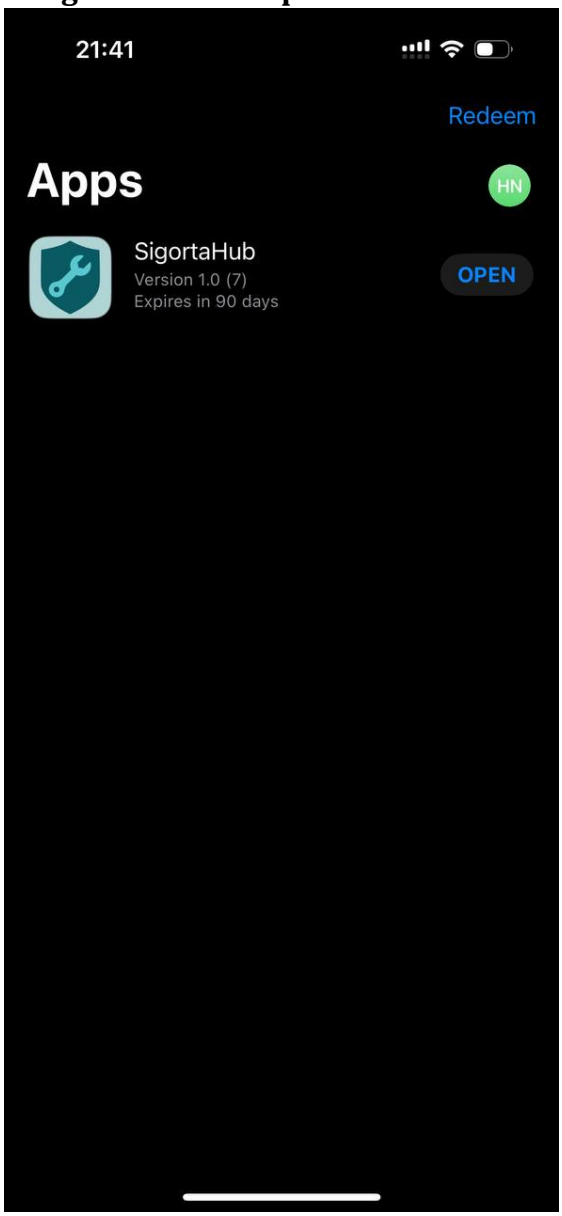


Page Design Sketches in drawio

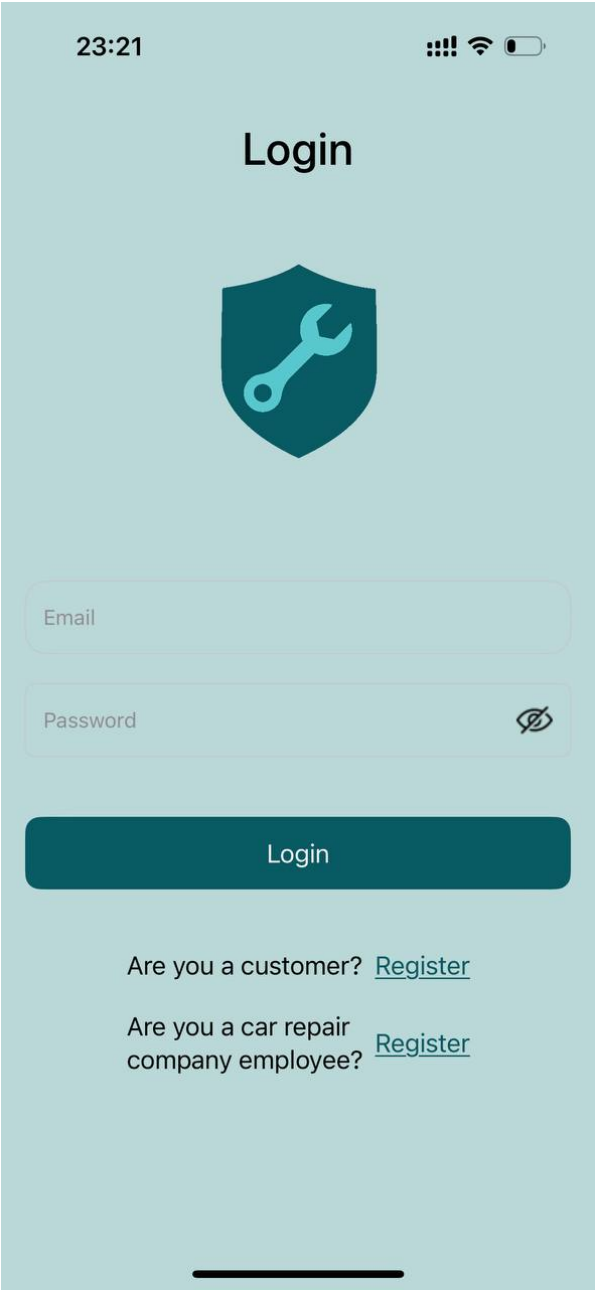




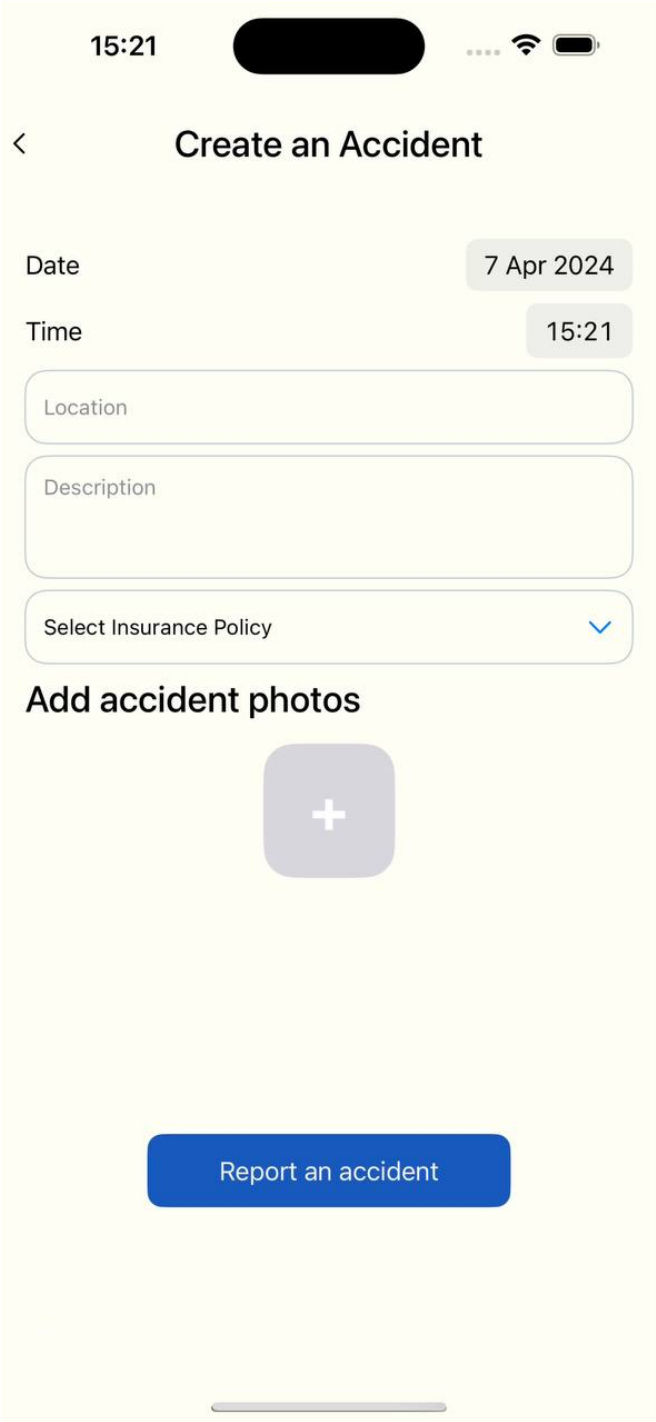
Images of the final product

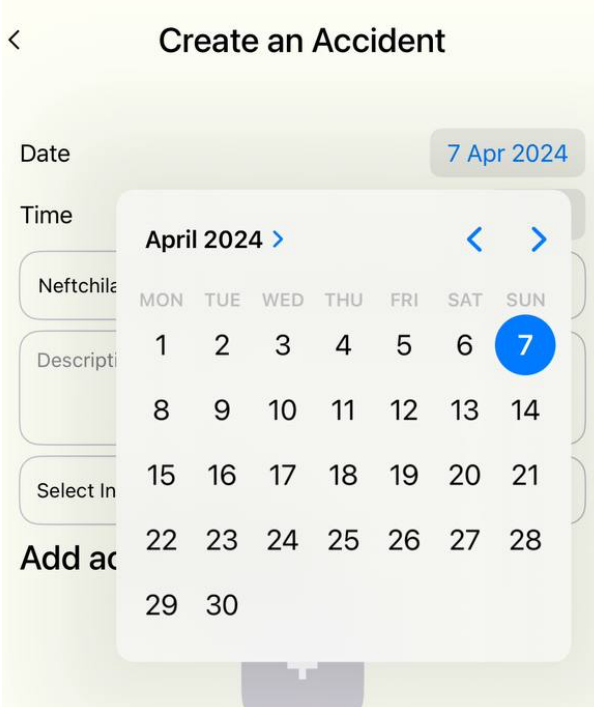


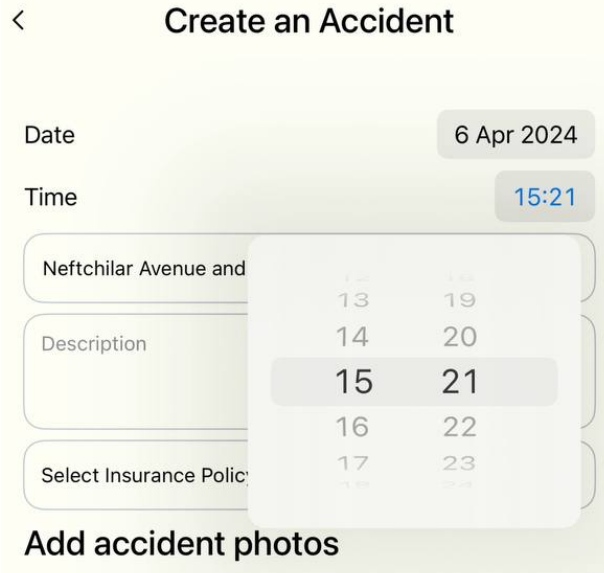
Screenshots of the software interface

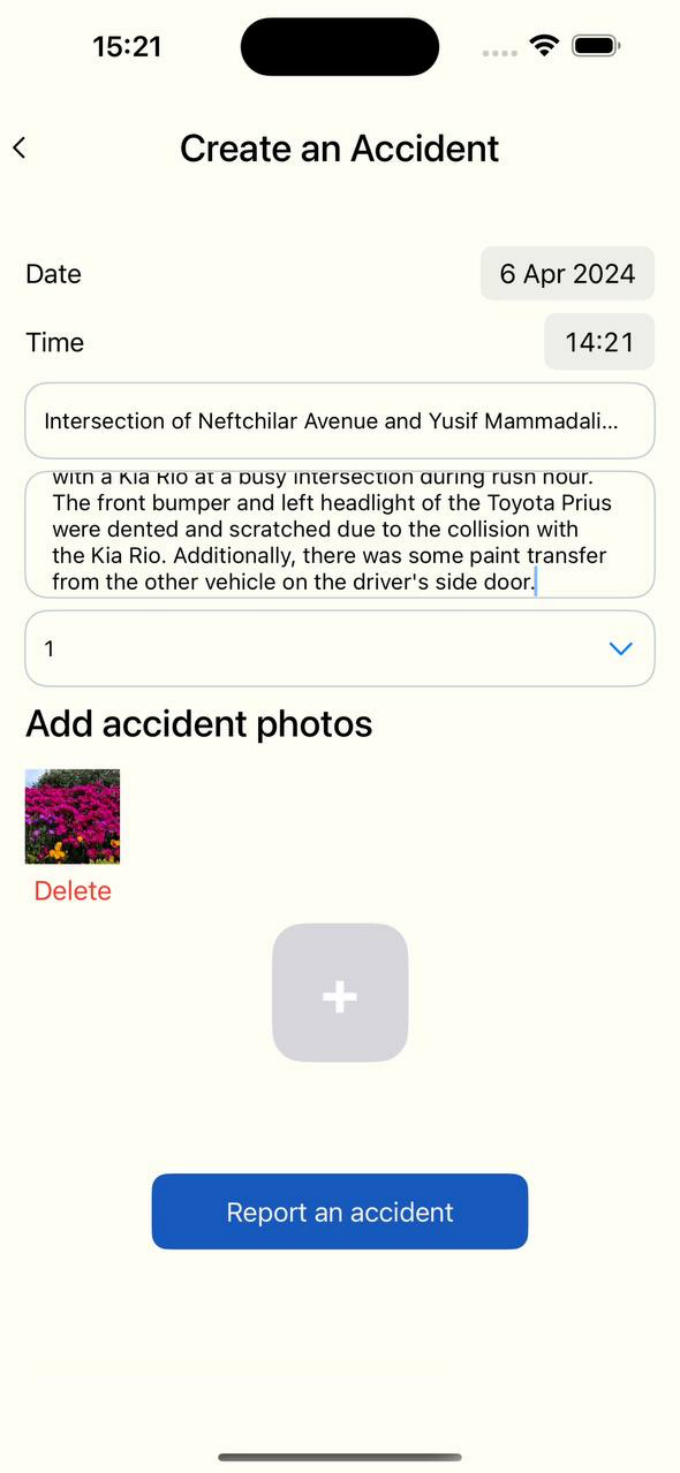


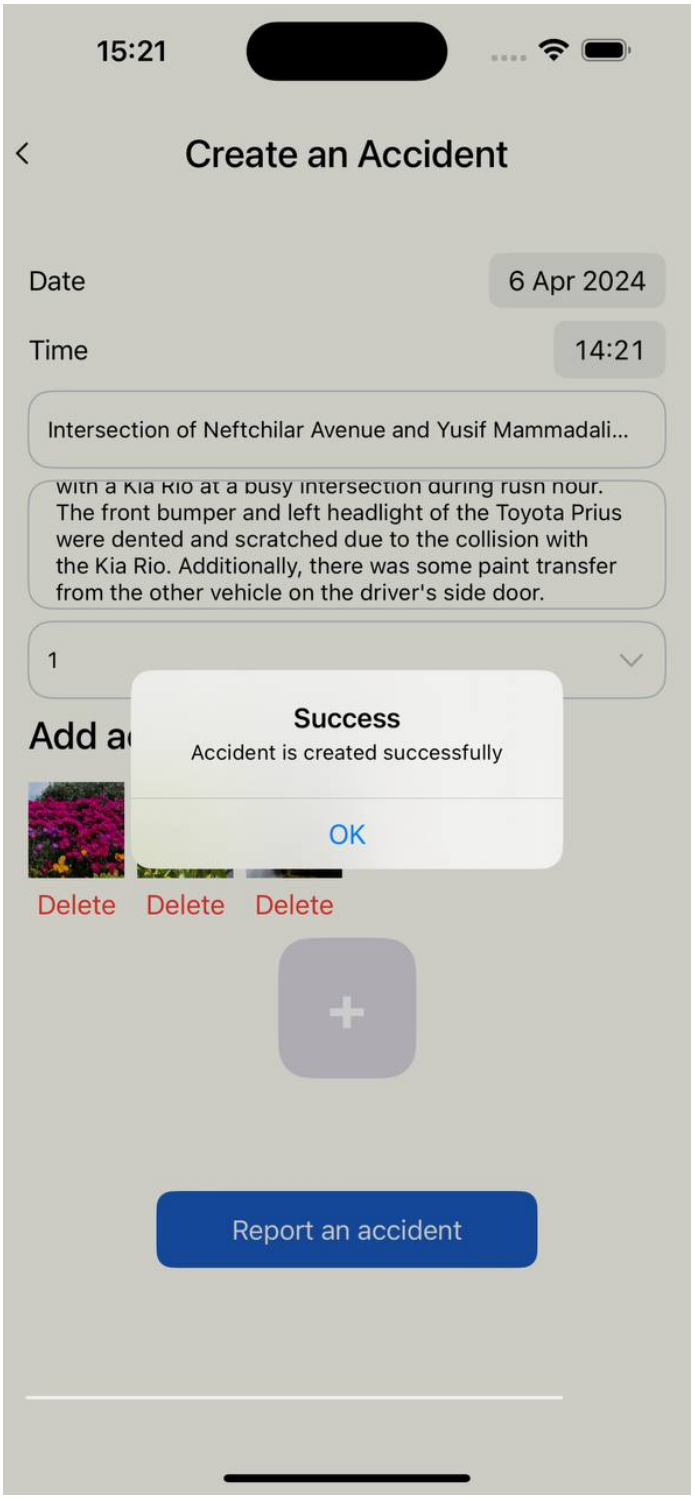
Accident Reporting








15:21
Create an Accident
Date
6 Apr 2024
Time
14:21
Intersection of Neftchilar Avenue and Yusif Mammadali...
with a Kia Rio at a busy intersection during rush hour. The front bumper and left headlight of the Toyota Prius were dented and scratched due to the collision with the Kia Rio. Additionally, there was some paint transfer from the other vehicle on the driver's side door.
1
Add accident photos
Delete
Report an accident


15:21
Create an Accident
Date
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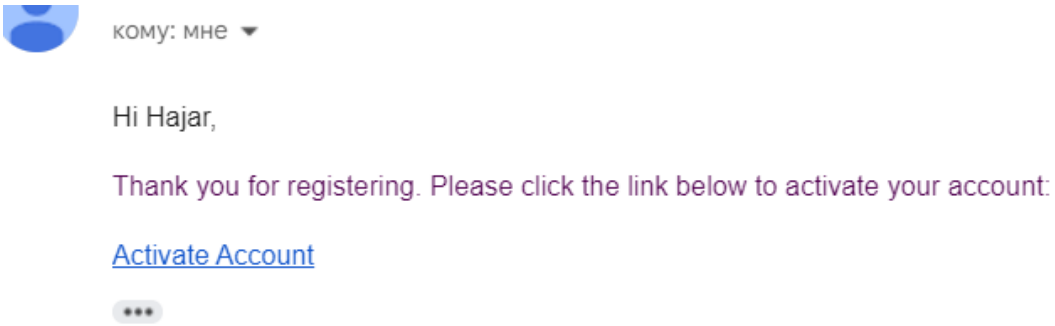
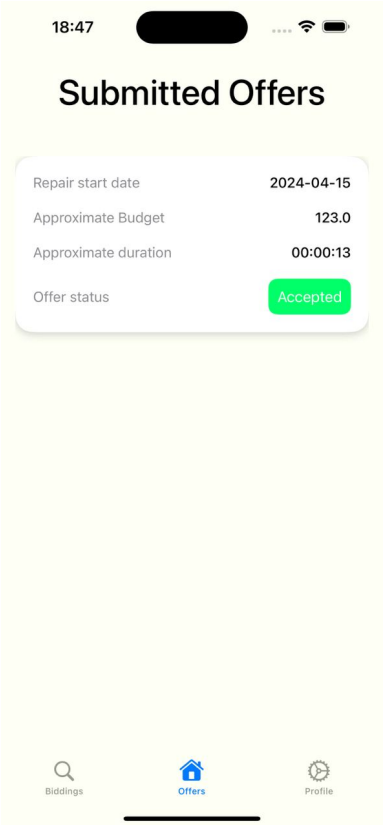
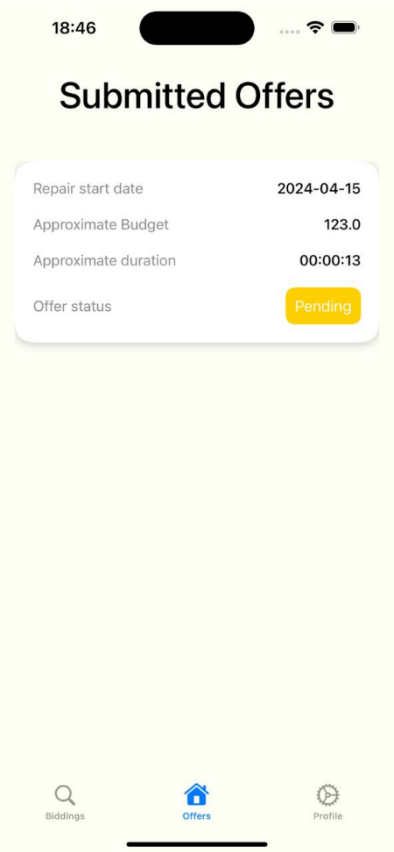
1
Success
Accident is created successfully
OK
Delete
Delete
Delete
Report an accident

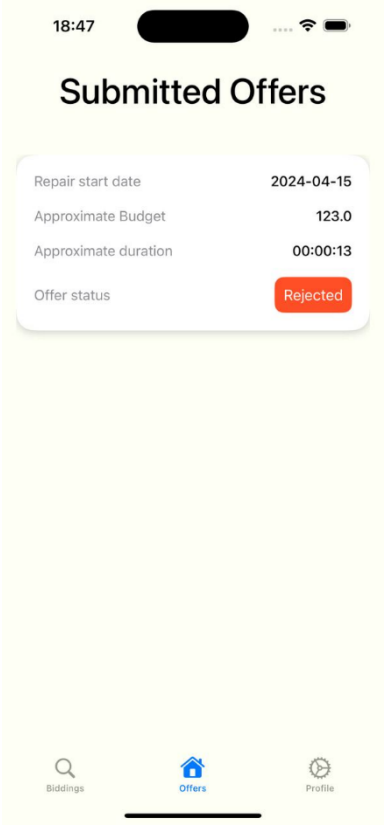
Email Verification Functionality

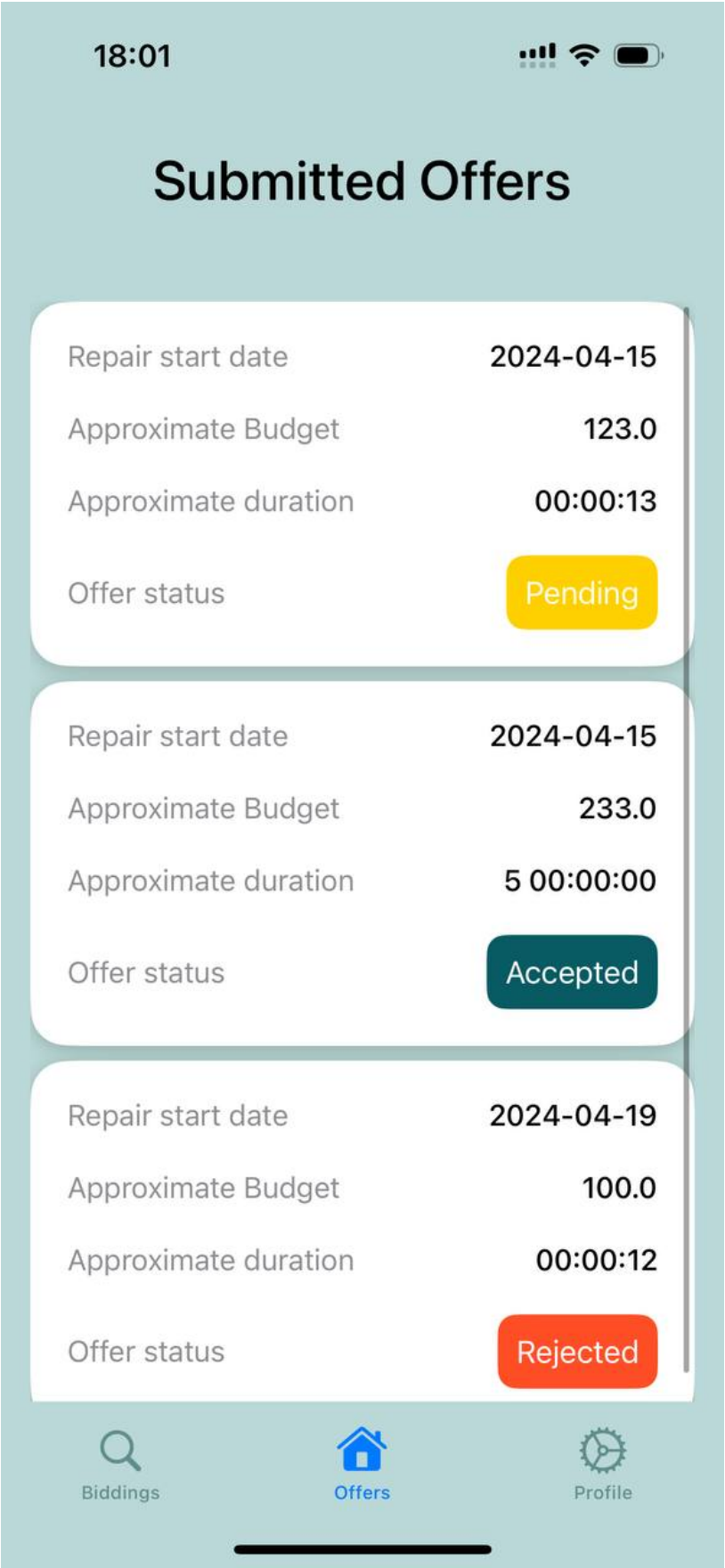


Bidding Offers by Car Repair Company








18:01
Submitted Offers
Repair start date
2024-04-15
Approximate Budget
123.0
Approximate duration
00:00:13
Offer status
Pending
Repair start date
2024-04-15
Approximate Budget
233.0
Approximate duration
5 00:00:00
Offer status
Accepted
Repair start date
2024-04-19
Approximate Budget
100.0
Approximate duration
00:00:12
Offer status
Rejected
Biddings
Offers
Profile