Car Doctor: An Android Application to Revolutionize Vehicle Service Sector

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FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the **Degree of Bachelor of Science in Computer Science and Engineering**

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APPROVAL

This Project titled **"Car Doctor: An Android Application To Revolutionize Vehicle Service Sector"**, submitted by **Mustafizur Rahman Tonmoy**, ID No: **213-15-4365** and **Jahid Hasan**, ID No: **213-15-4359** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **16 September, 2025**.

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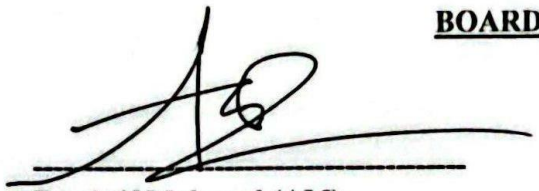

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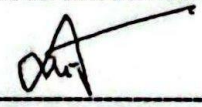

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Ms. Nusrat Khan, Lecturer,** Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this projectnor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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Finally, we must acknowledge with due respect the constant support and patience of our parents.

ABSTRACT

In the high-speed world of today, car maintenance typically results in causing most people more stress. It is a common experience, over and over again, to hear car owners complain about locating original parts, getting fair service costs and finding trustworthy workshops. Far too frequently, they are stuck grappling with problems like fake parts, hidden fees and shoddy repairs that leave them feeling ripped off, out of pocket and then wary. Service shop owners, meanwhile, face their own challenges. "Removing customers, saving bookings and reporting everyday sales can be tasking and time consuming this in a way diminishes the efficacy of businesses and slows them down in response to this, we created the Car Doctor, a Flutter-built Android application deployed to Firebase. Car Doctor is a simple, easy to use and safe car loan calculator. To car owners, it offers a way to shop and buy brand parts, compare service pricing and read reviews, and then book service appointments, all from within its app. It would also help them to be in a better position to decide and not get cheated by some of the service providers. With the application, owners of shops have total control of their clients, appointments and sales in real-time all information is kept secure and close to access as well as it is automatically updated by Firebase. Car Doctor is a one stop shop for car owners and service providers to come together and service a car in an easy, transparent and trust worthy manner. It's building trust and transparency, empowering customers to feel good about their choices and enabling shops to have the tools that they need to run their business smoothly and efficiently."

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Chapter 1
Introduction

This chapter introduces the challenges faced by car owners and service providers in the car maintenance industry. It also outlines the motivation behind the Car Doctor project and its objectives, setting the stage for the rest of the report.

1.1 Introduction

These days, car care is a headache for a lot of people. Drivers often encounter difficulty in sourcing original parts and reliable workshops. Whether it's sloppy repairs, price gouging or just plain poor service these problems pad the pockets of repairmen, and can expose the faults in your faith in such services. Service providers, meanwhile, struggle with customer management, booking processing, sales data tracking, and that reflects on the quality of the service provided and slows down business expansion. To address these issues, we created Car Doctor, an app that helps car owners find the right services infrastructure to maintain their cars. The app offers hassle-free experience of booking, genuine spare parts, standard industry pricing of labor and services, factory trained professionals and easy digital job cards as well as customer reviews of the service, thereby, transforming the service delivery process altogether. What distinguishes Car Doctor is a dedicated trust and transparency with other apps, which are largely seen as booking-centric apps, Plus A user can now be part of a complete ecosystem where they can compare services, search for genuine parts, leave feedback, and workshops can work on actual business not only to churn in more customers but more importantly to deliver better quality service. Closing this gap is what makes Car Doctor easy to trust and rely on to ensure that your car runs great for years.

1.2 Motivation

Our experiences and observation has motivated us to do this project. Like most car owners, we experienced difficulties with car maintenance. When we gave our car to a nearby workshop for servicing, we were confident that they would correct the problem. Two weeks later it happened again, and later we found that They had used fake parts We were frustrated, felt wronged, there was nothing that we could do. Well, car owners are often faced with situations like this. Meanwhile, there are lots of service shops that are having an issue themselves, for example, customer record, bookings processing and daily sales. This dis-organization leads to a poor customer experience and ultimately, lost business. That's why we built Car Doctor. It gives car owners a simple, trustworthy medium for sourcing authentic parts, price comparing service, reading reviews and appointments booking. Service providers get the support they need to manage things a whole lot better. We thought to make this app and by making this app we actually want to increase the trust and transparency along with all the modern tech (Flutter & Firebase) that very much helpful in this field.

1.3 Objectives

The key objectives of the project are:

- To make it easy for car owners to find, identify, and shop for authentic spare parts & add-on accessories through the app without the fear of procuring counterfeit products
- To build a service that would enable users to compare the prices of services, see what other customers are saying, and make an informed decision before making a booking on any car service.
- An easy, quick and user-friendly system to schedule an appointment with reduced waiting time, and 'fast forward' convenience for both the customer and the service provider What I claim as my invention is: 1. A system for booking appointments which includes
- To provide service providers with an integrated platform to manage Customer records, Bookings, Business records and information in the digital format.
- Sure are looking to implement a system allowing a real-time overview of daily sales and total workshop performance, and ensuring clients have secure data available wherever and whenever they need it.
- To build the product in latest technologies such as Flutter for cross platform app development, and Firebase to handle data security, scalability, and real time data management.

1.4 Methodology

The Car Doctor app was designed to be dependable, simple to use and saleable. To create the app, we pinpointed three primary pain points that users encounter on a daily basis: counterfeit parts and components, lackluster service experiences, and clunky booking processes. These were challenges that wound up defining the construction of the app. During store analysis, we generated a list of functional requirements (booking, price comparison, reviews), nonfunctional ones (security, speed, usability) and also tried to keep in mind that we wanted our product to have the freshest original parts lists. In terms of system architecture, we created an easy-to-use service that enables smooth communication between the flutter frontend and the firebase backend for effective management of users, services and transactions. We selected Flutter, Firebase to make the app cross-platform and real-time database with cloud storage along with some payment gateways for secure transactions. Chassis is modular and platform was designed preserving space for AI and IOT capabilities in the future. We deployed it with simplicity first then added extra features, which resulted in secure communication over the Volley Library between the app and backend. At user and service provider's sides, the app has been tested at unit, integration and user acceptance levels, built up to be better stability and usability with users' feedback. Following successful tests, the app was released in Google Play and Apple App Store with cloud hosting for real-time data sync. The app is a flexible architecture as well that could be easily adapted to future enhancements like IOT based vehicle tracking and predictive maintenance with incremental updates.

1.5 Project Outcome

Car Doctor Application is designed to provide you safe, reliable, well-maintained vehicle and help Authorized service providers to manage vehicle maintenance with same quick pace. It's meant to make car care more straight-forward, boost confidence and make things easier for both parties.
For car users, the application has the following features:

- Discover authentic car parts and locate authorized service centers in a few clicks.
- Don't be fooled by the fakes that will waste your time and money with below-standard performance and mediocre AEV quality.
- Accept bookings instantly and easily, without chasing for time, or extra calls needed.
- Compare prices, and read feedback from verified customers in order to make the right choice.

For Service providers it helps with:

- Systemize customer details, storing and managing in a secure, structured way.
- Take the hassle out of staffing and scheduling.
- Real-time Monitoring on daily sales and performance, aiding on workflow and business optimization.
- Build an open and trust-based relationship with their customers and improve the image of their services.

In a word, the project intends to set up a reliable, systematic, and efficient service for car repairing. Built using up-to- date material design with the aid of modern technologies like Flutter and Firebase, the application is secure and scalable ensuring flawless user experience. Car owner, service provider and the entire car service market over a long term, arise to be beneficiary from Car Doctor, Making this a more organized and trustworthy car care industry.

1.6 Organization of the Report

The report is organized in chapters, guiding the reader through an overview of the Car Doctor project. Each chapter follows its own theme, starting with a problem introduction, followed by the methodology, the implementation, and the results, and closing with the discussion.
Chapter 1: Introduction This chapter describes the overview of the project and the issues found in car maintenance industry is discussed in the project overview such as the use of fake parts, uncertain price for the service, and the untrustworthy service provider. This chapter also presents the motivation and objectives of the Project for solving these issues through the Car Doctor app. It concludes with a section on the shape of the report to help the reader make their way through the next chapters.

Chapter 2: Background in this chapter we have outlined a background and kernel that needs to be understood to grasp the significance of our project. That includes how to develop mobile apps which you can build using Google's Flutter cross-platform framework and the Firebase back-end service, where you can change data and automatically watch it change in real-time. The chapter also lists out some of the key challenges that car-owners and car-services face and which the Car Doctor app would try to address.

Chapter 3: Research Method The chapter presents the methodology applied to implement the Car Doctor App. It begins by providing an overview of the system and detailing the functional and non-functional requirements. This is then followed by lookups on the project system design and user interface (UI) design. Also, I attached a project plan and task-on-template section to show what's the deal with the project.

Chapter 4: Implementation and Results: In this chapter you will know how you can implement the car doctor app. This includes the (A) environment and (B) tools developed, the (C) software employed and (D) the quality assurance. It breaks down and considers the performance well of the app itself and whether it meets the mark in its intended purpose and helping to achieve the project's objectives.

Chapter 5: Engineering Standards and Design Challenges in the fifth chapter we describe the engineering standards (the software, hardware and communication standards) that were applied in the project. The societal, environment and sustainability considerations in the project are also discussed, and ethics concerns. The chapter also presents the project management, financial analysis and difficult engineering problems that were faced.

Chapter 6: Conclusion The final chapter concludes the contribution of the Car Doctor project. It finishes by summarizing general app performance for the problems posed in the introduction. The chapter concludes reflecting about some limitations of the project as well as the options to extend and develop the app and its functionalities.

Chapter 2
Background

This chapter provides the background knowledge needed to understand the project and reviews related research and applications. It also presents a gap analysis that shows where our proposed system contributes. Finally, it highlights similar applications to place our work in context.

2.1 Introduction

Necessary background knowledge to understand the rest of the report:
Car Doctor is an Android app, and knowledge of mobile apps in general is important. This also applies to the UI/UX navigation and how the user interacts. It is one Flutter app created for cross platform with Dart language, so accustom with the Dart (Variables,Function.aysnc/await). On the backend, Firebase manages services for things like authentication and real-time data with Fire store that is used to update bookings, car parts and reviews. The application connects to external services via REST APIs. The app fulfills grievances within the automotive care sector like counterfeit parts, arbitrary pricing and unreliable workshops while giving service shops a platform for customer retention, reservation management and sales funneling.

2.2 Literature Review

Kumar & Patel (2019) Car Service App for Mobile
This was an experimental research on impact of mobile applications of car servicing. The findings show that the mobile tools have helped decrease missed services and improve the collaboration with the workshops as well as users' overall satisfaction.

Lee et al. (2020) IoT-based Prognostic Vehicle Maintenance Technique.
Lee et al., employed a prototype testing approach by IoT sensors on mobile apps. Their studies indicated that predictive maintenance can help accurately forecast potential issues before it occurs, reduce costs and enhance vehicle durability.

(2021) Fake After Sales Spare Parts in the Automotive Aftermarket: Singh & Roy (2021)
According to Singh & Roy, in the research take from survey it is observed that counterfeit spare parts brings risk of safety, economic loss, lack of trust National Workshop Practice,

Hernandez et al. (2020) Higher Education Students' and Customer Acceptance of on-line

Car Services
This qualitative study has revealed trust in digital automotive services to be established based on transparency, transparent (fair) pricing and consumer reviews.

A Cloud-based Automobile Servicing Record System (Chen and Zhao, 2022)
Chen and Zhao investigated cloud service record systems through a case study. The findings were that thanks to platforms like Firebase, secure and live management of information is made available, making service records reachable and credible.

Ali & Khan (2021) Digitization in Car Garages
In a series of surveys and interviews, Ali and Khan demonstrated that digital tools which ranged from a mobile booking and sales tracking system played a critical role in boosting the productivity of the workshops, managing customers and expanding the business.

Williams (2021) Block chain in the Automotive Market and Supply Chain
This research showed that the authenticity of spare parts may be verified and forgery issue in spare parts of automotive supply chain may be precluded by using block chain technology through a case study.

Martin et al. (2022) AI-Driven Predictive Maintenance
Martin and his research team performed experiments that demonstrated how an AI model was able to predict car breakdowns in advance, reducing downtime and associated repair costs.

Sharma et al. (2019) These Would Be the Mobile App Platforms for Car Service Management
A design study was performed with the intention of studying mobile solutions for service tools in the automotive domain. The authors have emphasized that all features, scales and user-friendly applications are built for mobile apps using platforms like flutter.

Conclusion:

From the literature reviewed synthesis of identified challenges and solutions in automotive service management such as the necessity of transparency, trust, and verification of genuine parts. The research of IOT, AI, and cloud-based systems showed us the opportunities for efficiency, predictive maintenance, and data processing that are available through modern technology. Findings from these papers informed the design and development of Car Doctor, so that Car Doctor solves real problems of both general car owners and service providers in real life and adopts technologies such as Flutter and Firebase to provide a secure, scalable and easy-to-use solution.

2.2.1 Similar Applications

Zantrik (Bangladesh):
Zantrik is an on-demand car maintenance and roadside assistance platform in Bangladesh. Customers can schedule a service, view and follow up on maintenance work and buy original spare parts.
Methodological Implications: Highlights the significance of service booking transparency and customer feedback in developing trust.
How relevant is Car Doctor: Just like Zantrik, Car Doctor provides service booking, transparency and real time data tracking using Firebase.

Sheba.xyz (Bangladesh):
Sheba. xyz is a pay as you go car repair app where users can hire mechanics or other car services available in different payment methods.
Theoretical Contribution: Suggests the importance of certified dealers and several payment methods to build up trust between customers.
Relevance to Car Doctor: Sheba, on the other hand. While it's true that both xyz and Car Doctor are related to car, the former is about services, the latter – care.

Your-Mechanic (USA):
This app lets you book mechanics that come to your location immediately. Mechanic origin details, prices and there's a booking form.
Approach: Establishes trust with mechanic validation, customer reviews, and fair prices
Relevance to Car Doctor: Trust-building and transparency are both similar to Car Doctor, except that car doctor focuses more on the service providers with services sales

MainteGO (Global):
Online preventive Maintenance platform that provides reminders, bookings and service.
Methodical Contribution: Offer repeat business for preventative maintenance & service.
Relevance to Car Doctor: While you can book and maintain records via MainteGO, the Car Doctor is designed to work against fake parts and workshop management.

ESHLAH (Middle East):
ESHLAH brings vehicle owners and their required services.
Methodical Contribution: Integrates ease of part ordering and service scheduling.
Relevance to Car Doctor: a like-to-like composition on parts and services, but implemented now with real-time data management using Firebase for better maintenance.

2.3 Gap Analysis

The comparison table 2.1 shows details of such car service platforms like Zantrik, Sheba. xyz, YourMechanic, Eshlah and Car Doctor. Car Doctor distinguishes itself with authentic parts verification, transparent pricing, dynamic sales monitoring and workshop management functionalities that can't be found on other solutions. Sure there are other platforms that have usually all the standard features such as appointment booking, reviews and ratings but If we added expertise on trust, transparency, fake parts prevention and cloud integration (using Firebase) it leads me to believe that 'Car Doctor' will be a more effective product for cars users and service providers.

2.1 Gap analysis.

Features	**Zantrik**	**Sheba.xyz**	**GCTL Infosys**	**YourMechanic**	**Eshlah**	**Proposed System (Car Doctor)**
Genuine parts verification	No	No	No	No	Yes	Yes
Transparent service pricing	Partial	No	No	No	No	Yes
Customer reviews & ratings	Yes	Yes	Yes	Yes	Yes	Yes
Appointment booking	Yes	Yes	Yes	Yes	Yes	Yes
Real-time sales tracking	No	No	Yes	Yes	No	Yes
Service history / record management	Yes	No	Yes	Yes	Yes	Yes
Multiple payment options	Yes	Yes	Yes	Yes	Yes	Yes
Real-time notifications/reminders	Partial	No	No	Partial	No	Yes
Workshop management tools	Partial	No	Yes	No	Partial	Yes
Fake parts prevention system	No	No	Yes	No	No	No
Cloud-based system (Firebase)	No	No	Yes	Yes	No	Yes
Trust & Transparency focus	Partial	Yes	No	Yes	Partial	Yes

2.4 Summary

This chapter presented Car Doctor application including the basics of mobile app, cross-platform development with Flutter and Dart, and real-time data management through Firebase. It tackled issues in the industry such as counterfeit parts and bad workshop management. The review of literature revealed the technologies such as IOT, block chain and AI in automotive maintenance. Analysis of the competition showed that most of these apps were restrictive and unable to prevent fake parts, or even track sales in real time. There is a missing piece Car Doctor filling in with everywhere, real parts, online booking and notifications plus, the workshop tools. The app caters to building confidence between car owners and service providers. It is also scalable to support development requirements of automotive service industry in future.

Chapter 3
Research Methodology

This chapter outlines the methodology used in developing the Car Doctor app. System design, functional, non-functional requirements have been covered here. Also all the approach and process have been described here

3.1 Requirement Analysis & Design Specification

Car Doctor app, to serve both the car owners and service providers. Functional Requirements and their complete non-functional specifications have been listed in the app's requirement analysis as defined below. Functional Users can sign up on the app with firebase using secure login for logging in etc. It also allows users to book serviced on-demand, compare prices between providers and look for real vehicle parts. The app also lets the users place their comments and ratings for services that help in developing a trusted network of car owners and service providers. Non-functional requirements address performance, including fast and responsive running for the application and safe transfer of data. The app UI is meant to be simple and user-friendly as well scalable for growing needs of number of users and data. The system is designed using Flutter, which makes the app available for both Android and IOS devices. Firebase provides us real-time, secure backend support. Alert Messaging has been seamlessly integrated in the application to receive real time appointment and scheduling updates. App UI is simple, smooth and responsive which will give wonderful user experience on mobile devices as well as laptops. Focusing on security, usability, and scalability the Car Doctor app is a comprehensive solution for your car servicing requirements.

3.1.1 Overview

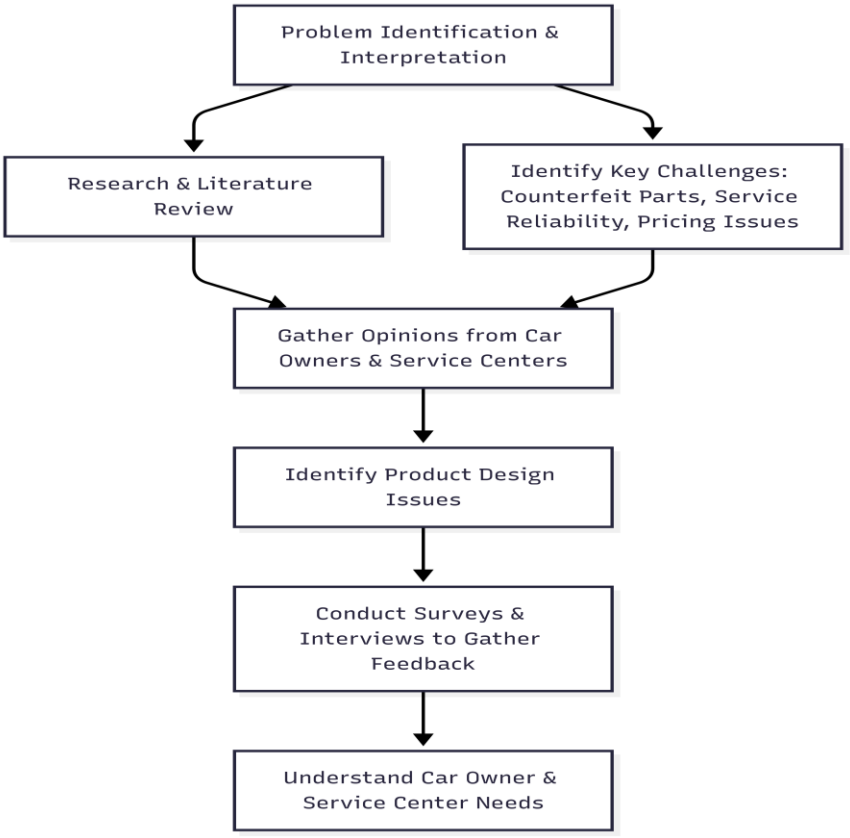
In this section we provide foundation of developing Car Doctor application by providing the requirement analysis and design specification set required to support the functionality, and performance and user experience of Car Doctor. Car Doctor aims to solve some of the most difficult issues in car repair industry. From counterfeit components, nontransparent price policy, service management to even everyone's behavior, Car Doctor would be building a mobile platform to help vehicle owner match with authentic parts and certified auto service and also as well as service advice. Featuring such functionalities as; user registration as well as Firebase authentication, appointment booking service on-the-go for your car, prices of the same service from different service providers, original car parts and so much more all identified through an intense requirement process. Non-functional requirements include performance (responsive and snappy behavior), security (encryption of data at rest and in transit over the wires), usability (intuitive and easy user experience), and. scalability (ability to

handle growing data and user activity). The system was designed using Flutter, a cross platform framework, which enabled to have strong platform specific application on Android and I OS platforms and to reduce development cost and its maintenance. Firebase - backend that offers synchronized-offline data, real-time data updates, support for bindings, cloud services etc. User interface The UI is minimal, responsive and flexible and fits to any devices from very wide monitors to small smartphones, as such all sizes of seat from tech savvy car owner to little service would be able to use it. This end-to-end approach is how the Car Doctor app is not only fulfilling a user need in the here and now, it is establishing a scalable, secure, and user friendly foundation for future services: - driver predictive maintenance and IOT orchestrations.

3.1.2 System Design

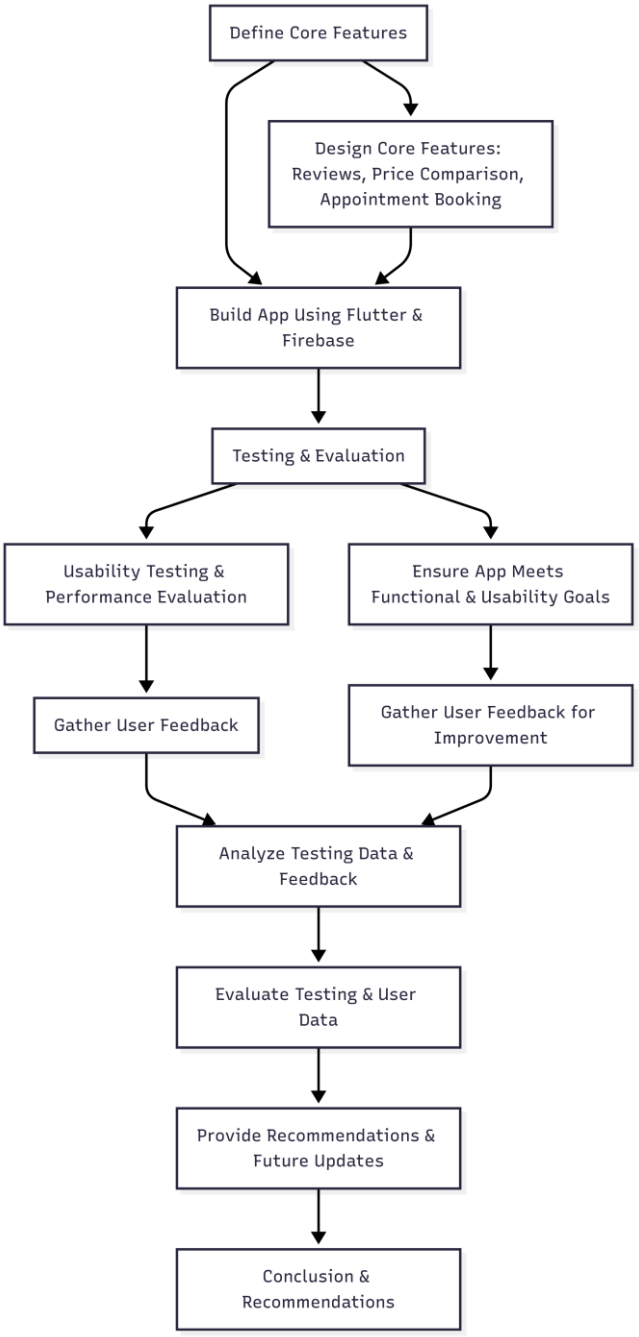
This Problem Identification and System Design diagram 3.1 shows the phase of how we have identified key challenges gathered opinion from car owners and service providers. And many more the problem identification phase is this diagram.

Figure 3.1: Problem Identification and System Design



This this diagram 3.2 shows the flow for development, testing and evaluation phases of Car Doctor App. It shows a clear flow of our implementation phase of the application.

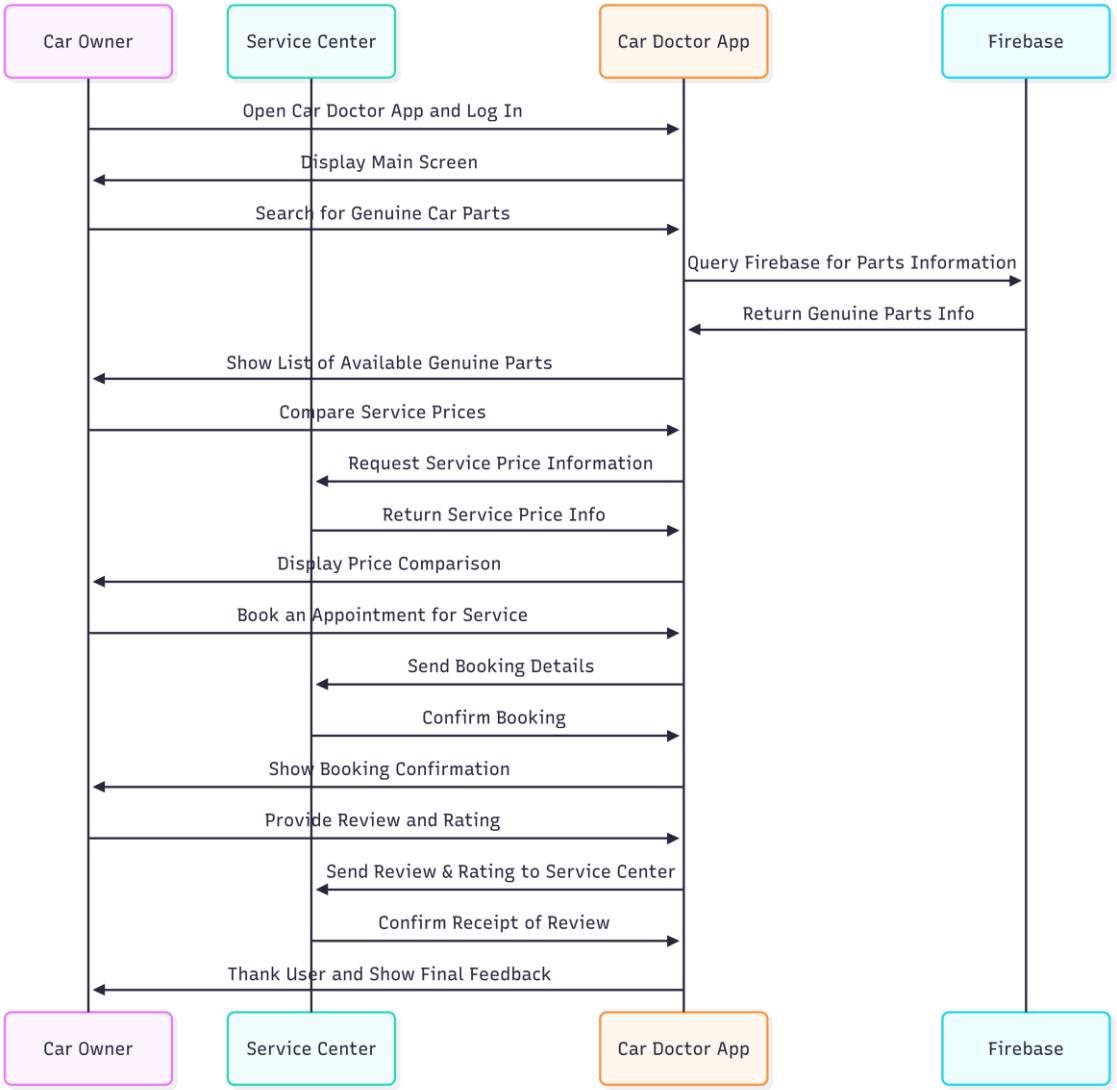
Figure 3.2: Development, Testing, and Evaluation



Sequence Diagram: -

This figure 3.3 illustrates the flow diagram of Car Doctor App, which describes interaction among Car Owner, service center and Firebase. The process starts with the owner of the car logging in to the app and searching for original parts of a car and viewing them available from firebase. The owner of the car can now compare prices of services by means of a query to the service center. Once the service has been selected, car owner makes an appointment This is confirmed by the service center. The car owner then feeds back a review after the entire service Which is passed onto the Service Centre. The app then thanks the user and provides closing feedback. This plan offers the same fluidity and convenience for both car owners and service centers.

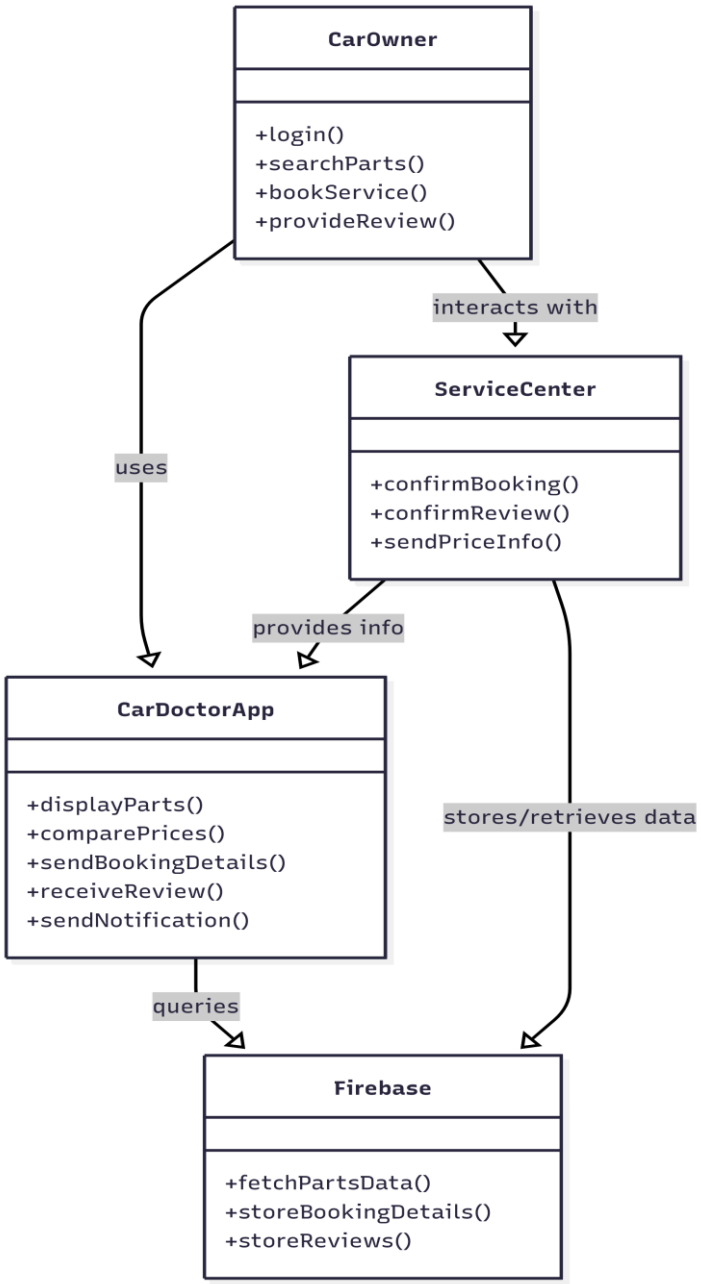
3.3 Sequence Diagram



Class Diagram

The class diagram 3.4 illustrates the association among important entities of the Car Doctor system. car Owner communicates with the Car Doctor App and has functions to look up parts, make appointments and leave feedback. The Service Center both adjusts pricing and verifies bookings & reviews, while the Car Doctor App is responsible for communication between car owner and service center, seeking Firebase for parts and services data. Important data like parts data, service bookings and reviews are stored with Firebase. This is a diagram to show the general function and interaction of the components of the app.

3.4 Class Diagram



3.1.3 Functional and Nonfunctional Requirements

Functional Requirements:

- User Management: Safe registration, login, password retrieval and account editing. Access is limited to users.
- Booking Appointment: Users can schedule and reschedule service appointments with live availability to avoid double booking.
- Catalog and Ordering searchable catalog of OEM parts with descriptions; cart items that users can add and checkout.
- Search and Filter: Followers may look parts by price, rating, location or type in just a few taps.
- Rating and review: Users can rate and write a review about services which are visible to other users for better assistance.
- Service Reminder & Order Status Docketing) on your booking, notice service reminders and order status via our notification service.
- Secure Transaction: Secure end-to-end encryption, supporting credit card and mobile payment.

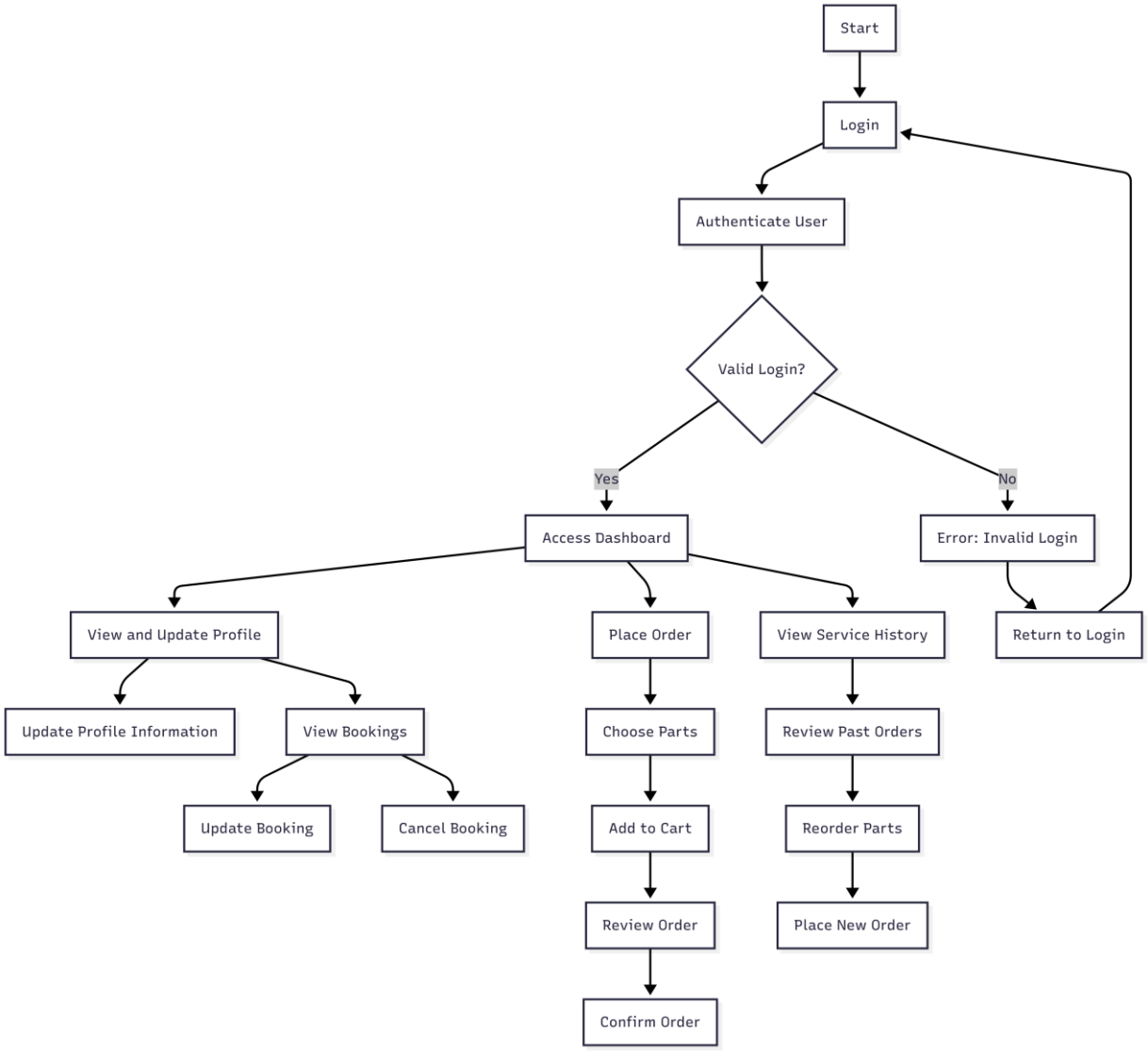
Non-Functional Requirements:

- Quality: The system should be reliable, testable and send consistent messages.
- Usability: The interface should be intuitive with a user-friendly clean design that overall runs smooth on Android and iOS.
- Data Trustworthiness: The system needs to provide accurate data, even in case of partial errors.
- Performance Hopefully these static pages will load in 2-3 seconds and support hundreds of users with no lag.
- Security: Encryption standard and secured authentication (OTP/token based) with role-based data access.
- Scalable: More users, services, shops should be supported without significant architect changes.
- Availability: The app must be available >99% of the time, with downtime limited to maintenance.
- Maintainable: The system must be sufficiently modular, with adequate documentation and ease of updating / incorporating new features.

3.1.4 Data Flow Diagram

The user flow logic in the Car Doctor app is illustrated in the diagram 3.5 and includes user registration (sign up) along with login and authentication. Once logged in successfully, the users have the dashboard section where from they can Profile Management, view & update booking information, request for a service and review of service history. After failed login, a retry message is shown on the Login screen. Users can also reorder parts according to previous service history (which shortens the time). It's a user-friendly app that has a seamless transfer from one activity to the next, so people are constantly on top of their appointments and services. The flow is built to be intuitive, to keep clutter down and let people engage with the most important features such as booking a service, buying some parts or leaving feedback. By doing this it makes using the app more user-friendly by allowing quick access to core features

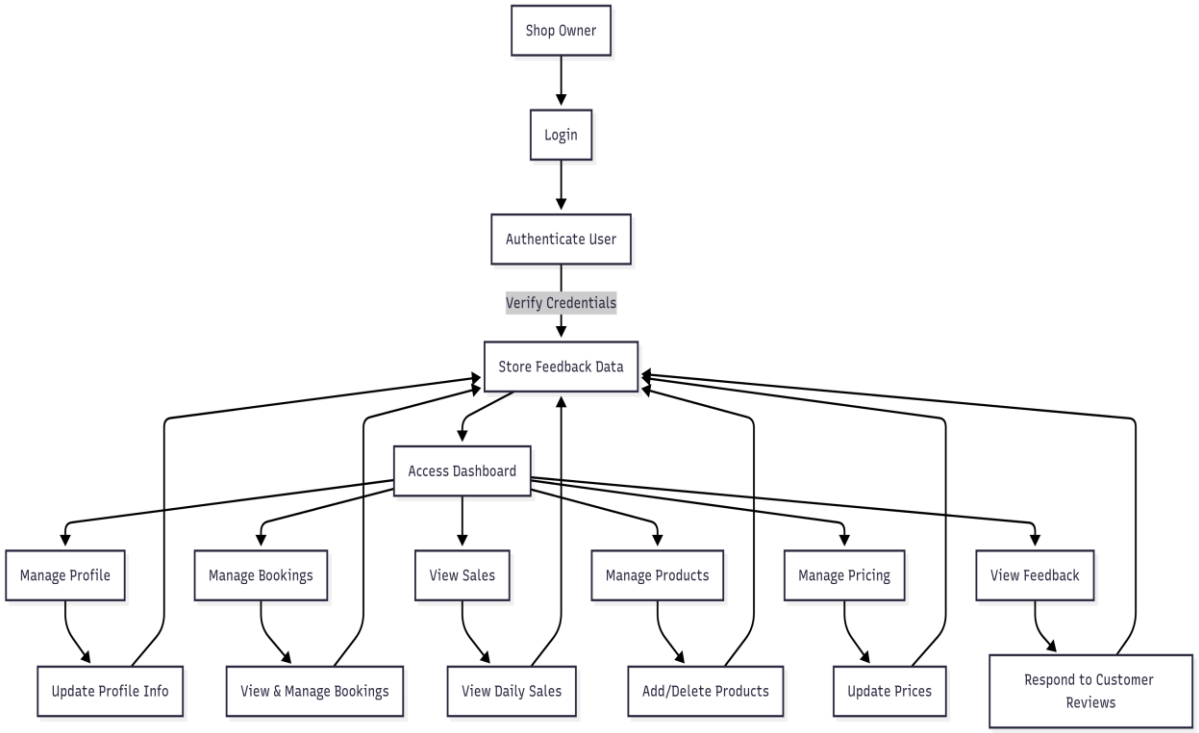
3.5 User Data Flow Diagram



Service provider Data Flow Diagram

This Data Flow Diagram (DFD) 3.6 defines the state of data for Shop Owner in Car Doctor application. The process starts with the Shop Owner being logged into the system, and their identities gets confirmed via Firebase. After signing in, the Shop Owner can manage a plethora of options from an intuitive user dashboard, available after logging in. These tasks involve updating their profile, taking control over bookings, seeing what sales have been made and finally the ability to change products information and pricing which is stored and kept in sync by Firebase. And shop owner can feedback customer review and reply to it. DFD is represented in a succinct way, with the central activities being presented without too much complexity and every process smoothly leads to the next, while all data are stored efficiently in the cloud. This provides a nice interface between the Shop Owner, Car Doctor App and Firebase.

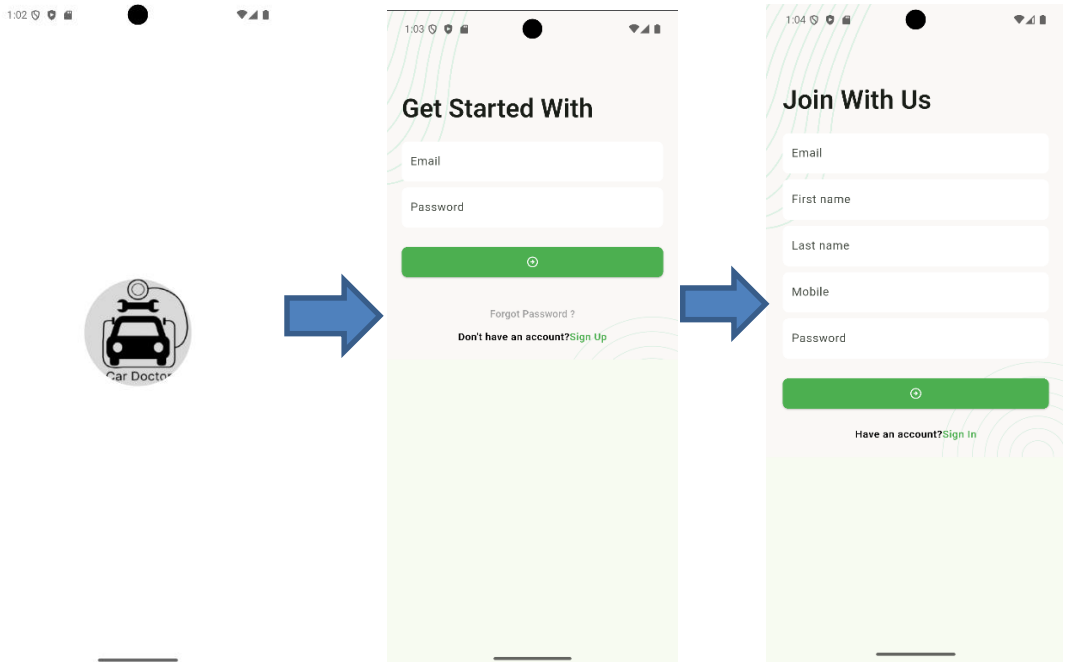
3.6 Service provider Data Flow Diagram



3.1.5 UI Design

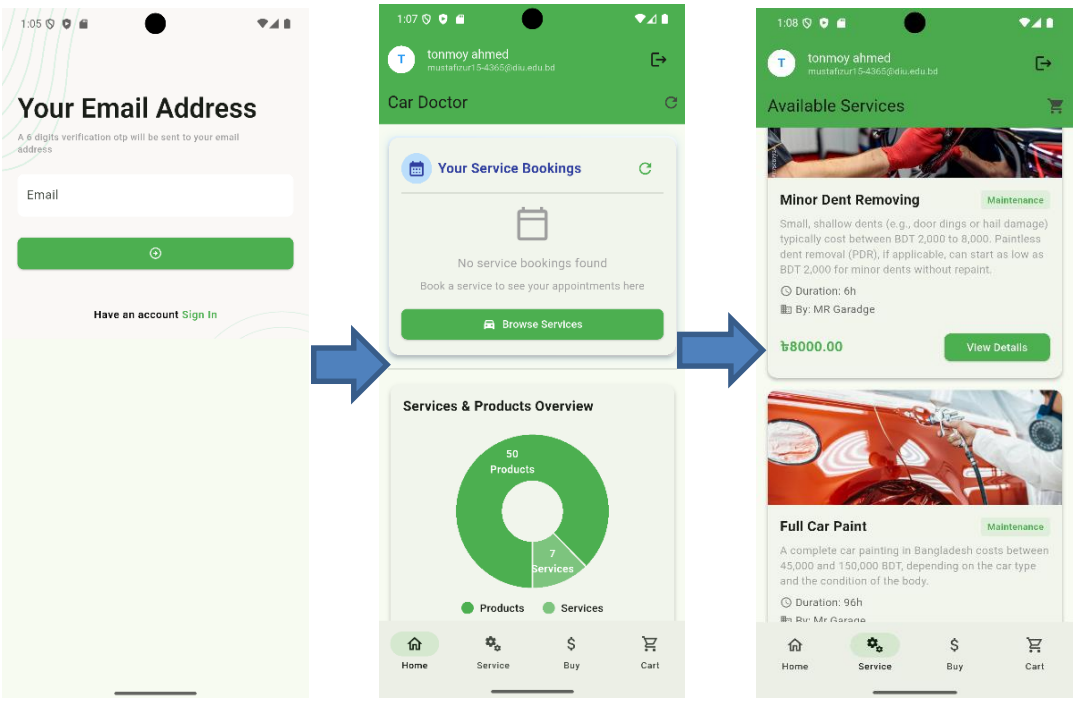
User UI

Fig 3.7 User Login & Signup Screen



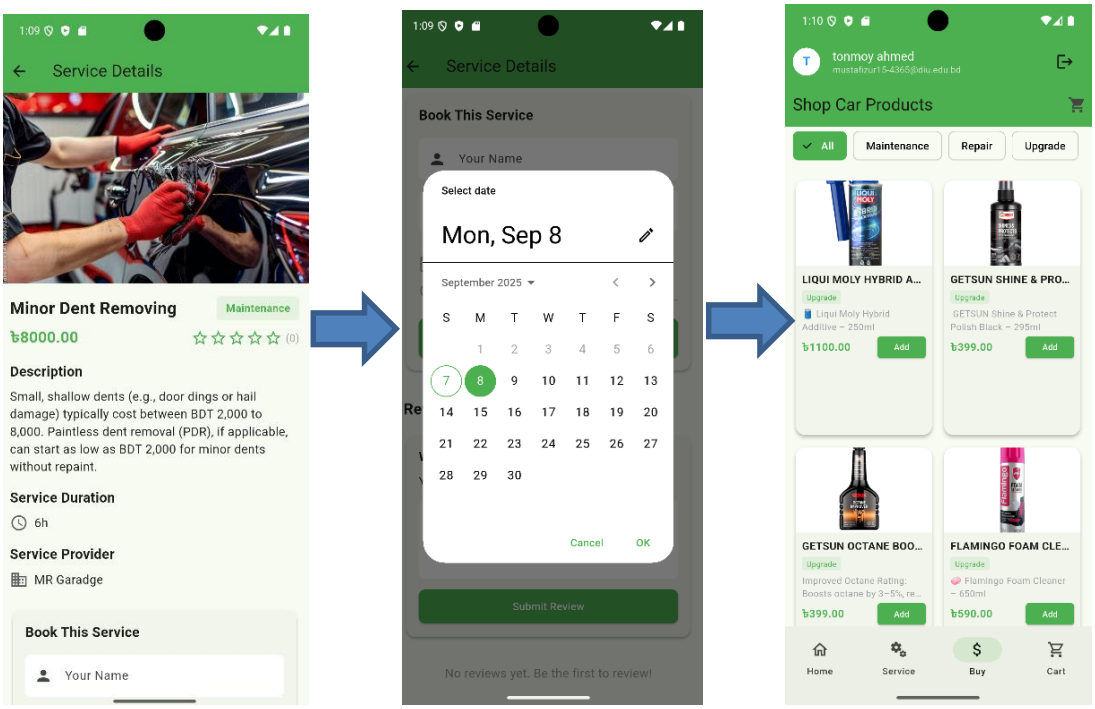
Loading page Log in Page Sign Up Page

Fig 3.8 User Forgot Password & Home Page Screen



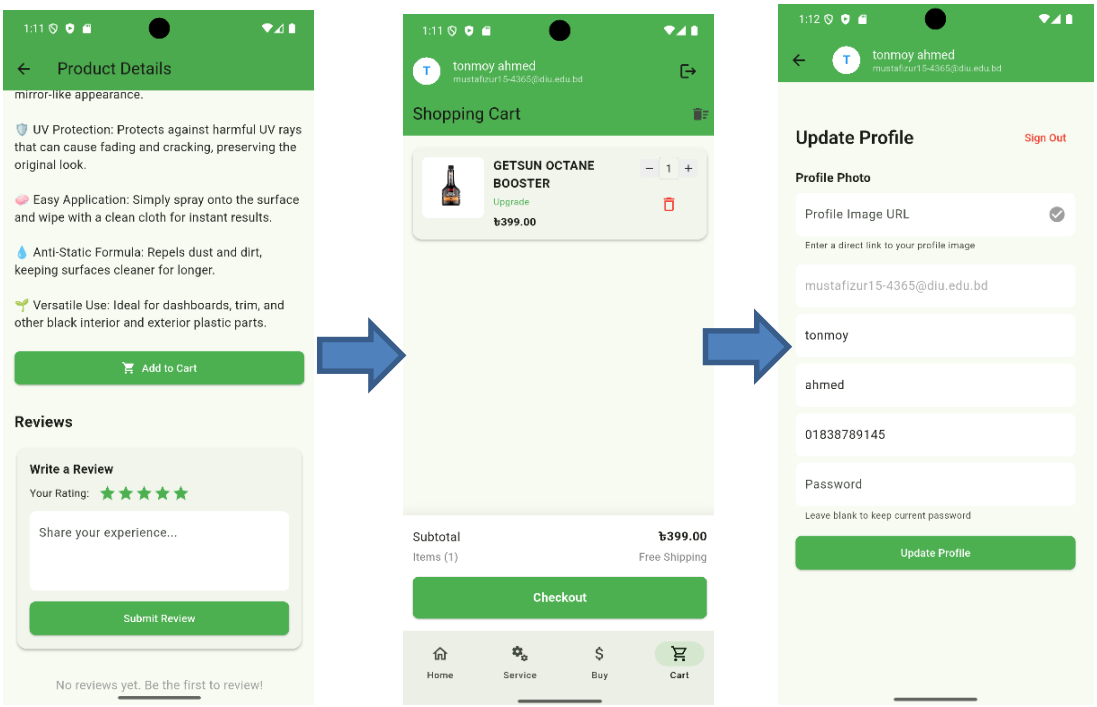
Forgot Pass Page User Home Page Service Page

Fig 3.9 User Service Details & Item Buy Screen



Service Details | Service Date Select | Item Buy Screen

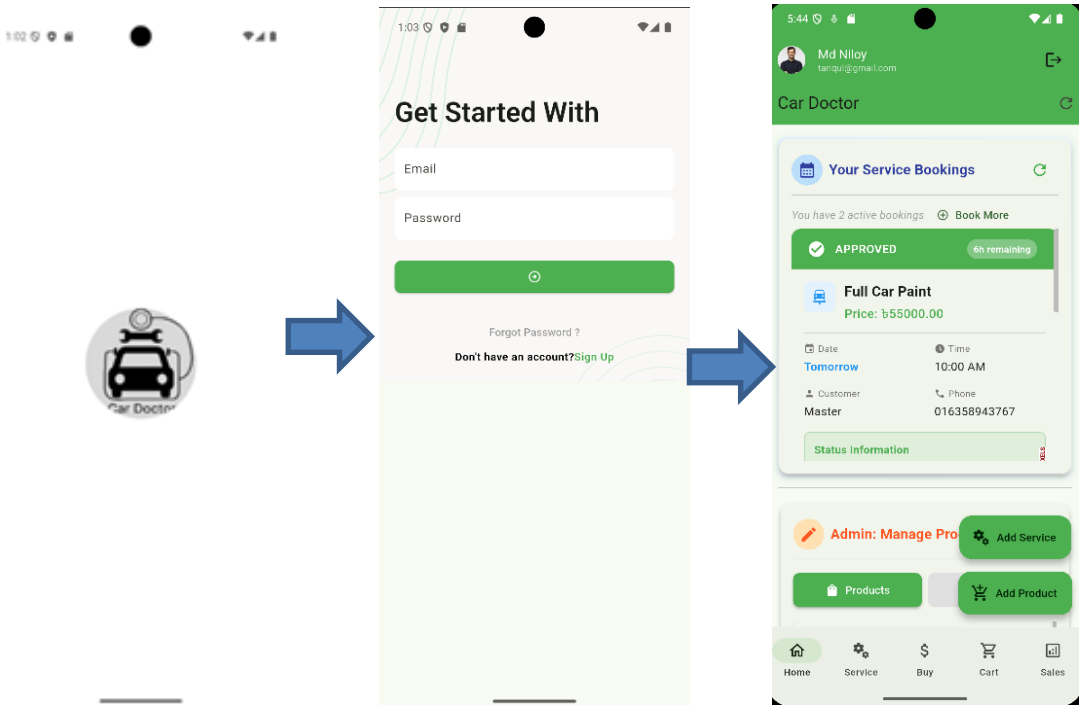
Fig 3.10 User Product Details, Cart & User Info Screen



Product Detail Page | cart page | User Info Page

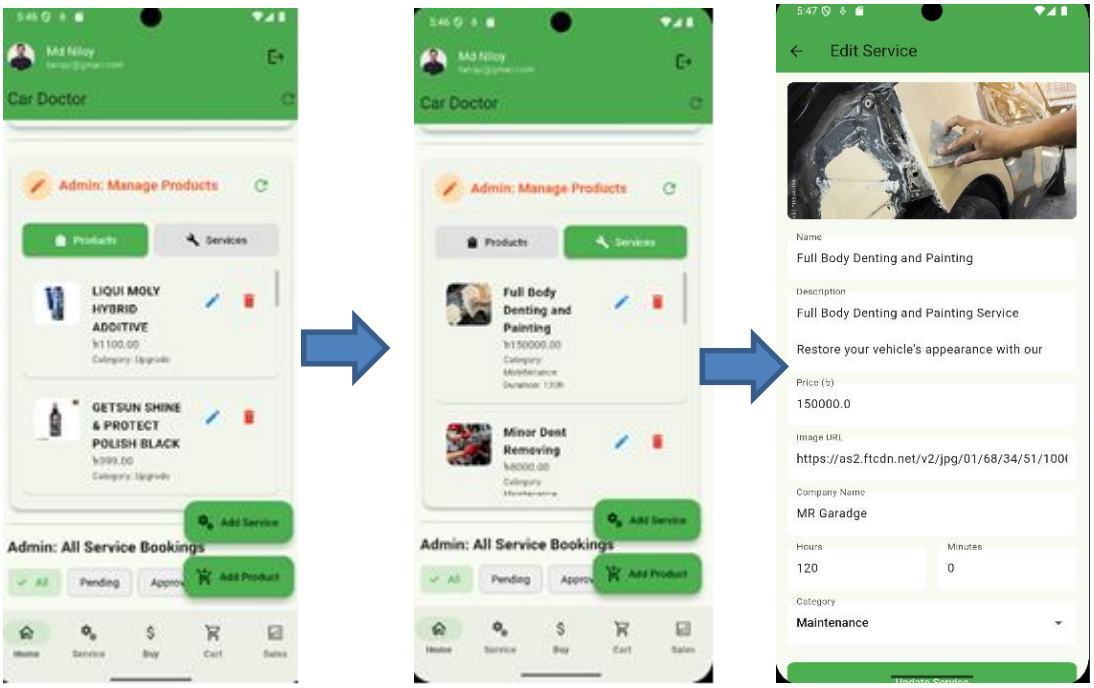
Shop Owner UI

Fig 3.11 Shop Owner Login & Dashboard Screen



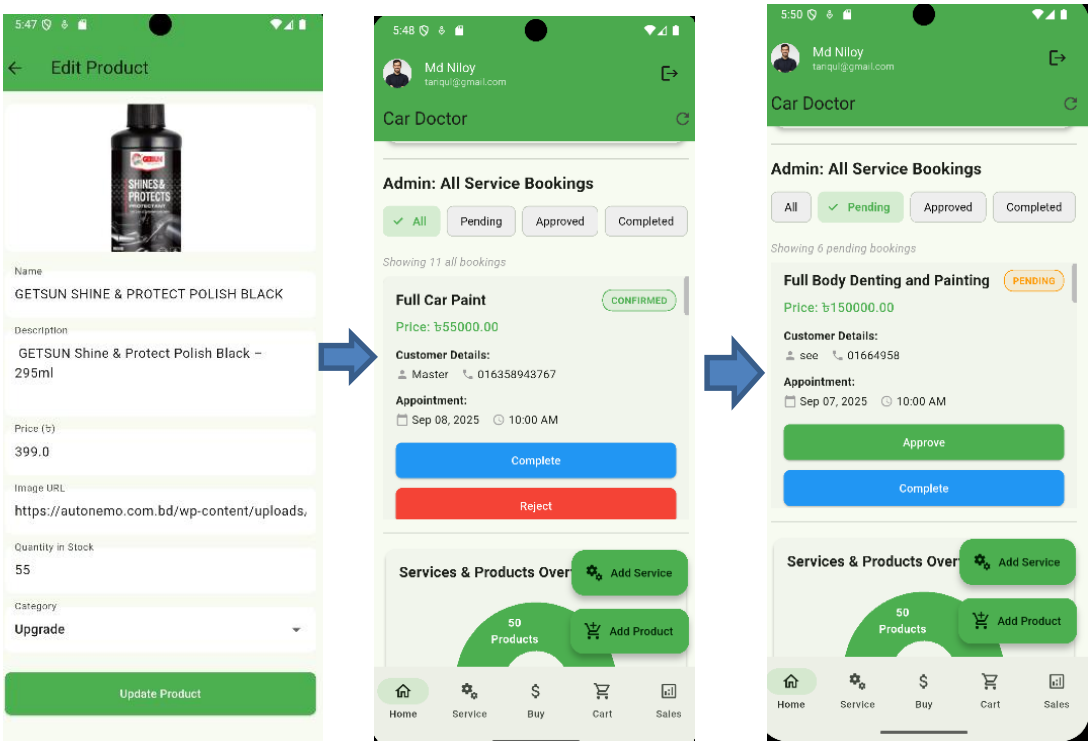
Loading Screen **Log in Screen** **Owner DashBoard**

Fig 3.12 Shop Owner Product, Service Add & Edit Service Screen



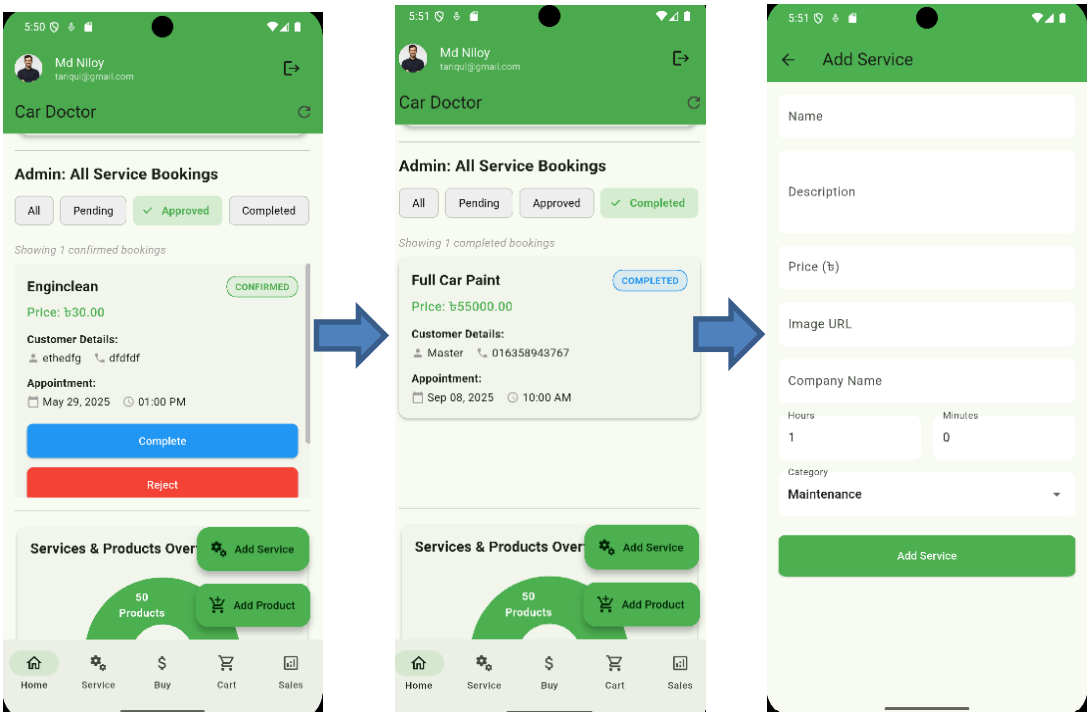
Added Products **Added Services** **Edit added Service**

Fig 3.13 Shop Owner Edit Product, Accept Request& Booking Screen



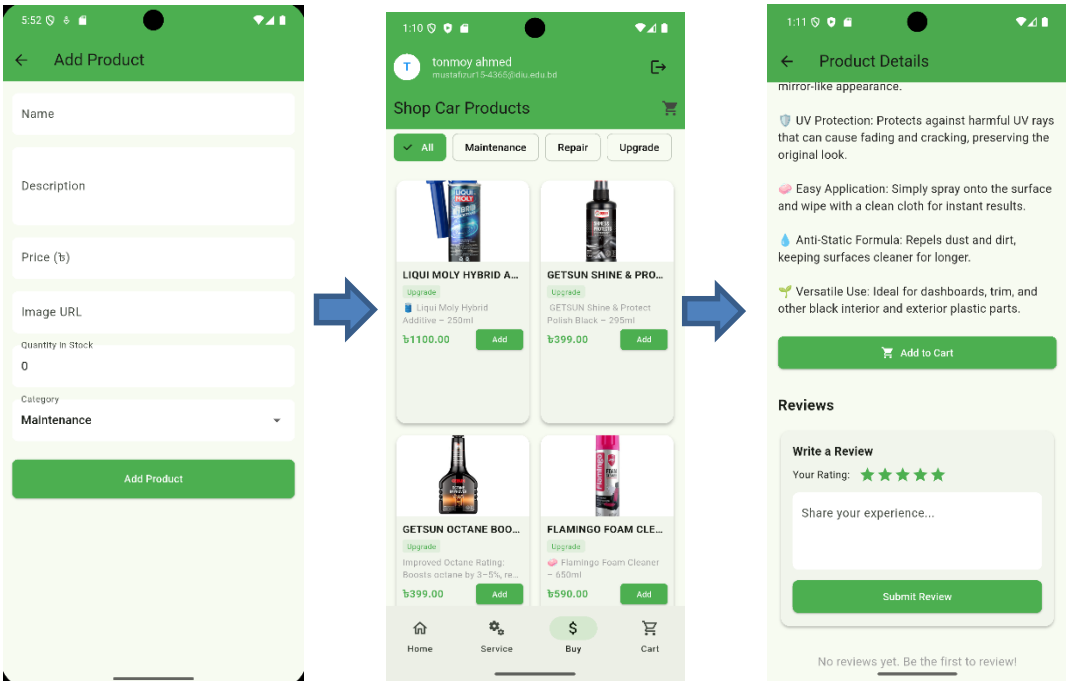
Edit Added Product **Booking Details All** **Booking Details Pending**

Fig 3.14 Shop Owner Booking & Add Service Screen



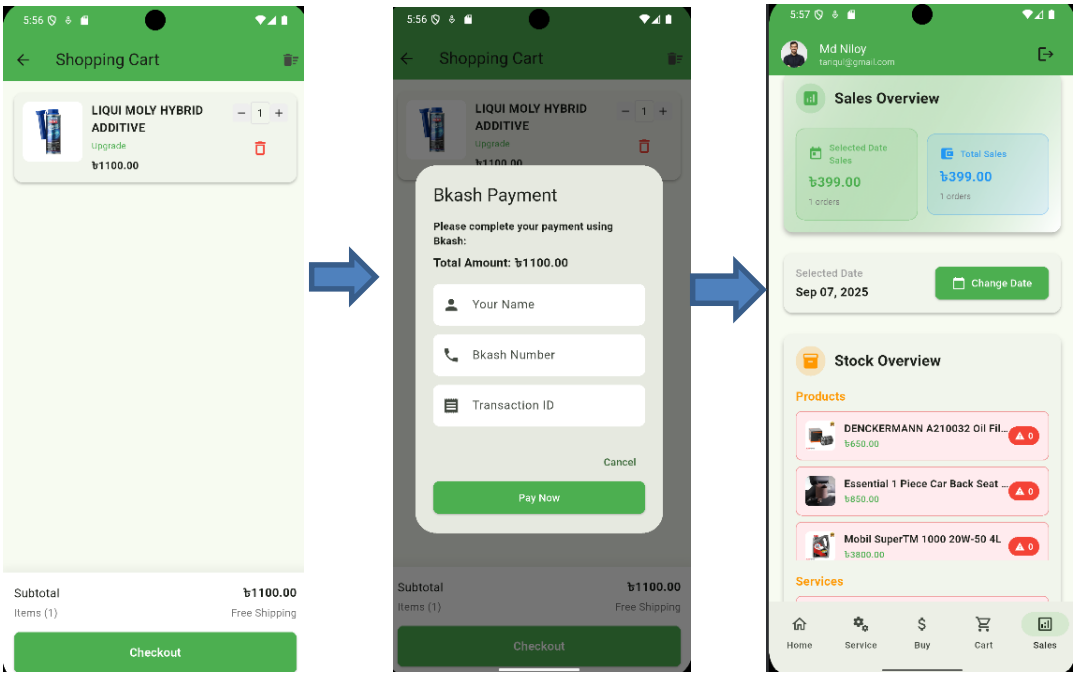
Booking Details Approved **Booking Details Completed** **Add Services**

Fig 3.15 Shop Owner Add Product, Buy Product & Product Details Screen



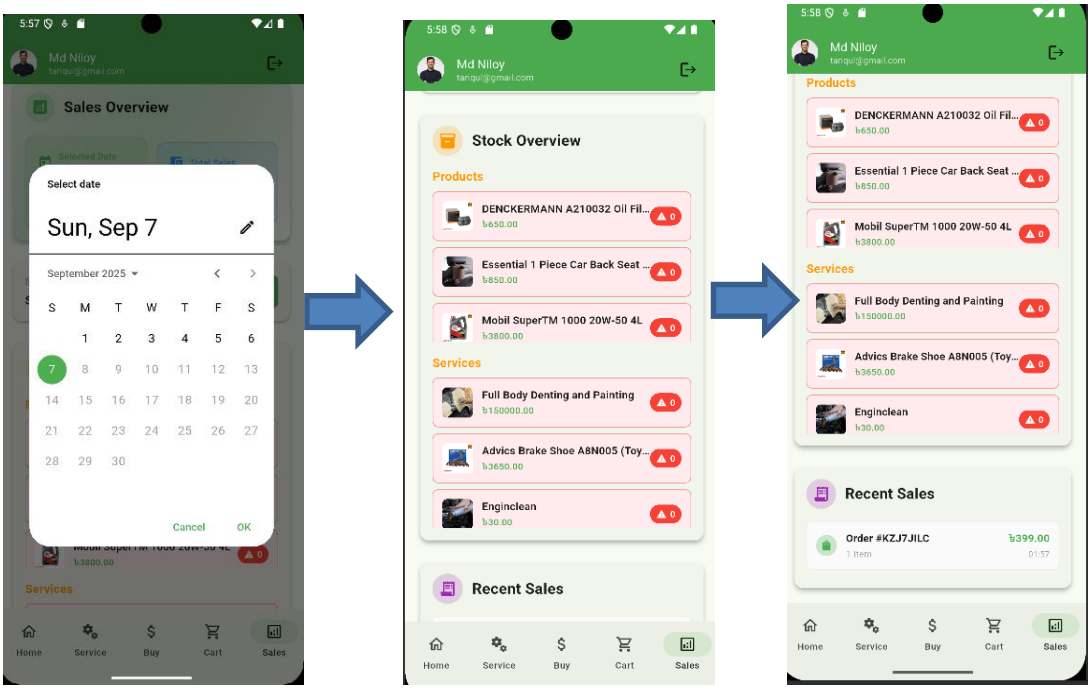
Add Product **Buy Product** **Product Details**

Fig 3.16 Shop Owner Shopping cart, Checkout & Sales Details Screen



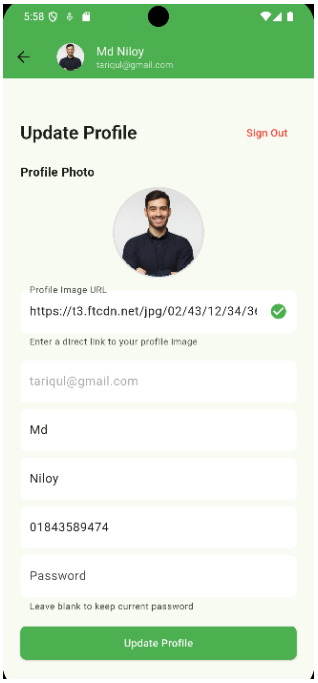
Shopping Cart **If pressed Checkout** **Sales Details**

Fig 3.17 Shop Owner Stock overview & Recent Sales Details Screen



To See Specific Day Sale **Stock OverView** **Recent Sales**

Fig 3.18 Shop Owner Profile Details Screen



Owner Profile Details

3.2 Detailed Methodology and Design

Several paths of development were considered in the case of this project before the final solution was chosen.

Alternate Solutions Considered:

Old School Service Directory Site: A basic directory of car service and spare parts providers. But this would only be a browsing and not booking or buying provision.

Third-party Integration Platforms: Use established e-Commerce or booking platforms and customizing it. This alternative was rejected because of limited customizability and further dependence on third-party APIs, besides potential licensing fees.

Exclusive Mobile App: Build a mobile app tailored to car service, part purchases, and appointment booking. Such a response is equipped with engaging the user better, the task being carried out in real-time and transactions are secure.

Final Solution Chosen:

We chose dedicated mobile application based approach as the most appropriate design pattern for the case of Bangladesh. The majority of service centers and garages around the country are small and cramped with no facilities for computing or using laptops. The use of websites in these spaces is awkward and time consuming because it involves continuous search and browsing through the internet. Almost everyone for today has a smartphone and that means that a Mobile App is available and easy to use. No website browsing required: No website navigation mess, direct booking/purchase and real-time notice. Furthermore, it permits users & small shop who do have money and ability to manage services in an efficient way but does not have expensive computer services.

Design Approach:

Frontend Design: Developed using Flutter to target Android and iOS.

Backend System: Authenticate with Firebase Real-time database and store data in it. Cloud Firebase push notification.

Database Design: Created to manage user information, booking dates, shop info, inventory, and reviews.

How the system flows: register>> Browse services/parts>> Book/request>> confirmation>> Feedback/reviews.

Fig 3.19System Flow Diagram

3.3 Project Plan

The Car Doctor was divided in several phases to guarantee an orderly progress and a correct finalization. There were key deliverable and goals for every phase so the team was guided effectively. Plan covers from Week12 to Week 48 and mostly includes research, design, development, test and deployment.

Table 3.1 Project Plan

Phase	Task/Activity	Start Date	Finish Date	Time Taken	Progress	Handled By
Requirement Analysis & Planning	Identify Users Needs	Feb 1, 2025	Feb 14, 2025	2 Weeks	100%	Mustafizur Rahman & Jahid Hasan
System Design	Architecture & UI Design	Feb 15, 2025	Mar 14, 2025	4 Weeks	90%	Jahid Hasan
Data Collection & Preprocessing	Collect Data And analyze	Mar 15, 2025	Apr30, 2025	7 Weeks	80%	Jahid Hasan
Frontend Development (Flutter)	Build Mobile UI	May 1, 2025	Jun 30, 2025	9 Weeks	90%	Mustafizur Rahman & Jahid Hasan
Backend Development	Firebase Setup	May 15 2025	Jul 15 2025	9 Weeks	90%	Mustafizur Rahman
Integration & API	Connect Front and Back end	Jul 1, 2025	Jul 31 2025	4 Weeks	90%	Mustafizur Rahman
Testing & Evaluation	Functional & Performance	Aug 1 2025	Aug 15 2025	2 Weeks	75%	Mustafizur Rahman & Jahid Hasan
Demo Application & Deployment	Deploy working application	Aug 16 2025	Aug 31 2025	2 Weeks	100%	Mustafizur Rahman
Documentation & Final Report	Final report & Presentation	Sep 1 2025	Sep 8 2025	1 Weeks	80%	Mustafizur Rahman & Jahid Hasan

This table describes main stages and tasks of the Car Doctor app creation. We were able to finish the Requirement Analysis and System Design at 100% and 90%, respectively. Data Collection and Frontend Development took around 7 and 9 weeks with almost 80% and nearly up to 90% completed. Backend Setup and API Integration were done in 9 and

4 weeks respectively at a rate of 90%. Testing and Demo Deployment 75% and 100% of completion in two weeks. Lastly, Documentation has been completed in a week with 80%

3.4 Task Allocation

The Task Allocation Table 3.2 following is a timeline of the stages (and estimated duration) in relation to a 48-week project program. The phases are: Requirement Analysis & Planning System Design Data Collection & Preprocessing Frontend Development (Flutter) Backend Development Each phase is over a period of weeks.

Table 3.2 Task Allocation

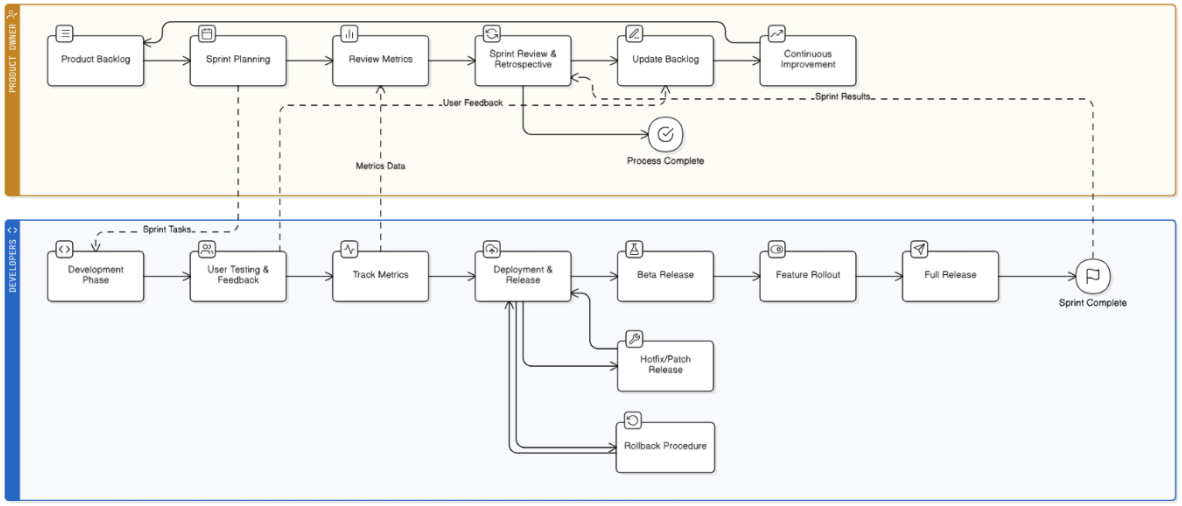
Tasks	Weeks																		
	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Requirement Analysis & Planning																			
System Design																			
Data Collection & Preprocessing																			
Frontend Development (Flutter)																			
Backend Development																			
Integration & API																			
Testing & Evaluation																			
Demo Application & Deployment																			
Documentation & Final Report																			

Model used for development:

The model adopted for this development is Agile, which follows adaptive planning and iterative development and delivery encouraged with constant user feedback. The model was selected for Car Doctor app because of its ability to create apps quickly, provide rapid feedback to the needs of users and react easily to changes in the course of development. 'The ERP there however requires constant upkeep, as they add new functionality book appointments, check prices or adding AI-based predictive maintenance and IoT integration; which makes Agile the perfect fit for this kind of work.

The Agile model begins with the generation of a Product Backlog, an ordered list of features or user stories that are prioritized according to customer needs. The team will do work in short sprints (2-4 weeks) to build specific features and review feedback at the conclusion of each sprint. This feedback is taken to backlog grooming for future sprints. Progress is measured in a few key statistics, and features are released incrementally, starting with beta releases up to the full release. The method supports the user centricity of the app and its market drivenness.

3.20 Agile Model Diagram



3.5 Summary

Car Doctor tackles problems such as fake parts, murky pricing and bad service by providing an open, easy-to-use site. Made with Flutter and Firebase, it allows car owners to purchase original parts, schedule appointments, compare prices and read reviews, and offers service providers Customer Relation Management and sales tracking tools. The app of the green and paperless operation, as well as General Data Protection Regulation compliant data practices, is initially concentrating on Bangladesh but will soon scale with AI and IOT capabilities.

Chapter 4

Implementation and Results

The chapter provides the detailed configuration of the development environment to develop the Car Doctor application in an environment having Windows operating system. It includes all necessary tools, software, and configurations for the application to run, test and debug properly.

4.1 Environment Setup

System Requirements:

- OS: Windows 10 or later(64bit)
- RAM: 8 GB or higher
- Disk Space: 2GB of disk space to install Flutter and Android Studio, plus an additional 1 GB for Android SDK and emulator system image.
- Processor: Intel i5 or better (emulators require VT-X support)
- Internet: SDKs, plugins, and Firebase tools require access to Google servers.

Installing Android Studio:

- Now first download and install the following from link1explained in Install the Google USB driver article Android SDK, Platform-Tools & Android Virtual Device(AVD).
- Setting up Flutter & Dart:
- Download and uncompressed the flutter sdk.
- If you have added Flutter to your path.
- Check the installation with flutter doctor

Emulator Setup:

- Open AVD Manager, and create new virtual device with 2GB Ram, 2 GB storage OK.
- Test with an emulator With hot reload enabled, you can experiment quickly, as the app builds and updates the changes as you make them To hot restart after making changes to the native code, press Streams default: false), If true, keystone SHA-1 will be fetched from Google Play Console; if false (default) then from key tool Execute your project using flutter run --no-hot Hitting r on doesn't recover home again into Hot Reload Use another shortcut for resetting it which is actually hiding under a command called same flutter run --no-hot just use R instead of r coming next custom keyboard package This package is just show-casing Some Hot Reloading while developing custom keyboard boss mod

Firebase Integration:

- Add your app in the next screen and give it package name of your app to create a firebase project.
- Download google-services. json and place it in the android/app/ directory
- Include Firebase dependencies to pubspec. yaml:
- Start Firebase in main. dart before running the app:

Running the App:

- Run it in Android Studio or run the following command in the terminal:
- flutter run
- For hot reload: r in the terminal, or Ctrl + S in an IDE.
- Hot restart: R (terminal) or Shift + Ctrl + F5 (IDE)

Troubleshooting:

- If emulator doesn't launch go to BIOS and enable Virtualization
- Adhere to flutter doctor warnings and correct things such a missing Dart SDK or the Gradle setup

4.2 Testing and Evaluation/Performance/ Comparative Analysis

Testing and Performance Evaluation

- Testing Approach: The stability and three properties of usability were checked:
- Functional Testing: Tested All Registration, Login, Logout and Unauthorized access.
- Service & Parts Preview: Tuned services and parts are displayed with the right information.
- Booking/Request System View the available services and order them, as well as accept request from others.
- Feedback & Reviews: Satisfactory feedback submitting and displaying.
- Notifications: push up Booking is successfully success messages which appears.

Usability Testing:

- Easy useful: Core features one click away.
- UI: The UI is clean, the fonts are checkable and easy to navigate.
- Flow: Seamlessness from sign-up to booking.

Compatibility Testing:

- Devices I was tried on Android 11,12 and 13, using two phones(6.1 inch and 6.7 inch screen).
- Orientation: Full portrait Compatibility tested in landscape orientation Overview The exact specifications of the test are needed.

Performance Testing:

- Response Time: The time taken to retrieve the statistics data from Firebase.
- Scalable: Tested multiple user booking at once.
- System Resources Utilization: App is tested on poorer quality device and requires just 4MB of memory to work efficiently.

To understand the effectiveness of Car Doctor, a comparison was made against existing solutions:

Comparative Analysis Table 4.1 compares Car Doctor Mobile App with Other Traditional Service Centers and Web-based Platforms. Shop hours restrict traditional centers, and in-person visits are necessary; web platforms require a computer system and internet. Accessible 24/7 through a straightforward telephone interface, the Car Doctor app features fast booking options and review integration. It's faster to use and because it is cloud-based, can be scaled up with ease unlike the slower, more limited applications of both traditional and web apps.

Table 4.1 Comparative Analysis

Feature / Criteria	Traditional Service Centers	Web-based Platforms	Car Doctor Mobile App
Accessibility	Limited to shop hours	Available via browsers	24/7 access on smartphones
Ease of Use	Manual, requires physical visit	Requires computer and internet	Simple mobile interface
Booking Process	In-person or phone call	Manual forms and search	Quick booking & confirmation
Feedback/Review System	Rare or informal	Optional, sometimes hidden	Integrated rating and reviews
Speed & Convenience	Slow, requires waiting	Moderate (desktop use)	Fast, smartphone-driven
Requirement	Shop visit, time, effort	Computer/laptop + internet	Smartphone with internet
Scalability	Limited to shop capacity	Limited by web access	Scales easily with cloud backend

4.3 Results and Discussion

The Car Doctor app was developed and ran successfully under an Android emulator in a Windows machine. The application proved to be highly stable, operated seamlessly and dealt with multiple operation without significant errors.

Results: The Car Doctor app performed well -in our test it ran well in an Android emulator on Windows platform. The app managed a variety of functions with few mistakes. Users were able to easily sign up and log in in a secure manner, and could look at car services, spare parts, suppliers etc. The booking experience was easy with fast confirmation, no waiting around and there were reviews to give the users assistance in selecting. Although the app was very responsive and robust, there is further room of improvement especially

for multiple users to interact at the same time.

Discussion:

Unfortunately, there were several substantial advantages relative to cf-biased methodology:

Accessibility: Smartphone access 24/7 to schedule appointments and utilize services any time.
Usability: The app was easy to use, making it suitable for users who were not tech-savvy.

Efficiency: The reservation platform was quick and easy to schedule, with no time wasted waiting for the customer or provider (or vice versa).

User Engagement: The feedback and the rating system gave a huge sense of reliability building transparency between clients and service professionals.

Scalability The app was capable to scale horizontally (extend the active service area of a specific workshop and users at the same time for without decrease in performance).

Reliability and Trust: Streaming/proxy analytics in real-time secured the trust factor, we are syncing data based using Firebase integration.

The app is a direct response to the problems associated with call centers and one 800 number service in general where Car Doctors model offers transparency, flexibility, is easy-to-use and fast. The company has won over both customers and drivers by making it more convenient and trustworthy for them to arrange car services. The app is scalable to handle the increase in volume and continues to enhance user (both customer and service provider) experiences.

4.4 Summary

The implementation and analysis of the application have discussed in this chapter Environment Setup The environment configuration was detailed (Windows, Android Studio, flutter, Dart SDK and Firebase integration). Testing confirmed that the app functioned correctly, was easy to use and compatible with other apps, and that all components performed as expected.
Through the test, it is shown that the system is working well to the user registration, service and parts browsing, In-time conformation booking, feedback/review. Comparative study revealed significant gains of the mobile app in comparison to conventional service stations and web-based approaches with respect to accessibility, efficiency, scalability, and user friendliness.
Overall the application Car Doctor was successfully developed and it was indeed a quick reliable and easy solution of booking and maintaining cars.

Chapter 5

Engineering Standards and Design Challenges

This chapter summarize the engineering practices applied to the Car Doctor app, describes the issues faced in the design of the system, and the social, environmental and ethical influence of the app. It even covers project management tips and tricks, including budget and revenue breakdown.

5.1 Compliance with the Standards

Here we describe the main engineering standards applied in the process the development of the Car Doctor app took and motivate the reasons why we have chosen them. We also review other criteria, and evaluate the advantages and disadvantages of each option.

5.1.1 Software Standards

Standard: Flutter for Front-End Development

Flutter mobile app development framework is used for cross-platform development. It enables you to build faster, and its cross platform so it works on Android and iOS devices. Flutter has the added advantage of a single codebase, thereby minimizing the effort and costs for maintenance support.

Alternatives: React Native also supports cross-platform development, but has a slightly lower performance than Flutter for complex UI manipulation operations. There are, however a smaller community and correspondingly less support.

Native Android and iOS Development: This results in developing two different codebases and invariably the higher developer costs and maintenance effort.

Pros of Flutter:

Single codebase for both platforms. Fast since it compiles directly to native code. Rich UI components and libraries. Cons of Flutter. Slightly higher learning curve than other frameworks such as React Native. Smaller community than React Native

5.1.2 Hardware Standards

Standard: Mobile Device Compatibility

- Reasoning: Car Doctor is a mobile app, which means it should be able to run on different smartphones such as a number Android and iOS devices from different manufacturers with different screen dimensions, processors performance, and OS versions. App needs to work smoothly without lag or bugs.
- Alternatives: Web App Building a web app may get rid of the hardware complaints, but it is less accessible, and not as convenient for our mobile-first users.
- Pros: Mobile applications are much faster and smoother than web applications. Mobile applications have touch feature that gives much better experience than web
- Cons: Mobile app development requires more time effort and resources than web app. Older devices can't run newer applications smoothly.

5.1.3 Communication Standards

Standard: Firebase for Real-Time Communication

- Why: As we are implementing real-time data and cloud message through firebase. Firebase is a great backend also for authentication, storage of data and real-time updates.
- Alternatives: AWS Amplify Cloud version that provides similar features with more added complexity in configuration management. Backend-as-a-Service (BaaS) such as Parse - might be an option, though Firebase has more integration with Google services and a much larger community.
- Pros of Firebase: Simple to add to mobile apps with real-time database and cloud functions. Security out of box with Firebase Authentication. Scalable and affordable for small to midsize apps
- Cons of Firebase: Less flexibility in the type of query you can run, in contrast to classical databases. Relies on Google's cloud service, it might be a downside for some use cases

5.2 Impact on Society, Environment and Sustainability

From a societal, environmental and business sustainability perspectives, there are obvious benefits of the Car Doctor App. Bringing power to the people, the app is revolutionizing the way drivers approach car maintenance with unprecedented transparency, efficiency and trust in the car service industry. In this chapter we discuss the potential of the app in daily life to society, to the environment and finally to the introduction of sustainable mobility as a standard in the automotive sector by evaluating the impact of the application.

5.2.1 Impact on Life

Convenience for people who owns vehicle - Car Doctor app serves automobile service as convenient as much possible with reliable professionals at the door step where you can check in high quality work on services, ratings and reviews. This, in turn, makes it super easy for customers to book appointments online without ever having to get on the phone or meet face-to-face. It can also be a powerful way to avoid bad service or surprising charges and bring peace of mind to car owners, said Simon Harwood, competitive strategy leads at Accenture where he has done research on the use of block chain for automotive clients.

Economic Impact: The app is a game changer for small and medium service providers by equipping them with digital platform at a pocket pinch price. It has assisted such operators in attracting greater numbers of customers with transparent pricing, convenient appointment booking, and reliable service. Providers can also track sales and performance in real time, helping them to maximize how they operate their businesses and scale. Our economy in the region thrives off our local businesses, with them they help make Car Doctor that more effective and help support more economic development.

5.2.2 Impact on Society & Environment

Society impact: The car doctor app is innovating the disorganized and untrusted auto service market. The application promotes honesty and trust on the marketplace to do so we provide full pricing, O.E.M. replacement parts, and customer ratings. Service providers want to perform well to get good reviews, which means the marketplace is a more competitive and reputable place. That will incentivize improving the quality itself, and stop the scamming, which in turn will raise industry norms.

Eco-Friendly Service: Not only do we offer great service; the Car Doctor is kind to the environment. The app pushes the sale of genuine parts, which tend to be more sustainable and longer lasting and therefore replaced less often. It also supports a scheme of recycling alternative car parts to reduce landfill emissions and new raw material production. Car Doctor also saves the environment with no more services data recorded on paper and greener, paperless ecofriendly service options for the industry and our planet.

5.2.3 Ethical Aspects

Trust the Car Doctor app is built on a strong bedrock of trust, reliability and ethics that translates all the way to autonomy and convenience for the customers, he added. An in-app review/rating system solves common problems found in the auto service industry (inflated costs, substandard parts). This means that there is accountability for both car owners (based on the quality of a service, as per user ratings) and for service providers (trying their best not to get bad reviews) so everybody can win. Privacy, data and security The company says that app it's built on keeps users' information private and complies with the EU General Data Protection Regulation (GDPR). Other important security factors include secured data encryption meaning personal details like name and address are secure as well as MFA for secure login. It also employs differential privacy, a technique that stores or shares only statistical summaries to prevent the disclosure of sensitive information. Customers can delete their data when they wish and delete the profile.

5.2.4 Sustainability Plan

Sustainability and Environmental Impact:

The Car Doctor app has a promise to help business, help the planet and put peace of mind in your pocket. As the app scales, we'll introduce additional features like AI predictive maintenance and integration with EV service networks to ensure that you see outsize growth and good industry best practices as time goes on. The app recommends long-lasting, eco-friendly parts, so there's less waste and overall impact on the environment when you repair your ride. It is also funded/funded for preventative maintenance and increases vehicle life/defers replacement cycles.

Say goodbye to paper The Car Doctor does its bit to save the thousands of trees that are thrown away and wasted on folded sheet metal by going all digital bills, appointments, service histories everything is stored electronically. The company's AI-based analytics notify users of vehicles in need of attention, which enables decreased drag on the road and improved fuel efficiency across a fleet, all while creating minimal emissions. What's more, the app is looking to launch a recycling marketplace that will see users offered money for recycling parts from their old vehicle the automotive world has become even greener. In these efforts, Car Doctor is on the front line to forge a path of environmentally-considerate practices in our industry.

5.3 Project Management and Financial Analysis

Cost Analysis:

The app was developed for Android with Flutter, at no cost. Backend configuration was handled using Firebase free edition, which also included the cloud hosting needs so no extra cost was spent on them. Data collection required a lot of effort and travelling, the cost varied between BDT 1,800–2,000 for each user. At this time, there are no operating costs for the app. So, the whole price of developing this app is BDT 1,800 - 2,000.

Table 5.1 Summary of Cost

Category	Details	Cost
App Development	Development of the app for android using flutter	0
Backend Setup	Firebase free version is used	0
Cloud Hosting	Firebase free version is covers our cloud hosting	
Data Collect	Data was collected from many users and had to travel a lot	1800-2000 BDT
Operation Cost	Currently no operation cost	0
Total Cost	Cost to create the app	1800-2000 BDT

5.4 Complex Engineering Problem

5.4.1 Complex Problem Solving

In order to develop the Car Doctor application, we faced several challenges that fall under the category of Complex Engineering Problems (CEP). The following table 5.1 maps our project to the seven CEP categories.

Table 5.2: Mapping with Complex Engineering Problem.

EP1 Depth of Knowledge	EP2 Range of Conflicting Requirements	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent of Stakeholder Involvement	EP7 Interdependence
✓		✓		✓		✓

Rationales for Each Mapping

EP1: Depth of Knowledge
The Work Spanned Distinct Areas of Computer Science and Engineering. Everything is wrapped up under the roof from app / (Flutter, Dart), plugin(dev) development / backend/cloud (Firebase), database admin and even UI/UX design. Without drawing on this body of knowledge from disparate disciplines, the app simply wouldn't work.

EP3: Depth of Analysis
We needed deep data flow analysis, security, booking concurrency and performance! Maybe it doesn't get into destructor, or you can't hold on to permission updates, or anything else you want to do in destructor. It's a little more thought-provoking than a lot of people would think about doing.

EP5: Use of Codes and Standards
That all this can be done in so many ways. Instead, we had to combine:
Flutter/Dart coding standards
Firebase security rules
UI/UX mobile app guidelines
Data privacy practices
This complicates the code, because of numerous codes to be codded.

EP7: Interdependence

Thus, the relations between the components are:
Verification: required for all reservations and host/guest reviews.
Reservations system: feeds updates into the sales report.
Sales records: bunk on accurate bookings.
Reviews: trust a job well done.
If one module goes down, other modules are dragged with it indicating a high degree of cross-dependence.

Mapping with Knowledge Profile

This section is designed to map the overall problem and EP1 ***(multiple between K3, K4, K5, K6, K8 for attaining EP1)*** to the Knowledge Profile.

Table 5.3: Mapping with knowledge Profile.

K1 Natural Science	K2 Mathematics	K3 Engineering Fundamentals	K4 Specialist Knowledge	K5 Engineering Design	K6 Engineering Practice	K7 Comprehension	K8 Research Literature
		✓	✓	✓	✓		✓

K3 - Engineering Fundamentals
Flutter and Dart - Mobile App Development Firebase - Backend Services: real-time data & CRUD operations I wanted to learn about how the front (UI in Flutter) talks with the back (database located in firebase storage) nothing happening' unless they talking'.

K4 - Specialist Knowledge
Skills needed: Mobile frame (Flutter Dart), cloud infrastructure (Firebase for authentication, data sync c and databases) and UX/UI Implementation. Being an end-user app, user interface was probably something they wanted to make smell and mess free for both a car owner and provider.

K5 - Engineering Design
We created a structure for our back-end and front-end to interface with each other. The UI has been kept simple as well as user friendly to ease your booking and manage the services easily. Security was one major concern, which mentioned about authentication and encryption etc. specification requirements related that to the request functions or non-functions.

K6 - Engineering Practice
The project was implemented employing common programming practices which include unit/integration testing, debugging and also optimization for scheduled performance on varied platforms. Security measures such as secure login/data and security were built into the system. Deployment was nothing more than submitting to the app stores and using CI (continuous integration) processes for updates.

K8 - Research Literature

Best practices studies on how to build web and mobile applications also improved stability and quality of execution. Cloud systems analysis such as Firebase set best practice for secure data management & real time synchronization. Inspired by books of UI/UX as a guideline for happiness user-centered, they built intuitive and easy-to-use design car services apps.

5.4.2 Engineering Activities

In this section, provide a mapping with engineering activities. For each mapping add subsections to put rationale (Use Table 5.3).

Mapping with Complex Engineering Activities

This section is designed to map the overall problem and EA's ***(multiple).***

Table 5.4: Mapping with Complex Engineering Activities.

EA1 Range of re sources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
✓	✓	✓	✓	✓

EA1 Resources Saturation:
Next: Mobile, Payment, Cloud, AI, IOT
Rationale: The Car Doctor app is not that demanding. The backend has support for real-time data processing and alerts and runs on mobile (Flutter) and cloud (Firebase) technology. Transaction requires payment gateways. And coming soon we plan to expand with AI and IOT. are estimates of maintenance and vehicle condition. A familiarity and consolidation with those resources are necessary in order to use the app.

EA2 Interaction
Heads: What's being bought, how it's being funded, where it's being purchased from/sold and the powers FORCE_MORDIS gives/grants these to.
Rationale: There is an inordinate amount of crossover between groups on the project. App must be easy to use friendly for Car owners, service providers, mechanics, vendors to use it with just a few clicks. How the app works is also determined by the regulatory and payer systems, ensuring both compliance and security? Dealing with this complexity demands solid engineering support.

EA3 Innovation:
Medium to High: Predictive Maintenance, IOT, Used Car Marketplace
Rationale: The product introduces sophisticated features such as AI-based predictive maintenance, vehicle IOT monitoring and used car market place. All these requirements make it different from ordinary service booking applications and therefore, challenges the modern software engineering model.

EA4: Impact on Society & Environment.
High: Building Confidence, Minimizing Counterfeit parts, Sustainable results
Rationale: Since it involves the service being digitized, the app is aimed at building trust for the provider and the user that gets eliminated with opacity. It reduces the propagation of fake parts in the market place and promotes green activities and conduct, with obvious social and environmental value.

EA5: Awareness:
Half and Half App dev is common but IOT and Scaling (or something similar) is not common
Rationale: Most developers already know how to develop mobile apps and equally, how to integrate with cloud.

5.5 Summary

The Car Doctor app is a cross-platform via flutter, and it means you need only single codebase for the user interface works on iOS and Android. The app is backed by Firebase to ensure the scalability with real time data and authentication, some limitations in handling queries as part of trade-offs compared to say AWS Amplify. The app eases the life of car owners and small mechanics by making the process simple to book car service and source parts, both can trust one another for transparent, fair pricing instead of falling into traps like fraud etc. based on user reviews. There is also an environmental benefit, by fostering original parts use and recycling. Ethically, the app is built extremely securely with strong encryption and multi-factor authentication. Development-wise, you keep the costs in check as there are cheap Flutter and Firebase solutions from a project management point of view. The app makes money to feature ads, in-app purchases (premium options), and a subscription model. The app also handles logistical tasks like app development, cloud integration and security, which are relatively complicated from an engineering standpoint, to make it simple for car owners who use the app while providing service providers with a powerful tool for booking and review management. The project, whose primary objective is to change the way we care for cars driving ethical and green principles.

Chapter 6
Conclusion

Car Doctor mobile application is a revolutionizing solution which aims to solve major issues in car servicing industry by being a vendor neutral and trust-based platform between car owners and service providers." Developed in Flutter to support both iOS and Android and Firebase for real-time backend, it makes authentic components, honest services and transparent booking processes easily accessible. This report contains a project overview and details the inspiration and technical basis for the personal robot, how it was implemented, its results, limitations and potential future directions.

6.1 Summary

Hence, the Car Doctor App was developed with an intention to solve prevalent problems in the industry through the removal of intermediaries, counterfeiting, and time consuming; all the services are offered in real-time with genuine, speedy, and user-friendly parts to enhance user experience. Furthermore, due to the multi-platform capabilities of the Flutter and Firebase, the application runs effectively in both Android and iOS's systems, with real-time updating and fast loading time, The Car Doctor reduced the hustle of service booking, parts comparison and view, and reviews and ran for 36weeks through the year, integrating Flutter and Firebase, Dart, and Android Studio. The challenge in the development process was to ensure that the app is simple on the user side and perfect on the server side without jeopardizing data security, fraud, and balance the two, respectively. The additional feature that the Car Doctor incorporates at the end of the system is transparency, environmentally friendly, for instance, recycling and preventive maintaining, and user protection, which includes full encryption and two-factor verification. Flutter and Firebase were low-cost assets in developing the system, and its revenue system includes freemium, transaction fees, and open avenues for subscriptions for both car owners and small service workshops. In conclusion, the Car Doctor app is looking forward to utilizing the technologies of the future, for instance, artificial intelligence and the internet of things.

6.2 Limitation

The Car Doctor app faces several hurdles as it tries to expand outside Bangladesh. The app is extremely localized to laws, languages and parts suppliers of that country so a new market would require this level of localization all over again, which adds time and costs. Synchronized service data through the internet in real-time is essential and in sparsely network covered areas, even small delay of the services can be perceived by users. Vendors will also need to be locally integrated, both to ensure that the right components are available and convince old-school service providers of value of digital we are still meeting people who refuse a digital diagnosis or service. Older users, who are more averse to technology and are interested in face-to-face meetings with mechanics, may not even adopt the app much anyway- which means severely limited penetration. What's more, the used car market is limited by the fact that buyers find it difficult to take confidence in quality particularly outside cities where there are too few consumers for the industry to function as effectively. Scalability is a problem as well because the app needs to service

more users and transactions as there are greater numbers of people using it, and particularly if by some miracle you have added complex new features like AI based maintenance or authenticity checking that stress the cost vs growth trade off. Security and privacy are both stake here, as such sensitive consumer data will need to be handled and stored securely there is a price tag for processing it under the constraints of global privacy laws like GDPR and CCPA). Finally, maintenance/updates are important to ensure your software is compatible with new OS's and to make users happy as more use your app grows While these constraints present different challenges they all certainly are going to require thoughtful planning and prayers being tailored to mean like so that car doctor can grow out ethically, secure and transparent for end user's experience would be possible as well as be more than enough for its users.

6.3 Future Work

New Player in Market: Car Doctor, which is currently focusing on car owners, plans to expand to buses, trucks and motorbikes. It will also provide maintenance logs, preventive care and service scheduling for fleet owners of buses. Truck services could include load management, to long-haul maintenance and motorcycle offerings may cover repairs, service plans and parts ordering. That would make Car Doctor an all in one app for any vehicle, be it a personal car or commercial fleet.

Total Vehicle Management: Car Doctor aspires to be the total vehicle-maintenance package. The app will also take care of scheduled maintenance such as oil changes, tire rotations and tune-ups. They will also be able to make service appointments and access diagnostic tools. It will also ensure that the product has genuine parts from authorized suppliers, thereby minimizing the chances of counterfeit products.

Used Car Marketplace: Car Doctor would turn an open-source used car market into a marketplace. Users of car can post the used cars for sale on used car listing, along with picture, feature and description. Trained mechanics that reviews the cars and reports on their condition, creating trust between buyers and sellers. The platform will even assist with safe transactions like mobile handling and funding for buyers.

Advanced Equipment Integration: It will incorporate artificial intelligence, predicting maintenance needs such as how worn brake pads or soft tire pressure becomes after a user has been driving. Smart IOT sensors will also be integrated to your car and collecting data and analyze them and give user reminder and notification or warning.

Geographical Expansion: Car Doctor plans to go international, initially concentrating on South Asia since car ownership is expanding rapidly there. The expansion will also involve localization of the app's language and features to reflect regional cultures, conforming to local vehicle maintenance regulations and forming alliances with local service providers and suppliers for a network-wide service offering.

Environmentally Friendly and Sustainably Focused: Car Doctor gets green. It will promote green maintenance by specifying the usage of low-carbon footprint oils and parts. It will also promote the recycling and remanufacturing of old car parts to cut down on waste. By that and from working digitally, Car Doctor results in much less paper- and will encourage to use sustainable alternatives.

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