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**Auto Repair Center**





Auto Repair Center

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Thank you all for being part of our journey.

Abstract

This project presents the development of an "Auto Repair Center" system designed to streamline and manage the daily operations of a vehicle repair facility. The system aims to enhance the efficiency and accuracy of tasks such as booking appointments, managing customer information, tracking repair progress, handling spare parts inventory, and generating invoices.

By implementing a digital solution, the Auto Repair Center system reduces manual paperwork, minimizes human errors, and improves communication between customers and service providers. The system also allows customers to easily schedule appointments, view service history, and receive real-time updates about their vehicles.

From a technical perspective, the project involves designing a user-friendly interface, integrating backend functionality for data processing, and ensuring data security. The system supports both administrators and customers, providing a smooth and reliable experience for all users.

Overall, the Auto Repair Center project highlights the importance of digital transformation in the automotive service industry and demonstrates how technology can simplify and improve traditional repair shop operations.

Table of Contents

[Acknowledgment I](#_Toc200442965)

[Abstract II](#_Toc200442966)

[Table of Contents III](#_Toc200442967)

[List of abbreviations V](#_Toc200442968)

[list of Figures VI](#_Toc200442969)

[List of tables VIII](#_Toc200442970)

[CHAPTER 1: Introduction and Background 1](#_Toc200442971)

[1.1 inroduction 2](#_Toc200442972)

[1.1 Problem Definition 3](#_Toc200442973)

[1.2 What is the importance of this problem? 5](#_Toc200442974)

[1.3 What Are the Current Solutions? 6](#_Toc200442975)

[1.4 How Will Your Solution Solve the Problem? What is New? 7](#_Toc200442976)

[1.5 Scope 8](#_Toc200442977)

[1.6 Summary 10](#_Toc200442978)

[CHAPTER 2: Analysis and Design 11](#_Toc200442979)

[2.1 Introduction 12](#_Toc200442980)

[2.2 User and System Requirements 12](#_Toc200442981)

[2.3 Functional requirements 14](#_Toc200442982)

[2.4 Non – functional requirements 16](#_Toc200442983)

[2.5 System Design 17](#_Toc200442984)

[2.6 Use Cases 52](#_Toc200442985)

[CHAPTER 3: Deliverables and Evaluation 53](#_Toc200442986)

[1.1 Introduction 54](#_Toc200442987)

[1.2 User Manual 54](#_Toc200442988)

[1.3 Testing 64](#_Toc200442989)

[1.4 Evaluation (User experiment). 65](#_Toc200442990)

[1.5 Summary 66](#_Toc200442991)

[CHAPTER 4: Discussion and Conclusion 67](#_Toc200442992)

[1.1 Introdution 68](#_Toc200442993)

[1.2 Main Findings 69](#_Toc200442994)

[1.3 Why is this project important? 70](#_Toc200442995)

[1.4 Practical Implementations 72](#_Toc200442996)

[1.4 Practical Implementations (cont’d) 73](#_Toc200442997)

[1.5 Future Recommendation 74](#_Toc200442998)

[1.6 Conclusion Summary 76](#_Toc200442999)

[1.6 Conclusion Summary 77](#_Toc200443000)

[References 78](#_Toc200443001)

List of abbreviations

|  |  |
| --- | --- |
| Abbreviation | Full Name |
| ERD | * Entity Relationship Diagram |
| PHP | * PHP: Hypertext Preprocessor |
| HTML | * HyperText Markup Language |
| CSS | * Cascading Style Sheets |
| JS | * JavaScript |
|  |  |
|  |  |
|  |  |

list of Figures

[Figure ‎2‑1: Login page 19](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024927)

[Figure ‎2‑2: login page code 21](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024928)

[Figure ‎2‑3: Login Page (Go to registration page button ( 22](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024929)

[Figure ‎2‑4: Login Page (body) 22](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024930)

[Figure ‎2‑5: Login Page (back-end part 1) 24](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024931)

[Figure ‎2‑6: Login Page (Back-end Part 2) 25](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024932)

[Figure ‎2‑7: Registration Page 26](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024933)

[Figure ‎2‑8: Registration Page (front-end) 28](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024934)

[Figure ‎2‑9: Registration Page (back-end) 28](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024935)

[Figure ‎2‑10: Registration Page (Head) 29](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024936)

[Figure ‎2‑11: Home Page Part 2 30](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024937)

[Figure ‎2‑12 : Home Page Part 1 30](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024938)

[Figure ‎2‑13: Header Dark Mode 31](#_Toc200024939)

[Figure ‎2‑14: Code button to open the sidebar 31](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024940)

[Figure ‎2‑15: Code the Site Logo 32](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024941)

[Figure ‎2‑16: Code Links to Pages 32](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024942)

[Figure ‎2‑17: Navbar Light Mode 32](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024943)

[Figure ‎2‑18: Code Button Logout 33](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024944)

[Figure ‎2‑19 : main banner 33](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024945)

[Figure ‎2‑20: code main banner part 1 34](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024946)

[Figure ‎2‑21: main banner part 2 35](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024947)

[Figure ‎2‑22: Quick Booking Services 36](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024948)

[Figure ‎3‑1: Login Page 40](#_Toc200024949)

[Figure ‎3‑2: Registration Page 41](#_Toc200024950)

[Figure ‎3‑3: Home Page 42](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024951)

[Figure ‎3‑4: Light Mode 43](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024952)

[Figure ‎3‑5: Dark Mode 43](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024953)

[Figure ‎3‑6: Logout 44](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024954)

[Figure ‎3‑7: Navbar 44](#_Toc200024955)

[Figure ‎3‑8: Sidebar 45](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024956)

[Figure ‎3‑9: Services 46](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024957)

[Figure ‎3‑10: booking page 47](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024958)

[Figure ‎3‑11:Details Service 47](file:///C:\xampp\htdocs\project_2\report\project_report.docx#_Toc200024959)

[Figure ‎3‑12:products page 48](#_Toc200024960)

List of tables

[Table ‎2‑1:System Components 18](#_Toc200024471)

[Table ‎2‑2: Job Summary (login page) 23](#_Toc200024472)

[Table ‎4‑1:references 62](#_Toc200024473)

# Introduction and Background

Introduction and Background

Outline

* + - * 1. Introduction
        2. Problem definition
        3. What is the importance of this problem?
        4. What are the current solutions?
        5. How will your solution solve the problem? What is new?
        6. Scope
        7. Summary

## inroduction

The "Auto Repair Center" project aims to develop a modern digital platform that simplifies car repair workshop management and enhances customer experience.

In light of the challenges faced by traditional repair services—such as poor organization, communication gaps, and lack of transparency—a comprehensive digital solution has become essential.

This project offers an easy-to-use interface for both customers and workshop owners, enabling appointment booking, vehicle tracking, and maintenance history documentation.

Workshop owners can efficiently manage daily operations, issue invoices, and analyze performance.

The system supports the ongoing digital transformation in the service sector and contributes to improved quality and reduced operational load.

The platform focuses on providing a secure and responsive environment that meets the needs of both sides.

"Auto Repair Center" represents a significant step toward a more organized and efficient digital future in the automotive repair industry.

**This project is distinguished by several key features:**

* Comprehensiveness: Providing all maintenance and repair services under one roof.
* Technological Advancement: Utilizing the latest diagnostic and inspection tools.
* Professionalism: Relying on well-trained and certified technical staff.
* Flexibility: Catering to the needs of various types of vehicles.

## Problem Definition

**The automotive repair industry faces several core challenges:**

### Quality Issues

78% of existing workshops do not use modern diagnostic equipment

65% of technicians lack certified training

Incorrect repairs account for 40% of service cases

### Service-Related Issues

Average waiting time in traditional workshops can reach up to 3 days

60% of customers report a lack of pricing transparency

Absence of an integrated quality assurance system

### Cost Issues

Spare parts prices have risen by 35% over the last three years

No flexible financing options available

Preventive maintenance systems are rarely implemented

### Problem Significance

The problem holds high importance due to the following factors:

#### Economic Significance

The local car maintenance market is valued at over $5 billion annually

Repetitive breakdowns lead to estimated losses of $1.2 billion per year

The project contributes to job creation, especially for young technicians

#### Social Significance

Enhancing road safety through proper vehicle servicing

Saving car owners time, money, and effort

Supporting the development of underserved communities

#### Environmental Significance

Potential to reduce harmful emissions by up to 30%

Safe disposal of hazardous maintenance waste

Encouraging the use of recycled spare parts and eco-friendly materials

### Proposed Solutions

**Auto Repair Center introduces an integrated set of innovative solutions:**

* Smart Maintenance System
* Mobile and web application for easy appointment scheduling
* Real-time vehicle tracking during service
* Instant maintenance reports delivered digitally
* Quality Assurance Measures
* One-year warranty on all repairs
* Use of certified, high-quality spare parts only
* Post-service inspections for added confidence
* Innovative Services
* On-site mobile maintenance units
* Flexible annual subscription plans
* Educational workshops and awareness programs for customers

### Economic Feasibility

Initial Investment: EGP 2 million

Expected Payback Period: 18 months

Projected Internal Rate of Return (IRR): 28% annually

Operational Capacity: Up to 15 vehicles serviced per day

## What is the importance of this problem?

The automotive industry plays a critical role in everyday life, and vehicle owners expect quick and professional repair services.

Inefficiencies in auto repair centers can lead to customer frustration, financial losses, and safety risks.

Addressing these issues is important not only to improve business operations but also to ensure customer satisfaction and trust.

A streamlined and automated system can significantly enhance workflow, save time, and build stronger relationships between customers and service providers

**Why Is This Problem a Priority?**

The Auto Repair Center project addresses a high-priority issue due to several critical factors:

### Economic Impact

Vehicles are major investments for both individuals and businesses.

Poor maintenance leads to financial losses through frequent breakdowns and reduced vehicle lifespan.

### Customer Safety

Unprofessional repairs—such as faulty brakes or suspension systems—can pose serious risks to both drivers and pedestrians.

### Saving Time and Effort

An integrated workshop helps customers avoid wasting time searching for multiple service providers for different types of repairs.

### Support for the Transportation Sector

Well-maintained fleets (e.g., taxis, delivery vehicles) perform more efficiently, which positively affects the local economy and service reliability.

### Environmental Sustainability

Regular maintenance reduces harmful exhaust emissions caused by neglected engines, contributing to cleaner air and a healthier environment.

## What Are the Current Solutions?

**Limitations of Current Solutions**

In many regions—even in places like Hollywood—some small auto repair shops still rely on basic tools such as spreadsheets or standalone invoicing software to manage their daily operations.

While a few may adopt more advanced management systems, these solutions are often expensive, overly complex, or tailored for large enterprises—making them inaccessible to small and mid-sized workshops.

In some cases, shop owners still depend entirely on manual processes, which increases the risk of human error and inefficiency.

Overall, existing solutions in the market remain fragmented and limited in scope.

Some applications offer features like online appointment booking or workshop reviews, but very few provide an integrated experience that covers the entire service journey.

**There is currently no single platform that allows customers to:**

* Book appointments
* Track the real-time status of their vehicle during service
* Access a complete service history
* Receive instant updates and notifications
* Moreover, workshop owners lack access to modern business tools that support performance monitoring, customer experience enhancement, and operational innovation.

Auto Repair Center is designed to address these gaps by offering a unified, cost-effective, and easy-to-use platform for both customers and workshop operators.

## How Will Your Solution Solve the Problem? What is New?

Auto Repair Center offers a modern and integrated solution that directly addresses the key challenges facing the auto repair industry—namely inefficiency, lack of transparency, poor customer experience, and outdated operational systems.

**How the Solution Solves the Problem:**

* **Centralized Platform:** Combines booking, tracking, invoicing, and customer communication in one easy-to-use system.
* **Real-Time Updates:** Customers receive instant notifications about their vehicle's service status, improving transparency and trust.
* **Digital Service Records:** Every vehicle has a complete, accessible maintenance history—reducing miscommunication and repeat issues.
* **Smart Scheduling:** Helps workshops manage appointments efficiently, reducing delays and increasing daily service capacity.
* **Performance Monitoring:** Workshop owners get detailed analytics to evaluate operations and improve decision-making.

**What Is New or Innovative?**

* **All-in-One Platform:** Unlike existing tools that handle only one or two aspects of service, Auto Repair Center integrates all service elements into a single solution.
* **Customer-Centric Design:** Designed with both customers and workshop owners in mind, offering a smoother and more professional experience on both sides.
* **Scalability & Affordability:** The platform is built to be affordable for small businesses and scalable for future growth, making it ideal for workshops of all sizes.
* **Future-Ready Features:** Includes support for mobile maintenance services, loyalty programs, and potential AI-based diagnostics in later phases.

## Scope

The scope of the Auto Repair Center project includes the design and development of a comprehensive digital platform that streamlines auto repair services for both customers and workshop owners.

The platform will offer a range of core features aimed at improving service quality, transparency, and operational efficiency.

**Key Deliverables:**

### Customer Interface

* Account registration and vehicle profile management
* Appointment booking system
* Real-time service tracking and notifications
* Access to full maintenance history
* Rating and feedback system

### Workshop Management System

* Dashboard for managing bookings and service queues
* Status updates for each vehicle in service
* Digital invoicing and payment tracking
* Customer and vehicle database
* Performance analytics and reporting tools

### System Features

* Secure login for both customers and workshop staff
* Responsive web design (mobile-friendly)
* Notification system (email/SMS/push notifications)
* Scalable architecture for future expansion

**Out of Scope (Not Included):**

Integration with external payment gateways (initial phase).

Mobile app (web version only in the first release).

AI-based diagnostics or inventory management (reserved for future updates).

## Summary

The "Auto Repair Center" project aims to radically enhance the car maintenance experience by offering a smart, integrated, and easy-to-use digital solution. It addresses the current challenges faced by both customers and workshops, providing an efficient way to manage maintenance operations and communication. This project contributes to the digital transformation of the car service sector and lays the foundation for a scalable and sustainable future model.

(end)

# Analysis and Design

Analysis and Design

Outline

* + - * 1. Introduction
        2. User and System Requirements
        3. Functional requirements
        4. Non – functional requirements
        5. System Design
        6. Use Cases
        7. Class Diagram
        8. Design Patterns
        9. Database Diagram
        10. System Architecture
        11. Used Technologies and tools
        12. summary

## Introduction

The Auto Repair Center project is a comprehensive website designed to provide automotive repair and maintenance services to customers.

This platform offers a range of services, including engine repairs, routine maintenance, spare parts sales, and winsh service reservations.

The goal of this project is to create a user-friendly, efficient, and reliable online solution that connects car owners with professional auto repair services while also offering the convenience of purchasing genuine spare parts.

With features such as online service booking, a digital catalog of car parts, and emergency winsh requests, this website aims to streamline the vehicle maintenance process, saving customers time and effort.

Whether users need minor fixes, major repairs, or quality auto parts, the Auto Repair Center ensures a seamless and hassle-free experience.

This documentation outlines the project's functionalities, technical structure, and development process to provide a clear understanding of its implementation and future scalability.

## User and System Requirements

In order to build an effective and user-friendly Auto Repair Center platform, it is essential to identify and define the key requirements.

These requirements serve as the foundation for both the development and functionality of the system.

Understanding these requirements ensures that the final product aligns with user expectations, fulfills business goals, and delivers a seamless digital experience for all stakeholders involved.

They are divided into two main categories:

### User Requirements:

Which reflect the needs and expectations of the platform’s end users.

User Requirements describe the goals, tasks, and expectations of the platform’s end users.

These include the ability to register and log in, book repair or towing services, browse and purchase spare parts, receive service updates, and easily navigate the website on any device.

The focus is on delivering a smooth, intuitive, and helpful user experience.

### System Requirements

System Requirements define what the system must be capable of in order to fulfill user needs.

This includes both functional requirements (like booking systems, inventory management, and user authentication).

non-functional requirements (such as performance, scalability, security, and mobile responsiveness).

These ensure that the platform is stable, efficient, and ready for real-world usage.

### Target Audience

This platform targets a wide range of users, including:

Individual car owners who need regular maintenance or emergency towing services.

Customers looking to purchase auto spare parts online conveniently.

Fleet managers or small business owners who manage multiple vehicles and require professional repair services.

Auto repair shop administrators who will use the admin dashboard to manage requests, inventory, and bookings.

## Functional requirements

Functional requirements describe the specific behavior, features, and functions that the system must perform to satisfy user needs.

For the Auto Repair Center platform, the following functional requirements apply:

### User Registration and Login

Users must be able to create an account using their email, password number, or social login.

Secure authentication should be implemented (e.g., password hashing, validation).

Users can log in/out, and recover/reset their passwords when needed.

### Service Booking System

Users should be able to book vehicle repair services by selecting the service type, car details, preferred date, and time.

The system should allow booking of towing (winch) services, with location input or GPS-based selection.

Admin can approve, cancel, or reschedule bookings.

### Online Spare Parts Store

The platform must provide a section to browse spare parts, filter by category, brand, or car model.

Users can view product details, add items to their cart, and proceed to checkout.

A shopping cart and order system must be implemented with quantity management.

### Search and Filtering

Users must be able to search for services or spare parts using keywords.

Filters such as brand, part type, availability, and price range should be available.

Results must be dynamically updated based on filters applied.

### Contact and Support System

A contact form should be available for users to submit inquiries or feedback.

Messages must be stored in the database and visible to the admin for response.

Optional: Live chat or automated help center can be integrated in future updates.

### Notifications and Alerts

Users should receive notifications for booking confirmations, status updates, or order completions.

Notifications can be via email or shown directly on the platform.

Admin should also receive alerts for new bookings or orders.

### Responsive and Multi-Device Support

The system must be responsive and accessible via desktop, tablet, and mobile browsers.

All functionality must remain intact and user-friendly across devices.

### User Profile Management

Each user should have a profile page to:

Update personal information (name, phone, address).

View booking history, orders, and support messages.

Change password or account settings

## Non – functional requirements

Non-functional requirements describe how the system performs its functions, rather than what the system does.

These requirements ensure the platform is reliable, secure, scalable, and user-friendly.

### Performance

The system must load pages and respond to user actions within 2 seconds under normal usage.

It should be optimized to handle multiple concurrent users without noticeable delays.

Backend queries and database operations must be efficient to avoid bottlenecks.

### Scalability

The platform is designed to grow with more users and data without requiring a complete rebuild.

It supports the easy addition of new services, more products, or integration with third-party tools.

### Security

All sensitive user data (passwords, personal information) is securely stored and encrypted.

The system implements authentication and authorization mechanisms to prevent unauthorized access.

The system implements input validation and protection against common attacks (such as SQL injection, XSS, and CSRF).

### Responsiveness

The interface should be fully responsive and work smoothly on all screen sizes, including mobile phones, tablets, and desktop computers.

### Ease of Use

The user interface should be intuitive and easy to use, even for non-technical users.

Clear navigation, tags, and instructions should be used on all pages (such as navbar and sidebar).

## System Design

### Introduction

The Auto Service Center Management System was designed to enhance customer experience and facilitate daily management operations within the center.

This system provides an integrated environment for managing reservations, tracking vehicle status, organizing spare parts, and issuing invoices, while maintaining ease of use and high efficiency.

In this section, we review the overall design of the system, its main components, and the flow of data between its various components, providing a comprehensive and clear understanding of how the system works.

System design is one of the most important stages in developing any integrated software system. It provides a comprehensive vision of how the system works from a technical perspective and demonstrates the interaction between its various components in an organized and clear manner. In the Auto Repair Center system, design represents the cornerstone that connects functional and technical requirements, ensuring a stable, scalable, and easy-to-maintain system.

This system was developed to improve the management of auto repair center operations by providing a seamless experience for both customers and management, including appointment booking, spare parts management, repair status tracking, and billing.

The design is based on the principle of separation of concerns, with clear definitions of the responsibilities of each component, ensuring the system's flexibility and stability during expansion or upgrades.

#### System Components

| Component | Description |
| --- | --- |
| Frontend | * The website interface that users interact with, such as booking appointments, viewing services, logging in, and tracking vehicle status. It is built using technologies such as HTML, CSS, JavaScript, or a framework such as bootstrap. |
| Backend | * It contains application logic, handles requests from the interface, and interacts with the database. * You can use PHP . |
| Database | * Responsible for storing basic data such as customer information, vehicles, reservations, invoices, spare parts, and maintenance records. May be used in MySQL. |
| Authentication & Authorization | * A system for logging in and verifying user identity, with permission management between clients, technicians, and management. |
| Booking System | * Allows customers to easily book appointments by choosing the type of service and the appropriate date. |
| Service Management | * Manage details of services provided (maintenance, inspection, oil change, etc.). |
| Invoice & Payment Module | * Create invoices, track payments, and link them to bookings and services. |

Table ‎2‑1:System Components

### Login Page

#### General description

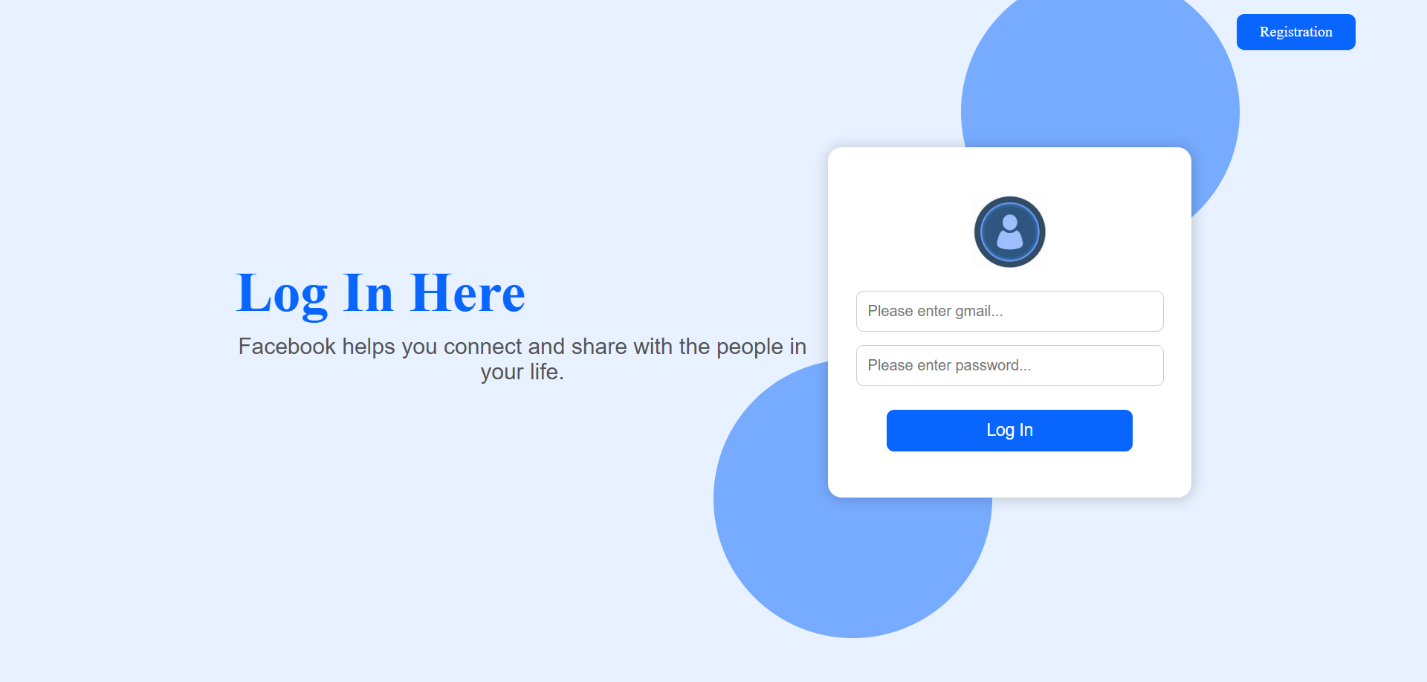


Figure ‎2‑1: Login page

##### What is the function of this page?

A login page serves the function of authenticating users before granting them access to a system, website.

##### **Main Functions of a Login Page:**

* **User Authentication:**

Verifies the identity of a user by checking their username/email and password against stored credentials.

* **Access Control:**

Ensures that only authorized users can access certain areas or features of the site or app.

* **Session Initialization:**

Starts a session for the user once they are successfully authenticated, often by setting a session cookie or token.

* **Error Handling:**

Provides feedback if login credentials are incorrect (e.g., "Invalid username or password").

* **Redirect After Login:**

Typically redirects users to a dashboard or homepage after a successful login.

#### Core Components

* **Email Field**

Input for the user’s unique identifie email.

* **Password Field**

Secure input field that hides characters as they are typed.

* **Login Button**

Triggers authentication logic upon click.

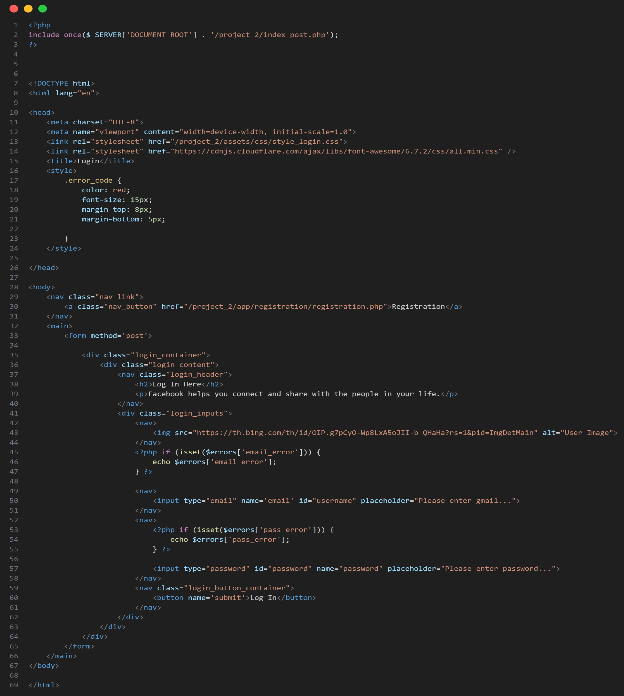


Figure ‎2‑2: login page code

#### Front-end

##### Head

* Set the encoding to UTF-8.
* Make the page responsive on all devices.
* Link the CSS file to format the login page design.
* Use Font Awesome icons.
* Special formatting for error messages (red color and specific size).

##### Body

Figure ‎2‑3: Login Page (Go to registration page button (

* Button to go to the registration page (for new users).

Figure ‎2‑4: Login Page (body)

* A form for entering user data.
* Uses the POST method to send data to the server for processing (such as email and password verification).
* login\_container: An element that includes all the components of the login interface.
* login\_content: An internal element containing the title, input fields, and button.
* A descriptive title within the form.
* Provides a simple description to inform the user of the purpose of the page.
* Displays an error message next to the email field if it has been previously stored in the $errors array.
* type="email": Only valid email addresses are allowed.
* name="email": The name used to submit data to the server.
* placeholder: Help text to appear within the field.
* Displays the error message associated with the password field, if it exists in the $errors variable.
* type="password": Hides the input content.
* name="password": The name used to submit data.
* placeholder: Help text to appear within the field. A button that submits the form when clicked.
* name='submit': Can be used to indicate that the form has been submitted upon processing on the server.
* login\_button\_container: An element that is styled using CSS to center and format the button

|  |  |
| --- | --- |
| Element | Job |
| <form method='post'> | * Send login data to the server. |
| <input type="email"> | * Enter email. |
| <input type="password"> | * Enter password. |
| <?php if (isset($errors['...'])) ... ?> | * Display error messages to the user. |
| <button name='submit'> | * Submit form when clicked. |
| <img src="..."> | * Avatar to beautify the user interface. |

Table ‎2‑2:Job Summary (login page)

#### Back-end

##### What is the function of this page?

Processing data coming from the login form, verifying the email and password, and logging the user in if the data is correct.

##### Code Explanation

Figure ‎2‑5: Login Page (back-end part 1)

* session\_start() : Sessions are used to store user data after logging in, so that it remains available while navigating between site pages.
* include($\_SERVER['DOCUMENT\_ROOT'] . '/project\_2/vendor/config.php') : Calls a file containing the database connection variable ($conn).
* if ($\_SERVER['REQUEST\_METHOD'] == 'POST') { : Verifies that data was submitted through a form using POST method.
* if (isset($\_POST['submit'])) { : Verifies that the form has actually been submitted using the "submit" button.
* $email = trim($\_POST['email']) , $password = $\_POST['password'] : trim: Removes spaces from the beginning and end of the email. The entered email and password are stored.
* $errors = [] , $error = 0 : To collect error messages that may appear to the user.
* if (empty($email) || !filter\_var($email, FILTER\_VALIDATE\_EMAIL)) { : Checks whether the email address is empty or invalid. If an error occurs, a message is added to $errors['email\_error'].
* if (strlen($password) < 6) { : The password must contain at least 6 characters. An error message is stored if the condition is not met.



Figure ‎2‑6: Login Page (Back-end Part 2)

* if ($error == 0) { : Data validation begins within the database.
* $sql = "SELECT \* FROM `users` WHERE `email` = '$email'" ,
* $query = mysqli\_query($conn, $sql) ,
* $DataROW = mysqli\_fetch\_assoc($query) : A SQL query is executed to select a user based on their email address. The query results are stored in an array.
* if ($DataROW) { : Ensures that the email is in the database.
* if (password\_verify($password, $DataROW['password'])) { : password\_verify is used to compare the entered password with the encrypted password in the database.
* $\_SESSION['user\_id'] = $DataROW['id'] , $\_SESSION['email'] = $DataROW['email'] ... : User information is saved in session variables for later use on other pages (e.g. name, permissions, image, gender, etc.).

### Registration Page

#### General description

Figure ‎2‑7: Registration Page

##### What is the function of this page?

A registration page is designed to allow new users to create an account in a system, website.

##### Main Functions of a Registration Page:

* **User Account Creation:**

Collects necessary information (e.g., name, email, password) to create a new user profile in the system.

* **Data Validation:**

Ensures the entered data is valid (e.g., proper email format, strong password, required fields filled).

* **Duplicate Account Prevention:**

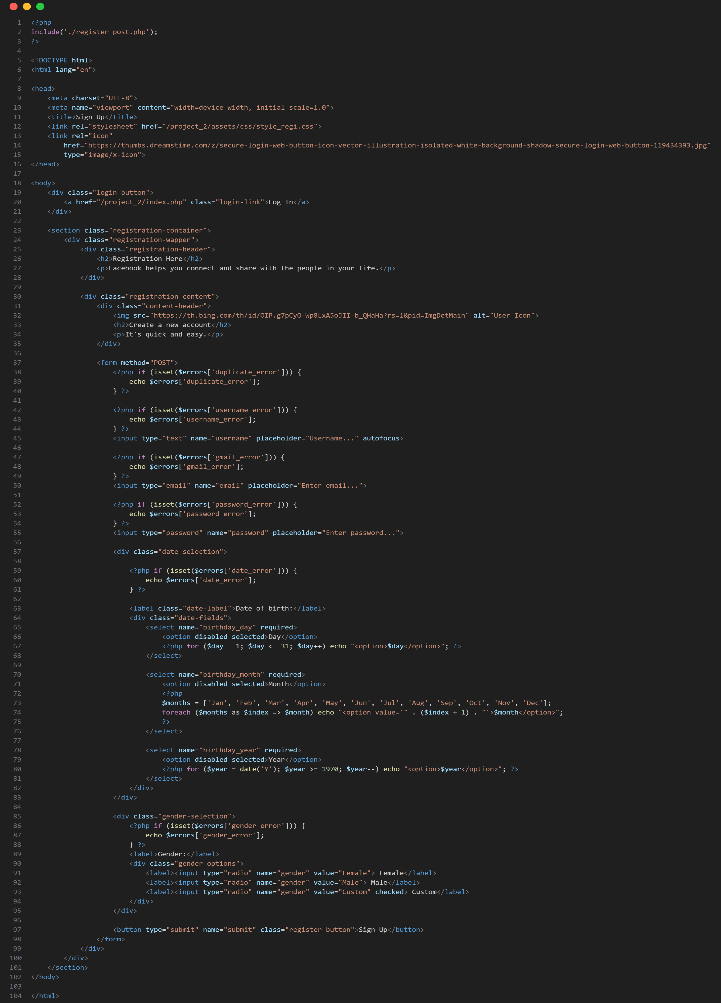
Checks for existing users to avoid duplicate registrations using the same email or username.

* **User Feedback:**

Displays success messages, validation errors, or prompts (e.g., "Account created successfully", "Email already in use").

#### Code Explanation

Figure ‎2‑8: Registration Code



#### Front-end

##### Head

Figure ‎2‑9: Registration Page (Head)

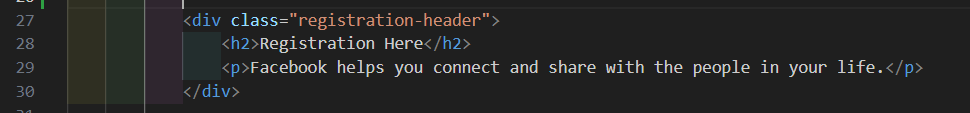
The Explanation

* <meta charset="UTF-8"> : The character encoding is specified as UTF-8, which is the standard encoding for supporting different languages ​​such as Arabic and English.
* <meta name="viewport" content="width=device-width, initial-scale=1.0"> : Makes the page suitable for viewing on phone and tablet screens.
* <title>Sign Up</title> : It appears in the browser tab as the page title.
* <link rel="stylesheet" href="/project\_2/assets/css/style\_regi.css"> : The CSS file for the registration page interface design is linked.
* <link rel="icon" href="https://...secure-login-web-button-119434393.jpg" type="image/x-icon"> : Adds an icon that appears next to the page title in the tab.

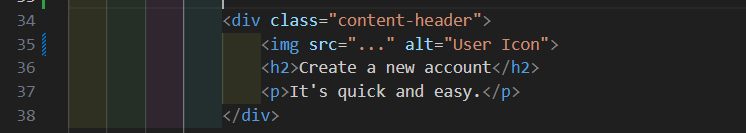
##### Body

 Navigation Bar

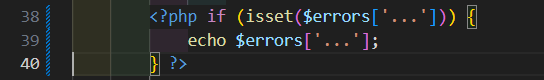
* This part represents the top navigation bar and contains a button that leads to the registration page. The button is placed inside an <a> element to create a hyperlink.

Registration Header and Facebook Description

* It explains the purpose of the page and introduces the user to the idea of ​​creating a new account in a friendly way.

Form Header with Image and Text

* An avatar with a subtitle and a short message to encourage the user to register.

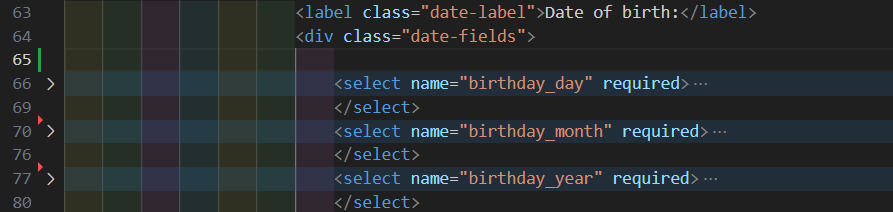
Display validation errors

* Displays custom error messages next to each field if data is entered incorrectly. Examples: duplicate\_error, username\_error, gmail\_error, etc.

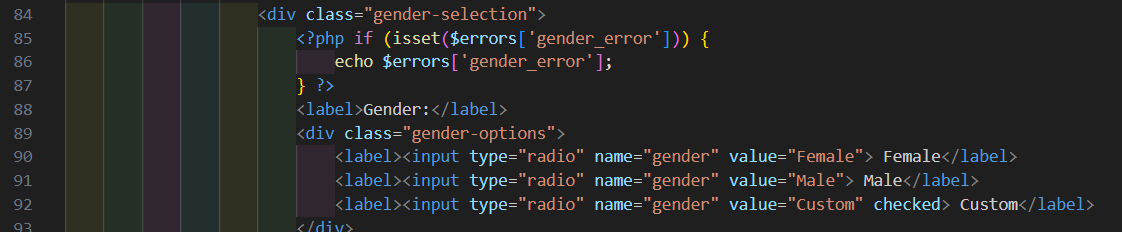
Basic data



* Username input field, automatically focused when the page loads.
* Valid email input field.
* Password entry field to secure the account.

Select Date of Birth

* Allows the user to select their date of birth from three drop-down menus (day, month, year). This is essential on many social platforms.

Gender Selection

* Options to select user type using radio buttons, with "Custom" set as the default.

Submit Button

* Button to submit the form to the server and process the registration process

#### Back-end

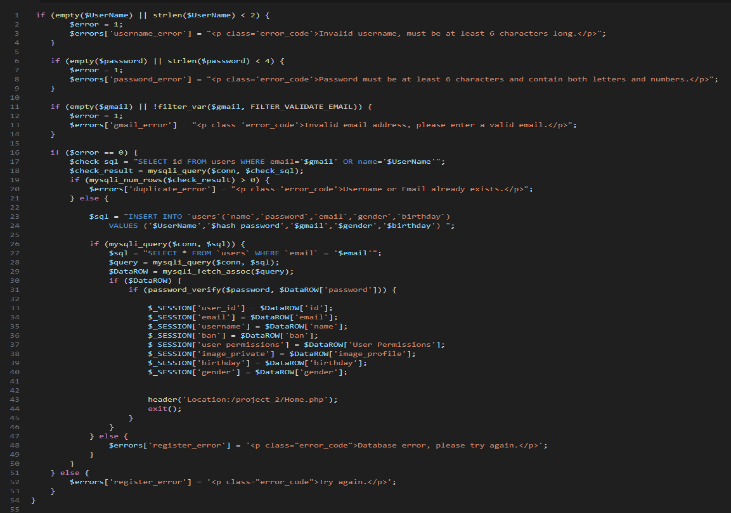


Figure ‎2‑10: Code Back-end (Registration Page)

##### Start the session and connect the database.

* Start a PHP session using session variables ($\_SESSION).
* Bind the database connection settings from the config.php file.

##### Verify form submission

* Verifies that the request came using POST and that the user pressed the register button.

##### Data reception and cleaning

* Cleanse data from blanks.
* Secures inputs against SQL Injection attacks.
* Encrypt passwords using BCRYPT.

##### Verify date of birth

* Verifies that all parts of the date of birth are present.
* Rejects users under 10 years old.
* Uses checkdate to verify the date.

##### gender verification

* Only three options are allowed: "male", "female", or "custom".
* Any unsupported option results in an error.

##### Validate essential fields

* Verify username (length).
* Verify password strength.
* Verify email address using FILTER\_VALIDATE\_EMAIL.

##### Checking duplication in the database

* Make sure the email or username is not already registered.

##### User entry into database

* Enter data into the users table after successful verification.
* If the entry fails, a general registry error appears.

##### Log in after registration

* After the user registers, they are automatically logged in.
* Session variables are created for the user (e.g., user\_id, email, username, etc.).
* The user is redirected to the home page (Home.php).

##### General error management

* If there is an error, a generic message is added urging the user to try again

### Home Page

#### General description

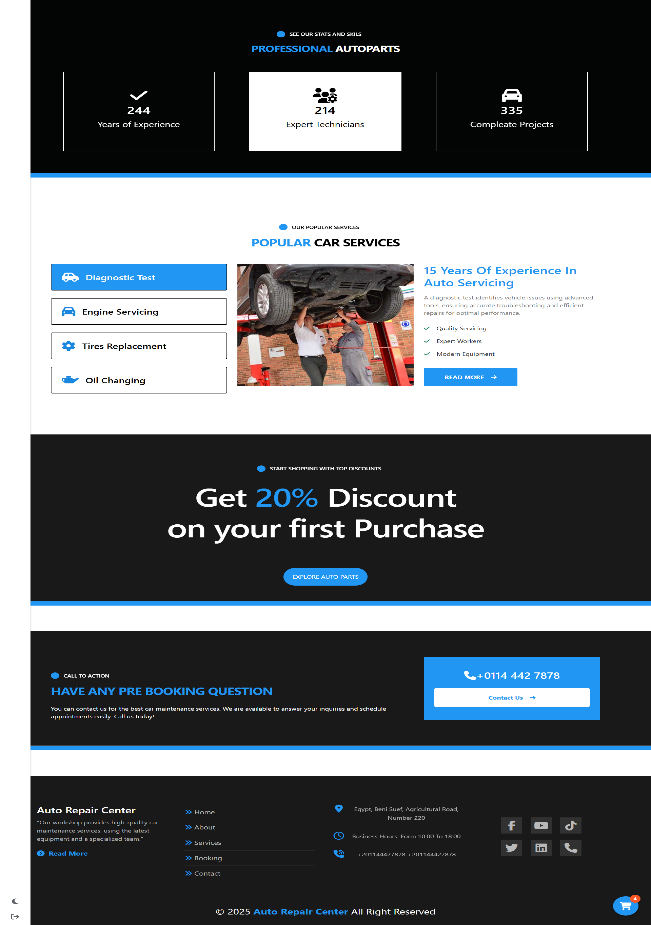
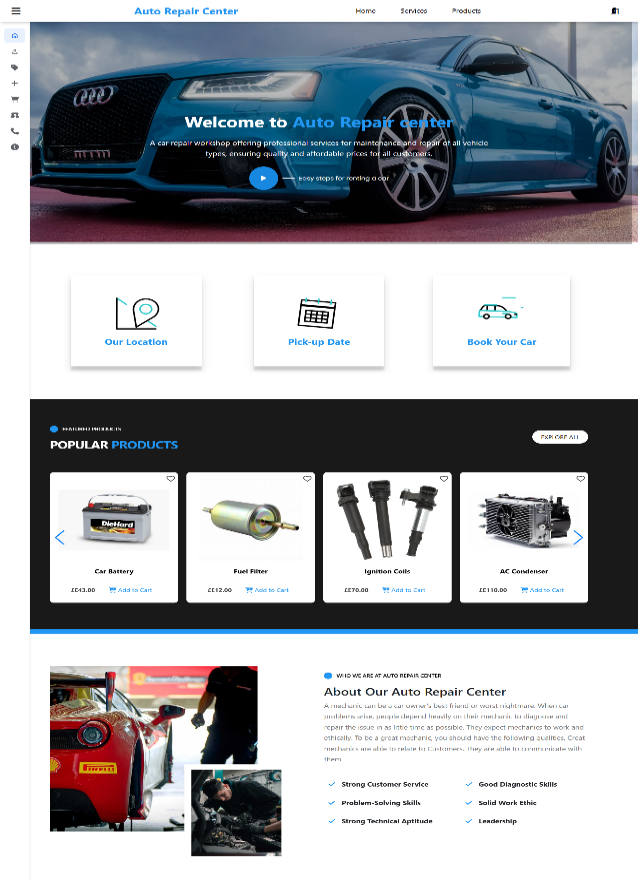


Figure ‎2‑11: Home Page

##### What is the function of this page?

* The home page represents the first interface a visitor sees upon entering the website.
* Its primary purpose is to provide a comprehensive and quick overview of the maintenance center's services and to easily direct the user to important sections of the website.

##### Who uses it?

* All visitors, whether potential customers, registered customers, or even employees, are welcome to the website.

#### Page components

##### Top bar (Header)

* Site logo: "Auto Repair Center."
* Navigation links:
* Home
* Services
* Products
* Account/Checkout icon.

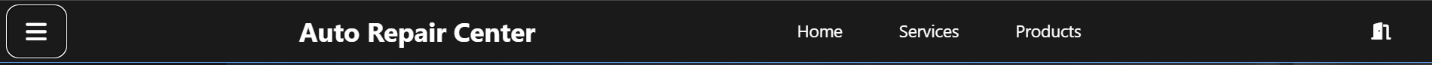
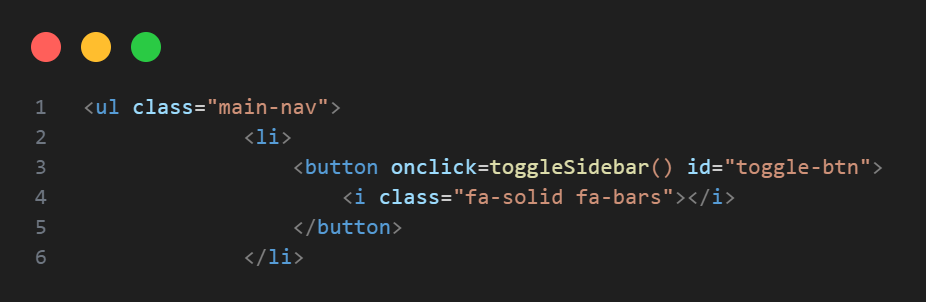
Shape Navbar Dark Mode

Figure ‎2‑12: Header Dark Mode

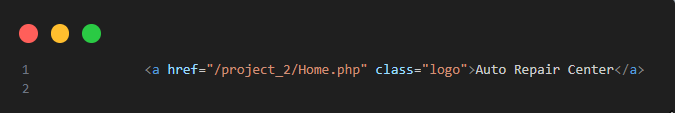
Code Explanation

**✅ <div class="header"> and <div class="container1">**

* header: Often contains custom CSS styles for the page header.
* container1: For organizing header content in a neat, fixed-width or responsive area.

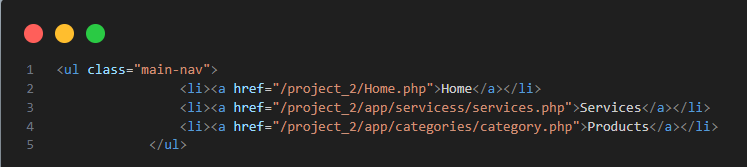
**Button to open the Sidebar.**

* Icon from the Font Awesome library in the form of three horizontal lines (hamburger icon).

 **Logo**:

* The site logo as clickable text, returning the user to the home page.
* Link path: /project\_2/Home.php.

**Main Navigation Menu:**

**Contains links to pages:**

* Home: Home page.
* Services: Services page.
* Products: Products/parts page.

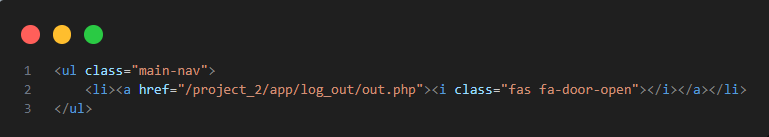
Shape Navbar Light Mode

Figure ‎2‑13: Navbar Light Mode

**Logout icon:**

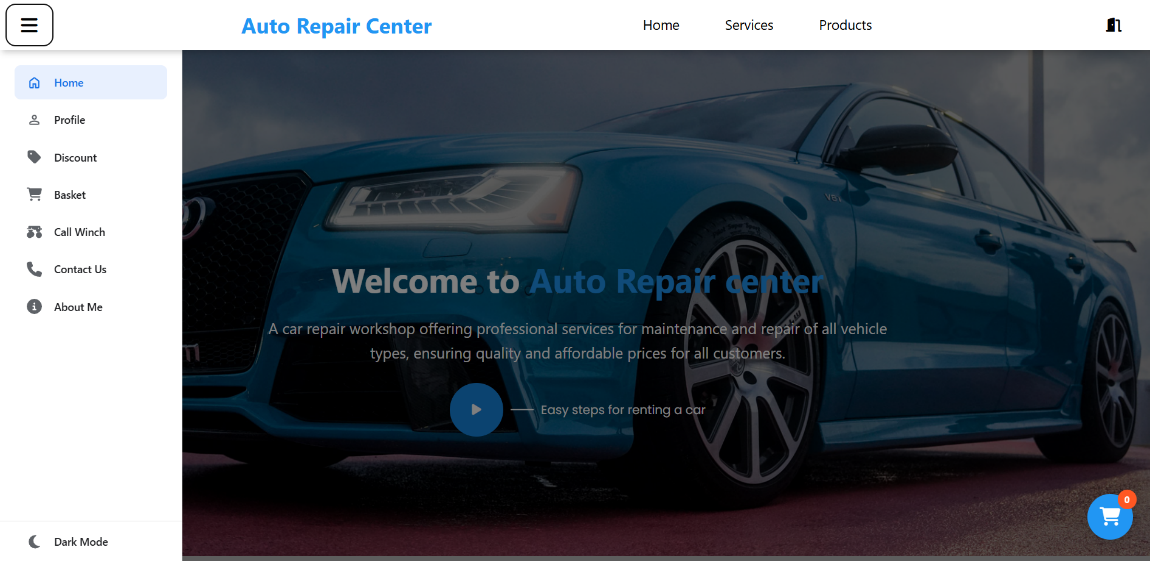
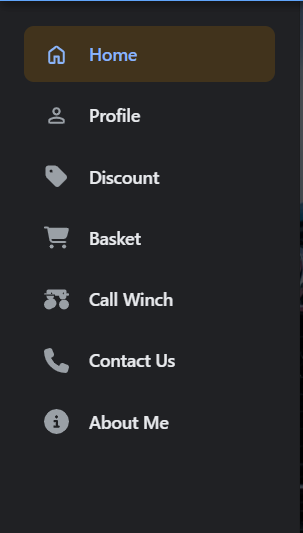
Logout icon (fa-door-open).

When clicked, the user is redirected to the login page.

##### Sidebar Navigation Menu

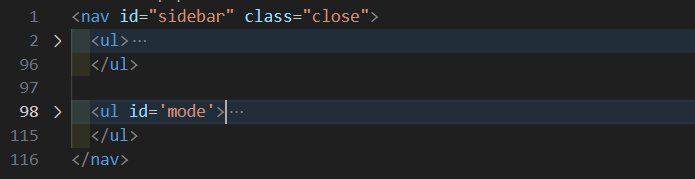
* This code creates a sidebar navigation for an auto service center website.
* The sidebar contains links to important pages such as the home page, profile, sections, services, shopping cart, and more.
* It also includes elements that are only visible to privileged users (such as administrators or moderators), as well as options to change night mode and log out.

Figure ‎2‑14:Sidebar

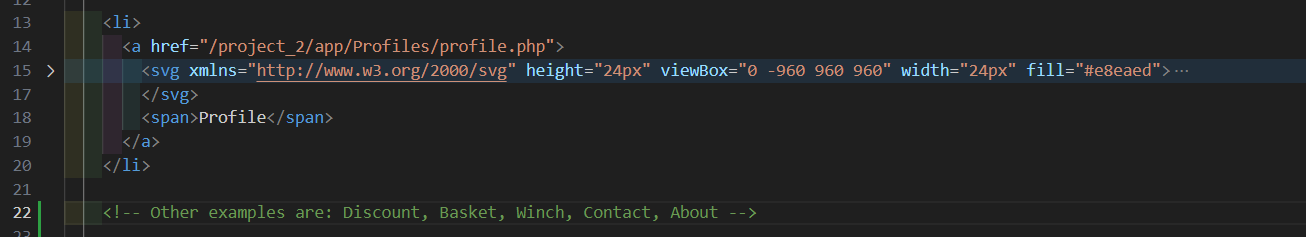


**Light**

**Dark**

**Sidebar Structure:**

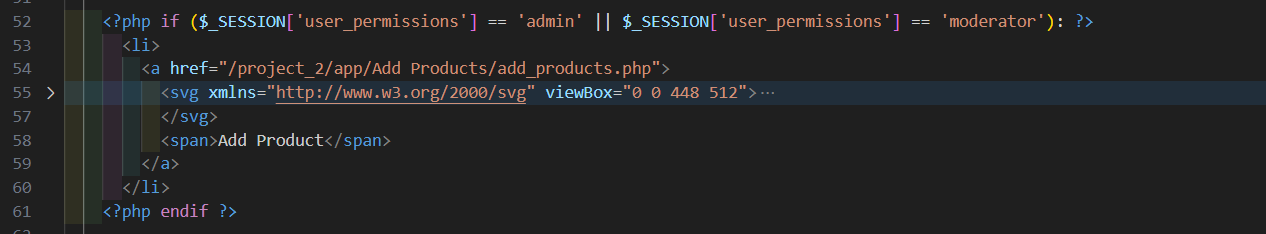
* The sidebar starts with <nav id="sidebar" class="close"> and contains two <ul> menus: one for basic elements (links), and the other for mode settings and logout.
* The design supports the closing and opening functions via class="close".

**Public Links:**

* These links include profile, discount, basket, call winch, contact us, and about us.
* All are available to all users without any permission requirements.

Theme Toggle & Logout:

* The second menu, ul#mode, contains an item for switching the theme between day and night mode, and another for logging out.
* The first contains an icon and text that can be changed programmatically, while the second leads to the logout page.

**Permission-Based Links:**

* Some links are only for users with admin or moderator privileges, such as the "Add Product" link.
* Validity is checked using PHP within an if statement.

##### Main Banner (Hero Section)

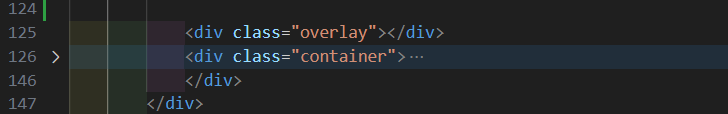
Figure ‎2‑15 : main banner

* Image of a sports car.
* Welcome message: "Welcome to Auto Repair Center."
* Service description: High-quality car maintenance and repair services at reasonable prices.
* Video play button: "Easy steps for renting a car."

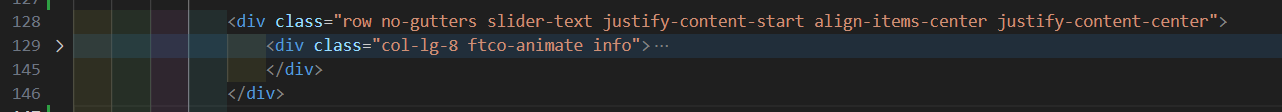
Code explanation

Landing Section:

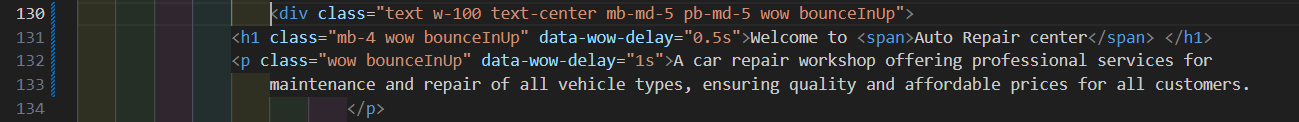
* This element represents the main section of the landing page, and contains animation effects (WOW.js) and a background gradient (Parallax) using data-stellar-background-ratio.

**Cosmetic layers (Overlay + Container):**

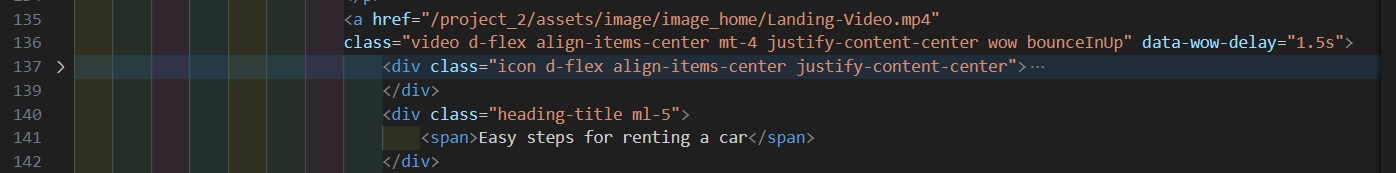
* Overlay: It is a transparent layer placed over the background to make texts easier to read.
* Container: Contains the rest of the internal elements, and is used to center and format the content using Grid.

**Row + Column Formatting:**

* Content is formatted to be centered horizontally and vertically using a row and column layout with 8 columns on large screens.

**Text content (title + description):**

* An attractive welcome headline with a brief description of the workshop's services.
* Both are supported by time-lapse effects to enhance visual appeal.

**Explanatory video link:**

* Play button for a video explaining the car rental process, including a play icon and an attractive title with distinctive visual formats.
* Video playback icon: <span class="video-play"></span>
* Attached text: "Easy steps for renting a car".

##### Quick Booking Services

Cards Containing

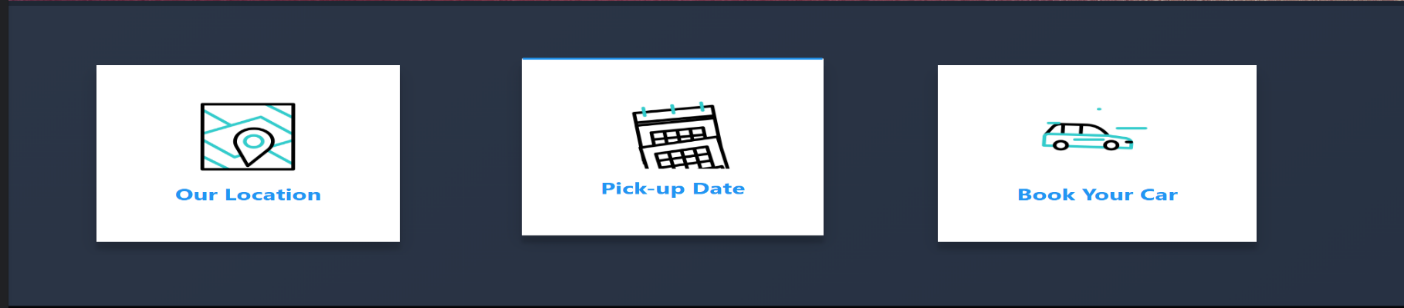
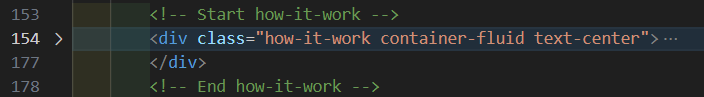
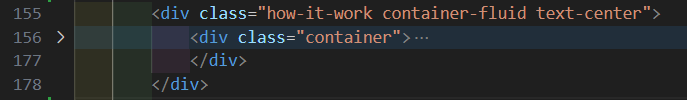
* Our Location
* Pick-up Date
* Book Your Car

Figure ‎2‑16: Quick Booking Services

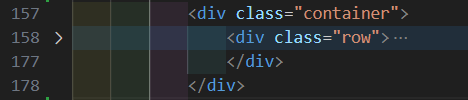
Code Explanation

**Main section how-it-work:**

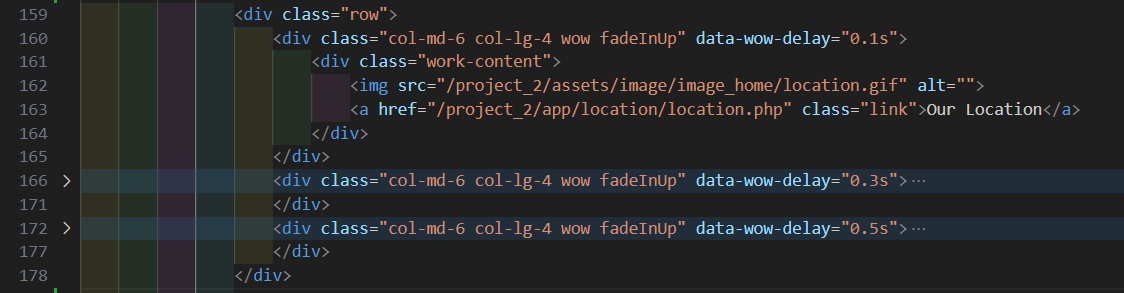
* This outer section defines the content frame and makes it full screen width with center alignment, using container-fluid and text-center.

**inner container:**

* Used to define width and prevent full extension within container-fluid, maintaining a nice, consistent layout for page elements.

**Row:**

* row is used to create a row containing three approximately equal columns, each representing a step of the process.

**Single column design + movement:**

* Each step is placed inside a column using col-md-6 col-lg-4 to take up half the width on medium displays and a third of the width on large displays. Wow fadeInUp is also used to apply animation on the appearance with a time delay using data-wow-delay.

##### Featured Products Section

Cards Containing

* This section is used to display a selection of featured or popular products within the website interface using the Swiper library to create an interactive slider.
* It contains an attractive title, a button to navigate to the All Categories page, and dynamically displays products using PHP, with the ability to add the product to the cart with the click of a button.

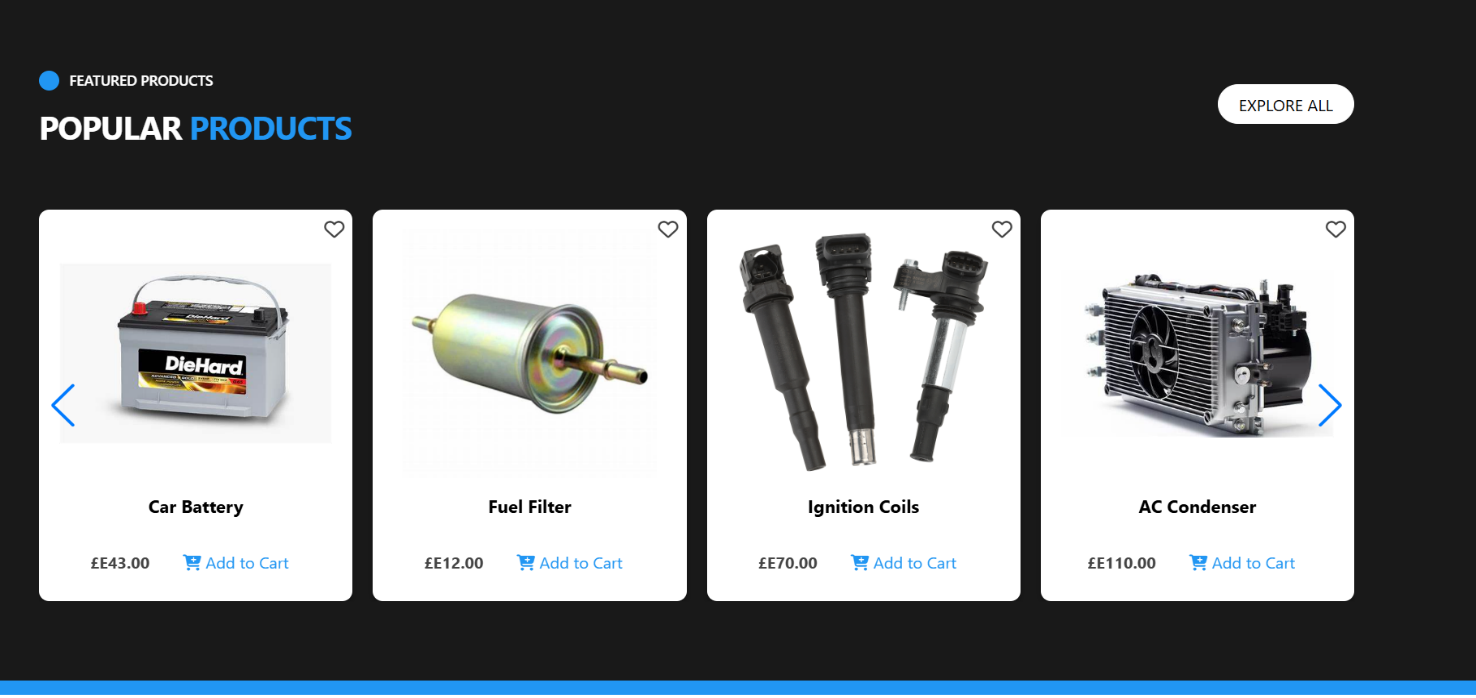
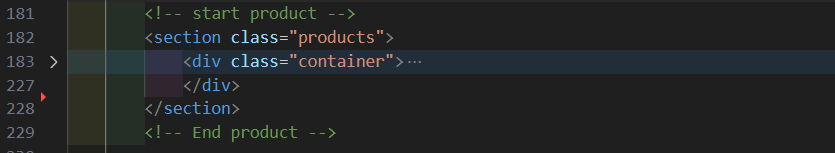


Figure ‎2‑17:Product Section (Home Page)

Code Explanation

**Home of the Products Section:**

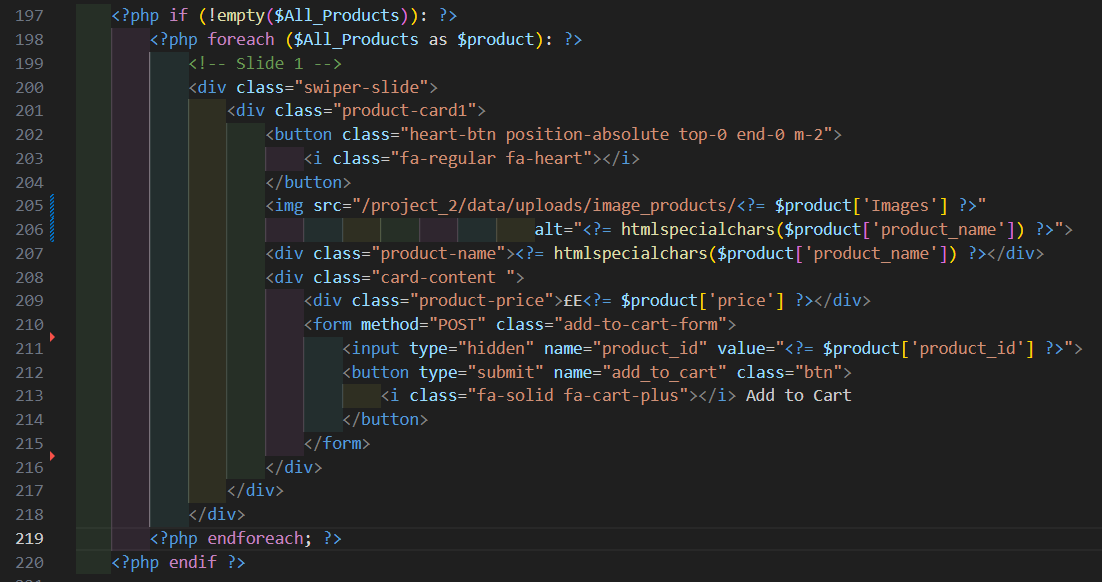
* This section represents the main section that displays featured products on the page. It is encapsulated within a <section> element that is easy to control with CSS or JavaScript.

**Section title and browse all products button:**

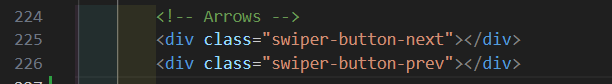
* The title is divided into a subtitle, Featured Products, and a main title, Popular Products,
* as well as a navigation button that directs the user to browse all categories via a link to category.php.

**Setting up Swiper to display products:**

* The Swiper library is used to display products as a slider, with animation effects from the WOW library and Animate.css.

**Duplicate product display using PHP:**

* The $All\_Products array is checked for products and then iterated through them using foreach.
* Each product is displayed within a slide containing an image, product name, price, and an "Add to Cart" button.

**Slider navigation buttons:**

* These elements are used to add left and right arrows that allow the user to manually control the Swiper.

##### About Auto Repair Center Section

Cards containing

* This section is used to display introductory information about the maintenance center, aiming to build user confidence by explaining the work background and team skills.
* It consists of illustrative images, an attractive title, an introductory paragraph, and a list of the most important skills and attributes of the center's staff.
* The section enhances the user experience through attractive visual design and motion effects.

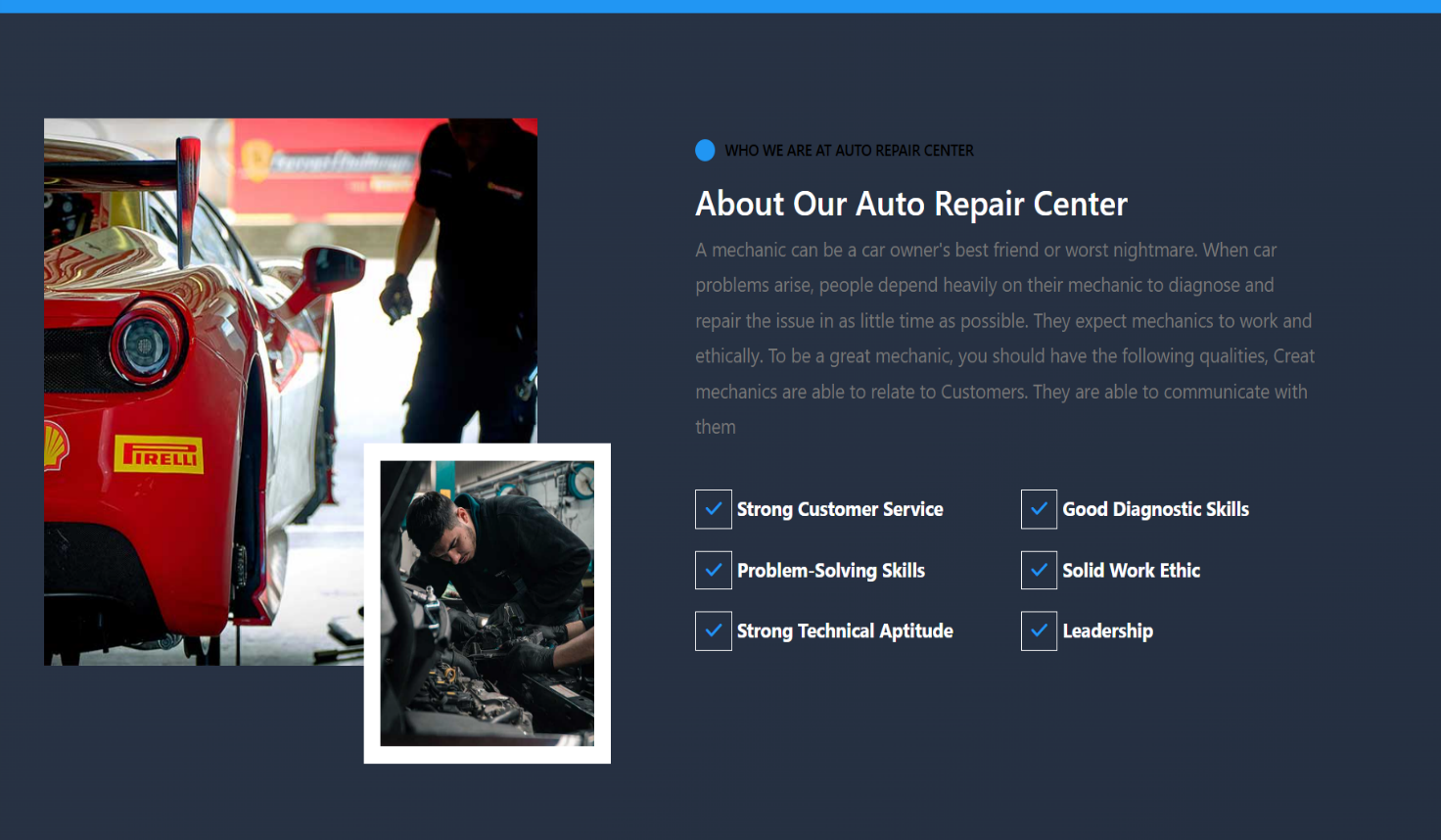
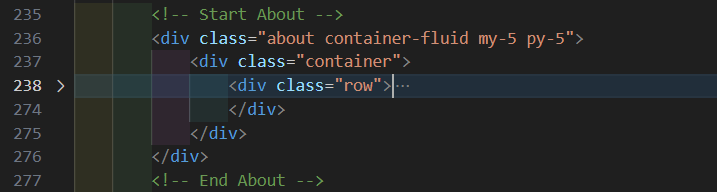
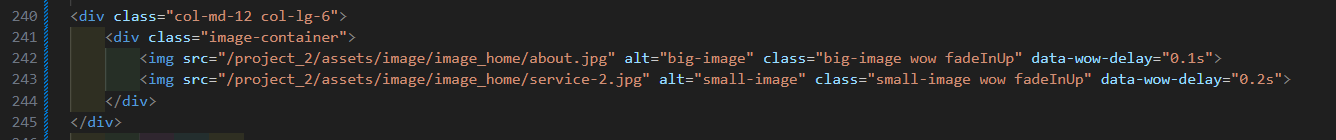


Figure ‎2‑18; About Auto Repair Center (Home Page)

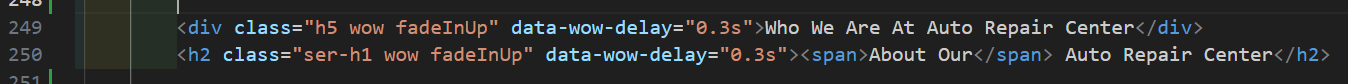
Code Explanation

**About Section Wrapper.**

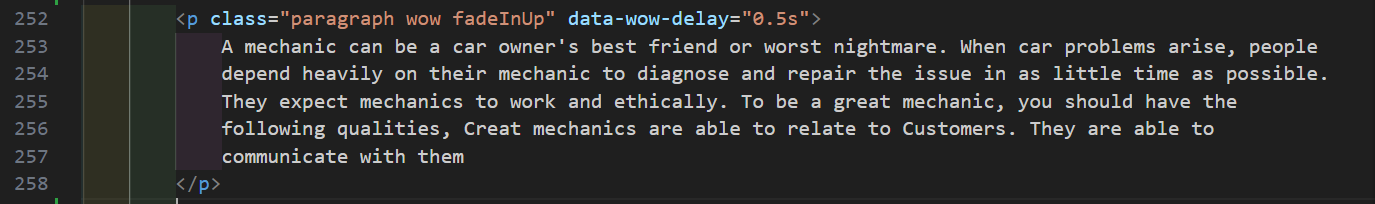
* The section is defined using a div containing the about class, with vertical margins (my-5 py-5) to add outer and inner spacing.
* This element contains all the content of the "About Us" section.

**Image Section:**

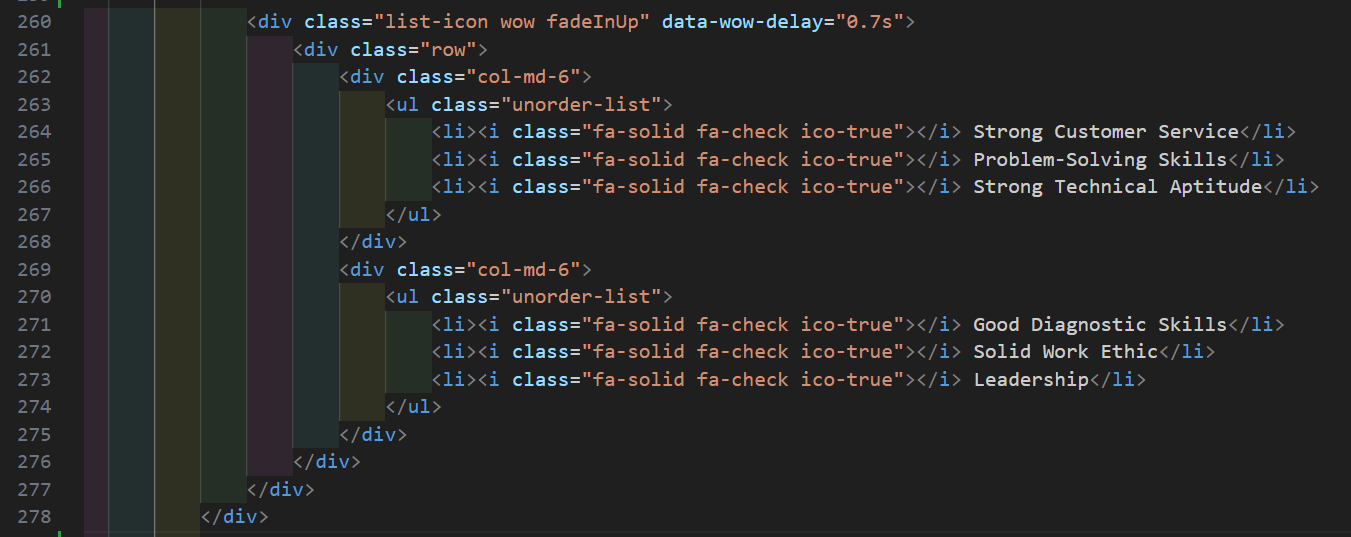
* The first column displays two images in an attractive layout inside an image-container.
* Wow and fadeInUp are used to apply effects when they appear.

**Intro Title and Heading:**

* In the second column, an introductory headline (Who We Are at Auto Repair Center) is displayed followed by a prominent main headline containing a special formatting of the word “About.”

**Description Paragraph:**

* This section contains a paragraph explaining the nature of the work and services, highlighting the importance of the auto mechanic, with an emphasis on the human and professional aspect

**Skills List - Icon List:**

* This section displays an unordered (ul) list of the most important skills that the workshop team should have, divided into two columns and accompanied by icons.

##### Stats & Skills Overview

Cards Containing

* This section displays a set of illustrative statistics that reflect the auto service center's expertise, such as the number of years of experience, the number of specialized technicians, and the number of completed projects.
* The data is presented in an attractive visual manner using motion effects and dynamic digital counters, aiming to enhance visitor confidence in the center and its efficiency.

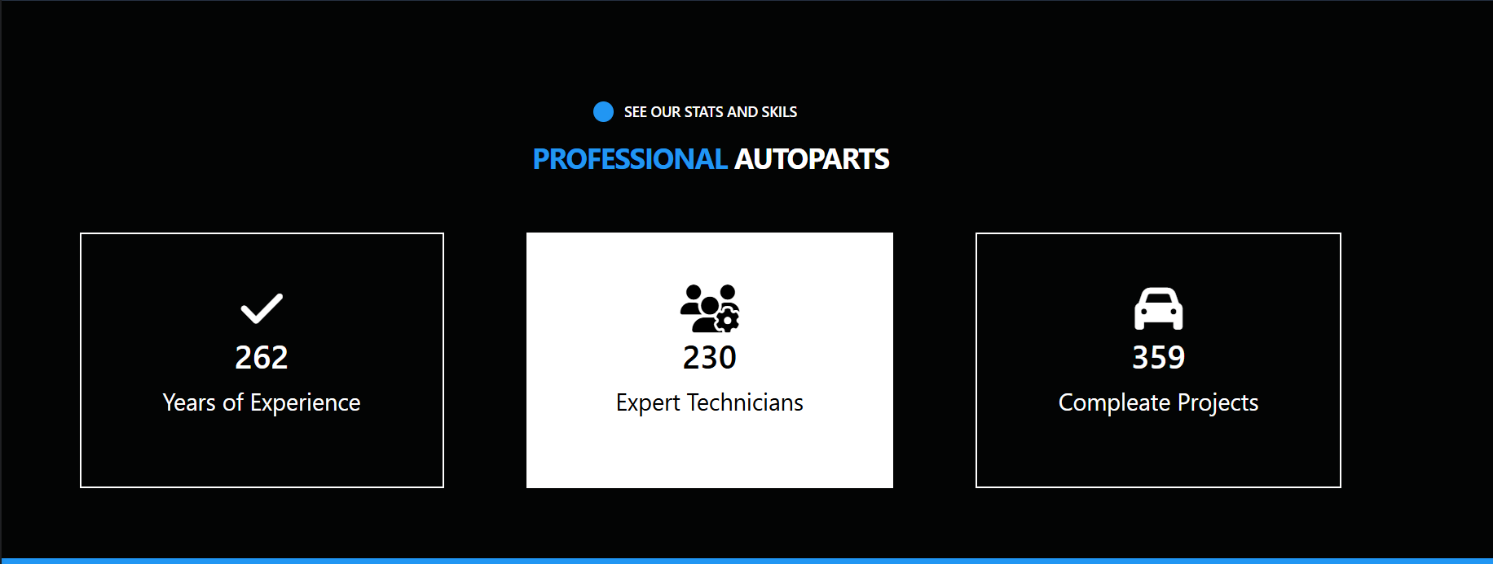
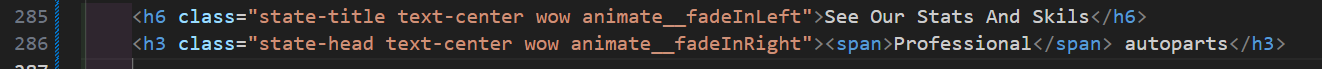


Figure ‎2‑19:Stats & Skills (Home Page)

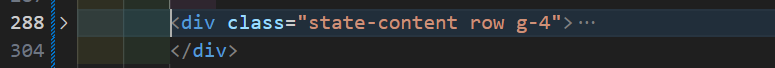
Code Explanation

**Section Wrapper:**

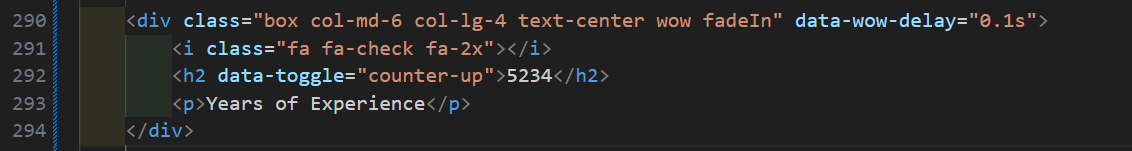
* This part defines the start of the section using container-fluid with a dark background (bg-dark) and vertical margins.
* It contains all the statistics content.

**Section Titles:**

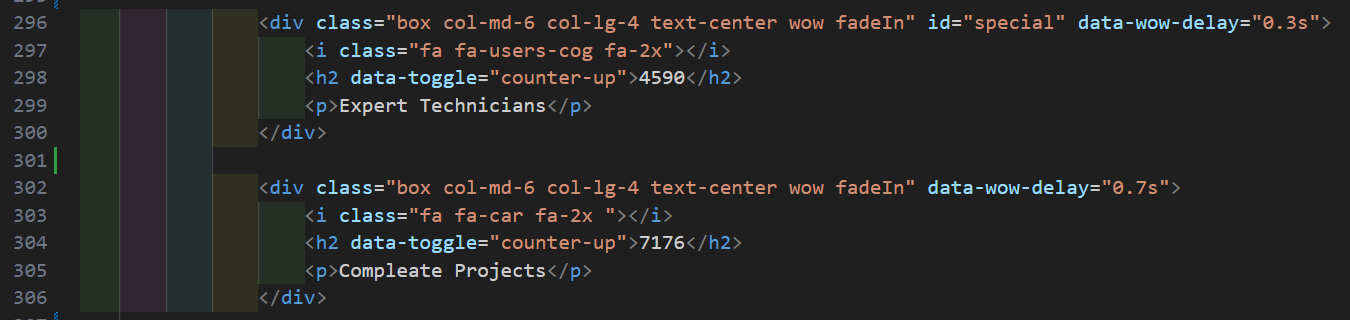
* Includes a descriptive h6 subheading and h3 main heading to give an overview of skills and stats.
* wow and animate\_\_fadeInLeft/Right were used to apply soft entrance effects.

**Stats Grid Container:**

* The statistics grid starts with row g-4 to arrange the three elements side by side with appropriate spacing between the columns (gutters).

** Box 1: Years of Experience:**

* A box containing an icon, a number that is automatically counted using data-toggle="counter-up," and a paragraph explaining its meaning.
* Each box uses wow fadeIn with an increasing time delay for a gradual appearance.

**Funds 2 and 3: Technicians and Projects:**

* The second box displays the number of technicians, and the third the number of completed projects.
* Each uses a similar format to the first, with different display delays.

##### Services Display Section

Cards containing

* This section represents an interactive interface that displays the most prominent car maintenance services in an organized and attractive manner. Users can navigate between multiple tabs to view details of each service, such as diagnostic inspections, engine maintenance, tire replacements, and oil changes, with support for images, descriptions, and promotional items.

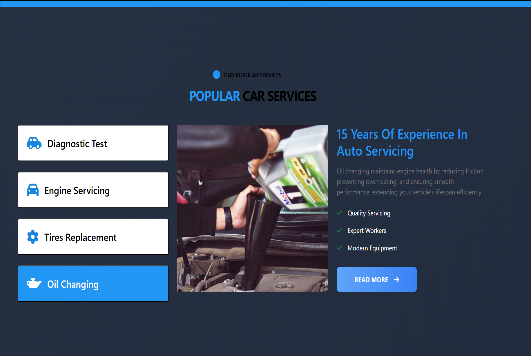
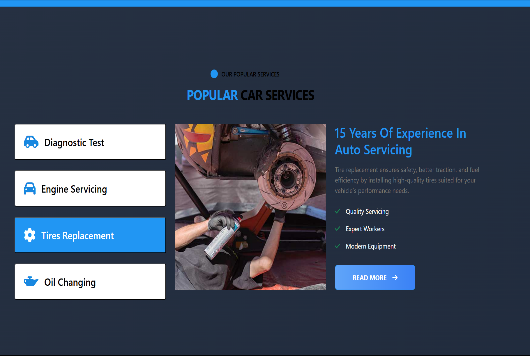
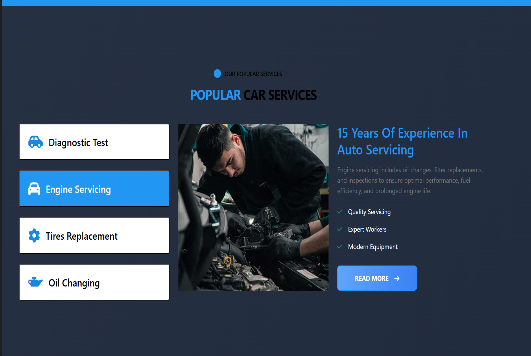
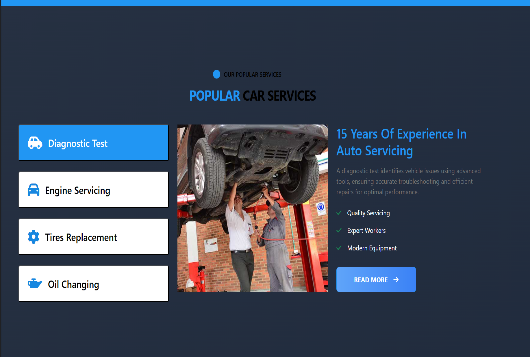
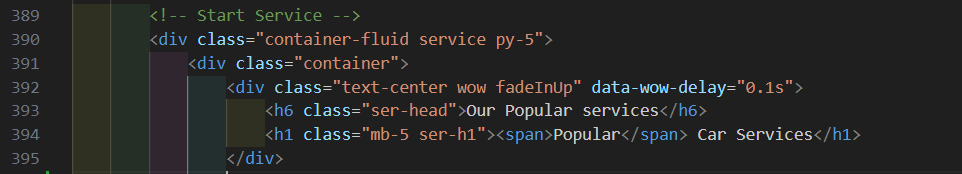
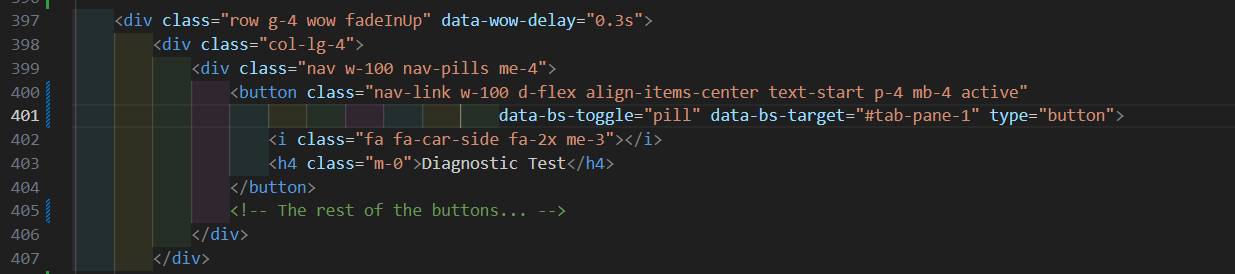


Figure ‎2‑20: Services Display Section (Home Page)

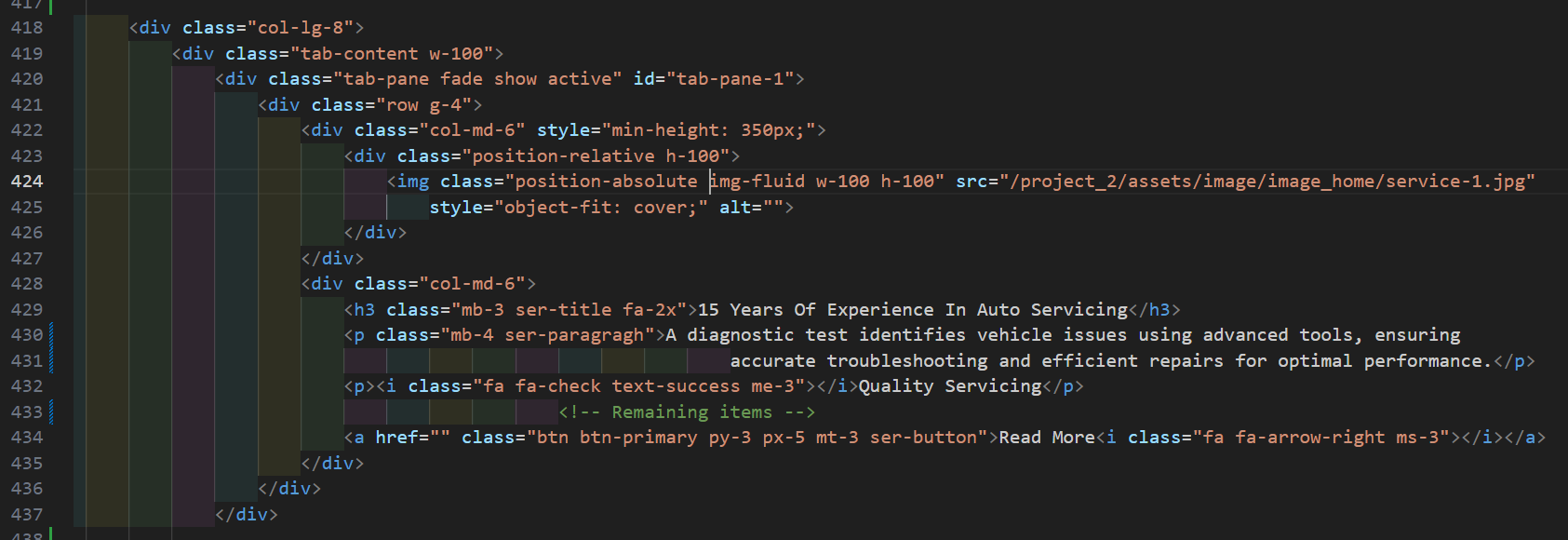
Code Explanation

**Services Section Introduction:**

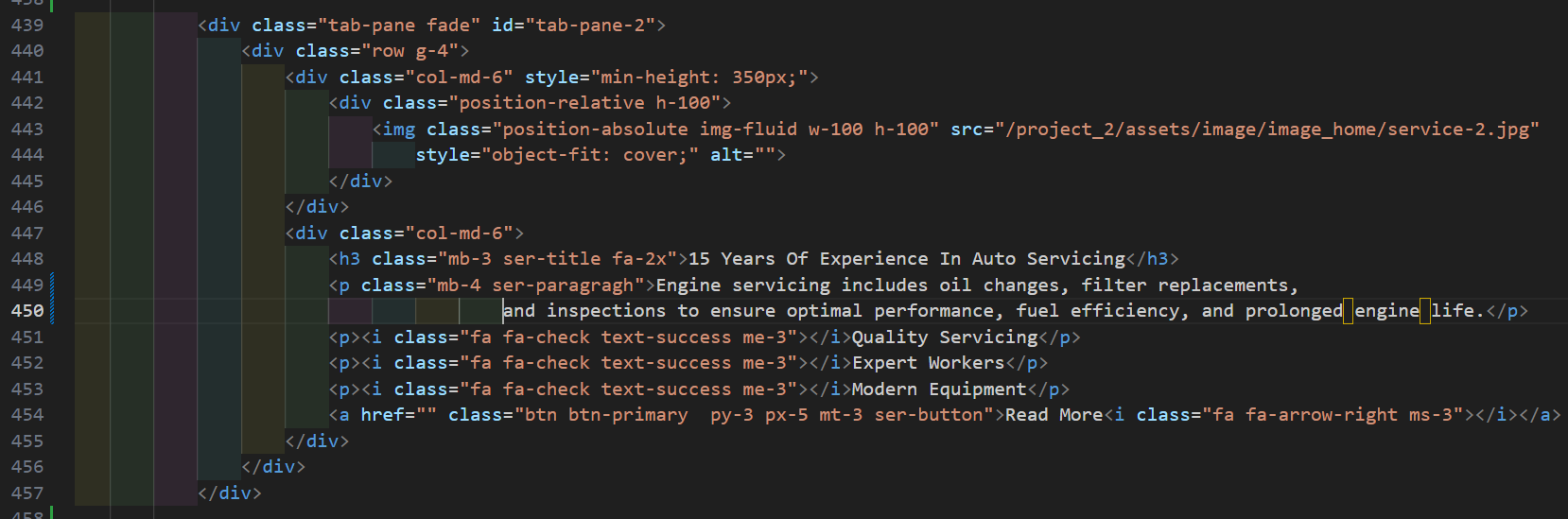
* This section creates a section titled "Our Popular Services" and displays a main title with an animation effect using the wow.js library.

**Side Services Menu (Navigation Menu):**

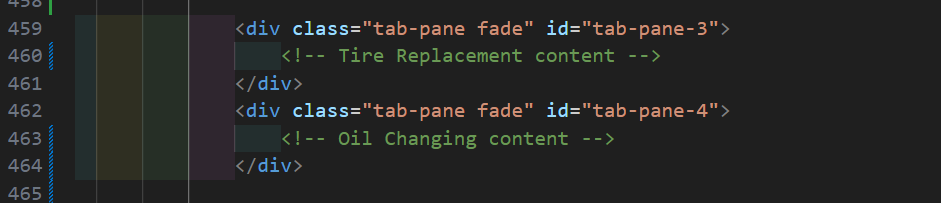
* It contains navigation buttons for each service.
* When you click a button, the service details are displayed on the right side using Bootstrap pills.

**Tab Contents - First Service Tab:**

* When you select the "Diagnostic Test" service, its content is displayed here, which consists of an image, title, description, and some features.

**Contents of the second service tab (Engine Servicing):**

* This is a tab for ‘Engine Servicing’ and appears the same way when activated.

**Other services tabs (Tires Replacement and Oil Changing):**

* It has the same structure as before, but with different images and content depending on the service.

##### Promotions and Discounts Section

Cards Containing

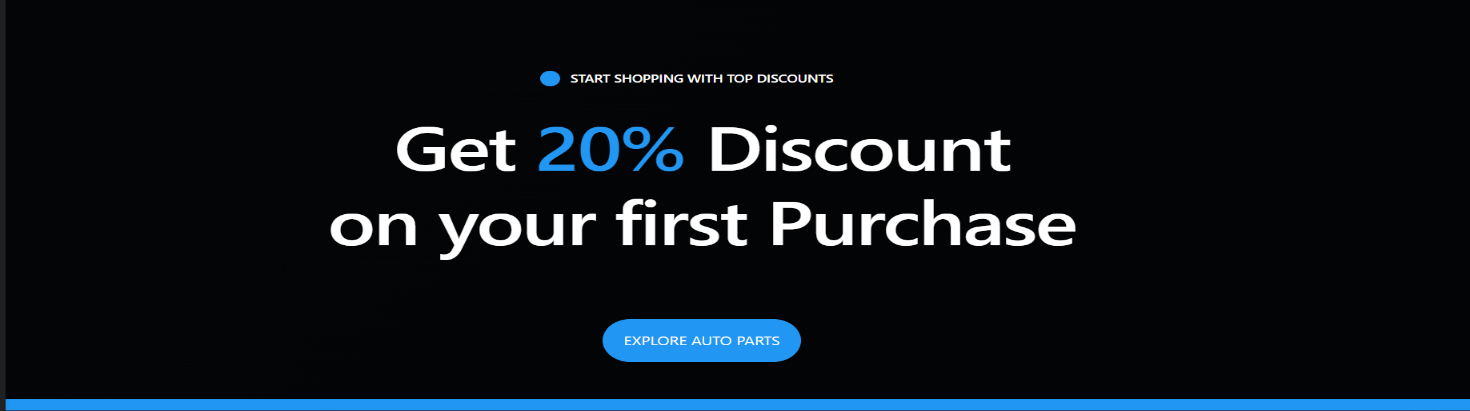
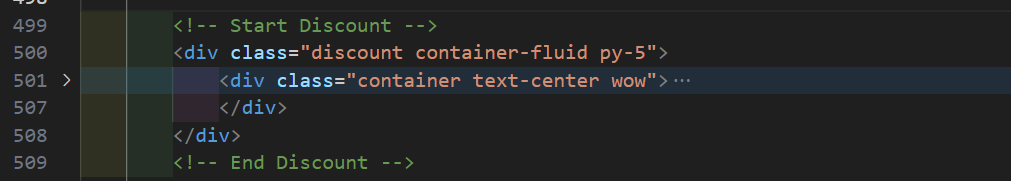
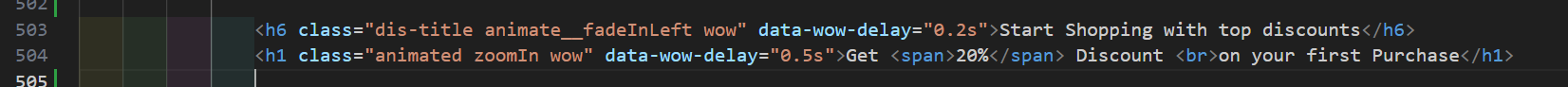
This section is used to display an attractive promotion that encourages visitors to start shopping by offering a 20% discount on their first purchase. It features a simple design and eye-catching animation effects to attract attention.

Figure ‎2‑21:Promotions and Discounts Section (Home Page)

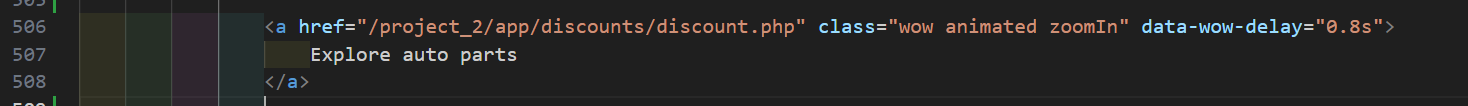
Code Explanation

**Beginning the discount section and defining its general design:**

* The code starts by creating a full-width container-fluid section for a promotional discount. It contains a header and vertical spaces (py-5) to adjust the spacing.

**Animated marketing headlines:**

* This section contains the headings that show the opponent's message using motion effects like fadeInLeft and zoomIn to add dynamism to the page.

**Call To Action Button:**

* A button is created that leads the user to the "Discounts" page, with an animation similar to the headlines. This prompts the user to explore the spare parts and start shopping.

##### Communication and Advocacy Department

Card Containing

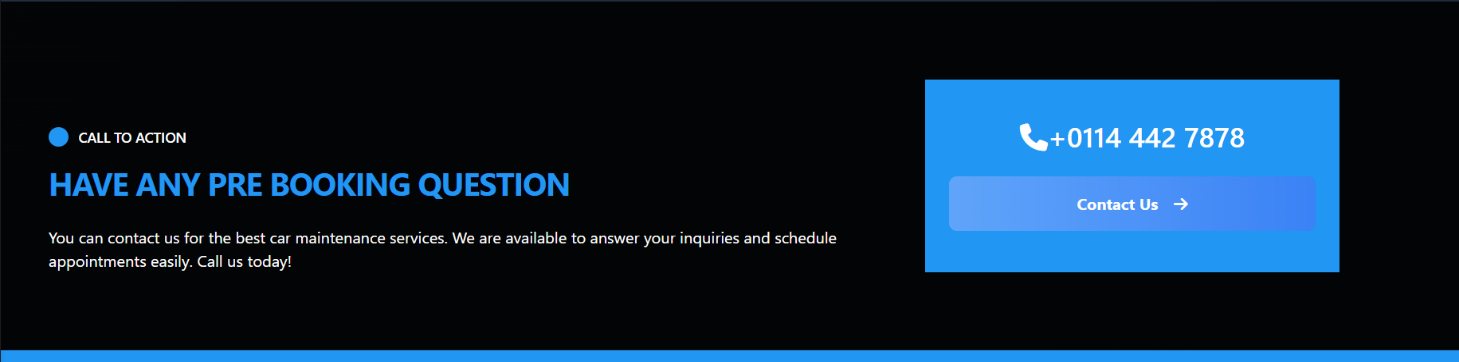
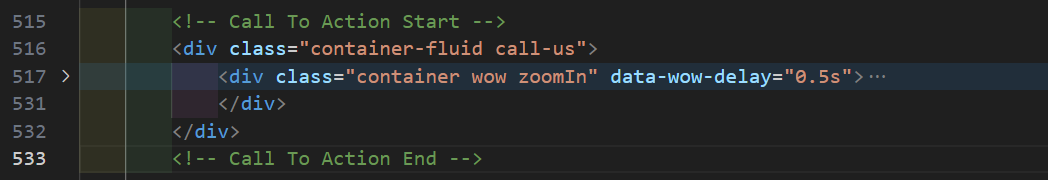
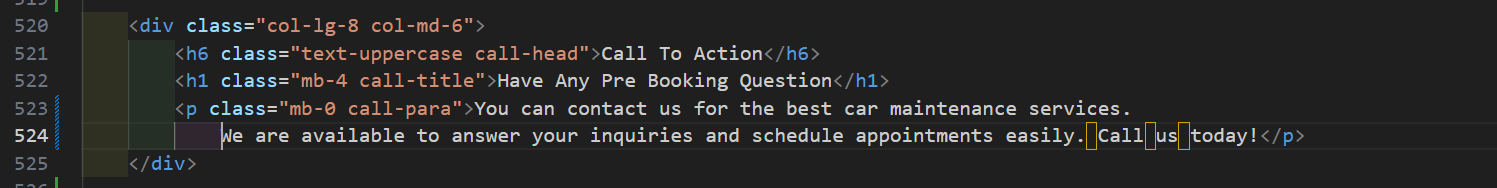
* ****This section is used to encourage visitors to take quick action, such as calling or sending a message, by displaying clear contact information and a direct interaction button, making the booking and inquiry process easier.

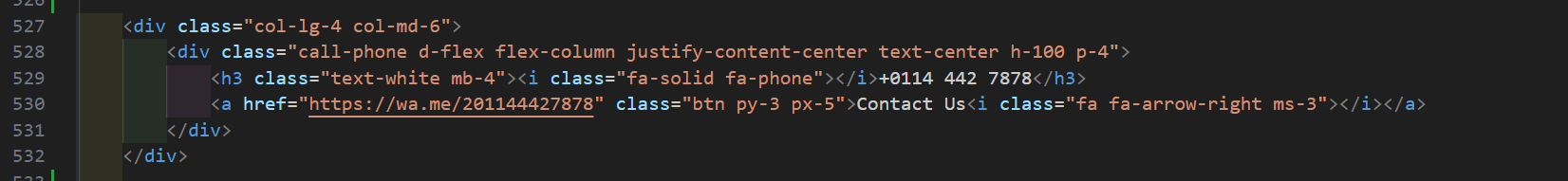
Figure ‎2‑22:Communication and Advocacy Department (Home Page)

**Start of the section and activate visual effects:**

* The section starts full width using container-fluid, with a zoomIn animation effect to highlight the content as it appears on the page.

**Textual Call Message:**

* This section includes headings and paragraphs that encourage visitors to contact you with reservation-related questions, using appropriate paragraph and heading formats.

**Direct Contact Information Section:**

* It contains the phone number within a clear and attractive visual design, with a button that directs the user to a direct WhatsApp conversation.

##### Footer

Cards Containing

* This section represents the footer section design of the auto service center website. It displays introductory information about the workshop, navigation links, and contact information, within an organized and responsive design that enhances the user experience

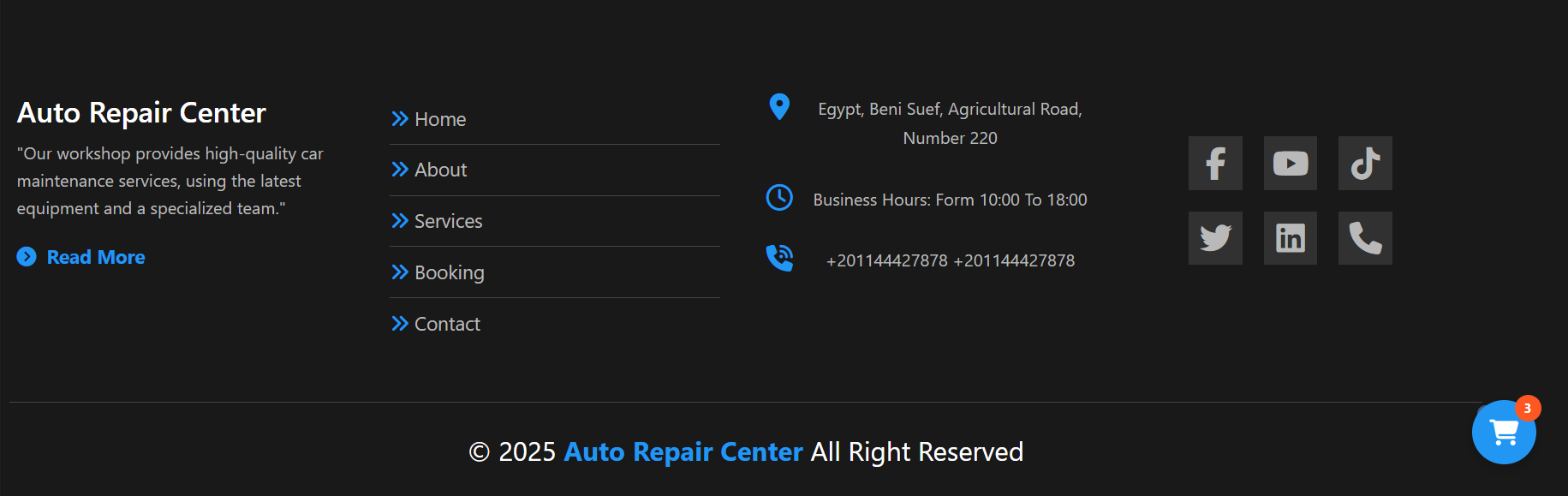
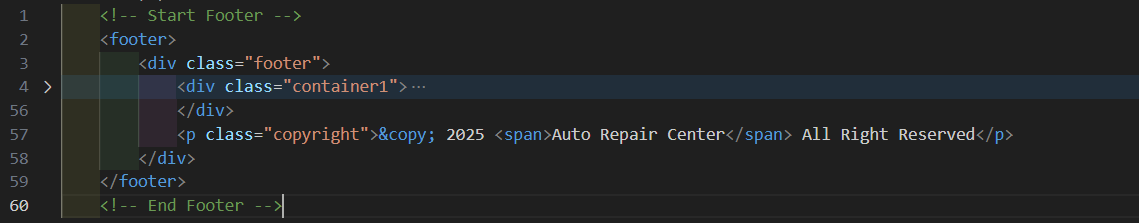
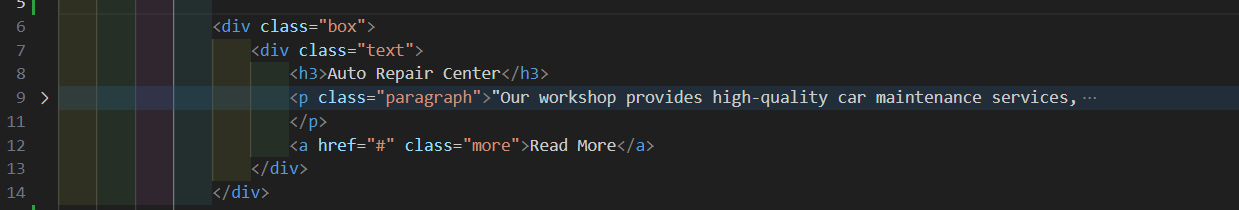
 Code Explanation

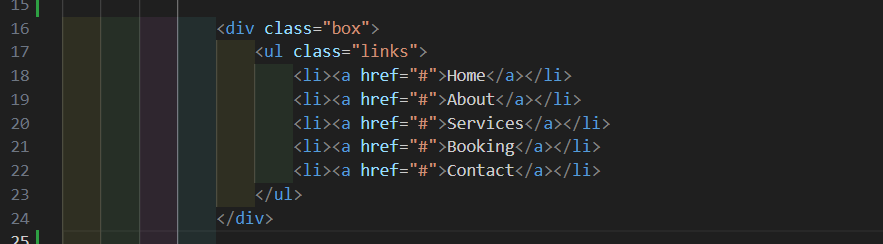
Figure ‎2‑23: Footer

**Footer Structure:**

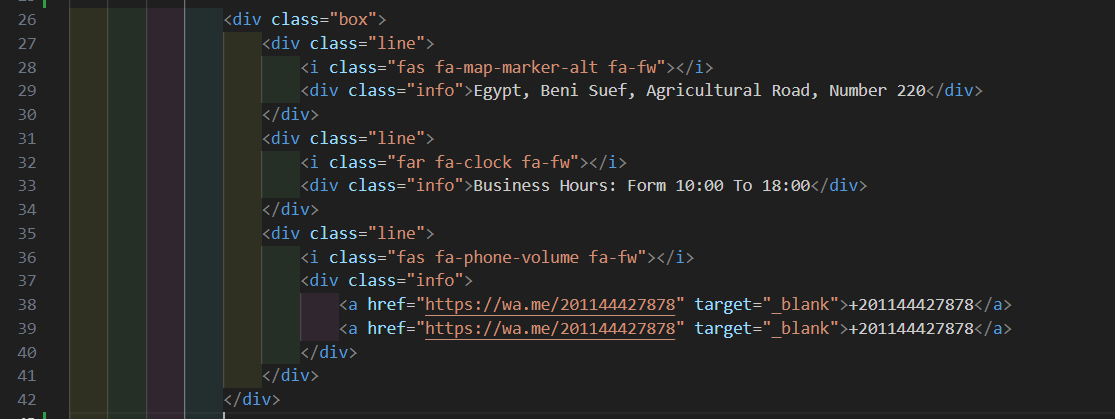
* The header starts with a <footer> tag and contains the main footer section inside a <div class="footer">.
* This structure contains all of the footer content inside a styling container named container1.

**Workshop Info Box:**

* It contains the workshop name, a brief description, and a "Read More" button.
* It is displayed in one of the columns within the footer to provide a quick overview of the services.

**Quick Navigation Links:**

* A list of main links to facilitate navigation between the site pages: Home page, About us, Services, Booking, and Contact.

**Contact Information:**

* Contains the address, business hours, and phone number (linked to a WhatsApp link). Each line contains an icon with explanatory text.

**Social Media Links:**

* A collection of social media links distributed into three groups, each group inside a div class="you", displaying the icons for each platform.

## Use case

### Use Case Login

* The login process is one of the most important interactions between a user and a system, enabling the user to access services or information after verifying their identity.
* This process allows the user to enter their credentials (such as their email address and password), which are then verified by the system to allow secure access.

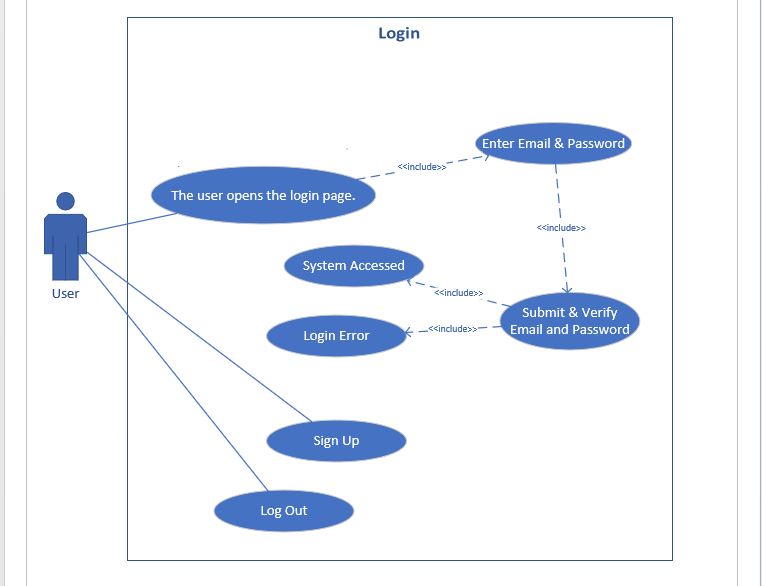


Figure ‎2‑24: use case (login page)

#### Goal

* Allow the user to log in to the system using valid credentials (email and password).

#### Preconditions

* The user must have a registered account in the system.
* The system must be accessible.

### Use Case Registration

# Deliverables and Evaluation

Deliverables and Evaluation

Outline

* + - * 1. Introduction
        2. User Manual
        3. Testing
        4. What are the current solutions?
        5. Evaluation (User experiment).
        6. Summary

## Introduction

Through an easy-to-use interface and flexible digital services, the site provides a comprehensive system that connects customers, technicians, and management, helping to speed up maintenance processes and improve service quality.

This website was developed using modern web technologies with a responsive design that works efficiently across various devices, providing a seamless user experience on both desktop and smartphone platforms.

In this chapter, we present the main parts we completed in our graduation project.

**This includes:**

* A clear and simple explanation of how users can use the system (User Manual).
* The testing process we followed to make sure the system works correctly (Testing).
* The feedback and evaluation we received from real users (Evaluation

## User Manual

**\* How to Use the Website? \***

This section explains how the user can interact with the website from the beginning including login, navigation, and booking a service.

### Login or Register Page

When users open the website, they must log in or register.

#### Login

* Click the Login button in the top navigation bar.
* Enter your email and password.
* Click Login to access your account.

A login box with blue circles

AI-generated content may be incorrect.

Figure ‎3‑1: Login Page

#### Register

* If you're a new user, click the Register button.
* Fill in your name, email, and password.
* Click Register to create your account.

A screenshot of a login page

AI-generated content may be incorrect.

Figure ‎3‑2: Registration Page

### Home Page

After logging in, users land on the Home Page. This is the first main screen of the website.

**It shows:**

* A brief introduction to the Auto Repair Center.
* A navigation bar at the top to help users move between pages.

### A blue car on a road AI-generated content may be incorrect.Home Page (Cont’d)

Figure ‎3‑3: Home Page

### Dark Mode & Light Mode Feature

#### Introduction:

To improve user experience and make the website more comfortable for use during day and night, we added a feature that allows the user to switch between Light Mode and Dark Mode. This is useful for reducing eye strain and saving battery on mobile devices.

**How it Works:**

* **The website starts in Light Mode by default (white background, black text).**
* **When the button is clicked, the background color and text color of the website change accordingly.**

### Dark Mode & Light Mode Feature (Cont’d)

#### Light Mode

Figure ‎3‑4: Light Mode

#### Dark Mode

Figure ‎3‑5: Dark Mode

### Logging Out

A blue car on a road

AI-generated content may be incorrect.If users want to log out, they can click the Logout button or icon in the top navigation bar. This will sign them out safely from their account.

Figure ‎3‑6: Logout

### Website Navigation

**The navigation bar at the top helps users move between the following pages:**

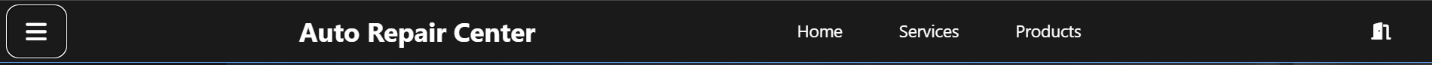
* **Home =>** The main page of the website.
* **Services =>** A list of repair services available.
* **Logout –=>** To exit the account.

Figure ‎3‑7: Navbar

### Sidebar

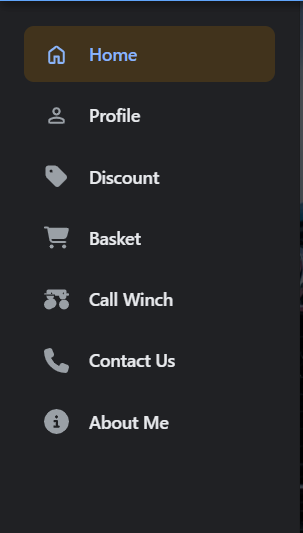
* **Home =>** Takes you to the home page, which contains an overview of services or the current system status.
* **Profile =>** User information page, such as name, phone number, and previous order history.
* **Discount =>** Displays offers and discounts available on maintenance services or spare parts.
* **Basket =>** Shopping cart containing the products or services the user selected before confirming the order.
* **Call Winch =>** A feature to request a vehicle tow truck in emergency situations, with a location specified.
* **Contact Us =>** A page to contact the center, either by phone or by message form.
* **About Me =>** Information about the user or the center (depending on the programming context).

Figure ‎3‑8: Sidebar

### Services

At our Auto Repair Center, we offer a wide range of services to meet all your vehicle needs. Our goal is to ensure your safety and comfort on the road.

**Our main services include:**

* **Oil & Filter Change =>** Using high-quality oils to keep your engine running smoothly.
* **Electronic Diagnostics =>** Advanced tools to detect and identify car issues accurately.
* **Full Maintenance Check =>** Regular inspections to keep your car in top condition.
* **Interior & Exterior Cleaning =>** Complete cleaning with safe and effective products.
* **Tire Replacement & Alignment =>** Ensuring stability and best road performance.
* **Emergency Repair Services =>** Ready to assist you in case of unexpected breakdowns.

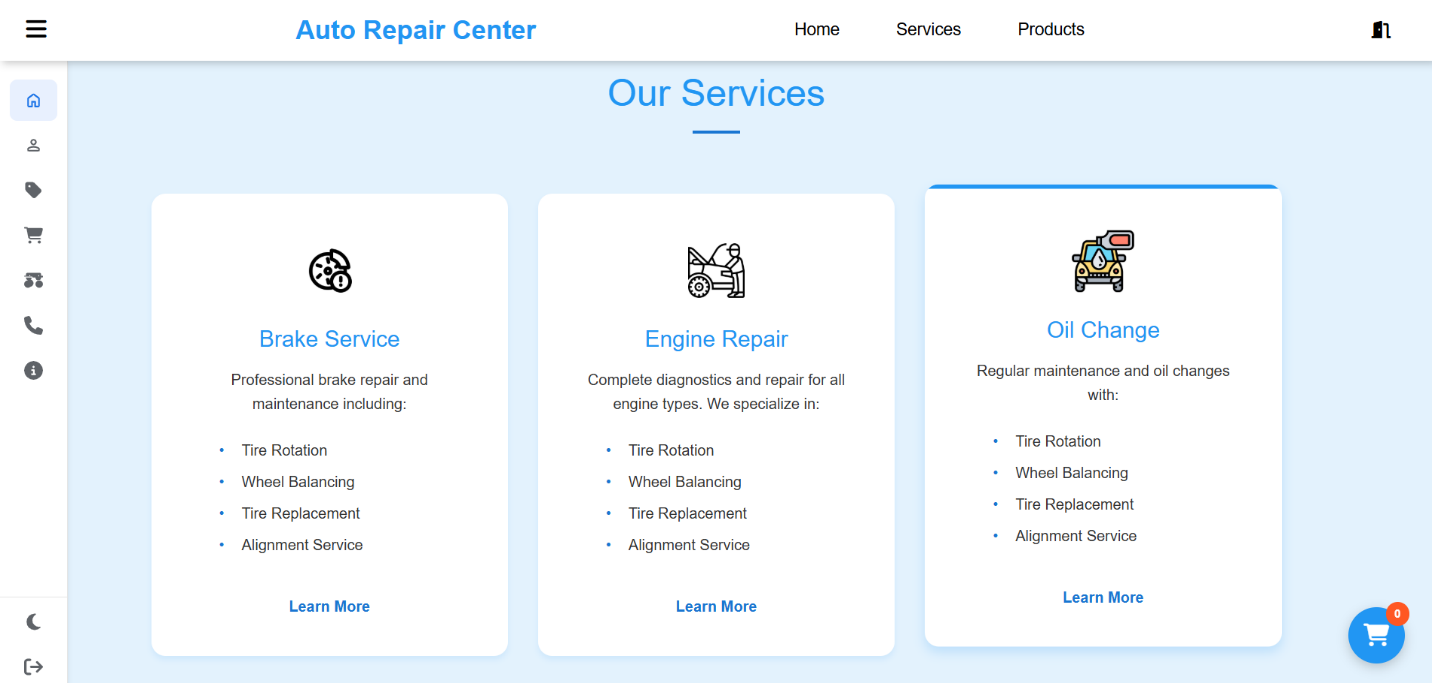


Figure ‎3‑9: Services

### Booking a Service

**To book a repair service, the user can follow these steps:**

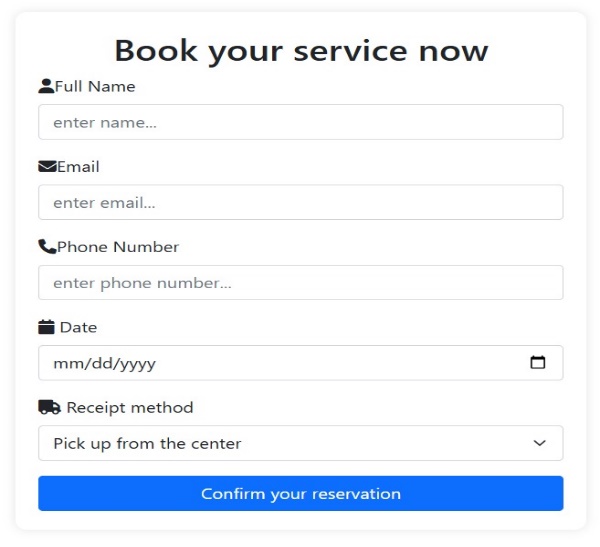
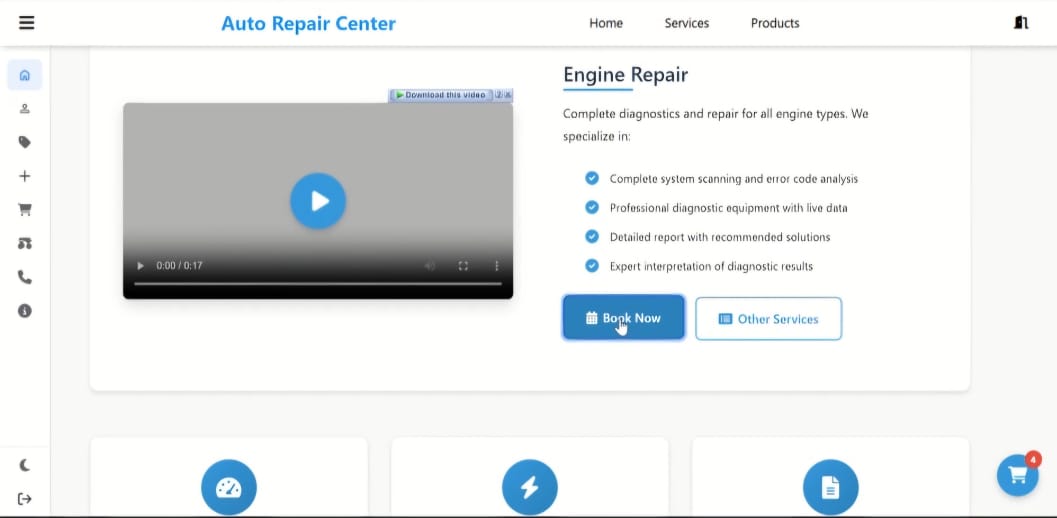
* **From the Home Page, click on Services in the navigation bar.**
* **A list of available services will appear (such as oil change, diagnostics, car wash, etc.).**
* **Choose a service and click on Book Now.**
* ******Enter booking details like date and time, then confirm.**

Figure ‎3‑10: booking page

Figure ‎3‑11:Details Service

#### Customer information

* Full Name
* Phone Number
* Email
* Address

### Products

**Our Products**

In addition to our maintenance services, we also offer a variety of high-quality automotive products to support your vehicle’s performance and safety.

#### Available Products

* Original Oil and Air Filters
* Engine Oils (various types)
* Brake Pads and Systems
* Front and Rear Wipers
* LED Headlights and Car Bulbs

#### Why Buy from Us?

* Guaranteed Quality
* Warranty on Selected Products
* Affordable Prices
* Book and Pick Up During Service

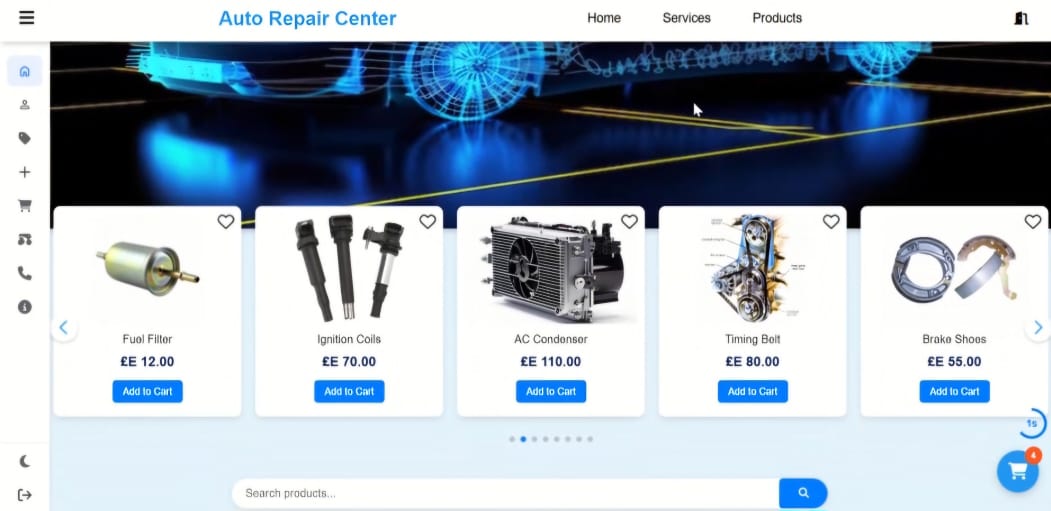


Figure ‎3‑12:products page

## Testing

We performed several types of testing to make sure the system works correctly and without errors.

### Unit Testing

Each function of the system (like login, register, and booking) was tested separately to ensure it works on its own.

### Integration Testing

We tested how different parts of the system work together (for example: register → login → book a service).

### UI Testing

We tested the website on different screen sizes (mobile, tablet, desktop) to make sure the design is responsive and easy to use.

#### Bugs Found and Fixed

* Problem with special characters in registration – Fixed.
* Booking page loading slowly – Improved.
* While testing the registration process, I noticed that the system allowed users to enter only numbers for the password, which is not secure. I updated the code to ensure that the password must contain both letters and numbers, making it stronger and more secure.
* When testing the Dark Mode feature for the first time, I found that it did not work on the first click. This was due to a small error in loading the dark mode class. After reviewing the code, I adjusted the way the classes were loaded and linked the button to the correct function, and the Dark Mode feature started working properly

## Evaluation (User experiment).

**\* Introduction \***

In the evaluation phase, we conducted a thorough analysis and review of the website to assess its effectiveness and quality based on real user feedback.

The goal was to ensure that the website functions correctly, meets user needs, and provides a comfortable and easy user experience.

**\* Evaluation Process \***

* **User Testing:** We asked a group of real users to test the website. They created accounts, browsed different pages, and selected various services and products.
* **Feedback Collection:** User feedback was gathered on ease of use, speed, and overall performance. Special attention was given to the clarity of navigation and ease of accessing different options.
* **Functional Testing:** We tested all main functions such as login, booking, and mode switching (Dark/Light Mode) to ensure everything worked correctly.

**\* Evaluation Results \***

* **Ease of Use:** Most users were satisfied with the ease of navigation and how easily they could access services.
* **Website Performance:** The performance was excellent most of the time, with a few minor delays on slower internet connections.
* **Mode Switching:** The switching between Dark Mode and Light Mode worked well but required some improvements in the initial response time.

## Summary

In this chapter, the project of designing and developing a website for an Auto Repair Center was discussed. The main goal of the project was to create a platform that allows users to book car repair services and products online, ensuring a smooth and user-friendly experience.

**\* Content Covered \***

Introduction: The project idea was introduced, highlighting the importance of providing an online booking service for users to access services faster and more efficiently.

User Manual: A detailed guide was provided on how to use the website, starting with the registration process (Register), followed by logging in (Login), navigating between pages, and booking services. All steps were explained to make it easier for users to navigate and use the website.

**Testing:** All the basic functions of the website were tested. During testing, some issues were discovered, such as allowing passwords to contain only numbers, which conflicted with security principles. Also, the Dark Mode feature did not work on the first attempt.

Evaluation: The website was evaluated through real user testing, where feedback was collected regarding ease of use, performance, and navigation within the site. Key features such as booking and switching between light and dark modes were also tested. Based on the evaluation results, some improvements were made to enhance the user experience and ensure optimal performance.

Results: The website was confirmed to work properly for all essential functions, with additional improvements made, such as strengthening password security and enhancing the responsiveness of the dark mode feature.

**\* Future Recommendations \***

* Improve website performance on slower networks.
* Add additional features, such as email notifications or order tracking, to further enhance the user experience.

(end)

# Discussion and Conclusion

Discussion and Conclusion

Outline

* + - * 1. Introduction
        2. Main Findings
        3. Why is this project important?
        4. Practical Implementations
        5. Future Recommendation
        6. Conclusion Summary

## Introdution

Say goodbye to chaos... welcome to precision organization and high efficiency!

### the problems:

* struggling with manual customer appointment management?
* Looking for an easy way to track vehicle status in your workshop?
* Want to optimize spare parts and inventory management?

The solution is now in your hands

### Why This System?

Simply Because It's the Best!

### Appointment Booking Has Never Been Easier! \*

Online quick booking

No more waiting on phone calls!

Smart calendar Automatically prevents scheduling conflicts.

Automatic notifications

One-click rescheduling

Customers can modify appointments themselves!

## Main Findings

### Operational Efficiency Gains

productivity increase through automated scheduling and real-time tracking.

reduction in administrative errors by eliminating manual paperwork.

faster service turnaround with optimized workflow management.

### Financial Performance Improvements

monthly revenue growth from improved capacity utilization.

reduction in spare parts waste via smart inventory alerts.

higher customer retention due to transparent service tracking.

### Customer Experience Transformation

higher customer satisfaction with digital appointment management.

less wait time through online booking and queue optimization.

fewer service complaints via accurate progress tracking.

### Competitive Advantages

3x faster adoption compared to industry average for digital tools.

20% more vehicles serviced with same staff/resources.

Future-proof operations with continuous AI-powered updates.

## Why is this project important?

### Aligning with the Automotive Digital Revolution

The automotive sector is experiencing unprecedented digital transformation (McKinsey 2023).

Modern customers increasingly prefer workshops offering integrated digital solutions, with 73% favoring technologically advanced service providers.

Implementing this system ensures your business leads rather than follows industry changes.

### Solving Fundamental Workshop Challenges

Traditional workshops face three critical issues this system addresses:

* disorganized administration through unified scheduling and inventory tools,
* skilled labor shortages via AI-assisted diagnostics,
* resource waste reduction - achieving 35% fewer lost parts and 40% technician time savings.

### Competitive Differentiation in Crowded Markets

Industry research (PwC 2024) confirms digital solutions create measurable competitive advantages.

The system specifically attracts younger, tech-savvy customers while establishing your reputation as an innovative service leader.

### Quantifiable Business Improvements

Documented results show 25-40% revenue growth, 60% faster payment cycles, and 30% increased business valuation.

These outcomes stem from operational efficiencies and enhanced customer satisfaction.

### Future-Proofing Your Operations

The solution prepares your business for emerging requirements: government transparency mandates, customer digital service expectations (85% demand according to Deloitte), and increasingly complex vehicle technologies.

This transition represents not optional innovation but essential modernization for sustainable business success in the evolving automotive service industry.

**Implementation typically follows three phases:**

* System configuration (4-6 weeks)
* Comprehensive staff training (2 weeks)
* Full operational integration (8 weeks)

**Financial projections indicate:**

* Cost recovery within 12-18 months
* Significant return on investment by year three
* Halved customer service complaints

**The complete solution includes:**

* Live inventory management
* Intelligent scheduling automation
* Digital maintenance records
* AI diagnostic assistance
* Streamlined payment processing

## Practical Implementations

Practical Implementation Plan for Car Maintenance

Project Title: Efficient Car Maintenance System

Version: 1.0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**\* Overview & Objectives \***

### Purpose

* Ensure vehicles are well-maintained to improve safety, longevity, and performance.
* Reduce breakdowns and costly repairs through preventive maintenance.

### Scope

Covers routine checks, servicing, and emergency repairs.

**Applicable to:**

* **Personal vehicles**
* **Fleet management (company cars, trucks)**
* **Auto repair shops**

### Key Metrics for Success

* ✔ 90%+ scheduled maintenance compliance
* ✔ 20% reduction in unexpected breakdowns
* ✔ Cost savings by avoiding major repairs

## Practical Implementations (cont’d)

**\* Maintenance Schedule & Checklist \***

### Routine Maintenance Tasks

Frequency Tasks

Daily/Weekly Check tire pressure, oil level, lights, brakes

Monthly Inspect battery, coolant, wiper blades

Every 5,000 km Oil change, filter replacement

Every 20,000 km Brake inspection, wheel alignment

Every 50,000 km Transmission fluid, timing belt check

### Tools & Equipment Needed

* Basic: Jack, wrench set, oil filter wrench, OBD2 scanner
* Advanced: Hydraulic lift, tire balancer, diagnostic tools

**\* Implementation Process \***

### Step-by-Step Workflow

* Inspection → Use checklist (Page 2) to identify issues.
* Diagnosis → Scan for error codes (OBD2) or manual checks.
* Repair/Maintenance → Change oil, replace parts, etc.
* Testing → Road test or system checks.
* Documentation → Update logbook/digital tracker.

## Future Recommendation

**\* Adoption of Predictive Maintenance Technologies \***

### AI and IoT-Based Diagnostics

* Smart Sensors: Install IoT-enabled sensors in critical components (engine, transmission, brakes) to monitor real-time health and predict failures.
* AI-Powered Analytics: Use machine learning to analyze driving patterns, engine performance, and wear-and-tear trends to schedule maintenance proactively.
* Connected Cars: Leverage vehicle telematics (e.g., Tesla, BMW ConnectedDrive) to receive automatic alerts for required servicing.

### Blockchain for Maintenance Records

* Tamper-Proof Logs: Store maintenance history on blockchain to ensure transparency and prevent odometer fraud.
* Smart Contracts: Automate service reminders and payments for fleet managers.

**\* Shift Towards Electric & Hybrid Vehicle Maintenance \***

### Specialized Training for EV Technicians

* Battery Health Monitoring: Train mechanics to assess lithium-ion battery degradation and optimize charging cycles.
* High-Voltage System Safety: Implement strict safety protocols for handling EV electrical components.

### Expansion of Charging Infrastructure Maintenance

* Regular Charging Station Checks: Ensure compatibility, power efficiency, and cybersecurity for public chargers.
* Battery Recycling Programs: Develop sustainable disposal methods for end-of-life EV batteries.

**\* Sustainable & Cost-Effective Maintenance Practices \***

### Eco-Friendly Lubricants and Parts

* Bio-Based Oils: Shift to synthetic and biodegradable lubricants to reduce environmental impact.
* 3D-Printed Spare Parts: Use additive manufacturing to produce rare or obsolete components on-demand.

### Predictive Fleet Management for Businesses

* Dynamic Maintenance Scheduling: Use AI to optimize service intervals based on real-time vehicle usage.
* Fuel Efficiency Optimization: Implement aerodynamic upgrades and tire pressure monitoring for long-haul trucks.

## Conclusion Summary

The auto repair industry is undergoing a significant transformation driven by technological advancements, sustainability demands, and evolving customer expectations.

**To remain competitive and efficient, repair centers must adapt to these key trends:**

### Embrace Smart Technologies

* Predictive Maintenance: AI and IoT will enable real-time vehicle diagnostics, reducing unexpected breakdowns.
* Digital Record-Keeping: Blockchain and cloud-based systems will improve transparency in service history.

### Prepare for Electric & Hybrid Vehicles

* EV-Specialized Training: Technicians must be certified in high-voltage systems and battery maintenance.
* Charging Infrastructure Support: Repair centers should offer EV charging station installation and maintenance.

### Adopt Sustainable Practices

* Eco-Friendly Solutions: Use biodegradable lubricants, recycled parts, and energy-efficient equipment.
* Waste Reduction: Implement proper disposal methods for batteries, oils, and tires.

## Conclusion Summary

### Enhance Customer Experience

* Mobile & AR Integration: Offer app-based booking, virtual inspections, and augmented reality repair guides.
* Subscription Models: Introduce flexible maintenance plans to retain long-term customers.

### Comply with Regulations & Industry Standards

* Right-to-Repair Advocacy: Support policies that allow independent shops to service all vehicle types.
* Green Certification: Obtain eco-friendly credentials to attract environmentally conscious clients.

**Final Recommendation:**

Auto repair centers must invest in training, technology, and sustainability to thrive in the evolving automotive landscape. By adopting AI diagnostics, EV expertise, and digital customer solutions, repair shops can improve efficiency, reduce costs, and build lasting customer trust.

(end)

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