GARAGE WEB SYSTEM – FINAL PROJECT

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Dublin – Ireland

15th Aug 2020

ACKNOWLEDGEMENTS

I would like to begin by expressing my sincerely thanks to all CCT College staff and lecture which has participated and helped me, on the way, to increase my skills and knowledge.

Thanks to give enough support to face all difficulties and be able to go through them.

In addition, I would like to thank to my study group, and classmates who has inspired me to keep going and growing. Thanks to the people which has been patience.

And at last, but not less important, I would like to mention specially my grandmother which passed away on December last year. She was a very important person.

Thanks to those people who are always by my side giving me the needed support during this period. I do appreciate all what them have been made. All of you are very special and owns my gratitude. Those people are the most important pillars of my life and career: my parents, friends, family and girlfriend.

Many thanks!!!

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ABSTRACT

Ger runs a small garage where he carries out maintenance checks and he is supported by a small team of employees. The present document describes the Garage Web System designed based on Ger’s requirements. This application is to help Ger to better manage his garages so far he’s only had manual bookings, where the clients would come or call to the garage to book a service.

The new application has been being developed to support all stakeholders: clients can book their appointments, employees can consult them. The application provides login for staff and customers, staff and customer register, book, issue invoice and manage stock.

CHAPTER 1: INTRODUCTION

PROJECT CONTEXT

Ger manages a small team of 4 mechanics. All those employees are able to maintain different types of vehicle and perform any service or repair. In some cases, maintenance check will require parts or supplies (e.g. fluids, oil, tyres) which the staff will look for in the stock of supplies from the garage and invoice the customer for.

It is a small garage which carries out any type of services and repairs on cars, motorbikes, small vans and small buses. However, due to the high demand of bookings, Ger was facing, some issues which is going to be solved with the new application. The Web System allows customers and staff to login and register their details and customer can make appointment for their vehicles. The employees are able to view all booking assigned to them for the current day. Ger will also be able to manage and view all bookings and register new staff.

This web system is designed to assign automatically a booking to a staff member after a customer makes an appointment. Besides, the application allows Ger to print the schedule for any particular date, allocate costs to each booking or a basic fixed cost.

Taking into consideration the above scenario, the main services that need to be provided are:

- The customer can creates an account and books an appointment. After signing up and registering, the customer can visualise the last booking. The customer will also be able to update the following items:
    - User name and password, contact details and vehicle details;
- The staff will be able to check the schedule for the day, update booking status and complete information about services and prices.
- The administrator (Ger) will be allowed to create new staff, check and update bookings and monitor the stock.

Once registered, the customer can log-in and book a slot.

To book the appointment, the customer will be asked to pick a day, enter the vehicle's details, the type of service and give details about the issue. The customer can't make an appointment on Sundays as the garage is closed and also there will be a limit of services that can be booked per day.

The mechanic will need to update the booking status to either "Booked", "In Service", "Fixed / Completed", "Collected" or "Unrepairable/Scrapped".

Once the booking has been changed to "Completed" the application sends the invoice by email to the customer or can be printed from the screen.

Booking daily limit: the garage currently has 4 staff members who can carry out any kind of service. Each employee works at maximum on 4 vehicles per day. The total amount of services per day is the math between the number of staff members multiplied by the maximum number of services each employee can complete per day, so the daily limit for bookings is set to 16.

WHY IS IT A GOOD PROJECT?

Developing a web-based application enables us to go beyond the concepts we have learnt and apply them to a real-life case study. Also, it gives us the opportunity to articulate all the technologies we have studied during the course and others which we would have searched to implement this Web System.

The application has been built to serve small garages but can also attend to others businesses which purpose is to offer services (e.g hairdresser, computer maintenance, health consulting etc.). In addition, as it is web service based, new modules can be built and bigger garages could use this solution as well.

The system is a web service based architecture. It makes it easier to create new functionalities and integrate with other web applications. Also, troubleshooting and fixes are usually more straightforward because it is possible to isolate the problem. New modules can be added too (e.g. payments and e-invoices) with minimum effect, since they are independent blocks. The front-end is built using ionic calling the endpoints. In other words, to change the View layer only requires creating a new one and connecting to the same endpoints, without affecting the back-end.

Main goal:

Create a web-based application where customers can book their vehicles to a garage service.

Objectives:

- Research of technologies and review previous concepts;
- Define architecture and design diagrams;
- DB connection;
- Map JPA entities;
- Connect the Front-end with Back-end;
- Final report;

Areas to cover:

To build this web-based application I've used the following technologies and methodologies:

- Java 8, object oriented language;
- Java Persistence API, as Java software component to map the database using annotations, and manage queries on the DB;
- Spring Boot as a Java framework in order to create web services;
- Tomcat as HTTP web server provider;
- Gradle, an open-source build automation system based on Apache Ant and Apache Maven;
- Postman, a tool used to test RESTful APIs;
- Ionic Framework to build desktop apps using web technologies integrated to Angular.

- In terms of the project itself, the following areas will be covered:
- SCRUM as Project Management Agile Methodology;
- Project planning techniques such as Gantt Charts.

Personal challenges
It project development intends to address the following challenges:

- Front-end development

PROJECT PLAN:

Methodology:

Due to the complexity of working with and integrating a variety of stack technologies and also considering the size of the project, it has been managed using Scrum framework which is lightweight, simple to understand but difficult to master (Schwaber and Sutherland, 2017).

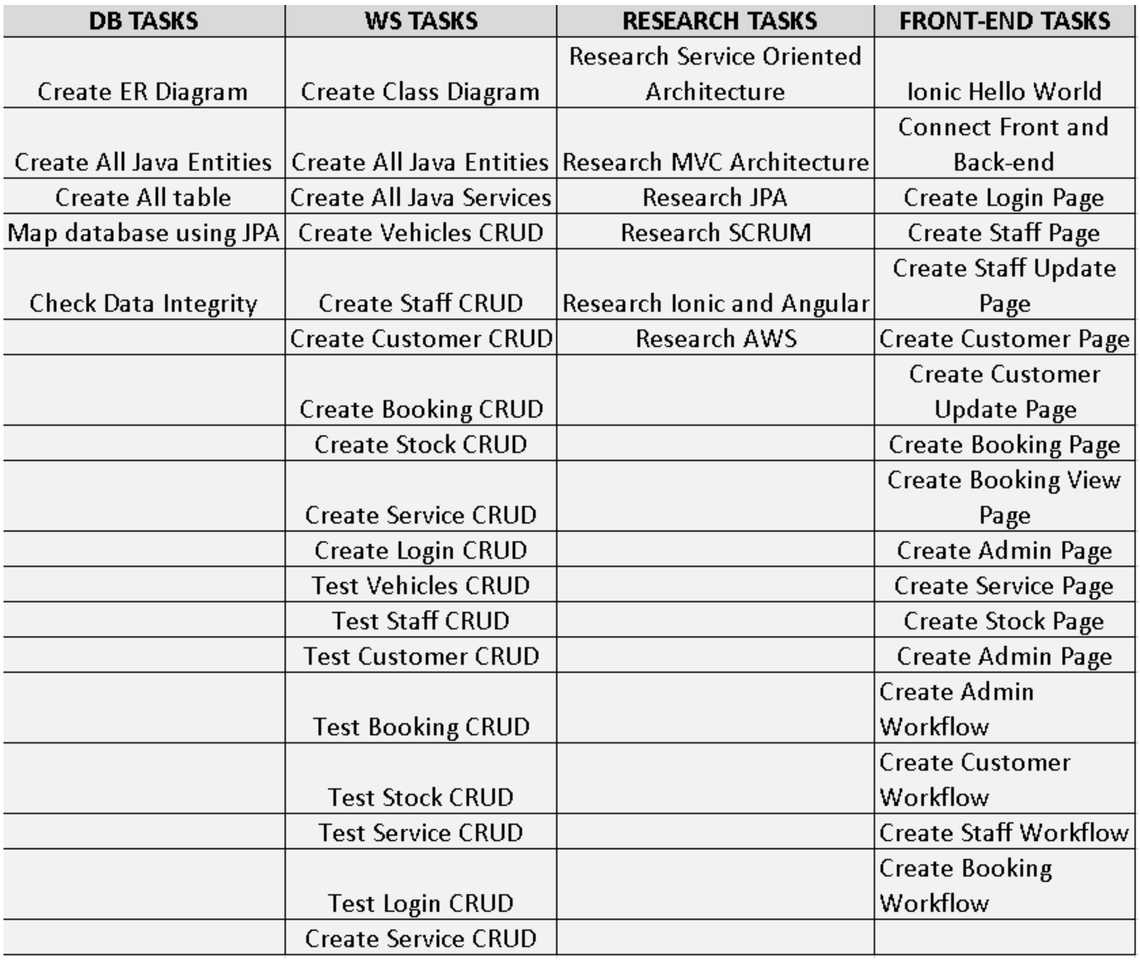
Scrum is a framework used to address complex adaptive problems, while productively and creatively delivering products of the highest possible value. It is for developing, delivering, and sustaining complex products and its definition consists of Scrum's roles, events, artifacts, and the rules that bind them together (Schwaber and Sutherland, 2017).

There are three types of team stakeholders. Product Owner (PO), Scrum Master and Developer. As the Scrum creators stated the complexity of mastering it, this project has been managed by Product Owner and Developer role.

The PO role has produced the followings artifacts:

- Product Backlog items;
- Ordering Product Backlog to best achieve goals;

See below list of product backlog items:



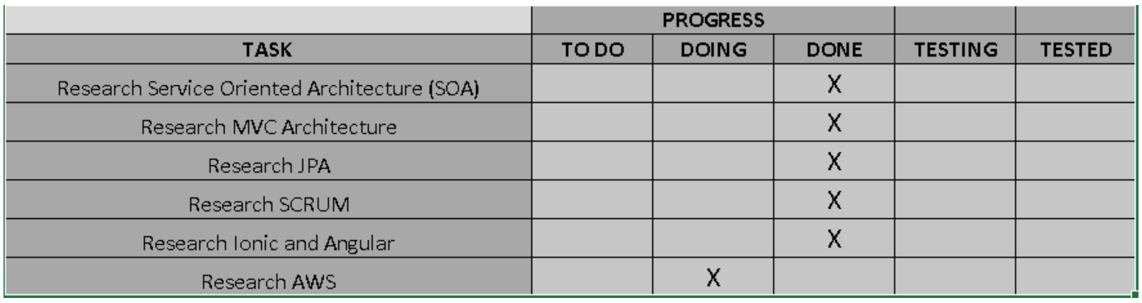
DB TASKS	WS TASKS	RESEARCH TASKS	FRONT-END TASKS
Create ER Diagram	Create Class Diagram	Research Service Oriented Architecture	Ionic Hello World
Create All Java Entities	Create All Java Entities	Research MVC Architecture	Connect Front and Back-end
Create All table	Create All Java Services	Research JPA	Create Login Page
Map database using JPA	Create Vehicles CRUD	Research SCRUM	Create Staff Page
Check Data Integrity	Create Staff CRUD	Research Ionic and Angular	Create Staff Update Page
	Create Customer CRUD	Research AWS	Create Customer Page
	Create Booking CRUD		Create Customer Update Page
	Create Stock CRUD		Create Booking Page
	Create Service CRUD		Create Booking View Page
	Create Login CRUD		Create Admin Page
	Test Vehicles CRUD		Create Service Page
	Test Staff CRUD		Create Stock Page
	Test Customer CRUD		Create Admin Page
	Test Booking CRUD		Create Admin Workflow
	Test Stock CRUD		Create Customer Workflow
	Test Service CRUD		Create Staff Workflow
	Test Login CRUD		Create Booking Workflow
	Create Service CRUD		

Product Backlog Item

Regarding the Development Team, it is the role which the stakeholder s work of delivering a potentially releasable Increment of “Done” product at the end of each Sprint (Schwaber and Sutherland, 2017).

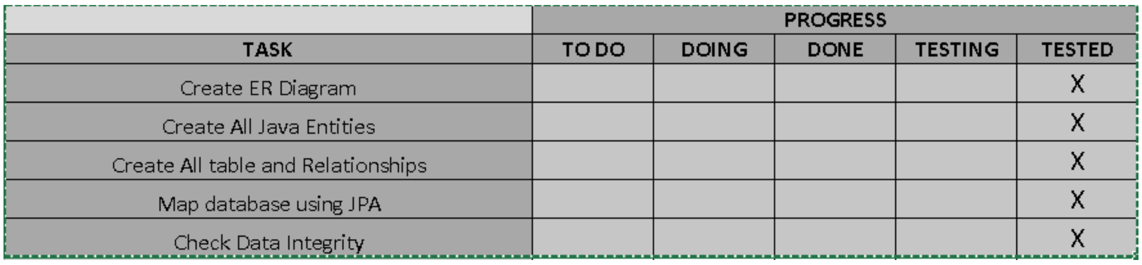
At part of the project, the developer’s work has been supported by a Kanban board. According to (Scrum, 2020): “Kanban is a strategy for optimizing flow. The practices in the Kanban Guide for Scrum Teams help enhance and complement the Scrum framework and its implementation.”

See below list of activities on the Kanban board which the development team has used to follow and release the product backlog.



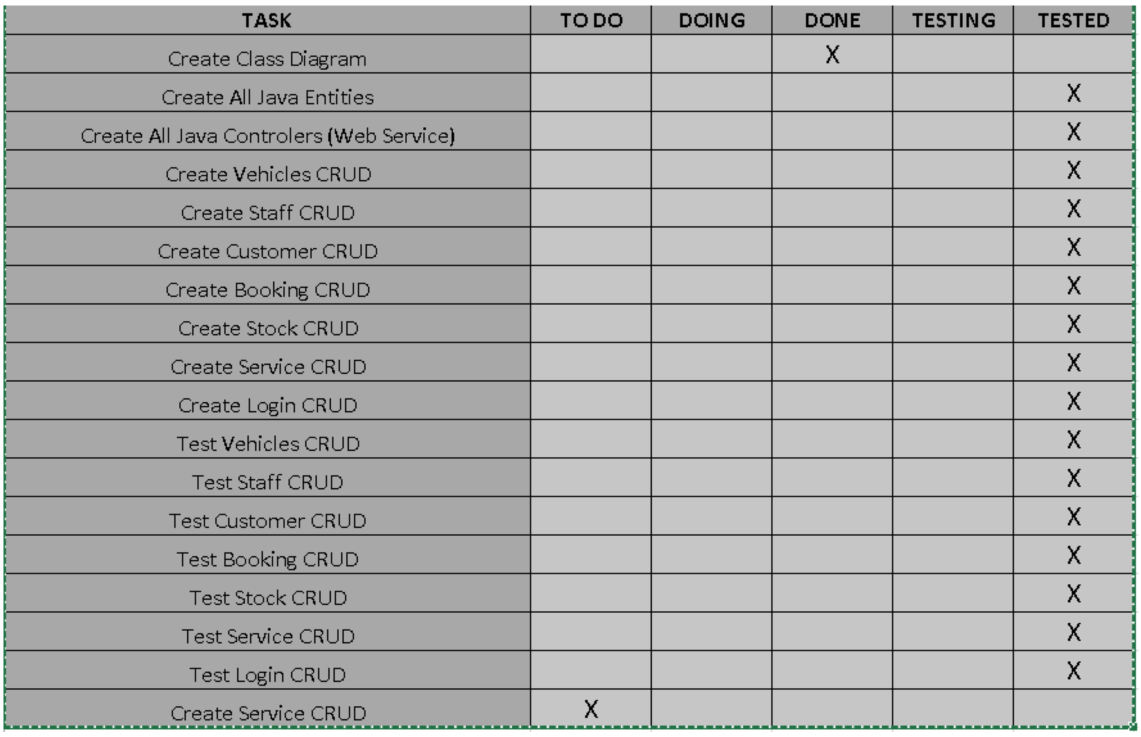
	PROGRESS				
TASK	TO DO	DOING	DONE	TESTING	TESTED
Research Service Oriented Architecture (SOA)			X		
Research MVC Architecture			X		
Research JPA			X		
Research SCRUM			X		
Research Ionic and Angular			X		
Research AWS		X			

Kanban Board: Research Tasks



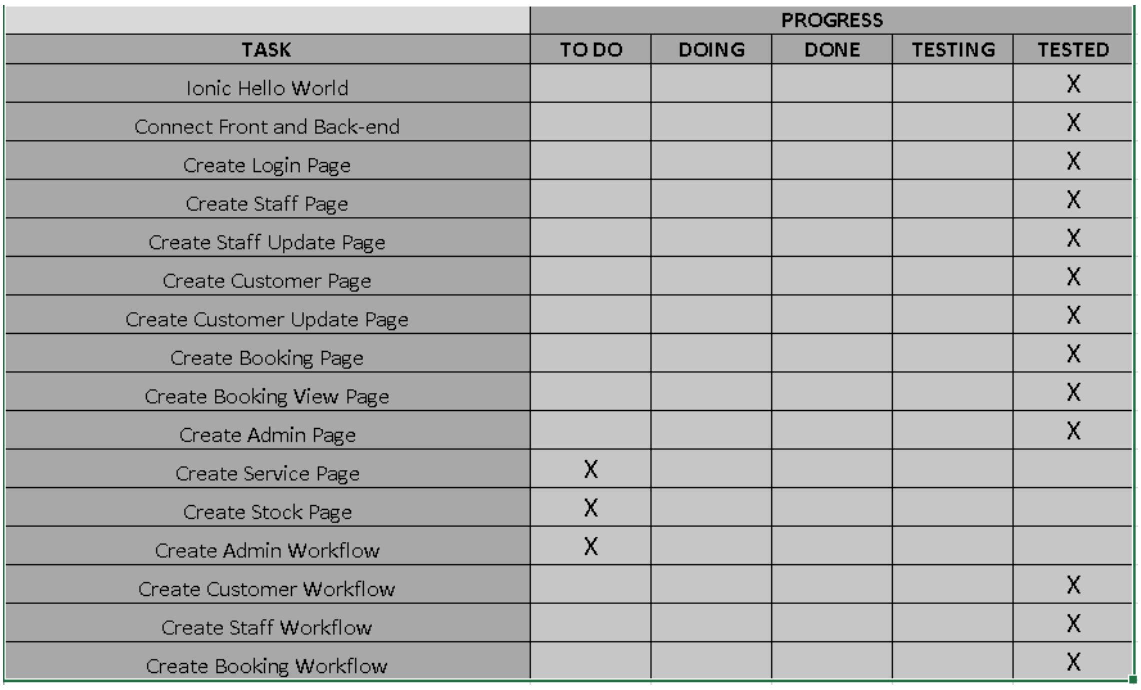
	PROGRESS				
TASK	TO DO	DOING	DONE	TESTING	TESTED
Create ER Diagram					X
Create All Java Entities					X
Create All table and Relationships					X
Map database using JPA					X
Check Data Integrity					X

Kanban Board: Database Tasks



TASK	TO DO	DOING	DONE	TESTING	TESTED
Create Class Diagram			X		
Create All Java Entities					X
Create All Java Controlers (Web Service)					X
Create Vehicles CRUD					X
Create Staff CRUD					X
Create Customer CRUD					X
Create Booking CRUD					X
Create Stock CRUD					X
Create Service CRUD					X
Create Login CRUD					X
Test Vehicles CRUD					X
Test Staff CRUD					X
Test Customer CRUD					X
Test Booking CRUD					X
Test Stock CRUD					X
Test Service CRUD					X
Test Login CRUD					X
Create Service CRUD	X				

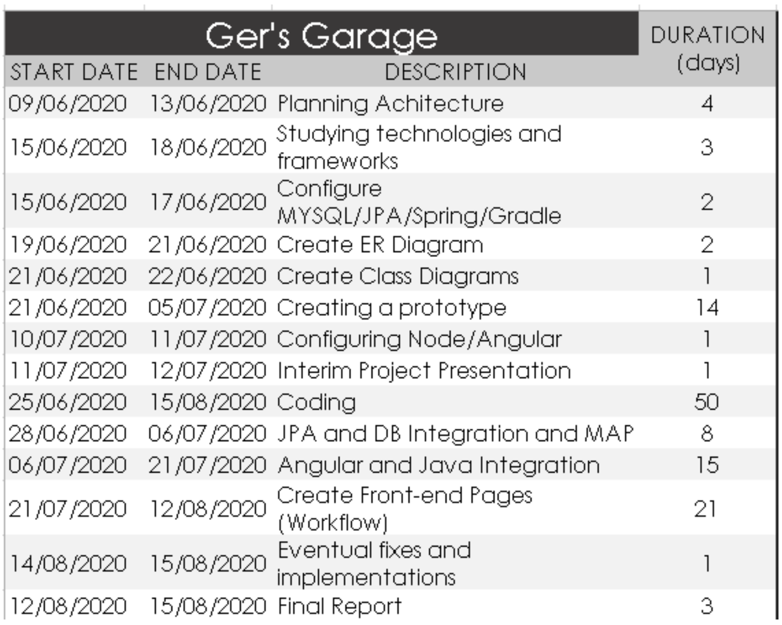
Kanban Board: Back-end Tasks



TASK	PROGRESS				
	TO DO	DOING	DONE	TESTING	TESTED
Ionic Hello World					X
Connect Front and Back-end					X
Create Login Page					X
Create Staff Page					X
Create Staff Update Page					X
Create Customer Page					X
Create Customer Update Page					X
Create Booking Page					X
Create Booking View Page					X
Create Admin Page					X
Create Service Page	X				
Create Stock Page	X				
Create Admin Workflow	X				
Create Customer Workflow					X
Create Staff Workflow					X
Create Booking Workflow					X

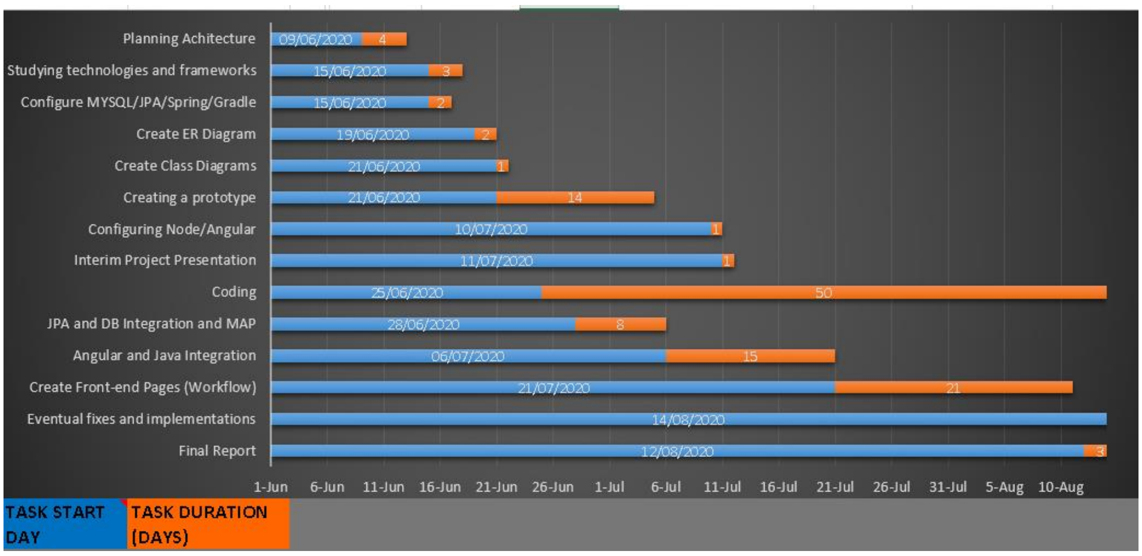
Kanban Board: Front-end Tasks

A Gantt Chart helped at the planning stage to outline and illustrate project schedule. It gives an overview of the project, the tasks and the deadlines.



Ger's Garage			DURATION (days)
START DATE	END DATE	DESCRIPTION	
09/06/2020	13/06/2020	Planning Achitecture	4
15/06/2020	18/06/2020	Studying technologies and frameworks	3
15/06/2020	17/06/2020	Configure MYSQL/JPA/Spring/Gradle	2
19/06/2020	21/06/2020	Create ER Diagram	2
21/06/2020	22/06/2020	Create Class Diagrams	1
21/06/2020	05/07/2020	Creating a prototype	14
10/07/2020	11/07/2020	Configuring Node/Angular	1
11/07/2020	12/07/2020	Interim Project Presentation	1
25/06/2020	15/08/2020	Coding	50
28/06/2020	06/07/2020	JPA and DB Integration and MAP	8
06/07/2020	21/07/2020	Angular and Java Integration	15
21/07/2020	12/08/2020	Create Front-end Pages (Workflow)	21
14/08/2020	15/08/2020	Eventual fixes and implementations	1
12/08/2020	15/08/2020	Final Report	3

Gantt chart: Timetable contents



Gantt chart: Bar Graph

This system was built over sprints of 1 week and using the Weekly Reflective Journal as a Sprint Review and Sprint Retrospective, which has given the possibility of revising Product Backlog and the Sprint Retrospective to create a plan for improvements.

CHAPTER 2: LITERATURE REVIEW

The second chapter presents the academic research reviewed and used Due to the complexity of working with and integrating a variety of stack technologies and also considering the size of the project, it has been managed using Scrum framework which is lightweight, simple to understand but difficult to master this web application.

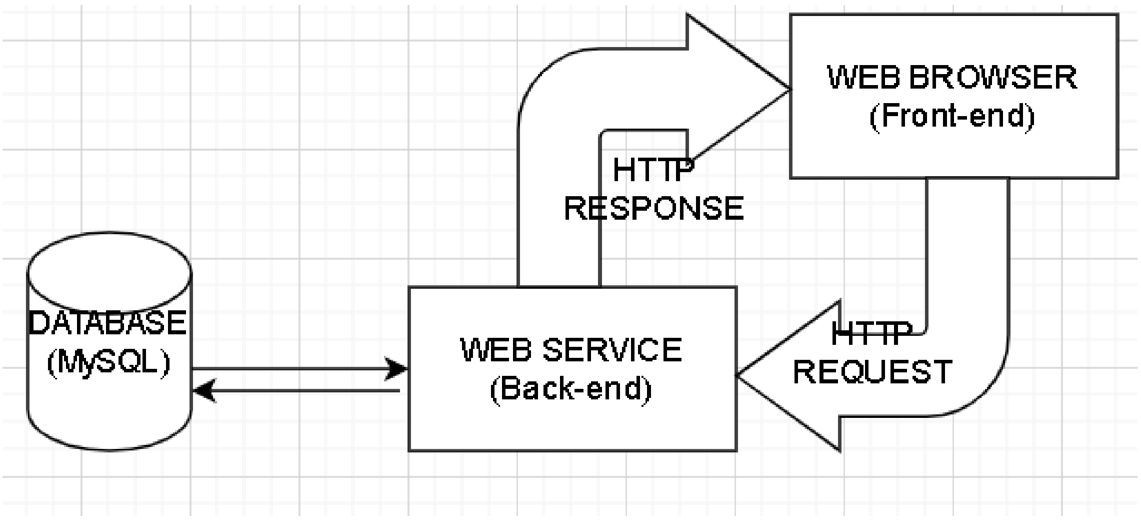
To achieve the project's objectives, the following areas have been researched:

- REST Architecture;
- Ionic / Angular;

Although other topics and areas have been studied, those were the most challenging and required a considerable amount of research and time to complete this project.

Representational State Transfer (REST)

REST is an architectural style which defines constraints, such as the uniform interface, that if applied to a web service induce desirable properties, such as performance, scalability and modifiability that enable services to work best on the Web (Oracle, 2013).



REST Architecture

Each service in this architecture keeps its own code and is able to execute a complete functionality. Taking the Customer workflow as a reference, it is possible to visualise functionalities apart from each other. Through HTTP Request Methods (GET, PUT, POST and DELETE) and using JSON. For instance, customer registration is a functionality where the front-end (Browser) asks the back-end (Web Service) the method to register and it has been exposed through an endpoint.

IONIC

Ionic is an open source, cross-platform framework used to develop web applications and hybrid mobile apps.

Ionic is a framework which helps to the frontend UX and UI interaction of an app, UI controls, interactions, gestures and animations. It is easy to integrate with other libraries or frameworks, such as Angular or React. Alternatively, it can be used standalone without any frontend framework using a simple script include (Ionic, 2020).

By integrating this framework with Angular libraries, using the command line (@ionic/angular), it gives all Angular core components and improves the development process.

CHAPTER 3: SYSTEM ANALYSIS & DESIGN

This web system is designed to meet Ger's mechanical garage needs. It is a small garage which carries out any type of services and repairs on cars, motorbikes, small vans and small buses as mentioned on the Chapter.

The third chapter will describe the application functional requirements and functional design. Also, it will show the diagrams that support both back-end and front-end.

FUNCTIONAL REQUIRENMENTS

The application implies functional requirements for administrators, customers and mechanics. Moreover, pre-set up is required.

PREREQUISITES

- At least one administrator and one staff member need to be set up;

MAIN REQUIREMENTS

- The customer must sign up to book their vehicles for a service;
- After signing up, the customer must make an appointment for their service;
- The staff member needs to update the booking status, add a description of any extra service, use supplies from stock and charge for it if necessary;
- Either Staff or Administrator must be able to print the invoice for the customer.

REQUIREMENTS PER SUBSYSTEM: ACCESS TO THE SYSTEM

Customer Register

The customer must access the web system and create an account in order to be able to make an appointment for their vehicles. By going through the registration page the customer will find a form where the required details will need to be filled in.

Required information on the form:

- Username and login;
- First and last name;
- Email, phone number and PPSN;
- Vehicles details;
  - Type;
  - Maker;
  - Model;
  - Fuel;
  - Manufacture;
  - Licence number;

Customer Log-in

To access the application the customer needs to provide the following:

- Username;
- Password;

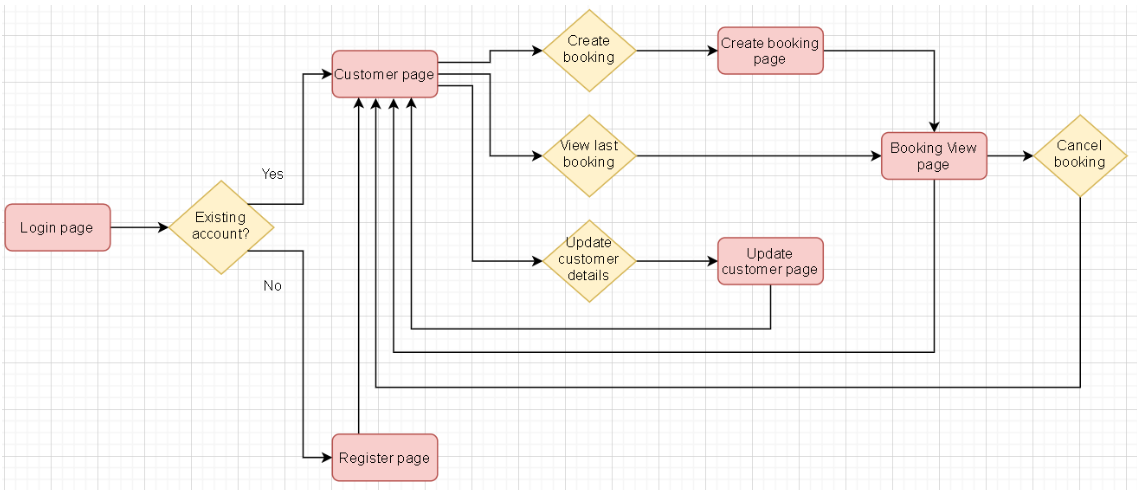
Customer Booking

In order to book the vehicles for a service the customer must go to the booking page and enter some details:

- Booking date (date of appointment);
- Type of Service: Annual Service, Major Service, Repair / Fault and Major Repair);
- Details about the issue;
- The system will automatically load the customer and vehicle details.

Customer Booking View

By accessing this page, the customer can visualise the last booking with the given details, plus the booking status and the mechanic attending the vehicle.



Customer Workflow

Staff Registration

Each staff member will be created by the administrator with no need to go to the registration page like in the customer workflow. To create accounts for the staff, the administrator must enter some personal details that should be given by employees beforehand.

Required information on the form:

- Username and login;
- First and last name;
- PPSN;

Staff Log-in

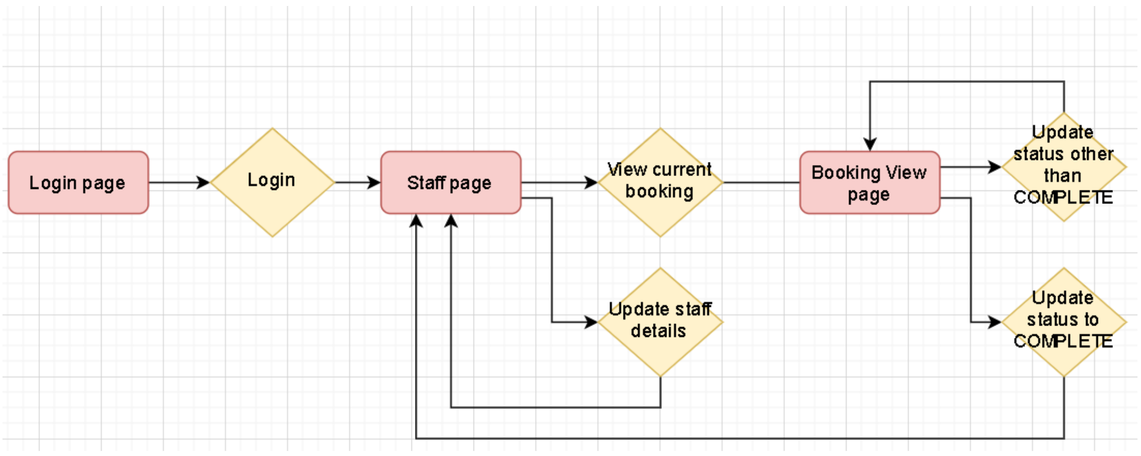
To access the application once the account is created the employee needs to enter the following:

- Username;
- Password;

Staff Booking View

On the booking page the staff members must update the booking status for the services that have been assigned to them. In case the service requires to use stock supplies, the staff can add it on the notes and also add the value and a description for the extra service:

- Booking Status (Mandatory): Booked, In Service, Fixed, Collected and Unrepairable/Scrapped;
- Description Extra Service (Optional)
- Extra Service Price (Optional);



Staff Workflow

Administrator Registration

As described in the prerequisites section, the web system admin will be set up at the very beginning through a database dump or a simple DB insert.

To create an admin account, the following details will be required:

- Username and login;
- First and last name;
- PPSN;

Administrator Log-in

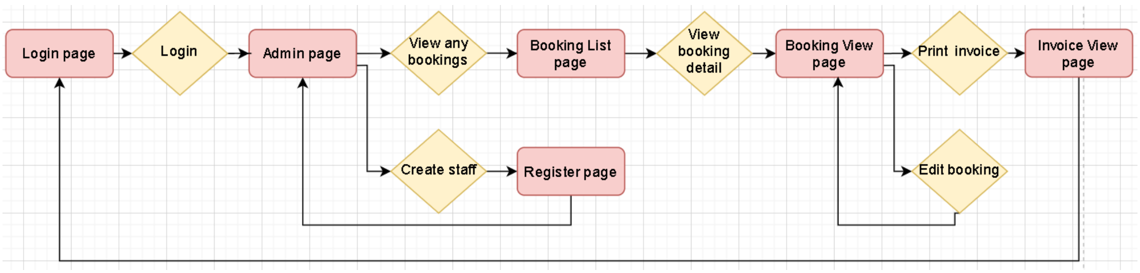
To access the application the admin role needs to provide the following:

- Username;
- Password;

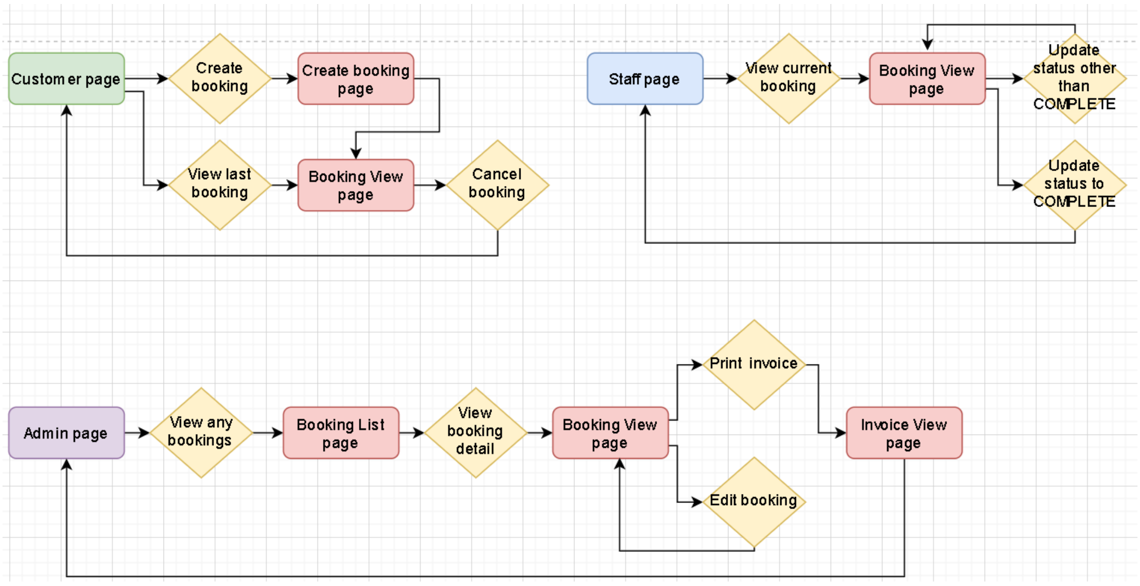
Administrator Booking View

On the booking page the administrator can view any booking. In addition, he is able to update the booking status. In case the service requires to use stock supplies, the administrator can add it on the notes and also add the value and description for the extra service:

- Booking Status (Mandatory): Booked, In Service, Fixed, Collected and Unrepairable/Scrapped;
- Description Extra Service (Optional)
- Extra Service Price (Optional);
- Print Invoice (Mandatory);



Administrator Workflow



Booking Workflow: Customer, staff and administrator

Wireframes

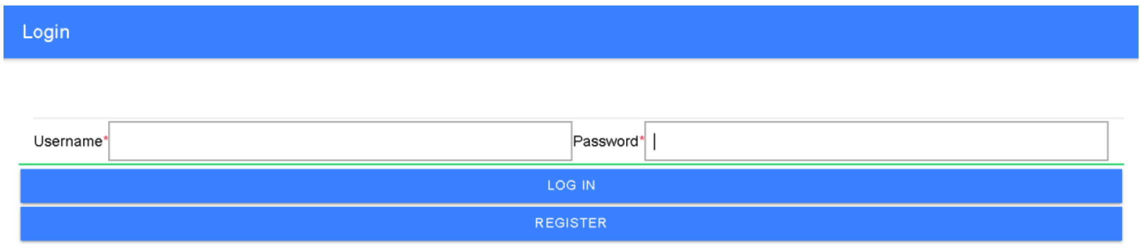
This section will depict the above workflows. For it, all requirements described on the previous section will be illustrated through wireframes.

PUBLIC PAGE

The Log-in and Register are public pages meaning that anyone with the link can access it.

Log-in Page

It allows customers to register and staff, administrator, and customers to sign in.

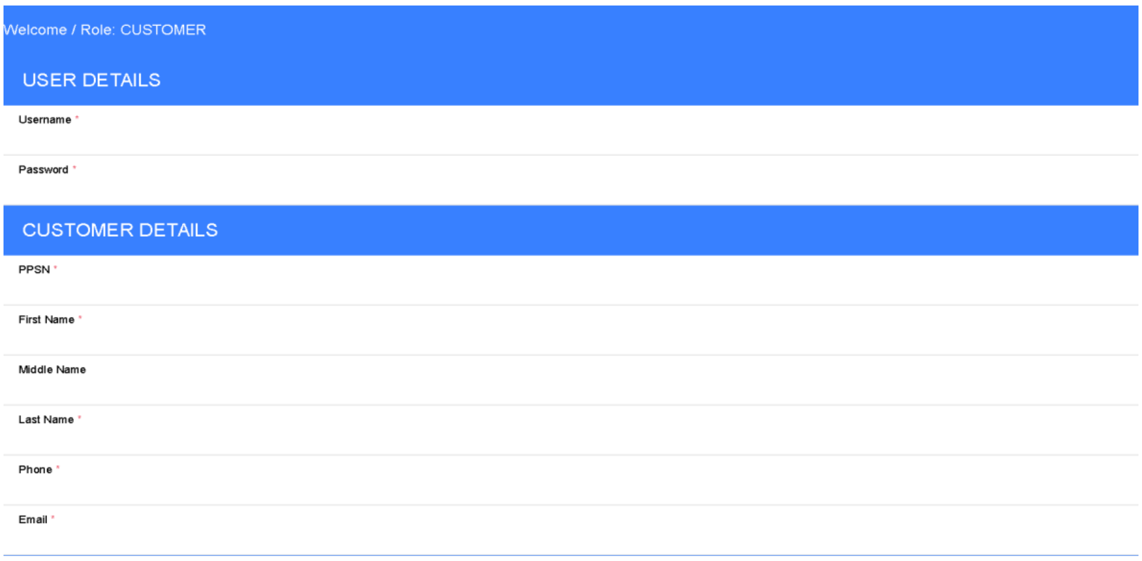

Login

Username*
Password*

Login Page

Register Customer Page

Creation of a new customer account by filling up required fields and optional information.


Welcome / Role: CUSTOMER

USER DETAILS

Username *

Password *

CUSTOMER DETAILS

PPSN *

First Name *

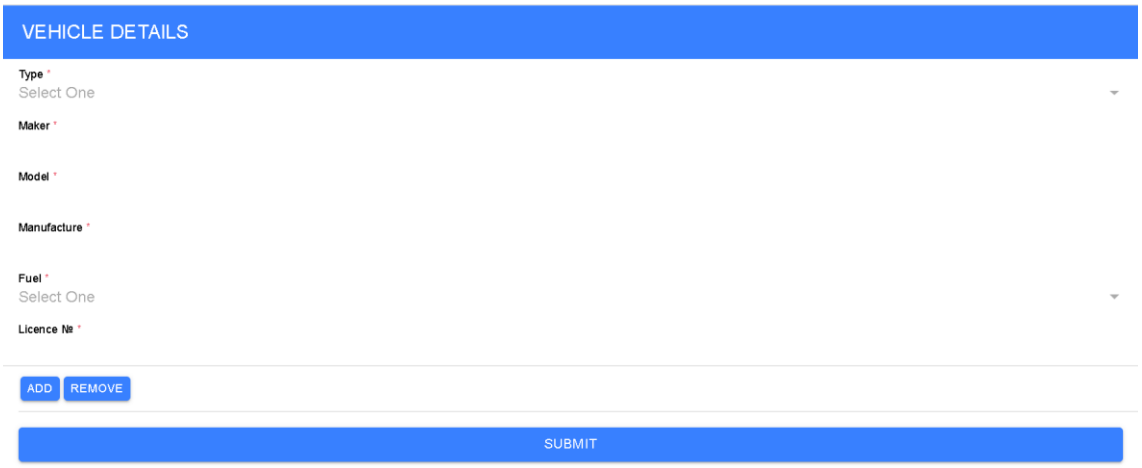
Middle Name

Last Name *

Phone *

Email *

Customer Register Page: User and Customer Details Section


VEHICLE DETAILS

Type *
Select One

Maker *

Model *

Manufacture *

Fuel *
Select One

Licence № *

ADD REMOVE

SUBMIT

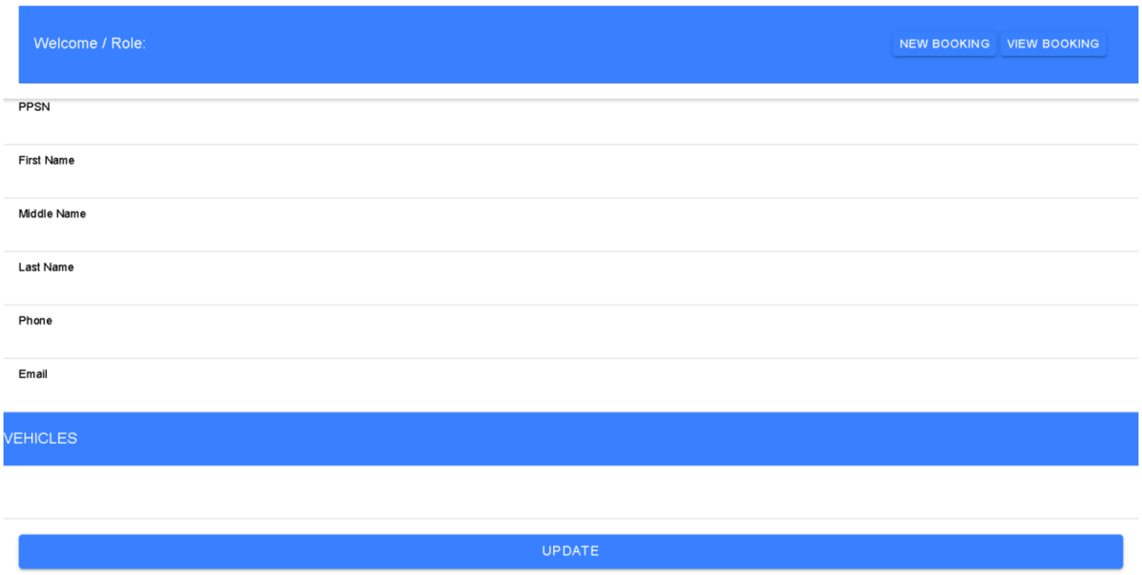
Customer Register Page: Vehicle Details Section

PRIVATE PAGE

Customer:

After creating an account, the customer can access the private page by using username and password on the log-in page. The customer page view will be loaded with their personal information and vehicle details.

At this point, the customer is able to update personal and vehicle details, make a new appointment and view the last one.


Welcome / Role:

NEW BOOKING VIEW BOOKING

PPSN

First Name

Middle Name

Last Name

Phone

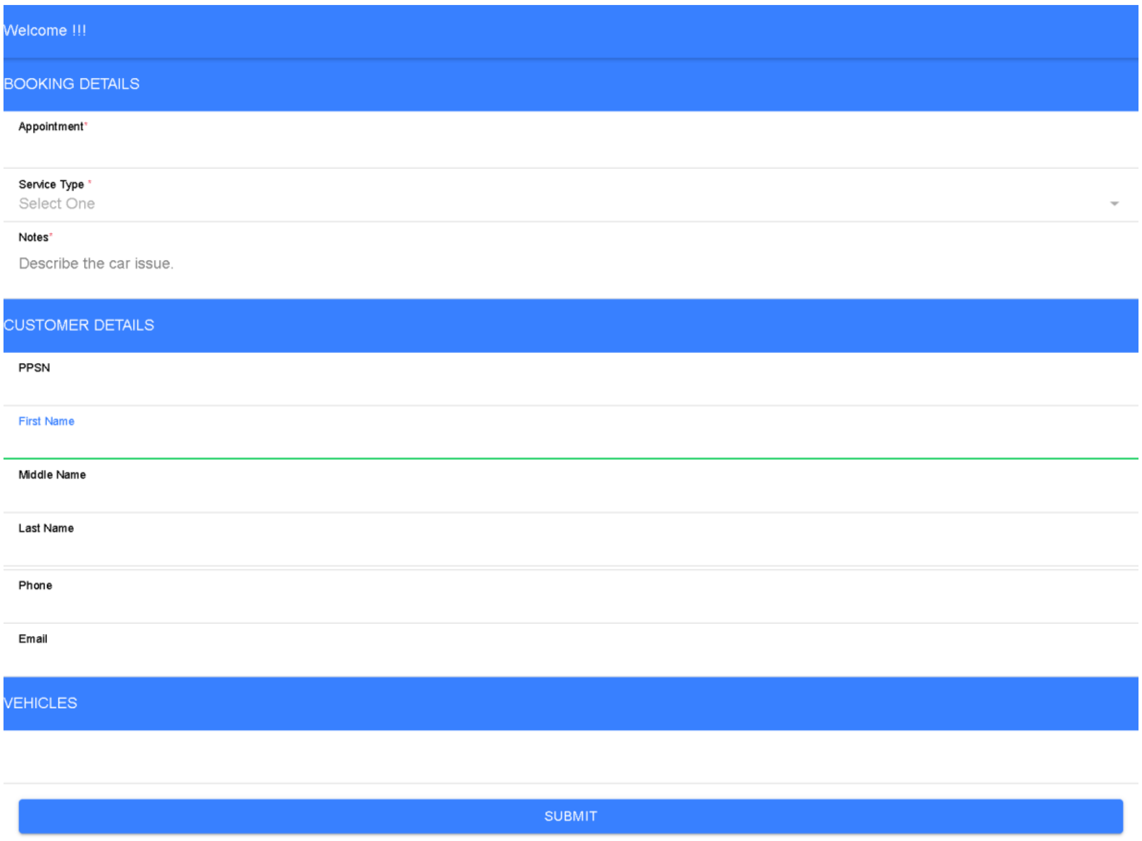
Email

VEHICLES

UPDATE

Customer Page

If the customer decides to access the new booking page, his details will be automatically populated and other details will be required on the booking form.


Welcome !!!

BOOKING DETAILS

Appointment*

Service Type *
Select One

Notes*
Describe the car issue.

CUSTOMER DETAILS

PPSN

First Name

Middle Name

Last Name

Phone

Email

VEHICLES

SUBMIT

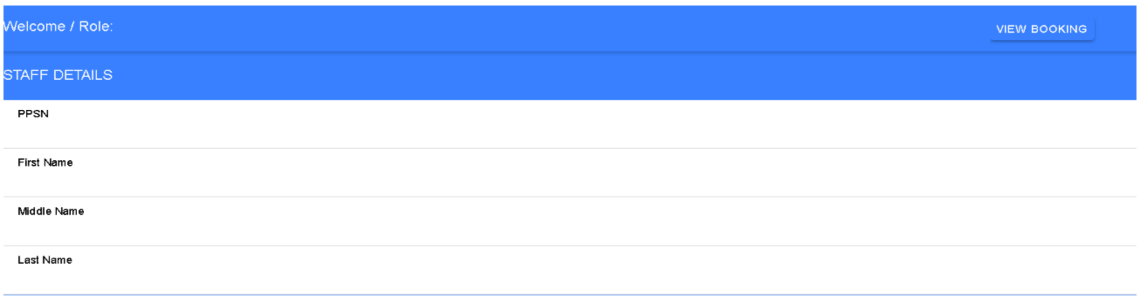
New Booking Page

In case they have already created a booking, customers can view the last booking page, which is very similar to the new booking page but brings additional information such as booking status and name of staff member who carried out the service.

Staff:

After getting their accounts created by the system admin, the staff members will access the private pages by entering their username and password on the log-in page and it leads to the staff page view where all personal data will be populated while the page is being loaded.

On this page, the mechanic is able to change personal details by using the button update. Also, it will be possible to view all the assigned bookings for the current day.


Welcome / Role:

VIEW BOOKING

STAFF DETAILS

PPSN

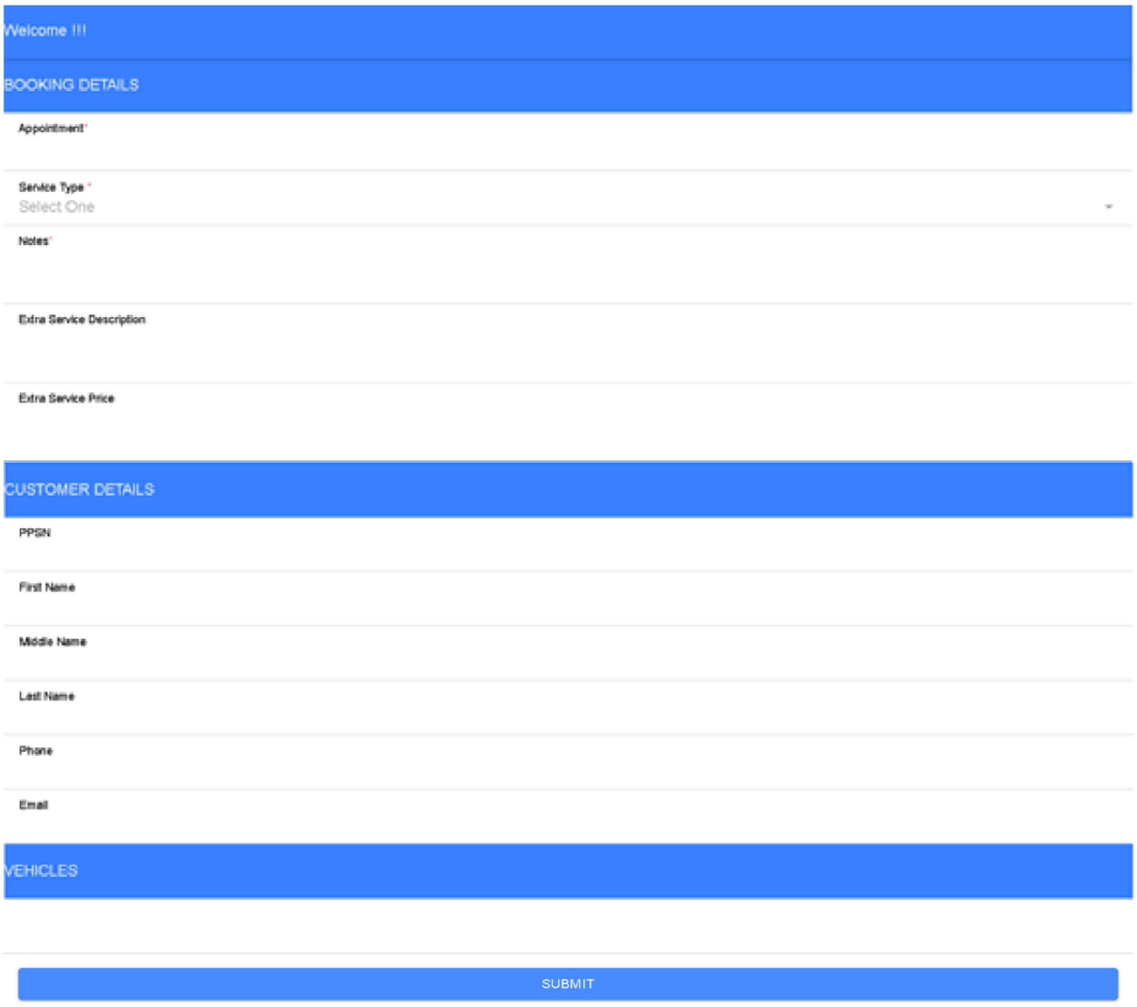
First Name

Middle Name

Last Name

Staff Page

If a staff member wants to access the booking page, it will first show a booking list for the current day; then he can click on a specific booking and the next page will show the details of the booking. On this page, the employee can change the status of the booking. This page is very similar to the booking page illustrated on the customer section. The small changes are: Booking status drop-down menu will be available for selecting the status and extra inputs (Extra service description and extra service price.)



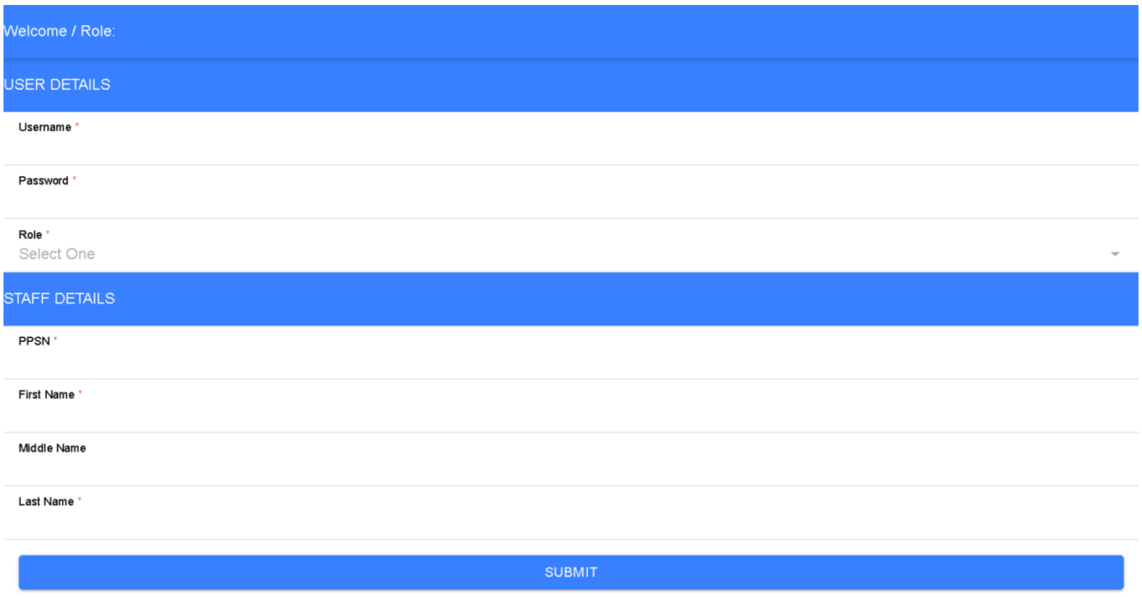
Booking View Page

Staff can also print the invoice for the customer.

Administrator:

After having an account set up at the very beginning, the administrator will access the private page by logging-in. It will bring to the administrator page view where all personal data will be populated while the page is being loaded.

On this page, the system admin is able to create staff accounts and view any booking. When creating new staff in the system, the staff registration page will be loaded and the admin will enter the staff details as shown on the image below.


Welcome / Role:

USER DETAILS

Username *	
Password *	
Role *	Select One

STAFF DETAILS

PPSN *	
First Name *	
Middle Name	
Last Name *	

Staff Register Page

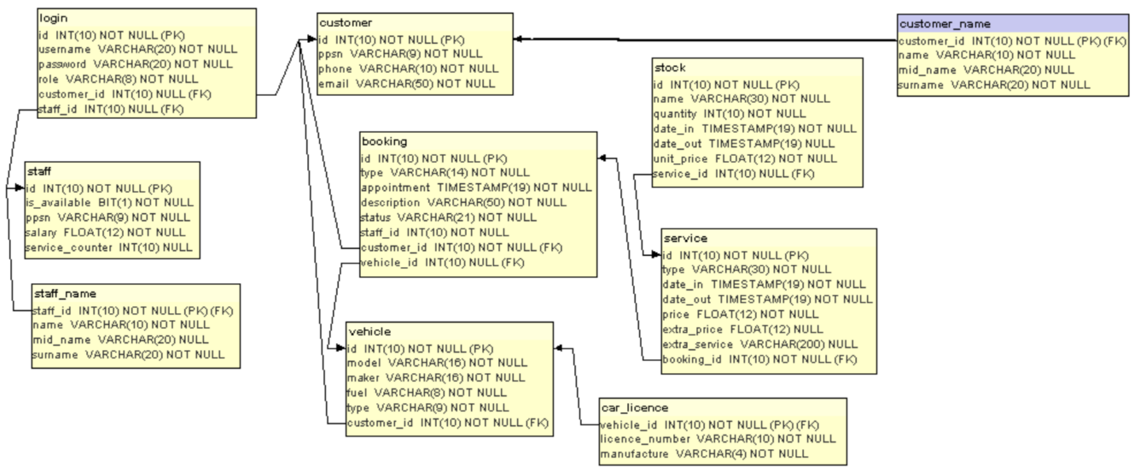
If instead of creating a new staff the administrator decides to view bookings, it leads to a list of bookings where it is possible also search per appointment date. By choosing one of them, the administrator will access the selected booking. It shows the same page and gives the e on the staff booking view page section.

DATABASE

A relational database (MySQL) has been used to build this project in order to store all relevant data about Ger's Garage Web System. Using this tool, required and additional tables have been created for a better working system. And to support the project with creation and drop tables and queries, a MySQL Workbench tool has been used.

Diagrams

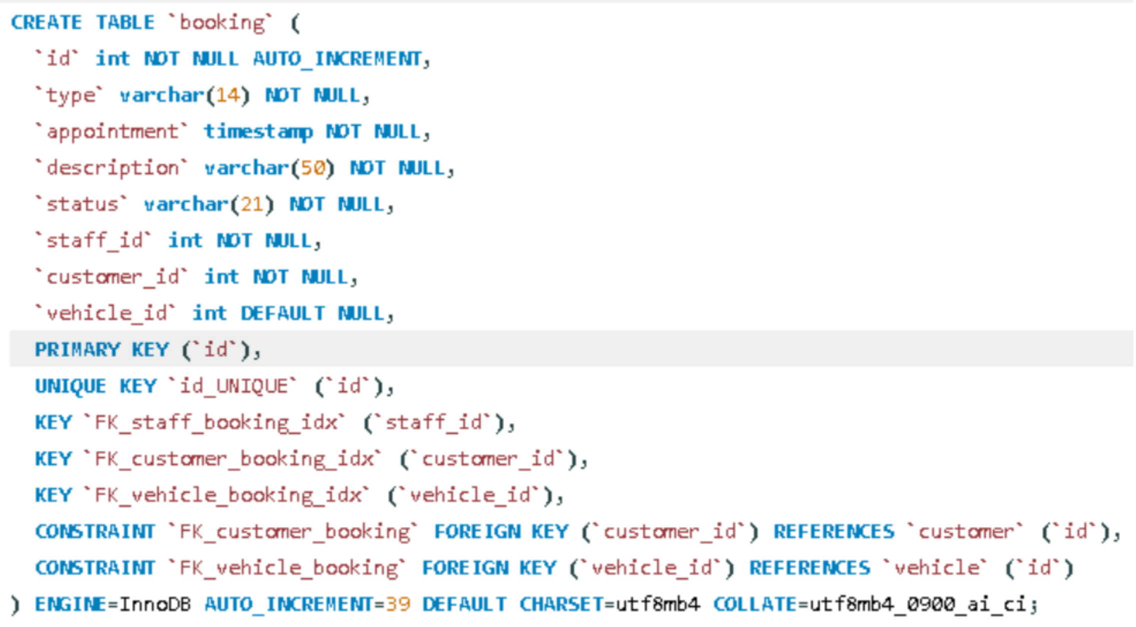
The project has been developed following the Entity Relation Diagram (ER). It depicts the database structure itself and helps on the development side. See the diagram below with the attributes, entities and relations.


login
id INT(10) NOT NULL (PK)
username VARCHAR(20) NOT NULL
password VARCHAR(20) NOT NULL
role VARCHAR(8) NOT NULL
customer_id INT(10) NULL (FK)
staff_id INT(10) NULL (FK)
customer
id INT(10) NOT NULL (PK)
ppsn VARCHAR(9) NOT NULL
phone VARCHAR(10) NOT NULL
email VARCHAR(50) NOT NULL
customer_name
customer_id INT(10) NOT NULL (PK) (FK)
name VARCHAR(10) NOT NULL
mid_name VARCHAR(20) NULL
surname VARCHAR(20) NOT NULL
stock
id INT(10) NOT NULL (PK)
name VARCHAR(30) NOT NULL
quantity INT(10) NOT NULL
date_in TIMESTAMP(19) NOT NULL
date_out TIMESTAMP(19) NULL
unit_price FLOAT(12) NOT NULL
service_id INT(10) NULL (FK)
booking
id INT(10) NOT NULL (PK)
type VARCHAR(14) NOT NULL
appointment TIMESTAMP(19) NOT NULL
description VARCHAR(50) NOT NULL
status VARCHAR(21) NOT NULL
staff_id INT(10) NOT NULL
customer_id INT(10) NOT NULL (FK)
vehicle_id INT(10) NULL (FK)
staff
id INT(10) NOT NULL (PK)
is_available BIT(1) NOT NULL
ppsn VARCHAR(9) NOT NULL
salary FLOAT(12) NOT NULL
service_counter INT(10) NULL
service
id INT(10) NOT NULL (PK)
type VARCHAR(30) NOT NULL
date_in TIMESTAMP(19) NOT NULL
date_out TIMESTAMP(19) NOT NULL
price FLOAT(12) NOT NULL
extra_price FLOAT(12) NULL
extra_service VARCHAR(200) NULL
booking_id INT(10) NOT NULL (FK)
staff_name
staff_id INT(10) NOT NULL (PK) (FK)
name VARCHAR(10) NOT NULL
mid_name VARCHAR(20) NULL
surname VARCHAR(20) NOT NULL
vehicle
id INT(10) NOT NULL (PK)
model VARCHAR(16) NOT NULL
maker VARCHAR(16) NOT NULL
fuel VARCHAR(8) NOT NULL
type VARCHAR(9) NOT NULL
customer_id INT(10) NOT NULL (FK)
car_licence
vehicle_id INT(10) NOT NULL (PK) (FK)
licence_number VARCHAR(10) NOT NULL
manufacture VARCHAR(4) NOT NULL

Entity Relational Diagram

Database Data Definition Language (DDL)

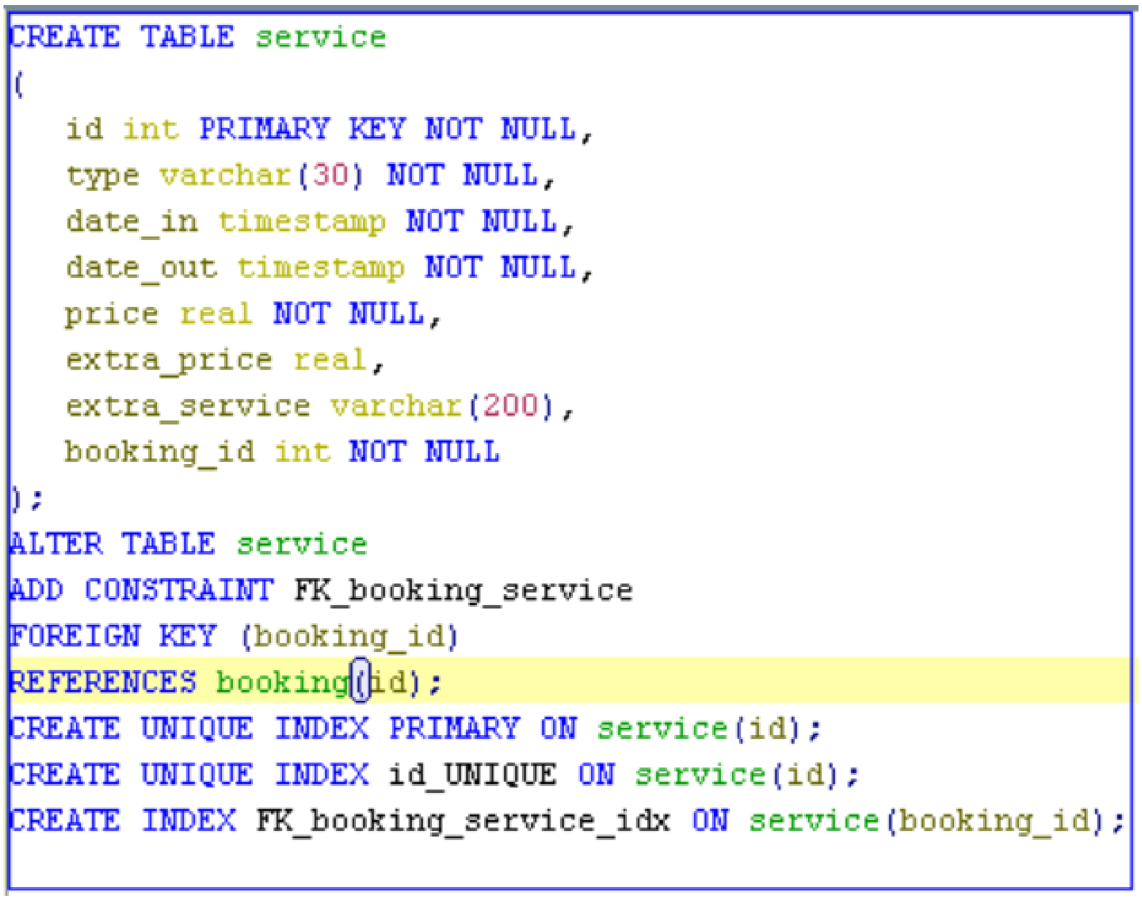
DDL defines structures such as database, schemas, constraints amongst others. It helps to create and make changes on the database. See below images of the DDL of this project:



```sql
CREATE TABLE `booking` (
  `id` int NOT NULL AUTO_INCREMENT,
  `type` varchar(14) NOT NULL,
  `appointment` timestamp NOT NULL,
  `description` varchar(50) NOT NULL,
  `status` varchar(21) NOT NULL,
  `staff_id` int NOT NULL,
  `customer_id` int NOT NULL,
  `vehicle_id` int DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_staff_booking_idx` (`staff_id`),
  KEY `FK_customer_booking_idx` (`customer_id`),
  KEY `FK_vehicle_booking_idx` (`vehicle_id`),
  CONSTRAINT `FK_customer_booking` FOREIGN KEY (`customer_id`) REFERENCES `customer` (`id`),
  CONSTRAINT `FK_vehicle_booking` FOREIGN KEY (`vehicle_id`) REFERENCES `vehicle` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=39 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
```

Booking Table DDL

It is possible to create a script for the table structure as well. It helps when replicating the database to another environment.



```
CREATE TABLE service
(
   id int PRIMARY KEY NOT NULL,
   type varchar(30) NOT NULL,
   date_in timestamp NOT NULL,
   date_out timestamp NOT NULL,
   price real NOT NULL,
   extra_price real,
   extra_service varchar(200),
   booking_id int NOT NULL
);
ALTER TABLE service
ADD CONSTRAINT FK_booking_service
FOREIGN KEY (booking_id)
REFERENCES booking(id);
CREATE UNIQUE INDEX PRIMARY ON service(id);
CREATE UNIQUE INDEX id_UNIQUE ON service(id);
CREATE INDEX FK_booking_service_idx ON service(booking_id);
```

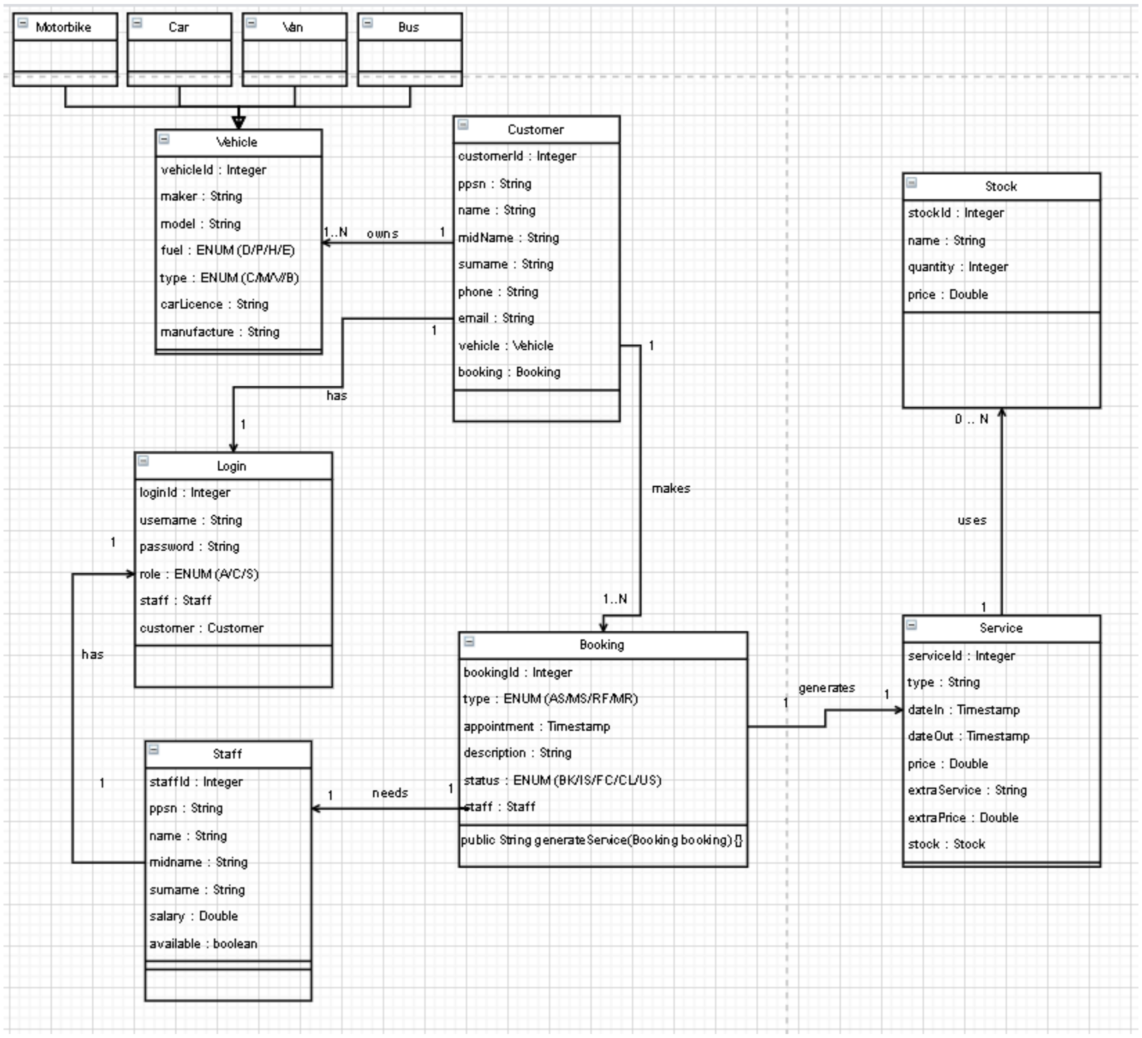
DB Script

BACK-END

Java is an Object Oriented (OO) language. The decision of using Java led by the fact that it is widely spread, with big companies building their systems with this language, and many forums and communities to provide help and guidance. Also, there are many different frameworks that support Java development.

Diagrams

In parallel with the ER diagram, a class diagram has also been produced to make it easier to view all classes, attributes, methods and relationships.



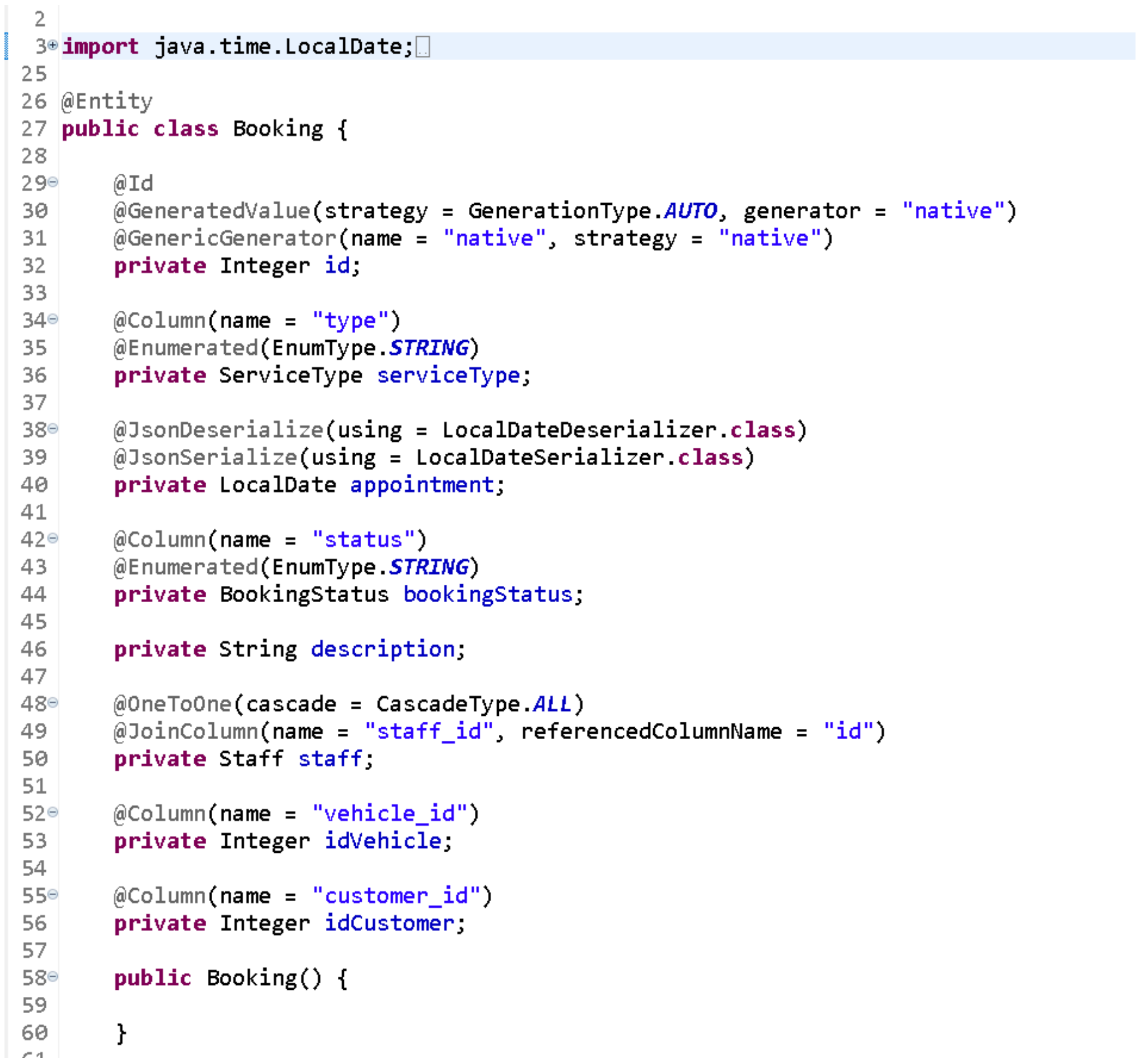
Class Diagram

This project will show some of the most known and used Java frameworks.

Java Persistence API

Previously described in Chapter 1, JPA helped on the Java development dealing with queries and database connection.

This API helps mapping by using annotations. See below Booking class being mapped with those annotations. Notice that it reflects the database.

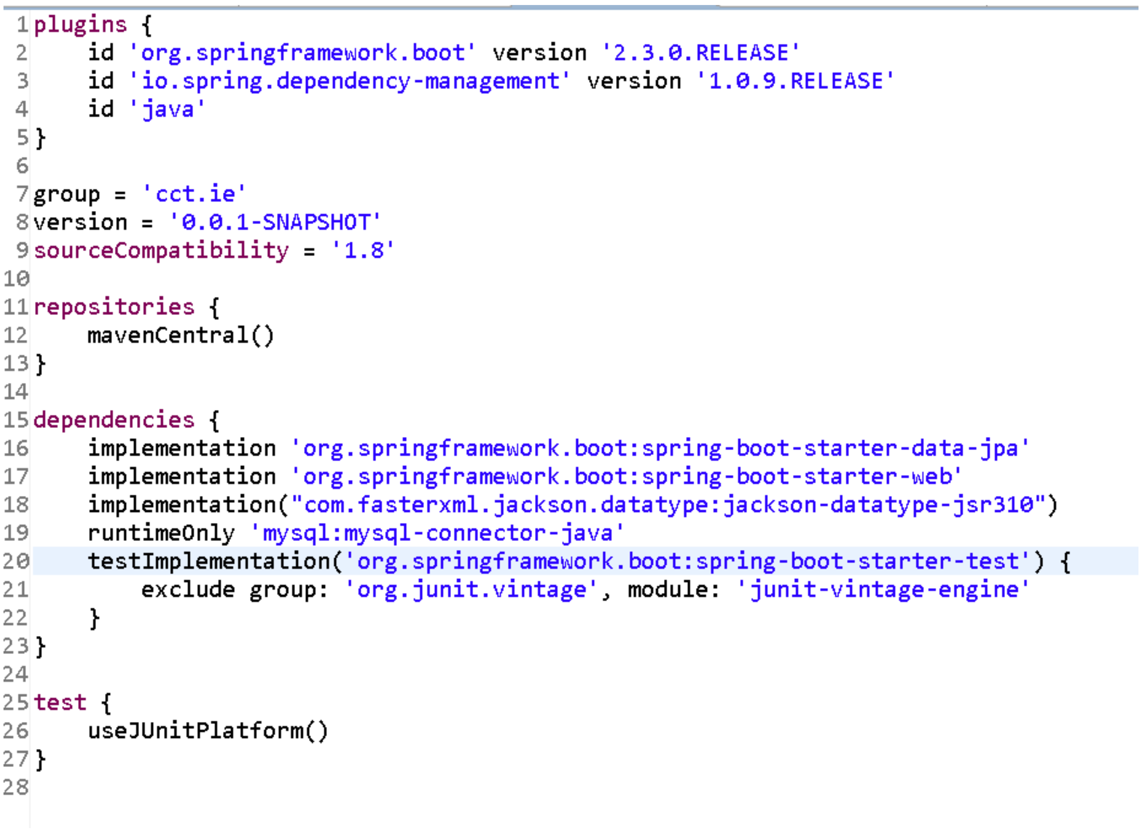


```java

import java.time.LocalDate;

@Entity
public class Booking {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO, generator = "native")
    @GenericGenerator(name = "native", strategy = "native")
    private Integer id;

    @Column(name = "type")
    @Enumerated(EnumType.STRING)
    private ServiceType serviceType;

    @JsonDeserialize(using = LocalDateDeserializer.class)
    @JsonSerialize(using = LocalDateSerializer.class)
    private LocalDate appointment;

    @Column(name = "status")
    @Enumerated(EnumType.STRING)
    private BookingStatus bookingStatus;

    private String description;

    @OneToOne(cascade = CascadeType.ALL)
    @JoinColumn(name = "staff_id", referencedColumnName = "id")
    private Staff staff;

    @Column(name = "vehicle_id")
    private Integer idVehicle;

    @Column(name = "customer_id")
    private Integer idCustomer;

    public Booking() {

    }
```

Booking Class using JPA annotations

Gradle Framework

The back-end development was done with this framework. It has a build automation tool to control and download project dependencies. By adding dependencies on the "build.gradle" file, similar to POM.xml from Maven, the project downloads all libraries which will be used to develop.



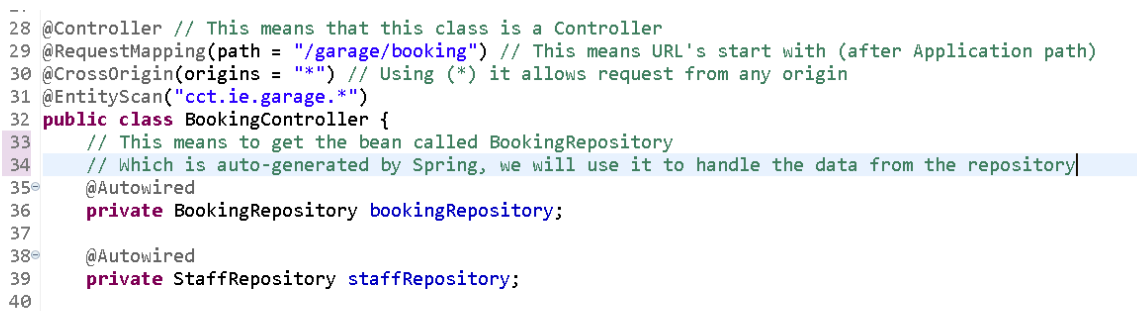
```
plugins {
    id 'org.springframework.boot' version '2.3.0.RELEASE'
    id 'io.spring.dependency-management' version '1.0.9.RELEASE'
    id 'java'
}

group = 'cct.ie'
version = '0.0.1-SNAPSHOT'
sourceCompatibility = '1.8'

repositories {
    mavenCentral()
}

dependencies {
    implementation 'org.springframework.boot:spring-boot-starter-data-jpa'
    implementation 'org.springframework.boot:spring-boot-starter-web'
    implementation("com.fasterxml.jackson.datatype:jackson-datatype-jsr310")
    runtimeOnly 'mysql:mysql-connector-java'
    testImplementation('org.springframework.boot:spring-boot-starter-test') {
        exclude group: 'org.junit.vintage', module: 'junit-vintage-engine'
    }
}

test {
    useJUnitPlatform()
}
```

Build.gradle

Spring Framework

It is a framework which allows to build web services. Springs annotations help on the development side. With those annotations, it becomes simple to create an HTTP Request and Response.

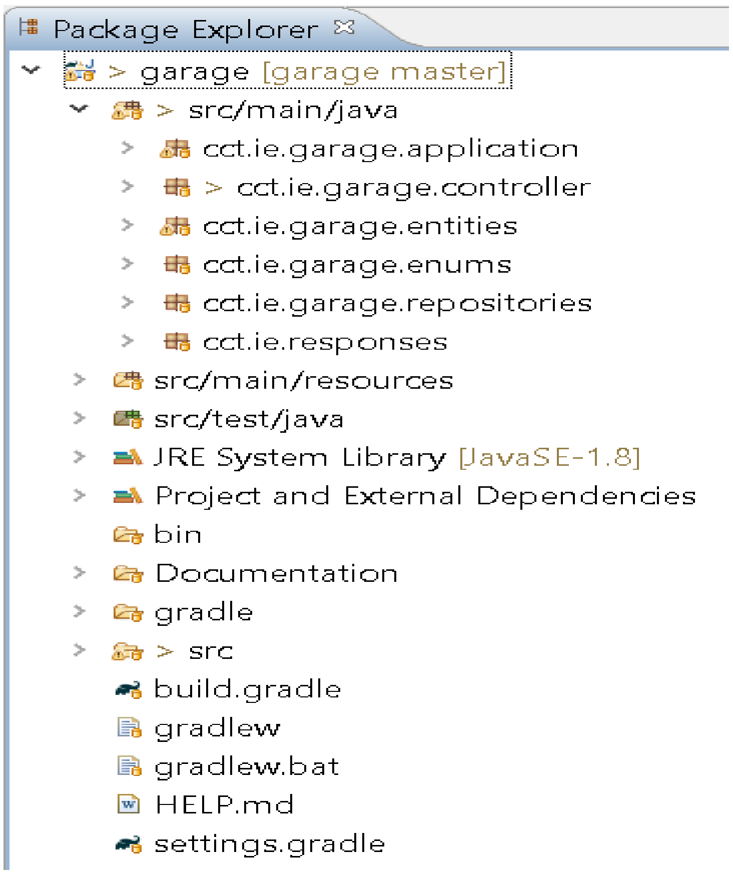
See below Booking Controller with some required annotation to build the web service.



```
@Controller // This means that this class is a Controller
@RequestMapping(path = "/garage/booking") // This means URL's start with (after Application path)
@CrossOrigin(origins = "*") // Using (*) it allows request from any origin
@EntityScan("cct.ie.garage.*")
public class BookingController {
    // This means to get the bean called BookingRepository
    // Which is auto-generated by Spring, we will use it to handle the data from the repository
    @Autowired
    private BookingRepository bookingRepository;

    @Autowired
    private StaffRepository staffRepository;

```

Spring Annotations

Also, see below the Java Project Structure.



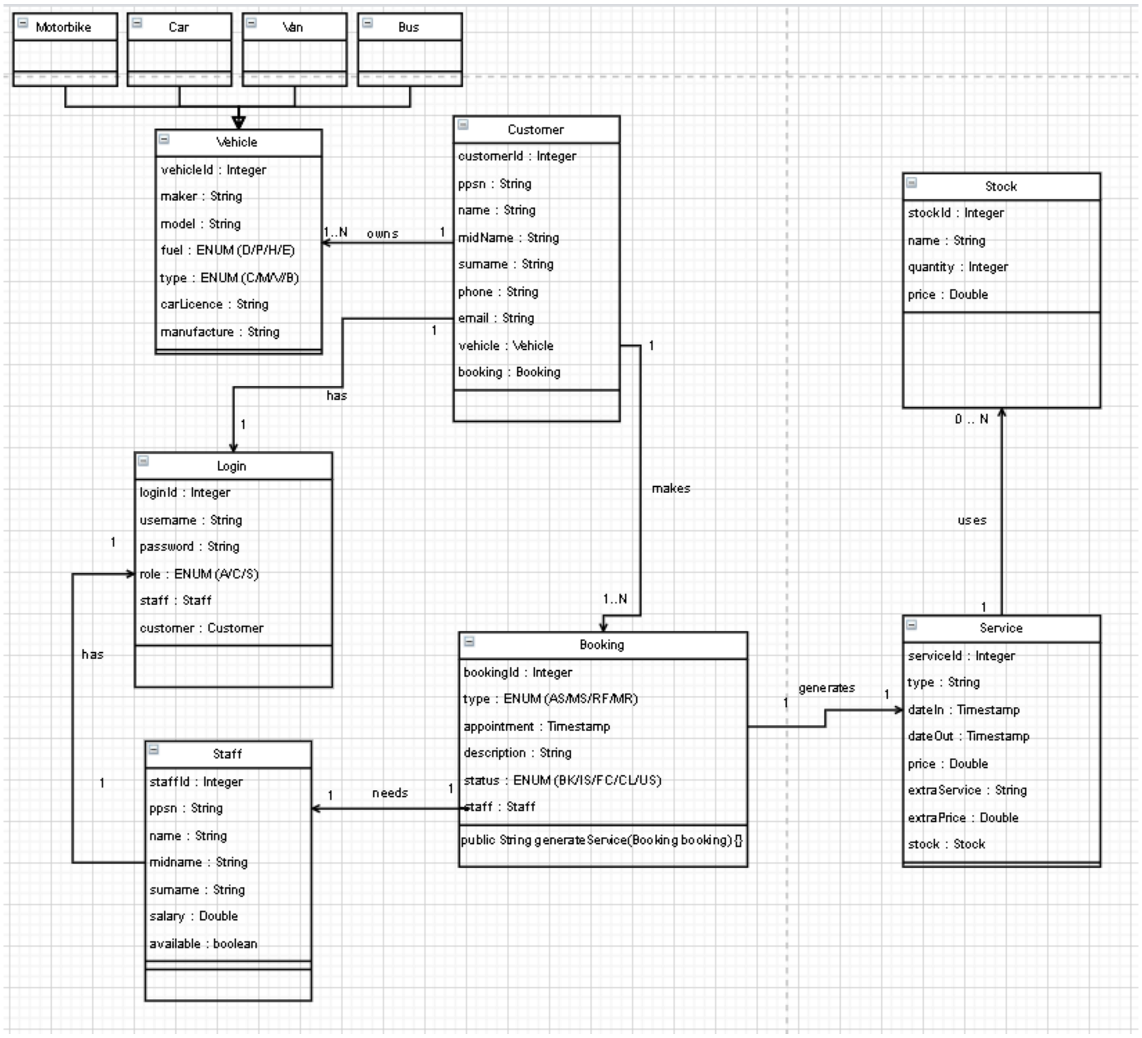
```
Package Explorer
garage [garage master]
  src/main/java
    cct.ie.garage.application
    cct.ie.garage.controller
    cct.ie.garage.entities
    cct.ie.garage.enums
    cct.ie.garage.repositories
    cct.ie.responses
  src/main/resources
  src/test/java
  JRE System Library [JavaSE-1.8]
  Project and External Dependencies
  bin
  Documentation
  gradle
  src
  build.gradle
  gradlew
  gradlew.bat
  HELP.md
  settings.gradle
```

FRONT-END

Ionic is the front-end language used for this application. Ionic combined with Angular is a powerful tool for front-end development. It has been built in an independent way, which makes it easier to customise the front-end layer.

Diagrams

In parallel with the ER diagram, a class diagram also has been produced to view all classes, attributes, methods and relationships.



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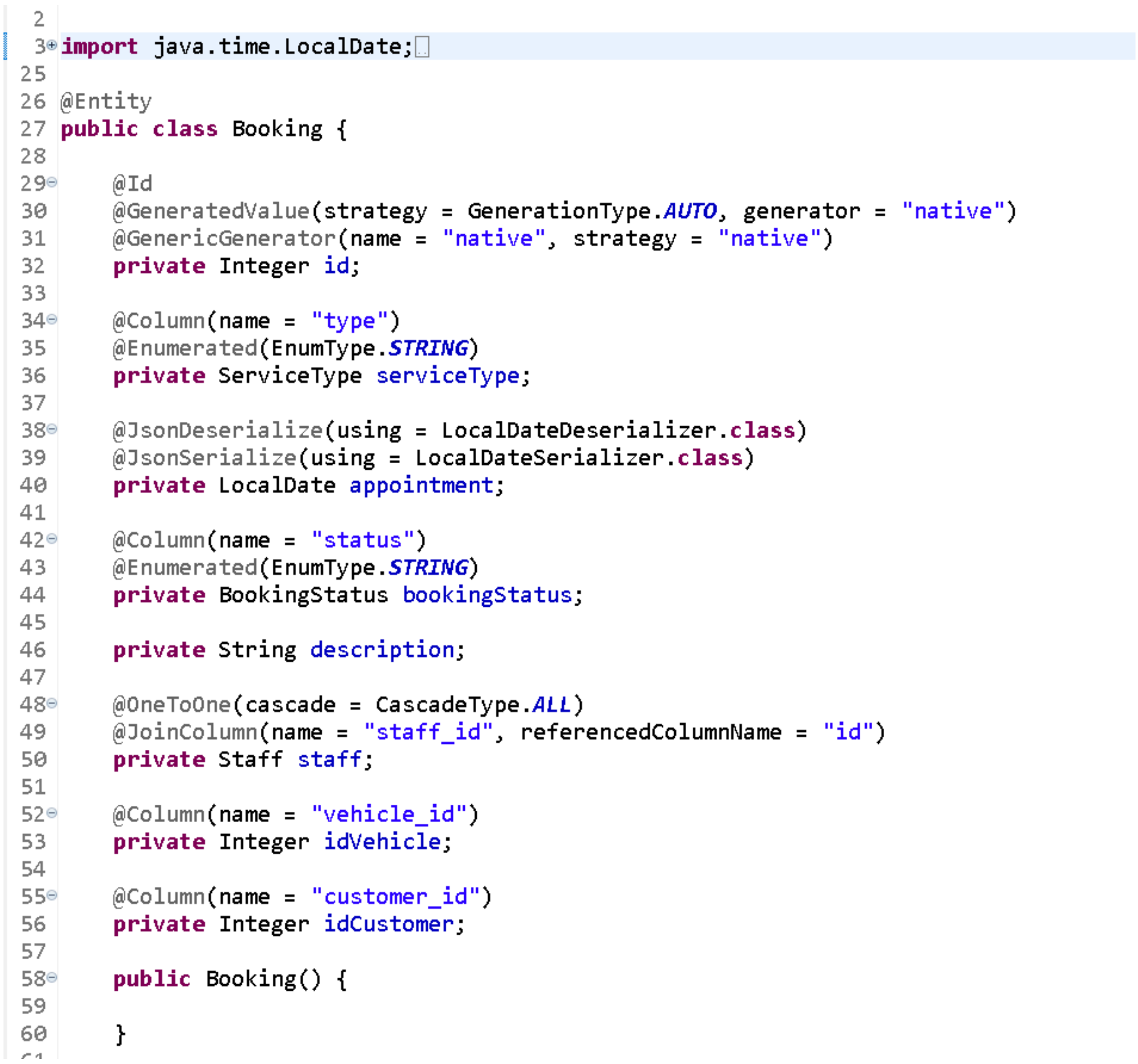
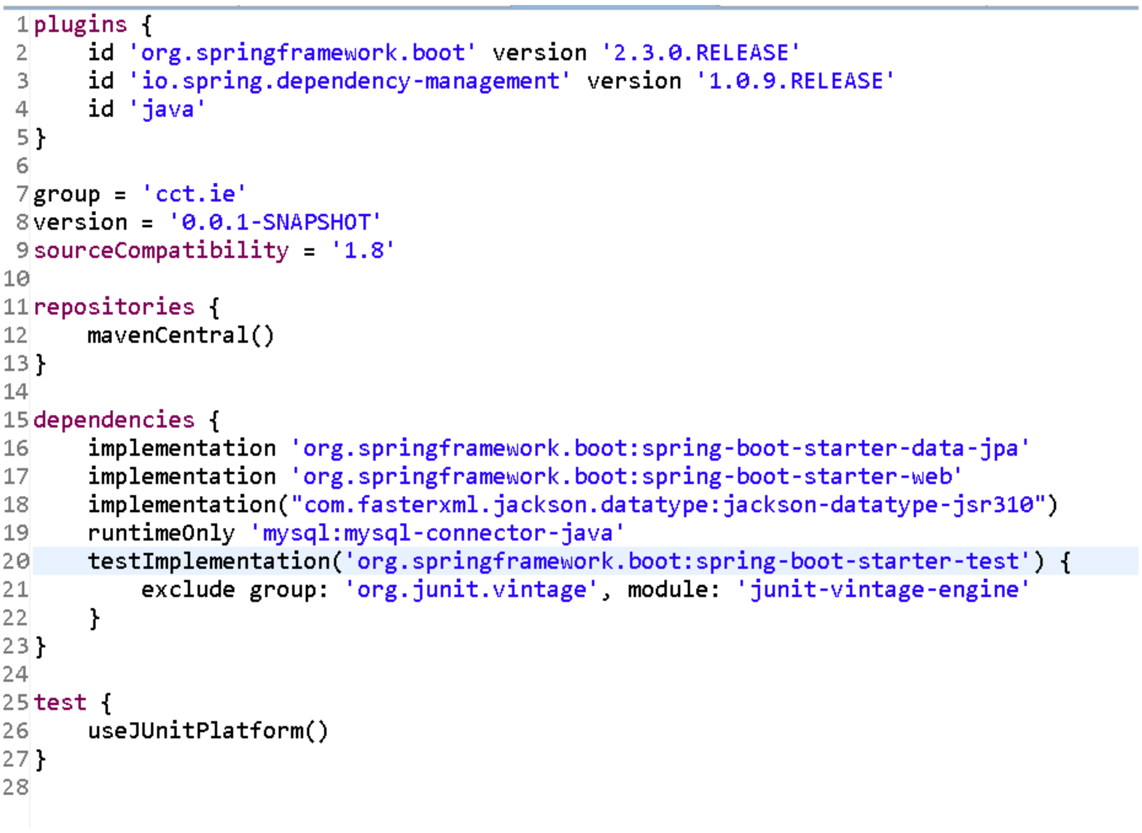


```

import java.time.LocalDate;

@Entity
public class Booking {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO, generator = "native")
    @GenericGenerator(name = "native", strategy = "native")
    private Integer id;

    @Column(name = "type")
    @Enumerated(EnumType.STRING)
    private ServiceType serviceType;

    @JsonDeserialize(using = LocalDateDeserializer.class)
    @JsonSerialize(using = LocalDateSerializer.class)
    private LocalDate appointment;

    @Column(name = "status")
    @Enumerated(EnumType.STRING)
    private BookingStatus bookingStatus;

    private String description;

    @OneToOne(cascade = CascadeType.ALL)
    @JoinColumn(name = "staff_id", referencedColumnName = "id")
    private Staff staff;

    @Column(name = "vehicle_id")
    private Integer idVehicle;

    @Column(name = "customer_id")
    private Integer idCustomer;

    public Booking() {

    }
```

Booking Class using JPA annotations

Gradle Framework

The back-end development started through this framework. It as a build automation tool to control and download project dependencies. With Gradle, by adding dependencies on the “build.gradle” file, similar to POM.xml from Maven, the project download all libraries which will be used to develop.



```
plugins {
    id 'org.springframework.boot' version '2.3.0.RELEASE'
    id 'io.spring.dependency-management' version '1.0.9.RELEASE'
    id 'java'
}

group = 'cct.ie'
version = '0.0.1-SNAPSHOT'
sourceCompatibility = '1.8'

repositories {
    mavenCentral()
}

dependencies {
    implementation 'org.springframework.boot:spring-boot-starter-data-jpa'
    implementation 'org.springframework.boot:spring-boot-starter-web'
    implementation("com.fasterxml.jackson.datatype:jackson-datatype-jsr310")
    runtimeOnly 'mysql:mysql-connector-java'
    testImplementation('org.springframework.boot:spring-boot-starter-test') {
        exclude group: 'org.junit.vintage', module: 'junit-vintage-engine'
    }
}

test {
    useJUnitPlatform()
}

```

Spring Framework

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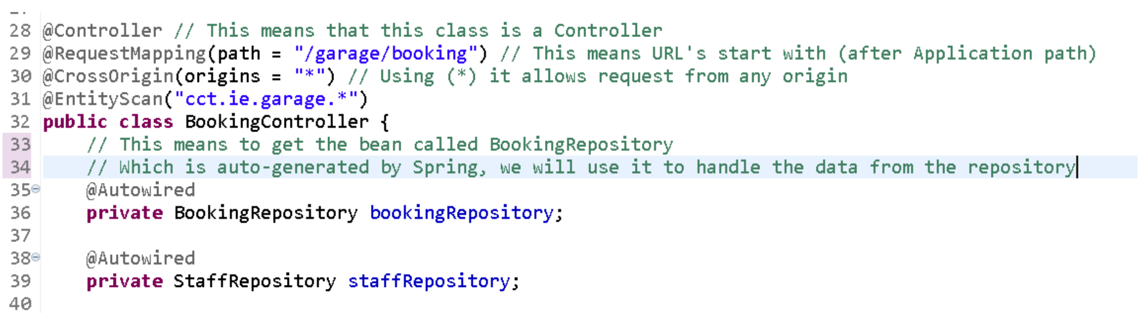
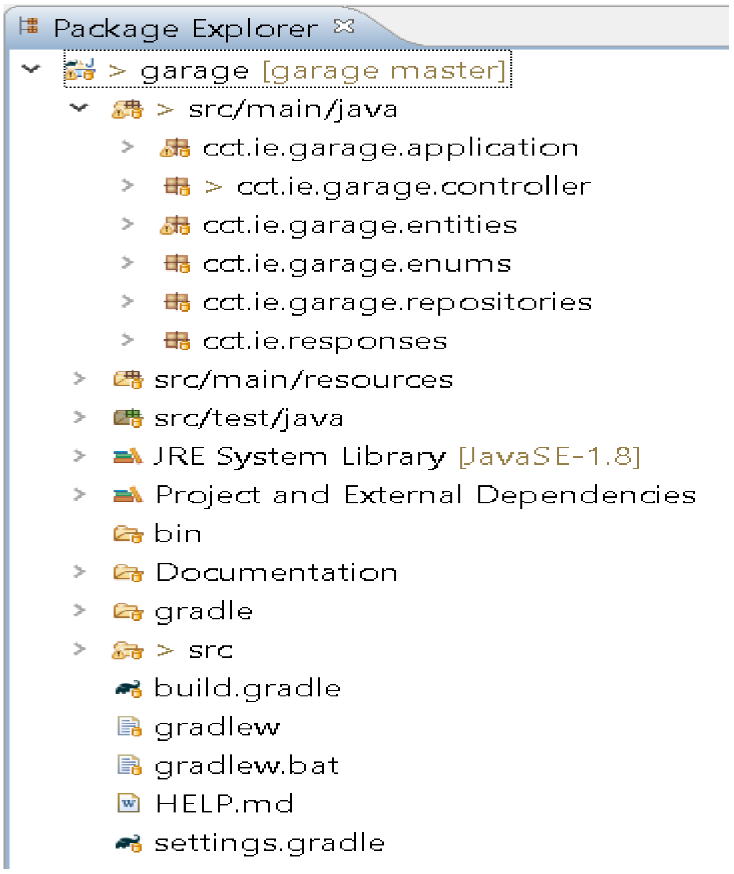
See below Booking Controller with some required annotation to build the web service.



```
@Controller // This means that this class is a Controller
@RequestMapping(path = "/garage/booking") // This means URL's start with (after Application path)
@CrossOrigin(origins = "*") // Using (*) it allows request from any origin
@EntityScan("cct.ie.garage.*")
public class BookingController {
    // This means to get the bean called BookingRepository
    // Which is auto-generated by Spring, we will use it to handle the data from the repository
    @Autowired
    private BookingRepository bookingRepository;

    @Autowired
    private StaffRepository staffRepository;

```

Spring Annotations

Also, see below the Java Project Structure.

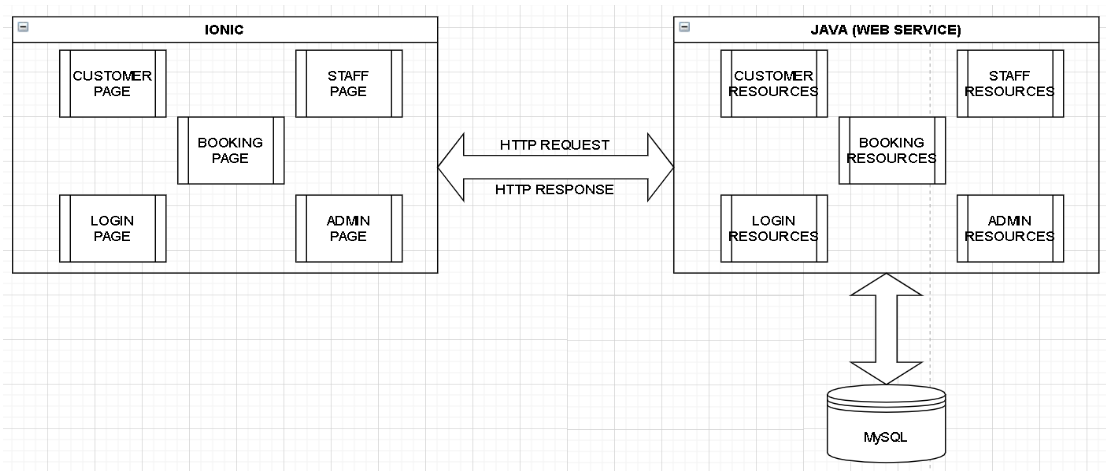


```
Package Explorer
garage [garage master]
  src/main/java
    cct.ie.garage.application
    cct.ie.garage.controller
    cct.ie.garage.entities
    cct.ie.garage.enums
    cct.ie.garage.repositories
    cct.ie.responses
  src/main/resources
  src/test/java
  JRE System Library [JavaSE-1.8]
  Project and External Dependencies
  bin
  Documentation
  gradle
  src
  build.gradle
  gradlew
  gradlew.bat
  HELP.md
  settings.gradle
```

FRONT-END

Ionic is front-end language used to build this application and integrated with Angular gives a powerful tool to front-end development.

The front layer has been built in an indepent way, what makes easier to customise the front-end. Towards this, it is just necessary build another front-end and call the endpoints, with no effect on the back-end side.



Garage System Architecture

CHAPTER IV: SYSTEM IMPLEMENTATION

As seen on Gantt chart through the specified tasks or on the product backlog on the previous chapters, the project life cycle has been split into 3 main phases:

- Management and Design;
- Development;
- Testing;

The previous chapters has explained about the first part of the life cycle and now, the development phase of the project will be shown.

ARCHITECTURE

The project architecture is based on Restful and uses Java 8 to build the web service and make the resource available. Besides Java, JPA manages the database access, Spring to support to create the endpoints, MySQL as a data store and Ionic to create pages to user accessibility.

TECHNOLOGIES IMPLEMENTED

FRONT END

- Ionic;
- HTML;
- CSS;
- JavaScript;
- Angular;
- HTTP Methods;
- JSON;

BACK END

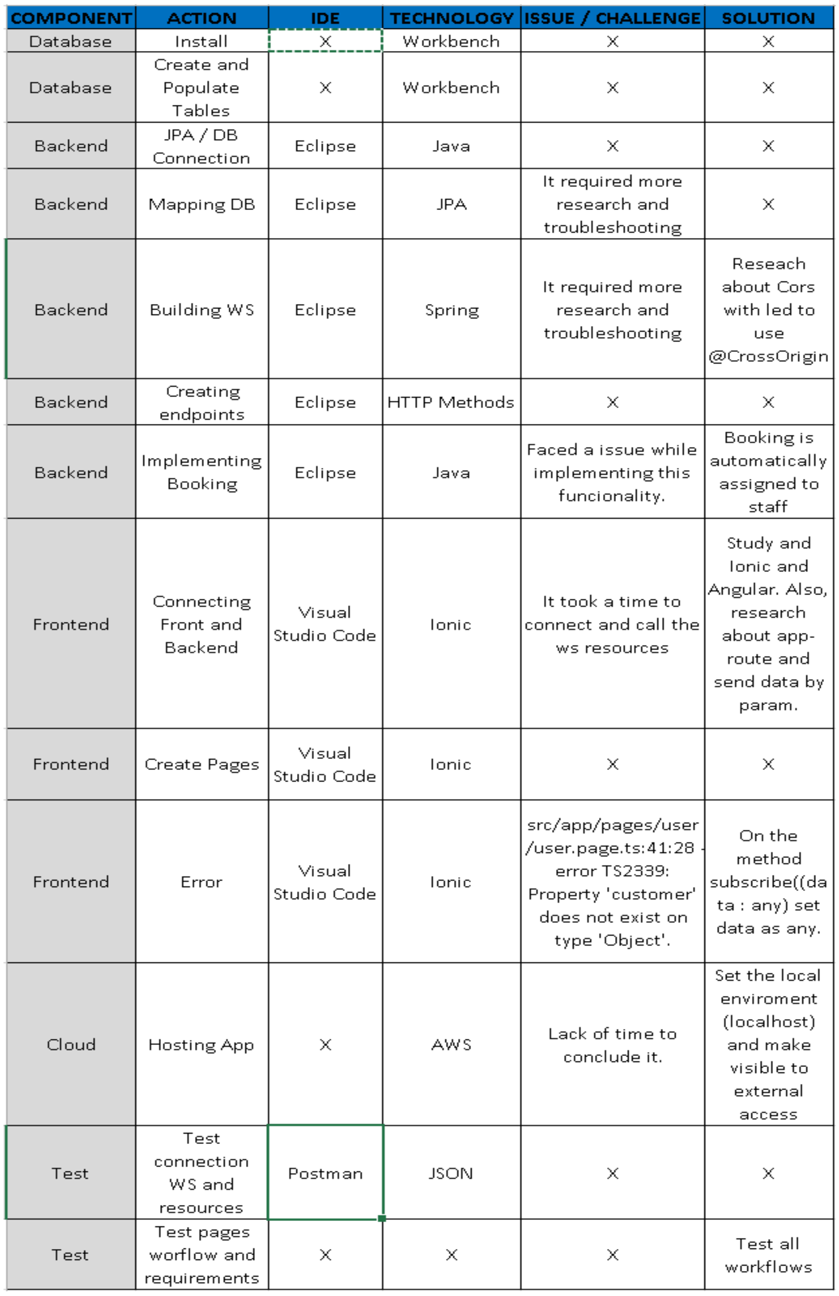
- Java;
- JPA;
- Tomcat;
- Spring Framework;
- Gradle;

DATABASE

- MySQL;

DEVELOPMENT

The following table summarizes all tasks on the development life cycle and includes issues, troubleshooting and solution accomplished on this project.



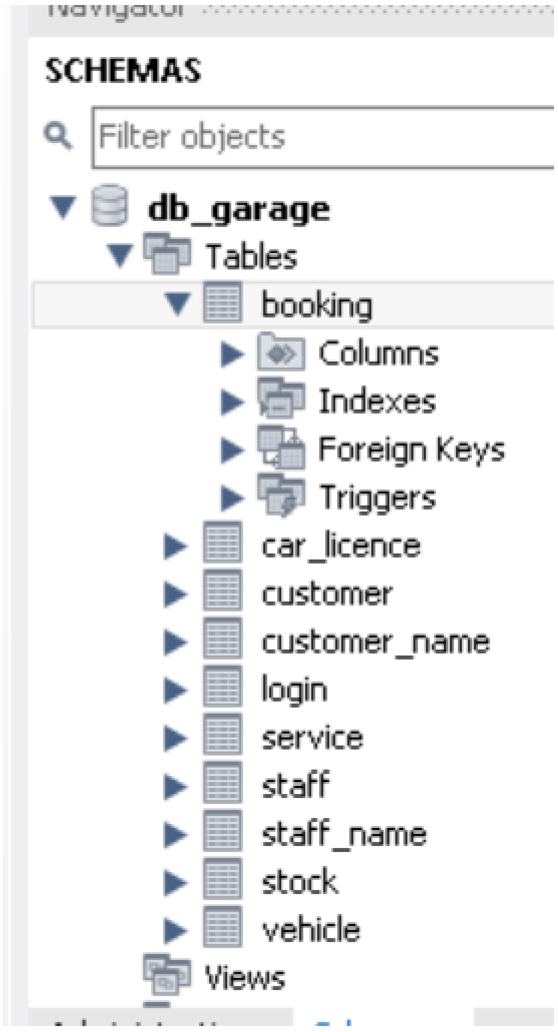
COMPONENT	ACTION	IDE	TECHNOLOGY	ISSUE / CHALLENGE	SOLUTION
Database	Install	X	Workbench	X	X
Database	Create and Populate Tables	X	Workbench	X	X
Backend	JPA / DB Connection	Eclipse	Java	X	X
Backend	Mapping DB	Eclipse	JPA	It required more research and troubleshooting	X
Backend	Building WS	Eclipse	Spring	It required more research and troubleshooting	Reseach about Cors with led to use @CrossOrigin
Backend	Creating endpoints	Eclipse	HTTP Methods	X	X
Backend	Implementing Booking	Eclipse	Java	Faced a issue while implementing this funcionality.	Booking is automatically assigned to staff
Frontend	Connecting Front and Backend	Visual Studio Code	Ionic	It took a time to connect and call the ws resources	Study and Ionic and Angular. Also, research about app-route and send data by param.
Frontend	Create Pages	Visual Studio Code	Ionic	X	X
Frontend	Error	Visual Studio Code	Ionic	src/app/pages/user/user.page.ts:41:28 - error TS2339: Property 'customer' does not exist on type 'Object'.	On the method subscribe((data : any) set data as any.
Cloud	Hosting App	X	AWS	Lack of time to conclude it.	Set the local enviroment (localhost) and make visible to external access
Test	Test connection WS and resources	Postman	JSON	X	X
Test	Test pages worflow and requirements	X	X	X	Test all workflows

Issue / Solution Tracking Sheet

IMPLEMENTATION OF THE SYSTEM: EXPECTATION VS. REALITY

Database

At this stage the project achieved the requirements on time. Researches about which database ended up leading to use MySQL. All DB structures such as schema, tables, columns, constraints and at last the data insert.



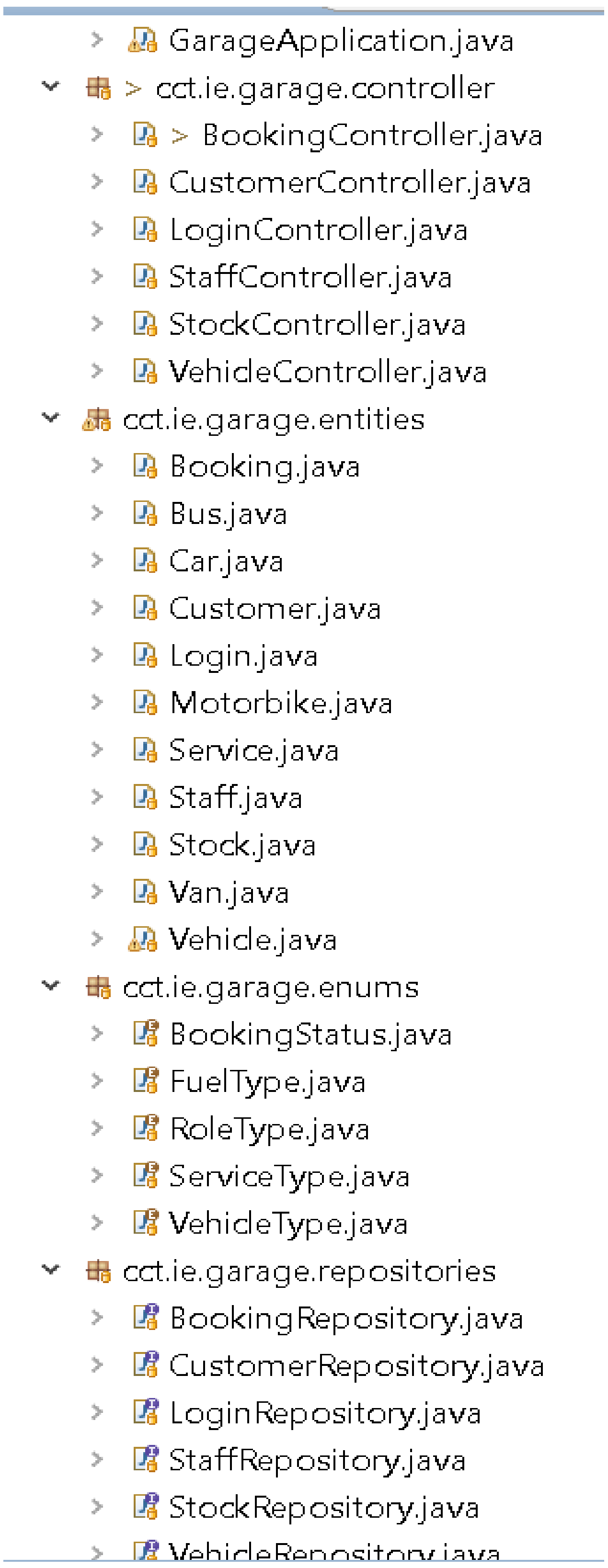
DB_GARAGE SCHEMA

Relational Modelling, such as third normalisation, has been used and some modification were made to the web system improvement.

Back-End

At the very beginning, due to previous knowledge on Java, Eclipse and database, the back-end development were as planned. Connection with database, JPA annotation and entity creation worked perfectly. However, while building the web service, few issues with Spring annotation and WS Controller have shown up. It affected the development process and led to the decision of only implement the main functionalities required for the project.

On the image below is going to show the Java WS structure.



```
> GarageApplication.java
v > cct.ie.garage.controller
    > > BookingController.java
    > CustomerController.java
    > LoginController.java
    > StaffController.java
    > StockController.java
    > VehicleController.java
v cct.ie.garage.entities
    > Booking.java
    > Bus.java
    > Car.java
    > Customer.java
    > Login.java
    > Motorbike.java
    > Service.java
    > Staff.java
    > Stock.java
    > Van.java
    > Vehicle.java
v cct.ie.garage.enums
    > BookingStatus.java
    > FuelType.java
    > RoleType.java
    > ServiceType.java
    > VehicleType.java
v cct.ie.garage.repositories
    > BookingRepository.java
    > CustomerRepository.java
    > LoginRepository.java
    > StaffRepository.java
    > StockRepository.java
    > VehicleRepository.java
```

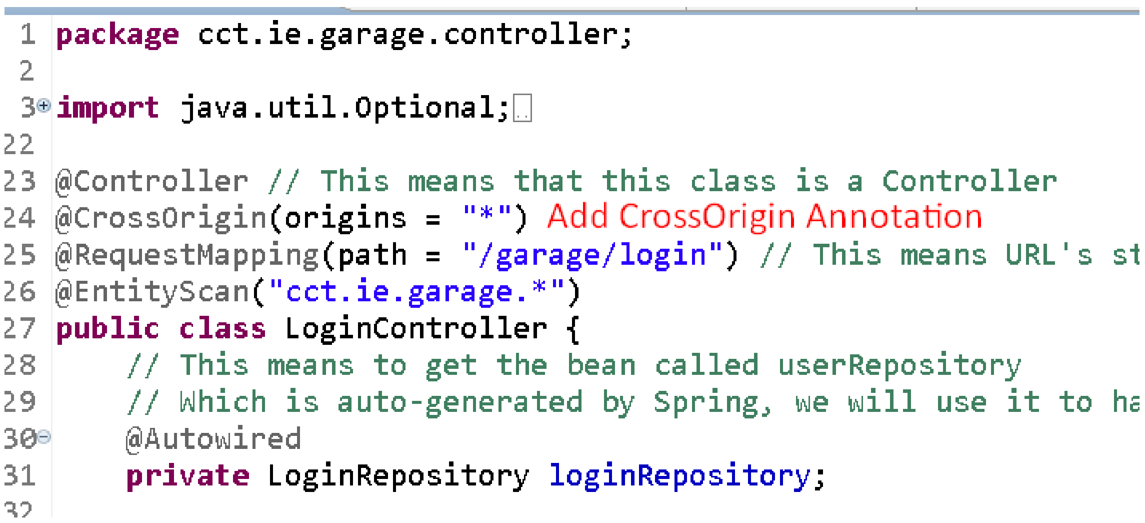
As a result of learning curve of Ionic and Angular, some functionalities have receive high priority and due to lack of timing others had to be left aside.

Functionalities not completed:

- Stock (Supplies);

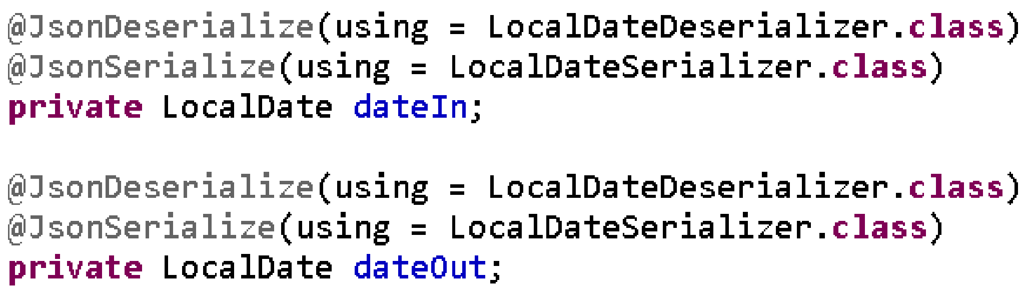
- Admin View All Bookings;

When connecting the front-end to the back, few changes needed to be done.



```
package cct.ie.garage.controller;

import java.util.Optional;

@Controller // This means that this class is a Controller
@CrossOrigin(origins = "*") Add CrossOrigin Annotation
@RequestMapping(path = "/garage/login") // This means URL's st
@EntityScan("cct.ie.garage.*")
public class LoginController {
    // This means to get the bean called userRepository
    // Which is auto-generated by Spring, we will use it to ha
    @Autowired
    private LoginRepository loginRepository;
```

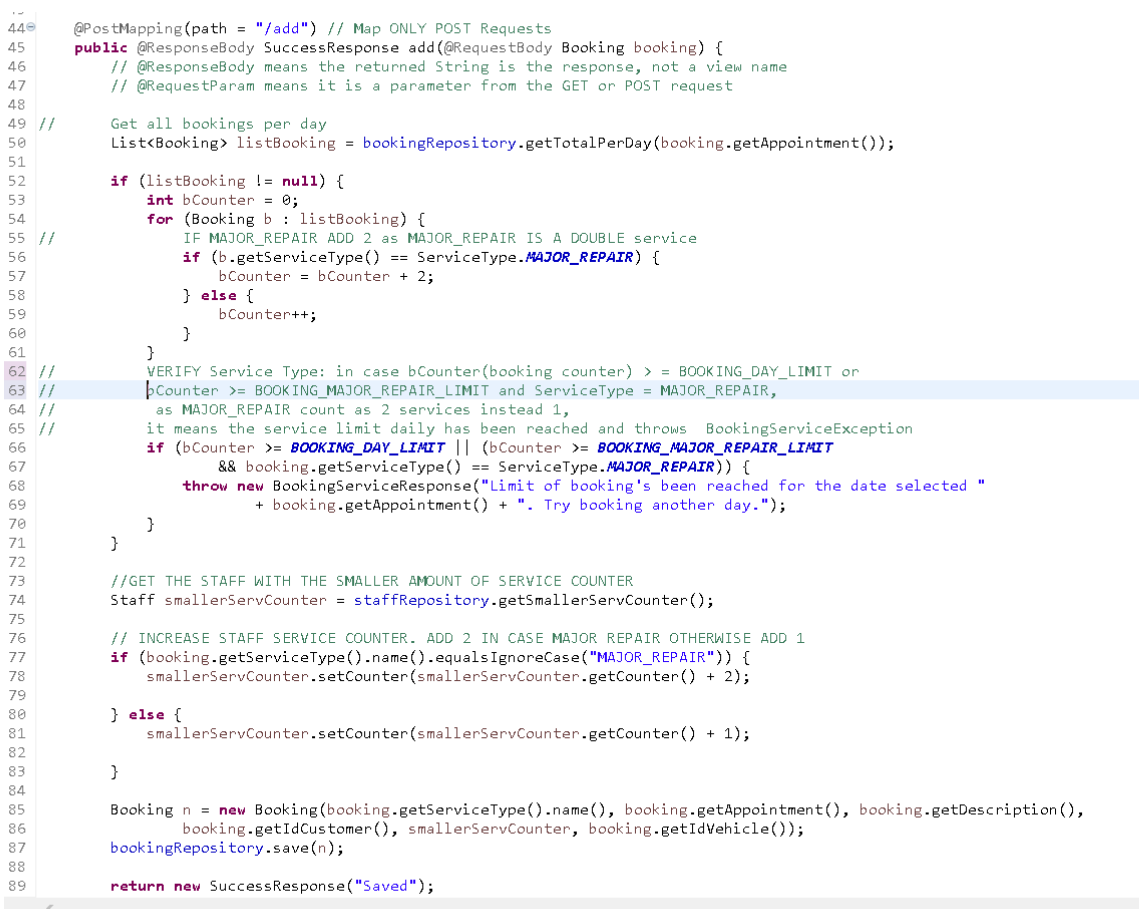
On the image above one of the changes were add this annotation to allow the back-end to receive request from any origin. It can also be used with a specific origin. For example: @CrossOrigin(origins = "http://localhost:8100").



```
@JsonDeserialize(using = LocalDateDeserializer.class)
@JsonSerialize(using = LocalDateSerializer.class)
private LocalDate dateIn;

@JsonDeserialize(using = LocalDateDeserializer.class)
@JsonSerialize(using = LocalDateSerializer.class)
private LocalDate dateOut;
```

At this stage, a date serializable issue has been faced. Using the Jackson library and (@JsonDeserialize and @JsonSerialize) there is no need to worry about date serialise.

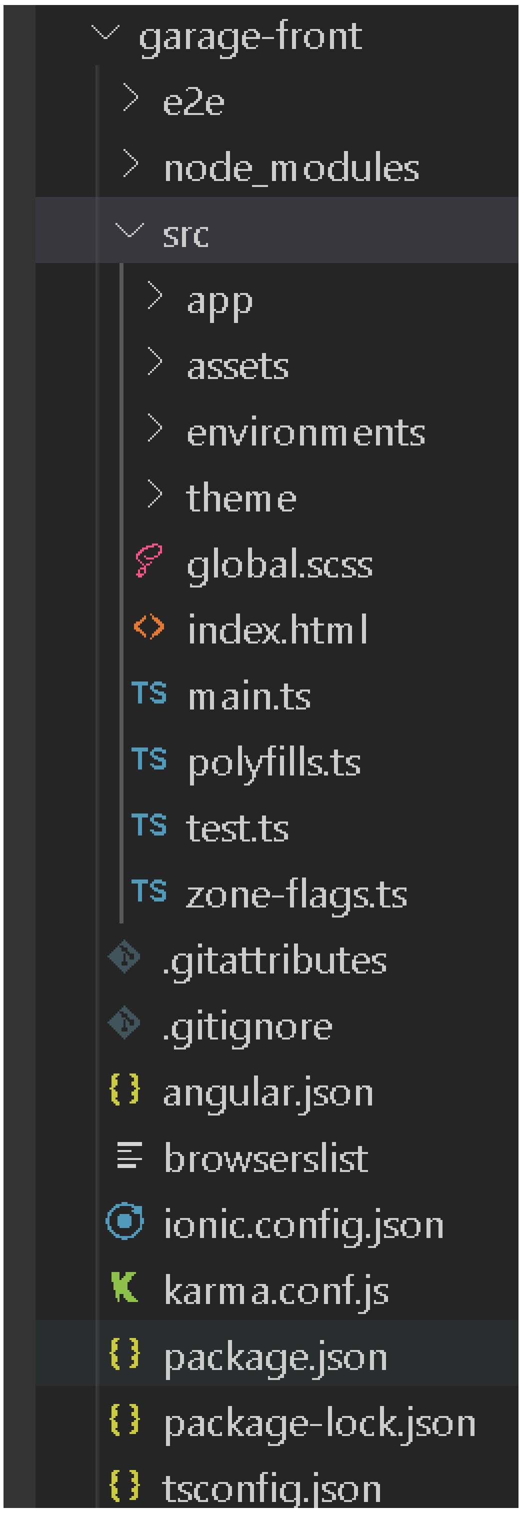
Despite some methods haven't been implemented, the most of functionalities were covered. Plus, instead of the Admin (Ger) being asked to assign all booking, as requirements, after customer making an appointment, it is automatically assigned to the staff with the smallest amount of service.



```
    @PostMapping(path = "/add") // Map ONLY POST Requests
    public @ResponseBody SuccessResponse add(@RequestBody Booking booking) {
        // @ResponseBody means the returned String is the response, not a view name
        // @RequestParam means it is a parameter from the GET or POST request

//      Get all bookings per day
        List<Booking> listBooking = bookingRepository.getTotalPerDay(booking.getAppointment());

        if (listBooking != null) {
            int bCounter = 0;
            for (Booking b : listBooking) {
//              IF MAJOR_REPAIR ADD 2 as MAJOR_REPAIR IS A DOUBLE service
                if (b.getServiceType() == ServiceType.MAJOR_REPAIR) {
                    bCounter = bCounter + 2;
                } else {
                    bCounter++;
                }
            }
//          VERIFY Service Type: in case bCounter(booking counter) > = BOOKING_DAY_LIMIT or
//          bCounter >= BOOKING_MAJOR_REPAIR_LIMIT and ServiceType = MAJOR_REPAIR,
//           as MAJOR_REPAIR count as 2 services instead 1,
//          it means the service limit daily has been reached and throws  BookingServiceException
            if (bCounter >= BOOKING_DAY_LIMIT || (bCounter >= BOOKING_MAJOR_REPAIR_LIMIT
                    && booking.getServiceType() == ServiceType.MAJOR_REPAIR)) {
                throw new BookingServiceResponse("Limit of booking's been reached for the date selected "
                        + booking.getAppointment() + ". Try booking another day.");
            }
        }

        //GET THE STAFF WITH THE SMALLER AMOUNT OF SERVICE COUNTER
        Staff smallerServCounter = staffRepository.getSmallerServCounter();

        // INCREASE STAFF SERVICE COUNTER. ADD 2 IN CASE MAJOR REPAIR OTHERWISE ADD 1
        if (booking.getServiceType().name().equalsIgnoreCase("MAJOR_REPAIR")) {
            smallerServCounter.setCounter(smallerServCounter.getCounter() + 2);

        } else {
            smallerServCounter.setCounter(smallerServCounter.getCounter() + 1);

        }

        Booking n = new Booking(booking.getServiceType().name(), booking.getAppointment(), booking.getDescription(),
                booking.getIdCustomer(), smallerServCounter, booking.getIdVehicle());
        bookingRepository.save(n);

        return new SuccessResponse("Saved");
```

Front-End

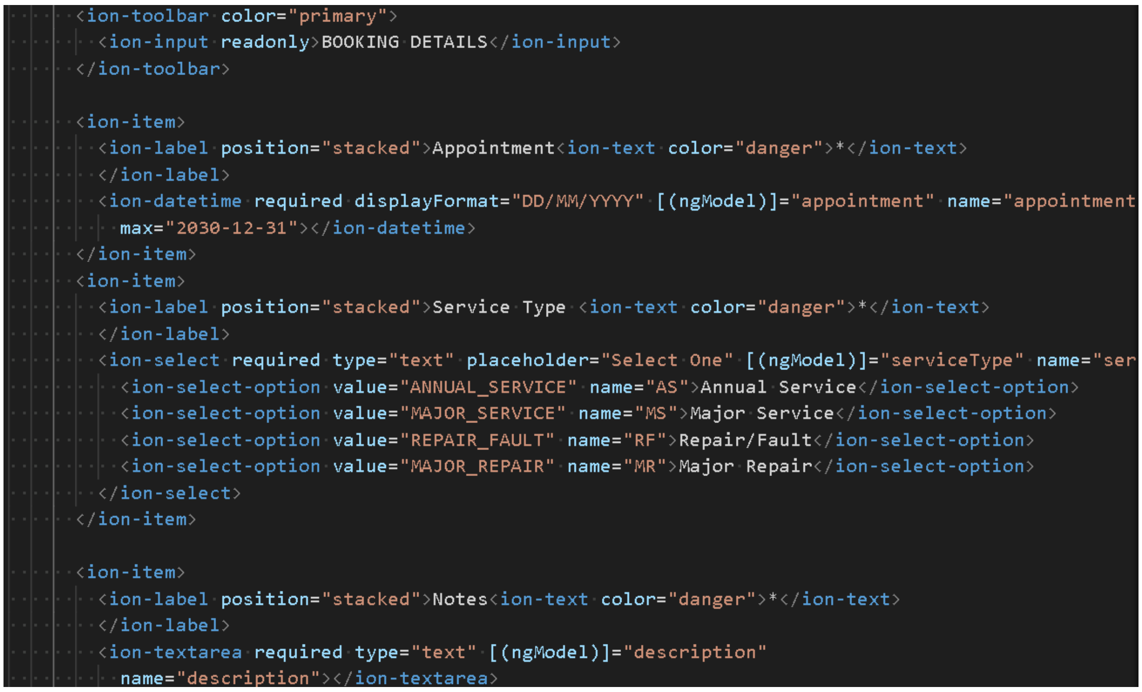
The front-end is the biggest challenge to build this web application. At the beginning, it took more time than estimated, leading to lack of time. However, after a considerable time spent to learn how to connect front and back-end and make the Ionic pages call the first endpoint, it became reasonably simple. Since all the core business is kept on the server side and exposed through WS resources, the front-end were designed and created only to send requests and get the responses.



```
garage-front
  e2e
  node_modules
  src
    app
    assets
    environments
    theme
    global.scss
    index.html
    main.ts
    polyfills.ts
    test.ts
    zone-flags.ts
  .gitattributes
  .gitignore
  angular.json
  browserslist
  ionic.config.json
  karma.conf.js
  package.json
  package-lock.json
  tsconfig.json
```

Visual Studio Code package structure

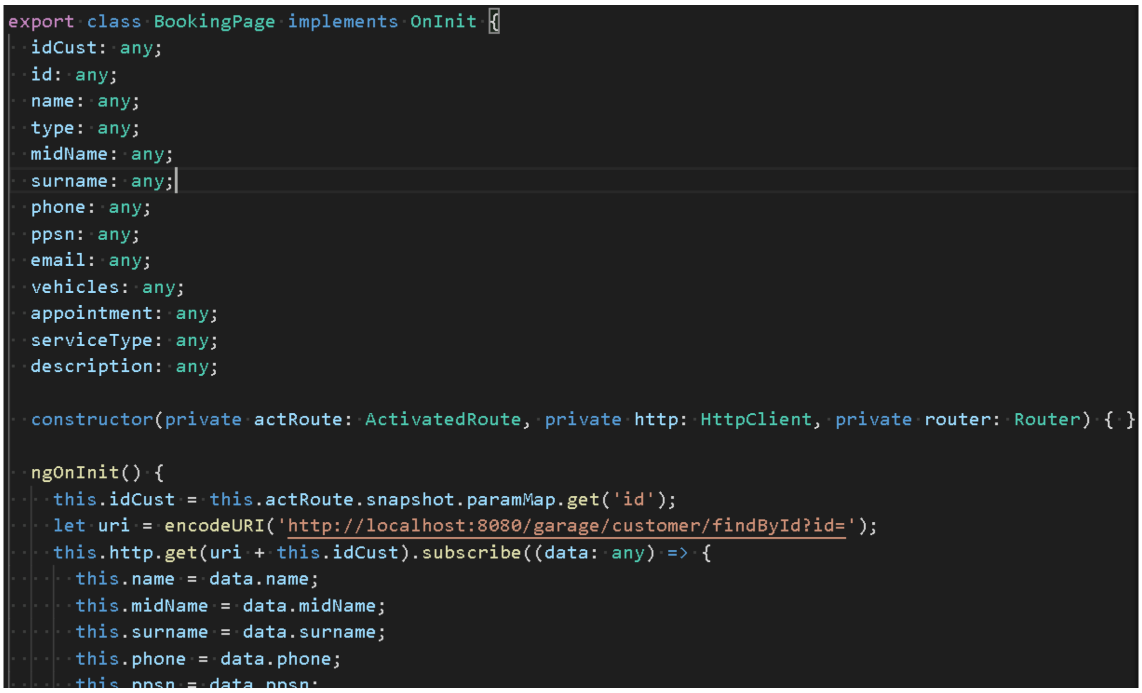
As planned, the front-end works apart of the back. See below a chunk of booking page.



```
    <ion-toolbar color="primary">
      <ion-input readonly>BOOKING DETAILS</ion-input>
    </ion-toolbar>

    <ion-item>
      <ion-label position="stacked">Appointment<ion-text color="danger">*</ion-text>
      </ion-label>
      <ion-datetime required displayFormat="DD/MM/YYYY" [(ngModel)]="appointment" name="appointment
        max="2030-12-31"></ion-datetime>
    </ion-item>
    <ion-item>
      <ion-label position="stacked">Service Type <ion-text color="danger">*</ion-text>
      </ion-label>
      <ion-select required type="text" placeholder="Select One" [(ngModel)]="serviceType" name="ser
        <ion-select-option value="ANNUAL_SERVICE" name="AS">Annual Service</ion-select-option>
        <ion-select-option value="MAJOR_SERVICE" name="MS">Major Service</ion-select-option>
        <ion-select-option value="REPAIR_FAULT" name="RF">Repair/Fault</ion-select-option>
        <ion-select-option value="MAJOR_REPAIR" name="MR">Major Repair</ion-select-option>
      </ion-select>
    </ion-item>

    <ion-item>
      <ion-label position="stacked">Notes<ion-text color="danger">*</ion-text>
      </ion-label>
      <ion-textarea required type="text" [(ngModel)]="description"
        name="description"></ion-textarea>
```

Booking.page.html

The previous code represents what is loaded on the user browser. On the other hand, ionic use its own back-end side. Following the image below, the frontend is calling the customer resource.



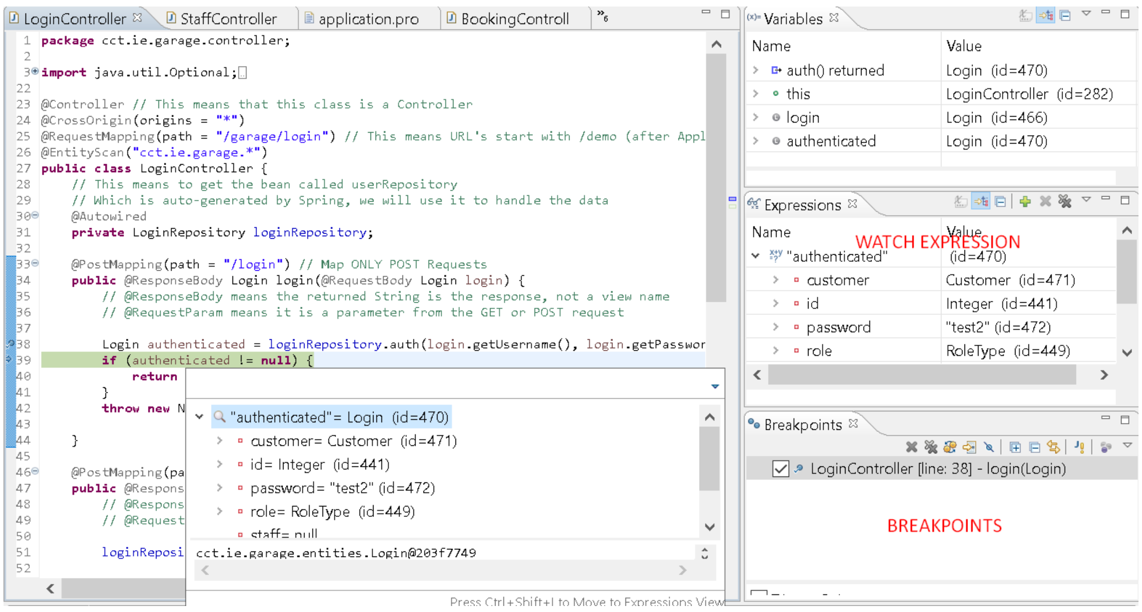
```
export class BookingPage implements OnInit {
  idCust: any;
  id: any;
  name: any;
  type: any;
  midName: any;
  surname: any;
  phone: any;
  ppsn: any;
  email: any;
  vehicles: any;
  appointment: any;
  serviceType: any;
  description: any;

  constructor(private actRoute: ActivatedRoute, private http: HttpClient, private router: Router) { }

  ngOnInit() {
    this.idCust = this.actRoute.snapshot.paramMap.get('id');
    let uri = encodeURI('http://localhost:8080/garage/customer/findById?id=');
    this.http.get(uri + this.idCust).subscribe((data: any) => {
      this.name = data.name;
      this.midName = data.midName;
      this.surname = data.surname;
      this.phone = data.phone;
      this.ppsn = data.ppsn;
```

Booking.page.ts

CHAPTER V: TESTING & EVALUATION

This section aim to describe the Ger’s Garage Web Application testing and evaluation process. It is very important to highlight that on the entire project life cycle, runtime tests were made. On the back-end and database, Postman and Eclipse debugging have helped on the development.

Using the Debug mode on Eclipse, this powerful tool helps the developer to look into and identify the error at run time. See below some functionalities.



```
1  package cct.ie.garage.controller;
2
3⊕ import java.util.Optional;
22
23 @Controller // This means that this class is a Controller
24 @CrossOrigin(origins = "*")
25 @RequestMapping(path = "/garage/login") // This means URL's start with /demo (after Appl
26 @EntityScan("cct.ie.garage.*")
27 public class LoginController {
28     // This means to get the bean called userRepository
29     // Which is auto-generated by Spring, we will use it to handle the data
30⊖    @Autowired
31     private LoginRepository loginRepository;
32
33⊖    @PostMapping(path = "/login") // Map ONLY POST Requests
34     public @ResponseBody Login login(@RequestBody Login login) {
35         // @ResponseBody means the returned String is the response, not a view name
36         // @RequestParam means it is a parameter from the GET or POST request
37
38         Login authenticated = loginRepository.auth(login.getUsername(), login.getPasswor
39         if (authenticated != null) {
40             return
41         }
42         throw new N
43
44     }
45
46⊖    @PostMapping(pa
47     public @Respons
48         // @Respons
49         // @Request
50
51         loginReposi
52
```

```
"authenticated"= Login  (id=470)
    customer= Customer  (id=471)
    id= Integer  (id=441)
    password= "test2" (id=472)
    role= RoleType  (id=449)
    staff= null
cct.ie.garage.entities.Login@203f7749
```

Name	Value
auth() returned	Login (id=470)
this	LoginController (id=282)
login	Login (id=466)
authenticated	Login (id=470)

Name	Value
"authenticated"	(id=470)
customer	Customer (id=471)
id	Integer (id=441)
password	"test2" (id=472)
role	RoleType (id=449)

☑ LoginController [line: 38] - login(Login)

Eclipse Debug

See on the illustration above few functionalities given on this mode. On the breakpoint tab is possible to identify: Class (LoginController), line where the interruption point has been placed (Line 38).

On the Expressions Tab is been shown an expression to be watched. Due to it, every time this expression is updated will be possible visualise. And at last, on the main tab, in this case, “LoginController”, when placing the cursor on the variable or object an pop up shows up with the values, type, quantity and others relevant details.

ACCESS TO THE SYSTEM TEST

Register form

TEST INPUT	EXPECTED RESULT	CURRENT RESULT	COMMENTS
New Customer Register	Save information on Customer Table and its relations, redirect to customer page and populate fields with saved details	Complete	
New Customer Register form vaidation	Save information on Customer Table and its relations, redirect to customer page and populate fields with saved details	Customer stays at the same page.	There is validation but not message error.
New Staff Register	Admin inputs staff details and redirected to admin page	Complete	
New Customer Register form vaidation	Save information on Customer Table and its relations, redirect to customer page and populate fields with saved details	Admin stays at the same page.	There is validation but not message error.

Login Form

TEST INPUT	EXPECTED RESULT	CURRENT RESULT	COMMENTS
New Customer / Staff / Admin Login	Chech account and redirect to the customer page	Complete	
New Customer / Staff / Admin Login form vaidation	Message in case mandatory fields are not fill up	Customer stays at the same page.	There is validation but not message error.

Booking Form

TEST INPUT	EXPECTED RESULT	CURRENT RESULT	COMMENTS
Customer Booking Page	Save booking details on Booking Table and its relations, redirect to booking page and populate fields with saved details	Complete	
Customer Booking Page form vaidation	After saving, rediretc to the booking view page	Customer stays at the same page.	There is validation but not message error.
Admin / Staff Booking Page	Go to booking view	Staff Complete	Admin booking view functionality not copleted. However, it is not a problem since staff workflow is working and he can do the same action of the admin role on this page.

CHAPTER VI: CONCLUSION & FURTHER WORK

CONCLUSION

This project aim to achieve Ger's garage needs. Even though I haven't implemented all required functionalities, I feel relieved and comfortable with what I have achieved. On this project, I have been able to reach most of web application requirements and also overcome the challenges applied by myself.

It is clear, few functionalities are still missing and somehow it is not completed. However, as explained on the Chapter 1, it doesn't affect much the application since it is micro service based. Due to it, this web application is still functional.

Moreover, I still intend to implement those missing functionalities, increase and improve database and core business. Plus, keep studying and researching about Ionic, Angular and others front-end tools, frameworks and languages because it is the area where I have spent more time and where I am still not felling completely comfortable.

Also, this project helped to catch up with old technologies which I have been away a while.

In my opinion, it has been very challenging. First of all, because of the project complexity and short time to achieve all requirements. It is important to highlight that, due to Corona Virus, made things a bit harder.

When I started the course I assumed it would be a bit challenging. However, after facing different errors, dealing with new technologies, running against time, I have realised it has been further overwhelming than supposed.

Although, I could find, analyse and solve all issues which has appeared. I have also overcome all challenges, caught up with technologies I knew already and learnt new ones, such as Ionic and Angular.

After one year, facing all problems, issues and challenges and going always beyond. Keeping my head up trying to find a solution and replanting when going towards obstacles and at the end being able to release this web application and the final report, I can say: I have one this battle.

FURTHER WORK

Next Steps (Fixes):

- Complete missing functionalities: Admin booking view, messages error validation, print invoice;
- Host the application on cloud (AWS);

Next Steps (Improvements):

For the next version, new functionalities will be implemented:

- Payment Method;
- E-invoice;

APPENDIX A: SOURCE CODE

All the source can be found on:

Documentation: https://github.com/fampinho/garage/tree/master/Documentation

Back-end: https://github.com/fampinho/garage

Front-end: https://github.com/fampinho/garage-front

DATABASE

```
CREATE TABLE `booking` (
  `id` int NOT NULL AUTO_INCREMENT,
  `type` varchar(14) NOT NULL,
  `appointment` timestamp NOT NULL,
  `description` varchar(50) NOT NULL,
  `status` varchar(21) NOT NULL,
  `staff_id` int NOT NULL,
  `customer_id` int NOT NULL,
  `vehicle_id` int DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_staff_booking_idx` (`staff_id`),
  KEY `FK_customer_booking_idx` (`customer_id`),
  KEY `FK_vehicle_booking_idx` (`vehicle_id`),
  CONSTRAINT `FK_customer_booking` FOREIGN KEY (`customer_id`) REFERENCES `customer` (`id`),
  CONSTRAINT `FK_vehicle_booking` FOREIGN KEY (`vehicle_id`) REFERENCES `vehicle` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=39 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `car_licence` (
  `vehicle_id` int NOT NULL,
  `licence_number` varchar(10) NOT NULL,
  `manufacture` varchar(4) NOT NULL,
  PRIMARY KEY (`vehicle_id`),
  UNIQUE KEY `vehicle_id_UNIQUE` (`vehicle_id`),
  KEY `FK_vehicle_car_licence_idx` (`vehicle_id`),
  CONSTRAINT `FK_vehicle_car_licence` FOREIGN KEY (`vehicle_id`) REFERENCES `vehicle` (`id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `customer` (
  `id` int NOT NULL AUTO_INCREMENT,
  `ppsn` varchar(9) NOT NULL,
  `phone` varchar(10) NOT NULL,
  `email` varchar(50) NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=96 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `customer_name` (
  `customer_id` int NOT NULL,
  `name` varchar(10) NOT NULL,
  `mid_name` varchar(20) DEFAULT NULL,
  `surname` varchar(20) NOT NULL,
  PRIMARY KEY (`customer_id`),
  KEY `FK_customer_customer_name_idx` (`customer_id`),
  CONSTRAINT `FK_customer_customer_name` FOREIGN KEY (`customer_id`) REFERENCES `customer` (`id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `login` (
  `id` int NOT NULL AUTO_INCREMENT,
  `username` varchar(20) NOT NULL,
  `password` varchar(20) NOT NULL,
  `role` varchar(8) NOT NULL,
  `customer_id` int DEFAULT NULL,
  `staff_id` int DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_customer_login_idx` (`customer_id`),
  KEY `FK_staff_login_idx` (`staff_id`),
  CONSTRAINT `FK_customer_login` FOREIGN KEY (`customer_id`) REFERENCES
`customer` (`id`),
  CONSTRAINT `FK_staff_login` FOREIGN KEY (`staff_id`) REFERENCES `staff`
(`id`)
) ENGINE=InnoDB AUTO_INCREMENT=33 DEFAULT CHARSET=utf8mb4
COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `service` (
  `id` int NOT NULL AUTO_INCREMENT,
  `type` varchar(30) NOT NULL,
  `date_in` timestamp NOT NULL,
  `date_out` timestamp NOT NULL,
  `price` float NOT NULL,
  `extra_price` float DEFAULT NULL,
  `extra_service` varchar(200) DEFAULT NULL,
  `booking_id` int NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_booking_service_idx` (`booking_id`),
  CONSTRAINT `FK_booking_service` FOREIGN KEY (`booking_id`) REFERENCES
`booking` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=utf8mb4
COLLATE=utf8mb4_0900_ai_ci;
---
```

```
CREATE TABLE `staff` (
  `id` int NOT NULL AUTO_INCREMENT,
  `ppsn` varchar(9) NOT NULL,
  `salary` float NOT NULL,
  `is_available` tinyint(1) NOT NULL,
  `service_counter` int DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  UNIQUE KEY `ppsn_UNIQUE` (`ppsn`)
) ENGINE=InnoDB AUTO_INCREMENT=27 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `staff_name` (
  `staff_id` int NOT NULL,
  `name` varchar(10) NOT NULL,
  `mid_name` varchar(20) DEFAULT NULL,
  `surname` varchar(20) NOT NULL,
  PRIMARY KEY (`staff_id`),
  UNIQUE KEY `id_UNIQUE` (`staff_id`) /*!80000 INVISIBLE */,
  KEY `FK_staff_staff_name_idx` (`staff_id`),
  CONSTRAINT `FK_staff_staff_name` FOREIGN KEY (`staff_id`) REFERENCES `staff` (`id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `stock` (
  `id` int NOT NULL AUTO_INCREMENT,
  `name` varchar(30) NOT NULL,
  `quantity` int NOT NULL,
  `date_in` timestamp NOT NULL,
  `date_out` timestamp NULL DEFAULT NULL,
  `unit_price` float NOT NULL,
  `service_id` int DEFAULT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_service_stock_idx` (`service_id`),
  CONSTRAINT `FK_service_stock` FOREIGN KEY (`service_id`) REFERENCES `service` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=6 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
CREATE TABLE `vehicle` (
  `id` int NOT NULL AUTO_INCREMENT,
  `model` varchar(16) NOT NULL,
  `maker` varchar(16) NOT NULL,
  `fuel` varchar(8) NOT NULL,
  `type` varchar(9) NOT NULL,
  `customer_id` int NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `id_UNIQUE` (`id`),
  KEY `FK_customer_vehicle_idx` (`customer_id`),
  CONSTRAINT `FK_customer_vehicle` FOREIGN KEY (`customer_id`) REFERENCES `customer` (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=75 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
---
INSERT INTO booking (id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES (4,'ANNUAL_SERVICE',{ts '2020-07-05 00:00:00.'},'description test1','IN_SERVICE',14,51,null);
---
INSERT INTO booking (id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES (5,'ANNUAL_SERVICE',{ts '2020-07-05 00:00:00.'},'description test1','BOOKED',5,52,null);
---
```

```sql
INSERT INTO booking
(id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES
(6,'MAJOR_REPAIR',{ts '2020-08-07 00:00:00.'},'description
test6','BOOKED',6,56,null);
```

```sql
INSERT INTO booking
(id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES
(7,'REPAIR_FAULT',{ts '2020-07-18 00:00:00.'},'description
test6','CANCELED',7,51,null);
```

```sql
INSERT INTO booking
(id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES
(8,'ANNUAL_SERVICE',{ts '2020-08-07 00:00:00.'},'FIRST
BOOKING','BOOKED',6,38,1);
```

```sql
INSERT INTO booking
(id,type,appointment,description,status,staff_id,customer_id,vehicle_id) VALUES
(9,'MAJOR_SERVICE',{ts '2020-08-07 00:00:00.'},'SECOND
BOOKING','BOOKED',5,38,1);
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (1,'1-
xyzIE01','2020');
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (24,'1-
xyzIE24','2020');
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (25,'1-
xyzIE25','2020');
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (28,'1-
xyzIE28','2020');
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (29,'1-
xyzIE29','2020');
```

```sql
INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (30,'1-
xyzIE30','2020');
```

```
---

INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (36,'1-
xyzIE36','2020');

---

INSERT INTO car_licence (vehicle_id,licence_number,manufacture) VALUES (37,'1-
xyzIE37','2020');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(38,'1045814BA','0873654123','1045814BA@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(39,'1104581BC','0873654155','1104581BC@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(40,'0945814ZA','0873670123','0945814ZA@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(46,'abc001','00000001','test@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(47,'abc002','00000002','test2@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(48,'abc003','00000003','test2@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(51,'abc003','00000003','test2@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(52,'abc003','00000003','test2@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(53,'abc0053','000000053','test53@gmail.com');

---
```

```
INSERT INTO customer (id,ppsn,phone,email) VALUES
(56,'abc0056','00000003','abc0056@gmail.com');

---

INSERT INTO customer (id,ppsn,phone,email) VALUES
(57,'abc0057','00000003','abc0057@gmail.com');



---

INSERT INTO customer_name (customer_id,name,mid_name,surname) VALUES
(38,'Fabio','Marques','Pimentel');

---

INSERT INTO customer_name (customer_id,name,mid_name,surname) VALUES
(39,'Albert',null,'Einstein');

---

INSERT INTO customer_name (customer_id,name,mid_name,surname) VALUES
(40,'Leonardo','','da Vinci');

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(1,'test','test2','CUSTOMER',38,null);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(10,'Albert','Einstein','CUSTOMER',39,null);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(14,'Leonardo','DaVinci','CUSTOMER',40,null);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(21,'staff1','staff1','STAFF',null,5);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(22,'admin','admin','ADMIN',null,null);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(23,'staff2','staff2','STAFF',null,6);
```

```
---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(27,'staff3','staff3','STAFF',null,7);

---

INSERT INTO login (id,username,password,role,customer_id,staff_id) VALUES
(28,'staff4','staff4','STAFF',null,14);

---

INSERT INTO staff (id,ppsn,salary,is_available,service_counter) VALUES
(5,'staff01',1800.0,0,10);

---

INSERT INTO staff (id,ppsn,salary,is_available,service_counter) VALUES
(6,'abc006',1800.0,0,10);

---

INSERT INTO staff (id,ppsn,salary,is_available,service_counter) VALUES
(7,'abc007',1800.0,0,9);

---

INSERT INTO staff (id,ppsn,salary,is_available,service_counter) VALUES
(14,'ABC008',1800.0,0,9);

---

INSERT INTO staff_name (staff_id,name,mid_name,surname) VALUES
(5,'Staff1','','Staff Surname1');

---

INSERT INTO staff_name (staff_id,name,mid_name,surname) VALUES
(6,'Staff2','Mid Name 2','Staff Surname2');

---

INSERT INTO staff_name (staff_id,name,mid_name,surname) VALUES
(7,'Staff3',null,'Staff Surname3');

---

INSERT INTO staff_name (staff_id,name,mid_name,surname) VALUES
(14,'Staff4',null,'Staff Surname4');

---

INSERT INTO stock (id,name,quantity,date_in,date_out,unit_price,service_id)
VALUES (4,'Break oil',5,{ts '2020-07-06 00:00:00.'},null,10.0,null);

---
```

INSERT INTO stock (id,name,quantity,date_in,date_out,unit_price,service_id) VALUES (5,'Front Torch',5,{ts '2020-07-06 00:00:00.'},null,50.0,null);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (1,'A4','Audi','ELETRIC','CAR',38);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (23,'4.0','Wolks','ELETRIC','CAR',39);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (24,'Uno','Fiat','ELETRIC','CAR',40);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (25,'Uno','Fiat','ELETRIC','CAR',48);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (28,'Uno','Fiat','ELETRIC','CAR',51);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (29,'Uno','Fiat','ELETRIC','CAR',52);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (30,'Uno','Fiat','ELETRIC','CAR',53);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (36,'Compressor','BMW','PETROL','CAR',56);

INSERT INTO vehicle (id,model,maker,fuel,type,customer_id) VALUES (37,'Compressor','BMW','PETROL','CAR',57);

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