Senior Design Project

Analysis And Requirements Report

AGEAB

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Project Group No: T2332

Alp Tuğrul Ağçalı - 21801799

Asım Bilal Ak - 21802887

Gökberk Altıparmak - 21901798

Emrehan Hoşver - 21903488

Yüksel Berkay Erdem - 21801863

1. Introduction

Nowadays, with the development of technology, many sectors have emerged. These sectors provided employment for many employees, and one of these types of employment is being a driver. Companies establish their own fleets to handle transportation and delivery tasks, or in addition to these, companies that focus solely on these sectors are formed to facilitate the transportation and delivery tasks of other companies. The common goal of all companies with their own fleet is to provide employment to their drivers and therefore, to find quality drivers.

With the increasing number of vehicles, traffic is becoming a more dangerous place day by day. Features that make driving easier continue to increase with the development of technology, but unfortunately, this is not enough to prevent accidents. According to a study conducted at Indiana University, almost 93% of traffic accidents are caused by human error[1].

When it comes to the cost of traffic accidents, this situation becomes more frightening. Traffic accidents have devastating consequences for both life and property. In the study conducted by NETS (Network of Employers for Traffic Safety) regarding this situation, the total number of deaths and injuries of workers, their relatives, and bystanders in accidents caused by fleet workers in 2018 was 3,939,734, and 32,734 of these were fatal injuries. When we look at the financial part of the matter, the total cost of accidents reaches 72.2 billion dollars. [2]. This number is equal to 9.5 times the net profit of automobile giant Mercedes in 2018 ($7.6 billion) [3].

AGEAB's aim is for companies to improve the quality of their drivers by evaluating the drivers in their fleets and to get rid of these financial and moral burdens as much as possible. It is planned to do this with a small add-on installed on the vehicle, and thanks to this add-on, the instant data of the drivers will be transferred to the database. Using this data, the ideal driving will be tried to be calculated, and finally, the aim will be to evaluate how close or how far the employees are driving to these standards.

2. Current System

A few firms in the market do similar tasks as we want, such as Arvento, Filo Sistem, and Shell. Even though there is a similarity, our design choices and implementation details make us competitive among those firms.

Arvento offers vehicle tracking, current traffic data, beginning and ending points of the travel, and real-time vehicle tracking [4]. They gather data from GPS/GSM and CAN [4]. Filo Sistem offers live speed, location, fuel consumption data, and regulation violation alerts. Filo Sistem gathers data from CAN[5]. Shell offers live location, fuel consumption data, alerts when there is a risky movement in the car and live speed. Shell collects data from CAN as well [6]. Companies above provide websites and mobile applications to their customers. Our solution will provide customers with live data, live speed, route information, driver vehicle appointments, and driver profiling. We believe driver vehicle appointments and profiling options make us competitive among the firms above.

3. Proposed System

3.1 Overview

The solution of the project, as mentioned in the previous section, is to create driving profiles of the drivers and enable fleet owner companies to have detailed information about their drivers. In addition, providing the live locations of the drivers to the employer is one of the features of this project. In this way, employers will be able to access both the driving profiles and current locations of their employees. By using ready-made modules that assist GSM/GPRS signals and measure acceleration/inclination/G force together with Ardunio, AGEAB aims to obtain the necessary information about driving from the embedded system and establish the necessary connections with the remote computer to send this information to the data processing stage. The received driving information will be analyzed and classified by artificial intelligence algorithms on the remote computer. The new driving analysis will be used in the artificial intelligence algorithm training phase to be used in later analysis, thus making the online learning cycle continuous. Analysis results will be included in the database to be displayed in the mobile application. Past driving and current driving information analyzed as a result of the processed data can be followed by the user with the mobile application we will develop. More than one vehicle and driving information will be observed

simultaneously on a single screen.

3.2 Functional Requirements

3.2.1 Employer Specific Requirements

- Employers have to create an account with the email and password.
- Employers should have the device that we will provide inside their vehicle.
- Employers should allow AGEAB applications to keep track of their vehicles on maps, both in real time and for the history of locations.
- Employers are able to see vehicles on application with their brand and model.
- Employers are able to see who uses their vehicles.
- Employers are able to see employees' performance on the road with various rankings such as good driver, normal driver, and bad driver.
- Employers are able to add and remove employees from AGEAB applications.
- Employers are able to add and remove vehicles.
- Employers will be able to see their vehicles all live from one map
- Employers are able to assign a car to their employees.
- Employers will be able to authorize individuals for specific roles.

3.2.2 System Specific Requirements

- The system should always keep track of vehicles.
- The Arduino device should send data via the SIM7600 GSM module to our server which comes from modules such as GPS and accelerometers which measure G-Force.
- The data that is coming from the Arduino should be processed on the server.
- The server should label the employees depending on their driving habits.
- The server should send the location of the driver to the application in real time.
- The history of the data which is coming from employees driving actions, is stored within the application to determine the habits of drivers. It is done based on ML algorithms.
- The system should warn employers when extreme situations occur, such as accidents and exceeding a certain amount of limits.

- The system should label the employees depending on corner, acceleration, braking, and bump performance.
- The Arduino device and modules should survive extreme conditions in Turkey, such as hot temperatures, cold temperatures, and vibration.
- Arduino devices and modules should be easily assembled to make vehicles because vehicles can be changed.

3.3 Non-Functional Requirements

3.3.1 Usability

3.3.1.1 User-Friendly Interface: The application should feature an intuitive, easy-to-navigate interface for employers to monitor vehicles, view employee performance, and manage vehicle assignments.

3.3.1.2 Accessibility: The application should be accessible on multiple platforms, including mobile and desktop, ensuring employers can access information anytime, anywhere.

3.3.1.3 Customizable Dashboards: Employers should have the ability to customize their dashboards to focus on metrics most relevant to their needs.

3.3.1.4 Multi-Language Support: Considering the diverse linguistic backgrounds in Turkey, the application should support multiple languages for wider accessibility.

3.3.2 Reliability

3.3.2.1 Data Accuracy: The system must provide highly accurate tracking and performance data to ensure employers can make informed decisions.

3.3.2.2 Robust Data Processing: The server must reliably process data from the Arduino device, ensuring consistent labeling of employee driving habits.

3.3.2.3 System Uptime: High system uptime is crucial, with minimal downtime for maintenance or updates to ensure continuous vehicle tracking.

3.3.2.4 Emergency Alert Reliability: The system should reliably detect and alert employers about extreme situations like accidents or limit breaches.

3.3.3 Performance

3.3.3.1 Real-Time Data Processing: The server should process and relay data (location, driving behavior) in real-time without significant lag.

3.3.3.2 Efficient ML Algorithms: Machine learning algorithms used for driver habit analysis should be efficient, minimizing processing time and resource usage.

3.3.3.3 Scalable Data Handling: The system should handle increasing volumes of data as more vehicles and employees are added without degradation in performance.

3.3.4 Supportability

3.3.4.1 Technical Support: Provide robust technical support for employers to address issues related to application usage or device malfunctions.

3.3.4.2 Documentation and Training: Offer comprehensive documentation and training materials to help employers understand and effectively use the system.

3.3.4.3 Regular Updates: Ensure the system, including the application and server software, receives regular updates for enhanced functionality and security.

3.3.5 Scalability

3.3.5.1 Modular Design: The system should be designed in a modular fashion, allowing for easy scaling as the number of users and vehicles increases.

3.3.5.2 Flexible Vehicle Integration: The Arduino device and modules should be designed to integrate easily with different types of vehicles to accommodate fleet diversification.

3.3.5.3 Cloud Infrastructure: Utilize cloud-based infrastructure to facilitate easy scaling of data storage and processing capabilities.

3.4 Pseudo Requirements

Based on the user interfaces provided in the images, we can deduce a set of pseudo requirements for the system. These are high-level requirements that outline the expected functionality of the application:

3.4.1 User Authentication:

- The system shall allow users to register by providing a username, password, and email address.
- The system shall allow registered users to log in using their username and password.
- The system shall provide users with options to recover forgotten passwords and usernames.

3.4.2 Driver Management:

- The system shall allow administrators to add new drivers by entering their full name, date of birth, and driver's license information.
- The system shall allow administrators to upload a photo/avatar for each driver.
- The system shall display the current active status of drivers (active/inactive).

3.4.3 Vehicle Management:

- The system shall display a list of all vehicles along with their active status.
- The system shall allow administrators to add and remove vehicles from the fleet.

3.4.4 Performance Monitoring:

- The system shall track and record drivers' performance based on categories such as curve handling, acceleration, braking, and response to bumps.
- The system shall allow users to view detailed reports on each category by clicking a "Click For Details" link.
- The system shall flag any poor performance categories in red for easy identification.

3.4.5 Incident Reporting:

- The system shall record any illegal moves made by a driver and display the last incident's type and location.
- The system shall integrate with Google Maps to visualize the location of any incidents or the current location of the vehicle.

3.4.6 Real-Time Location Tracking:

- The system shall provide a "Current Location" feature to display the real-time location of the vehicle using Google Maps when the driver is active.
- The system shall update the vehicle's location in real-time or at specified intervals.

3.4.7 Navigation and Accessibility:

- The system shall offer a navigation menu accessible through a hamburger icon to access different sections of the application.
- The system shall provide a user interface that is easy to navigate and use on mobile devices.

3.4.8 Data Privacy and Security:

- The system shall ensure the confidentiality of drivers' personal information and driving performance data.
- The system shall use secure methods for storing and transmitting data.

3.4.9 Notification System:

- The system may provide notifications to administrators regarding driver status changes, new incidents, or performance alerts.

3.5 System Models

3.5.1 Scenarios

Scenario 1

Use Case Name: CreateAccount

Actors: Company Official

Entry Conditions: The user is on the Login Page

Exit Conditions: The user is on the Welcome Page

Main Flow of Events:

1. The user taps on the "Register" button on the screen.
2. The application navigates the user to the Register Page.
3. The user enters his username.
4. The user enters his password.
5. The user enters his email address.
6. The software checks the existence of the username on the database.
7. The software checks the existence of the email on the database.
    a. The user clicks the register button
8. The software creates a new account by using the information entered.
9. The application navigates the user to the Home Page.

Scenario 2

Use Case Name: LoginAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Login Page

Exit Conditions: The user is on the Welcome Page

Main Flow of Events:

1. The user taps on the "Login" button on the screen.
2. The application navigates the user to the Login Page.
3. The user enters his username.

4. The user enters his password.

5. The software checks the match of the username and password on the database.

6. The application navigates the user to the Home Page.

Scenario 3

Use Case Name: SeeCurrentVehicleLocationAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "All Vehicles" button on the screen.

2. The software gets the vehicle information which is related to the company.

    a. The software accesses the model names of the vehicles.

    b. The software accesses the status of the vehicles (active or not).

3. The user taps on one of the active vehicles.

4. The software gets the vehicle location information.

5. The application navigates the user to the Vehicle Details Page.

6. The application shows the vehicle location on the map on the page.

7. The user taps the "Back" button.

8. The application navigates the user back to the Home Page.

Scenario 4

Use Case Name: AddVehicleAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Add Vehicle Page

Main Flow of Events:

1. The user taps on the "Add Vehicle" button on the Home Page.

2. The application navigates the user to the Add Vehicle Page.

3. The user enters the model name of the vehicle.

4. The user enters the year of production of the vehicle.

5. The user enters the plate of the vehicle.

6. The user taps on the "Add" button.

    a. The software sends the vehicle information and company information to the database.

7. The application navigates the user back to the Home Page.

Scenario 5

Use Case Name: SeeVehicleDetailsAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "All Vehicles" button on the screen.

2. The software gets the vehicle information which is related to the company.

    a. The software accesses the model names of the vehicles.

    b. The software accesses the status of the vehicles (active or not).

3. The user taps on one of the vehicles.

4. The application navigates the user to the Vehicle Details Page.

5. The application gets extra information about the vehicle.

    a. The software gets the driver name, if the vehicle is active.

    b. The software gets the location information, if the vehicle is active.

6. The application shows the information about the vehicle in related areas on the screen.

7. The user taps on the "Back" button.

8. The application navigates the user back to the Home Page.

Scenario 6

Use Case Name: RemoveVehicleAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "All Vehicles" button on the screen.

2. The software gets the vehicle information which is related to the company.

    a. The software accesses the model names of the vehicles.

    b. The software accesses the status of the vehicles (active or not).

3. The user taps on one of the vehicles.

4. The application navigates the user to the Vehicle Details Page.

5. The user clicks on the "Remove" Button.

    a. A dialog box is shown to get confirmation from the user.

6. The software deletes the vehicle information from the database.

7. The application navigates the user back to the Home Page.

Scenario 7

Use Case Name: EditVehicleInformationAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Vehicle Details Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "Edit" button on the screen.

2. The user begins to edit the information about the vehicle.

    a. The user changes the model name of the vehicle.

    b. The user changes the year of production of the vehicle.

    c. The user changes the plate of the vehicle.

3. The user taps on the "Done" button on the screen.

    a. The software sends the new vehicle information and company information to the database.

4. The user clicks on the "Back" button.

5. The application navigates the user back to the Home Page.

Scenario 8

Use Case Name: SeeDriverOfVehicleAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "All Vehicles" button on the screen.
2. The software gets the vehicle information which is related to the company.
   a. The software accesses the model names of the vehicles.
   b. The software accesses the status of the vehicles (active or not).
3. The user taps on one of the active vehicles.
4. The application navigates the user to the Vehicle Details Page.
5. The application gets extra information about the vehicle.
   a. The software gets the driver name.
6. The application shows the name of the driver on the top of the screen.
7. The user taps on the "Back" button.
8. The application navigates the user back to the Home Page.

Scenario 9

Use Case Name: SeeDriverProfileOfEmployee

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Driver Profile Page

Main Flow of Events:

1. The user taps on the "All Drivers" button on the screen.
2. The software gets the drivers information from the database:
   a. The software accesses the name of the driver.
   b. The software accesses the status of the driver (active or not).
3. The user taps on one of the drivers.
   a. The software accesses the average drive score of the driver.
   b. The software accesses the detailed drive score of the driver.
   c. The software accesses the last location that the driver moves illegally.
   d. The software accesses the current location of the driver, if available.
   e. The software accesses the profile picture of the driver.
4. The application navigates the user to the Driver Profile Page.
5. The application shows the information about the driver in related areas.
6. The user taps on the "Back" button.
7. The application navigates the user back to the Home Page.

Scenario 10

Use Case Name: AssignVehicleAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Vehicle Details Page

Exit Conditions: The user is on the Vehicle Details Page

Main Flow of Events:

1. The user taps on the "All Vehicles" button on the screen.
2. The software gets the vehicle information which is related to the company.
    a. The software accesses the model names of the vehicles.
    b. The software accesses the status of the vehicles (active or not).
3. The user taps on one of the inactive vehicles.
4. The application navigates the user to the Vehicle Details Page.
5. The user taps on the "Assign Driver" button.
    a. The software gets the drivers available in the company.
6. The application shows the driver list with the drivers' names and average drive score on a dialog box.
7. The user taps on one of the "Assign" buttons which is located on the right side of the drivers' name.
    a. The software sends information about the selected driver and the vehicle to the database.
    b. The software matches the driver and the vehicle on the database.
8. The dialog box is closed.
9. The user taps on the "Back" button.
10. The application navigates the user back to the Home Page.

Scenario 11

Use Case Name: AddEmployeeAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Add Employee Page

Main Flow of Events:

1. The user taps on the "Add Driver" button on the Home Page.

2. The application navigates the user to the Add Driver Page.

3. The user enters the name of the driver.

4. The user enters the age of the driver.

5. The user uploads the profile picture of the driver.

6. The user taps on the "Add" button.

    a. The software sends the driver information and company information to the database.

7. The application navigates the user back to the Home Page.

Scenario 12

Use Case Name: EditEmployeeInformationAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Driver Profile Page

Exit Conditions: The user is on the Driver Profile Page

Main Flow of Events:

1. The user taps on the "Edit" button on the screen.

2. The user begins to edit the information about the driver.

    a. The user changes the name of the driver.

    b. The user changes the age of the driver.

    c. The user uploads the new profile picture of the driver.

3. The user taps on the "Done" button on the screen.

    a. The software sends the new driver information to the database.

4. The user clicks on the "Back" button.

5. The application navigates the user back to the Home Page.

Scenario 13

Use Case Name: RemoveEmployeeAsCompanyOfficial

Actors: Company Official

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Driver Profile Page

Main Flow of Events:

1. The user taps on the "All Drivers" button on the screen.

2. The software gets the drivers information from the database:

     a. The software accesses the name of the driver.

     b. The software accesses the status of the driver (active or not).

3. The user taps on one of the drivers.

     a. The software accesses the average drive score of the driver.

     b. The software accesses the detailed drive score of the driver.

     c. The software accesses the profile picture of the driver.

4. The application navigates the user to the Driver Profile Page.

5. The user clicks on the "Remove" Button.

6. A dialog box is shown to get confirmation from the user.

7. The software deletes the driver information from the database.

8. The application navigates the user back to the Home Page.

Scenario 14

Use Case Name: SeeOwnProfileAsCompanyEmployee

Actors: Company Employee

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Driver Profile Page

Main Flow of Events:

1. The user taps on the "My Profile" button on the screen.

2. The software gets the drivers information from the database:

     a. The software accesses the name of the driver.

     b. The software accesses the status of the driver (active or not).

     c. The software accesses the average drive score of the driver.

     d. The software accesses the detailed drive score of the driver.

     e. The software accesses the last location that the driver moves illegally.

     f. The software accesses the current location of the driver, if available.

     g. The software accesses the profile picture of the driver.

3. The application navigates the user to the Driver Profile Page.

4. The application shows the employee information in related areas.

5. The user taps on the "Back" Button.

6. The application navigates the user back to the Home Page.

Scenario 15

Use Case Name: SeeAssignedVehicleAsCompanyEmployee

Actors: Company Employee

Entry Conditions: The user is on the Home Page

Exit Conditions: The user is on the Assigned Vehicle Page

Main Flow of Events:

1. The user taps on the "Assigned Vehicle" button on the screen.

2. The software finds the assigned vehicle to the employee on the database, if the employee is assigned.

3. The software gets the vehicle information from the database:

    a. The software gets the model name of the vehicle.

    b. The software gets the year of production of the vehicle.

    c. The software is the plate of the vehicle.

4. The application navigates the user to the Assigned Vehicle Page.

5. The application shows the vehicle information in related areas.

6. The user taps on the "Back" Button.

7. The application navigates the user back to the Home Page.

3.5.2 Object And Class Diagram
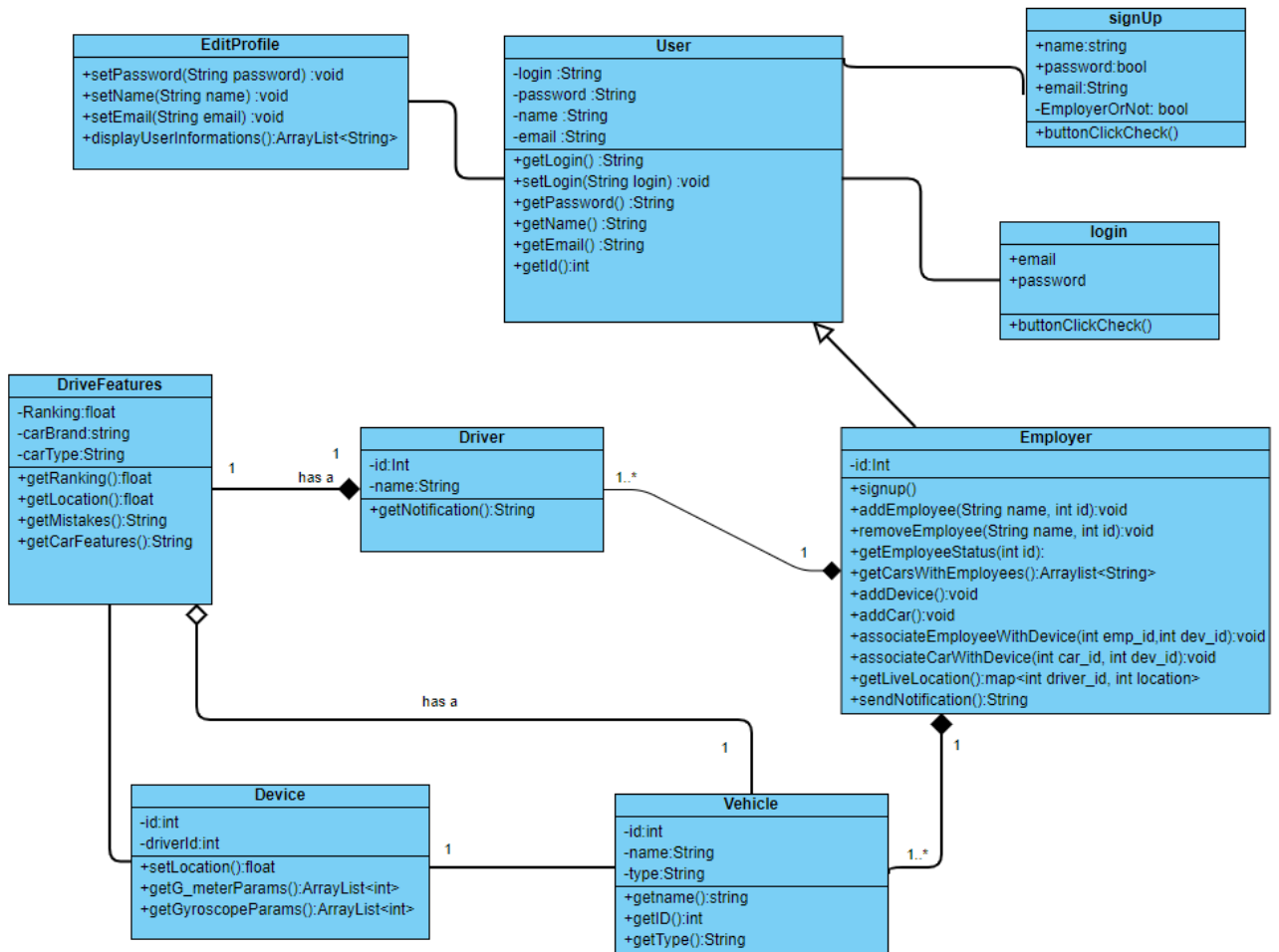
Explanation Of Object And Class Model:

User Class: Represents a user with operations related to login and sign up. It contains attributes such as login credentials and personal information.

EditProfile Class: Allows a user to modify their profile information, like password, name, and email. It can also display user information.

Driver Class: It is the property of the employer. It has additional attributes and operations specific to a driver, such as getting notifications.

DriveFeatures Class: Contains information and operations related to the driving features, like car brand, car type, and retrieving various car-related statistics and information.

Device Class: Represents a tracking device with attributes like device ID and driver ID, and operations for setting location and getting gyroscope parameters.

Vehicle Class: Contains details about a vehicle, with operations to retrieve the vehicle's name, type, and other features.

Employer Class: Represents an employer and contains methods to manage employees and their associated vehicles, including adding or removing employees, adding devices to the system, and associating cars with devices.

3.5.3 Use-Case Model
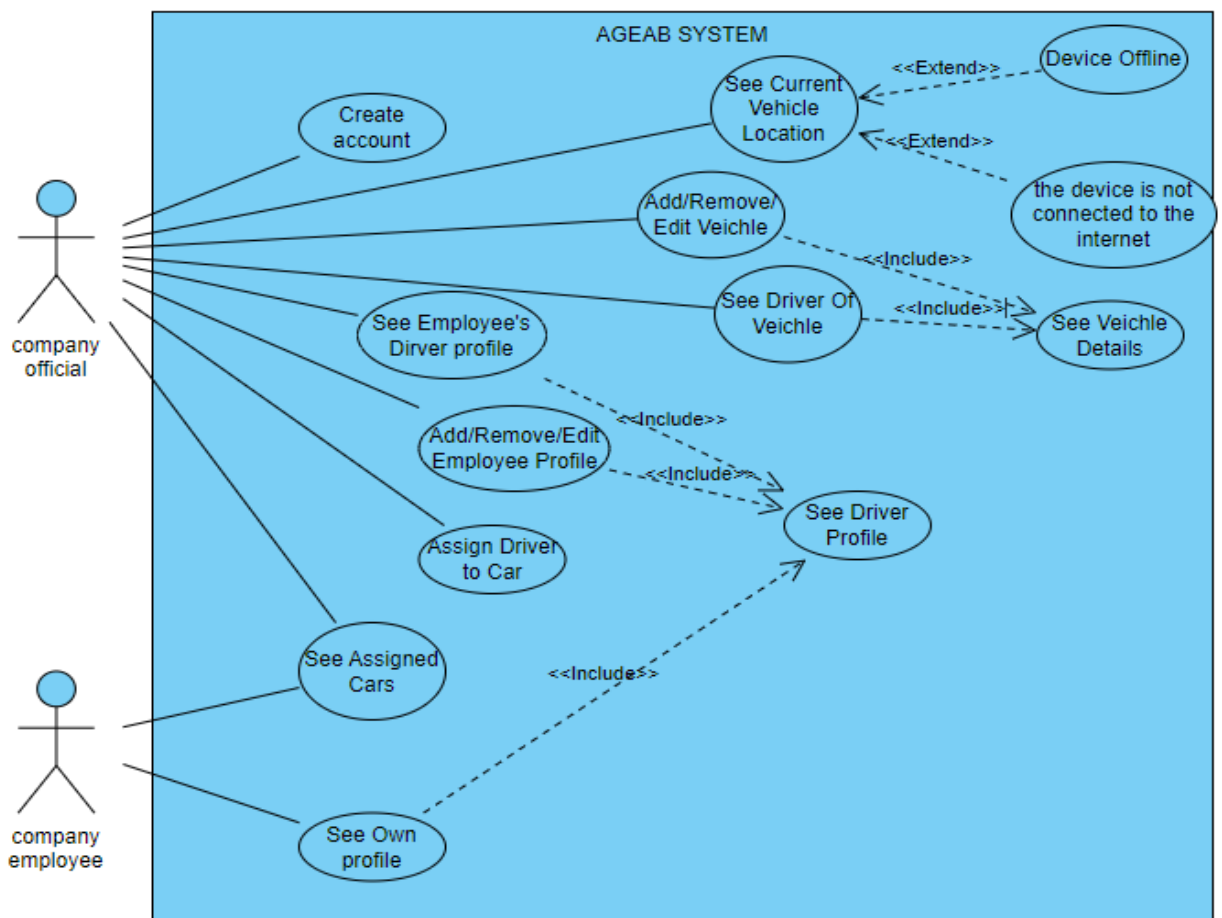
Actors: Company Official and Company Employee

Use-Cases:

For Company Official:

- Create Account
- See Vehicle (Driver) Location
- Add/Remove/Edit Vehicle
- See Driver of Vehicle
- See Employee's driver profile
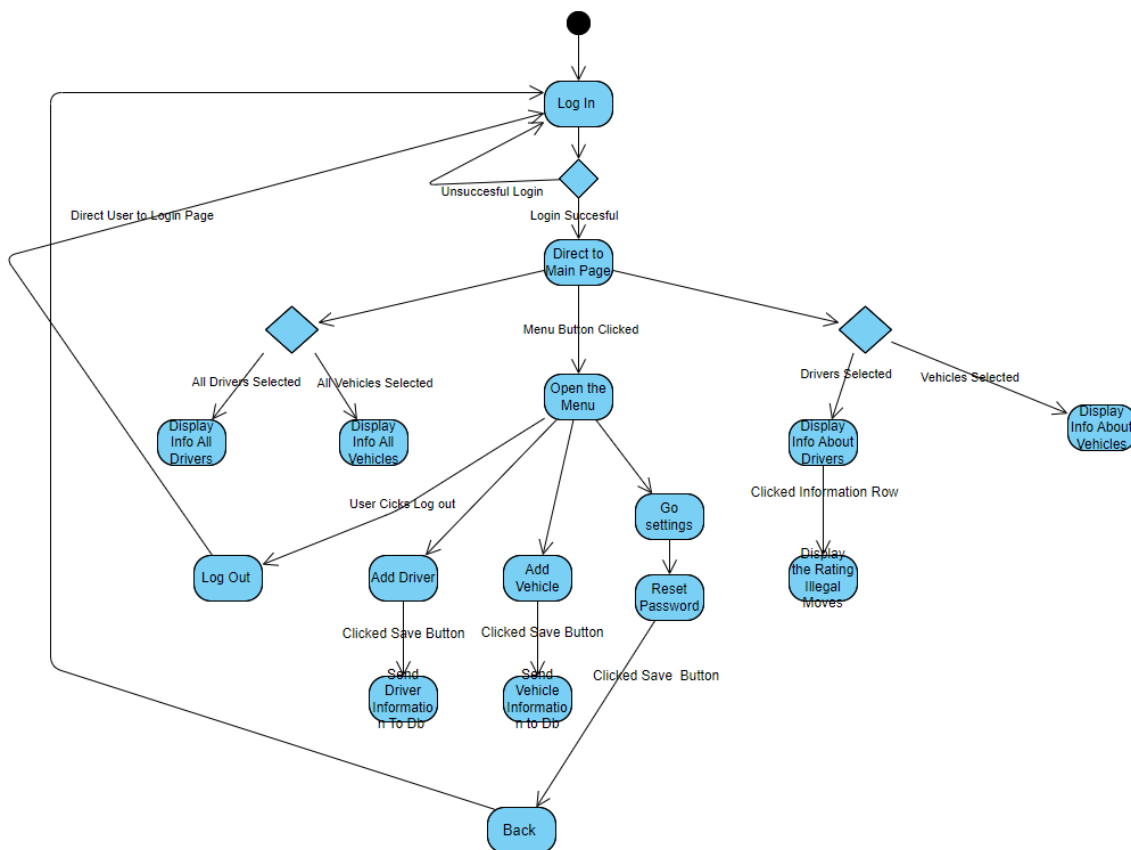- Add/Remove/Edit Employee

For Company Employee:

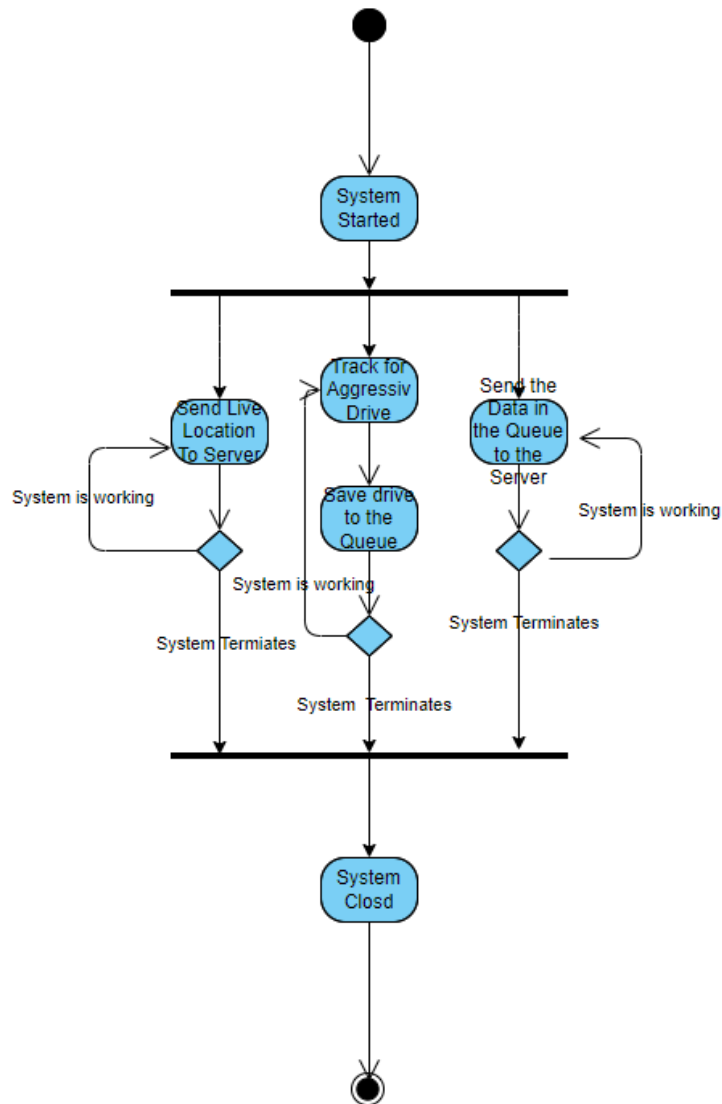- See Own driver Profile

For Both Actors:

- See assigned cars

3.5.4 Dynamic Models

3.5.4.1 Mobile Application Activity Diagram

3.5.4.2 Embedded System Activity Diagram

3.5.5 User Interfaces

3.5.5.1 Login Page
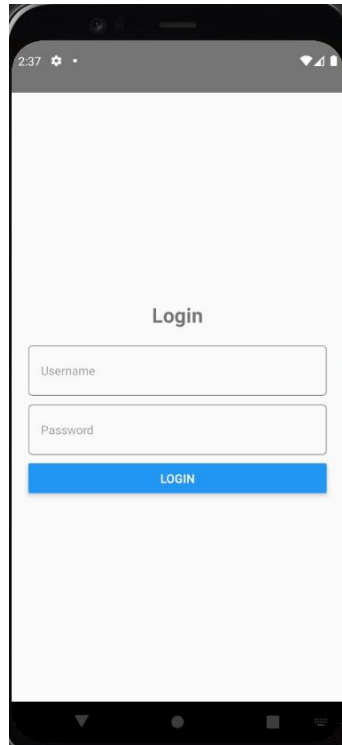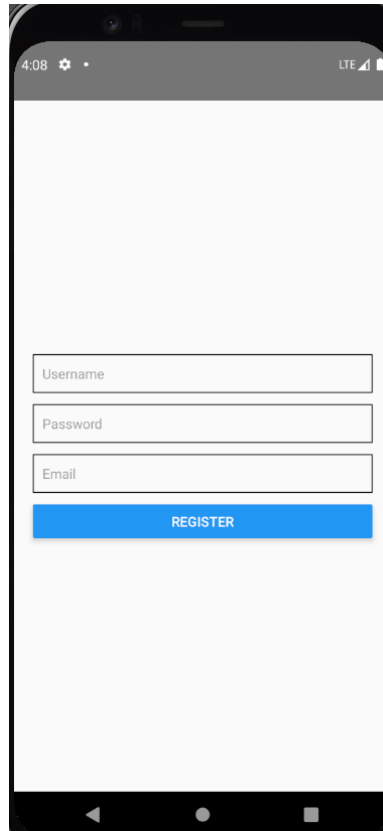
3.5.5.1.1 Username Field: There is a field labeled "Username." This is a text input field where users are expected to enter their unique username or possibly their email address associated with their account.

3.5.5.1.2 Password Field: Following the username field is the "Password" field. This is a secure text input designed to hide the characters as the user types for privacy and security. Users must enter the password that corresponds to their username here.

3.5.5.1.3 Login Button: Below the password input field, there is a large blue button labeled "LOGIN." This is a call-to-action button that users press to initiate the login process after they have entered their username and password.

3.5.5.2 Register Page
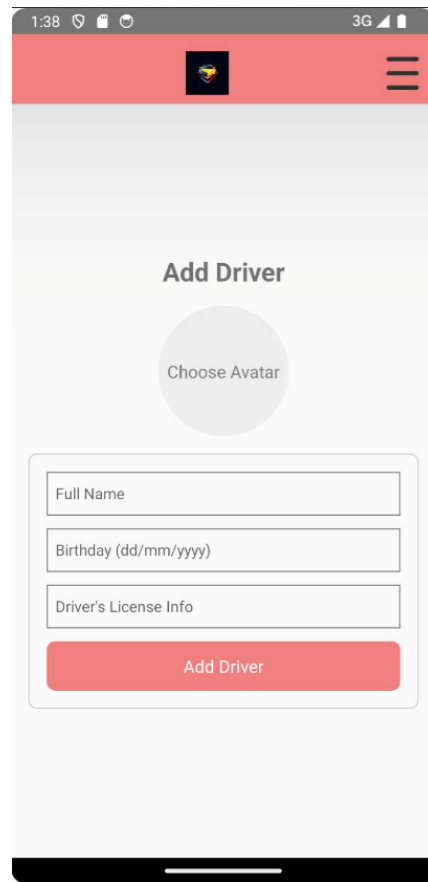
      3.5.5.2.1. Username Field: The first input field is labeled "Username". This is where new users will enter their desired username, which will be used to uniquely identify them on the platform.

      3.5.5.2.2. Password Field: The next input field is labeled "Password". Users are expected to enter a secure password that they will use to protect their account. The field should mask the input for privacy.

      3.5.5.2.3. Email Field: The third input field is labeled "Email". This is where users will enter their email address, which the platform will likely use for account verification and communication purposes.

      3.5.5.2.4. Register Button: At the bottom, there is a blue button labeled "REGISTER". This is the action button that the user will press after filling in their details to submit the registration form and create their new account.

3.5.5.3 Add Driver Page

3.5.5.3.1. Header Area: The top of the page has a header with a salmon-colored background. It features a logo on the left, which is the identifying mark of the application. On the right, there's a hamburger menu icon, suggesting that users can tap this to navigate to other parts of the application.

3.5.5.3.2. Title: The title "Add Driver" is prominently displayed, indicating that this page is used to enter information for a new driver into the system.

3.5.5.3.3. Choose Avatar: Below the title, there is a circular placeholder with the text "Choose Avatar." Users can tap here to upload or select a profile picture for the driver.

3.5.5.3.4. Full Name Field: The first text input field is labeled "Full Name". Here, users are expected to enter the driver's full legal name.

3.5.5.3.5. Birthday Field: The next field is for the "Birthday" where the expected format is denoted in parentheses (dd/mm/yyyy). Users should enter the driver's date of birth here.

3.5.5.3.6. Driver's License Info Field: Following that is a field labeled "Driver's License Info". In this field, users are meant to enter pertinent information regarding the driver's license, such as the license number and issuing state or country.

3.5.5.3.7. Add Driver Button: At the bottom, there's a red button labeled "Add Driver". After the above fields are filled in, clicking this button would presumably add the driver's information to the system.

3.5.5.4 Home Page

3.5.5.4.1 All Vehicles
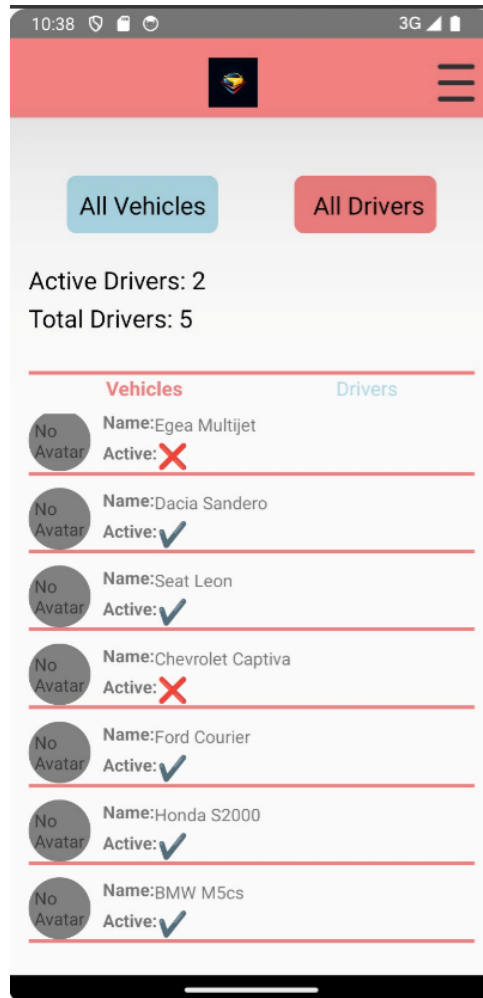
    3.5.5.4.1.1. Header Area: At the top, there is a header with a logo on the left-hand side, indicating the branding of the app. On the right, there is a hamburger menu icon, which users can tap to navigate to different parts of the app. The background color of the header is salmon, matching the general color scheme of the app.

    3.5.5.4.1.2. Navigation Tabs: Below the header, there are two tabs: "All Vehicles" and "All Drivers." The "All Vehicles" tab is highlighted, indicating that it is the currently selected view. Users can switch to the "All Drivers" section by tapping the other tab.

3.5.5.4.1.3. Status Summary: Directly beneath the tabs, there is a summary indicating "Active Drivers: 2" and "Total Drivers: 5". This provides a quick statistical snapshot to the user about the number of active versus total drivers. This part would be updated to reflect vehicles in the "All Vehicles" view.

3.5.5.4.1.4. List of Vehicles: The main content area lists vehicles. Each list item includes:

- **Avatar Placeholder**: A circle with "No Avatar" text, indicating where a photo or avatar of the vehicle could be displayed once added.

- **Vehicle Name:** The name of the vehicle (e.g., "Egea Multijet", "Dacia Sandero") is clearly listed. This is presumably the model or the designation used within the fleet for identification purposes.

- **Active Status:** Each vehicle entry has an "Active" status denoted by a tick (✔) or cross (✗) mark. A tick likely indicates that the vehicle is currently active or in service, while a cross might mean the vehicle is inactive, out of service, or under maintenance.

3.5.5.4.1.5. Divider Lines: Each vehicle entry is separated by a horizontal line, providing clear visual separation between the entries and improving readability.

3.5.5.4.2 All Drivers
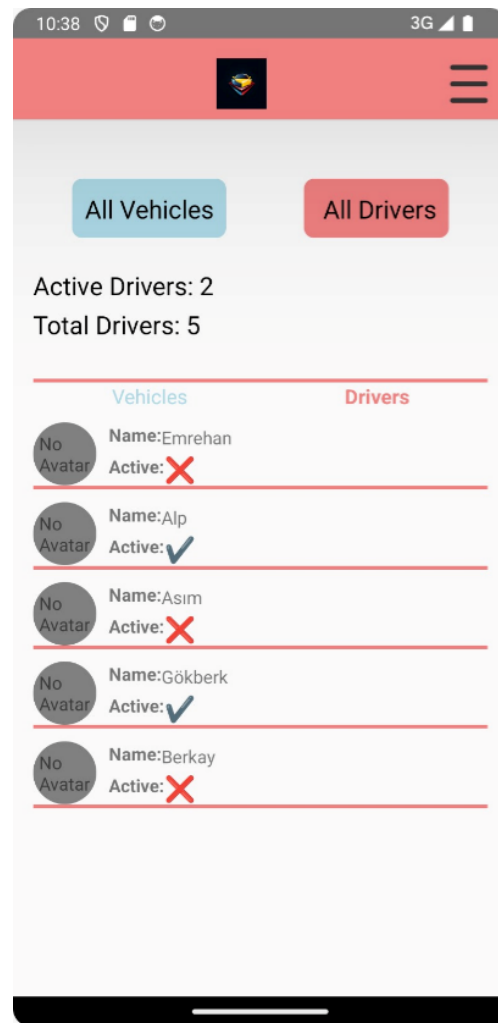
3.5.5.4.2.1. Header Area: The header remains consistent with the branding logo on the left and a hamburger menu icon on the right, with a salmon-colored background.

3.5.5.4.2.2. Navigation Tabs: There are two tabs at the top: "All Vehicles" and "All Drivers." Since the "All Vehicles" tab is currently active, the "All Drivers" tab would be activated when viewing the driver information.

3.5.5.4.2.3. Driver Status Summary: The section starts with a summary stating "Active Drivers: 2" and "Total Drivers: 5", which provides a quick statistical overview of the driver count, similar to the "All Vehicles" view.

3.5.5.4.2.4. Driver List: The main portion lists individual drivers, with each entry including:

    - Avatar Placeholder: A grey circle labeled "No Avatar", which would be where a driver's photo or avatar can be uploaded.

    - Driver Name: The name of the driver is listed (e.g., "Emrehan", "Alp"). This is the personal name of the driver and serves as their identifier in the system.

    - Active Status: Accompanying each driver's name is an "Active" status, indicated by either a red cross (✗) or a green check (✓). The check presumably signifies that the driver is currently active and available for duties, while the cross indicates they are not active at the moment.

3.5.5.4.2.5. Dividers: Red horizontal lines separate each driver entry, helping to distinguish between individual driver details.

3.5.5.5 User Profile
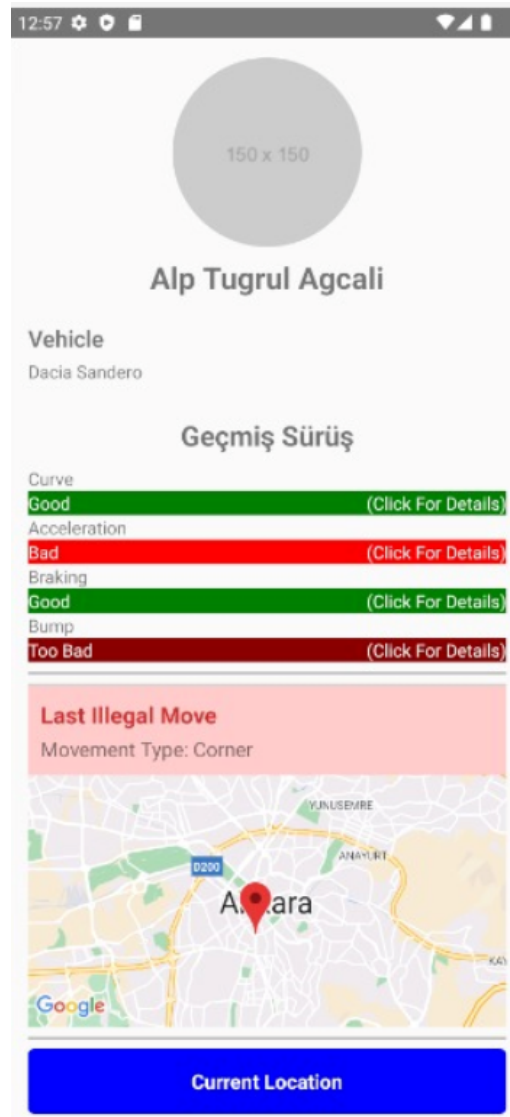
       3.5.5.5.1. Profile Photo Placeholder: At the top, there is a circular placeholder for a profile photo, with dimensions specified as "150 x 150", suggesting that a user can upload an image of these dimensions.

       3.5.5.5.2. Driver's Name: Below the photo placeholder is the name "Alp Tugrul Agcali," which identifies the driver whose profile is being displayed.

       3.5.5.5.3. Vehicle Information: Beneath the name, the vehicle associated with the driver is listed, in this case, "Dacia Sandero".

3.5.5.5.4. Past Driving Performance: This section translates to "Past Driving" and contains a list of driving performance categories, each with an evaluation:

- **Curve:** Evaluated as "Good"
- **Acceleration:** Evaluated as "Bad", highlighted in red
- **Braking:** Evaluated as "Good"
- **Bump:** Evaluated as "Too Bad", also highlighted in red

Next to each category is a "Click For Details" link, suggesting users can tap to get more detailed information on each performance aspect.

3.5.5.5.5. Last Illegal Move: This section shows the most recent illegal maneuver, labeled "Movement Type: Corner", which indicates the type of infraction.

3.5.5.5.6. Map Display: Below the "Last Illegal Move" section, there's an embedded Google Maps display, presumably showing the location where the last illegal movement occurred, marked with a red 'A' pin.

3.5.5.5.7. Current Location Button: At the bottom of the screen, there's a button labeled "Current Location". This implies that when the user presses this button, if the driver is currently active (driving the vehicle), the application will display the car's current location on Google Maps.

4. Other Analysis Elements

4.1 Consideration of Various Factors in Engineering Design

4.1.1 Constraints

Ergonomics: The product can be placed in more than one vehicle or can be moved from one vehicle to another if desired. At the same time, it can optionally be placed in more than one place in the vehicle. For this reason, only the necessary modules should be used in the product, and these modules should be as close to each other as possible and as small as possible in total volume. At the same time, if the product is placed in the vehicle, it should not block the driver's view. For these reasons, being as light, small and portable as possible is one of the things that should be considered as a priority.

Cost: The product contains more than one ingredient. These components have separate functions, and considering the requirements of these components for the final functions of the product, the need for budget adjustment has emerged. Performance criteria should also be taken into consideration when adjusting the budget. As a result of the research, purchasing components that provide sufficient efficiency in terms of performance and are most affordable in terms of price is very important in terms of the budget limits of the project.

Sustainability: The product must also be able to work on long journeys, at high temperatures and in situations where it is exposed to high acceleration. In addition to working in predictable situations, it should also be developed to be resistant to extreme and unpredictable conditions. Apart from the predictable features of the car, the car must also be suitable for the driving performed by the driver and should not be damaged in the process.

Effects of the factors: Since any intervention beyond the driver's initiative poses a danger to driving safety and life safety, the product should not have any impact on the driving experience. Additionally, since the product can be placed in a variety of locations, it should not pose any safety concerns when placed close to the engine, vehicle circuits or fuel tank. For this reason, the outer box of the product must be resistant to environmental factors. The product placed in the vehicle must be capable of providing a large number of data transfers.

For this reason, it was decided to use 3G or 4G as the GSM module. Thus, the internet speed will enable data transfer to work with high performance. In addition, the measurement frequency of the sensors placed on the product will be divided into certain intervals in order not to reduce the overall performance of the product and to avoid unnecessary measurements. The usage area of the product to be developed should not be restricted. Companies may want to measure for different vehicle types. For this reason, the product to be developed must be able to work independently of any vehicle model or brand. In this way, it should be possible to serve more than one vehicle model and brand with one product type. In addition to the hardware part, the software to be developed must be compatible with all smartphones.

Table 1: Factors that can affect analysis and design.

	Effect level	Effect
Public health	8	Any harmful (radioactive etc.) module should not be used.
Public safety	10	Any module that causes damage to the vehicle should not be used.
Public welfare	6	The production should be beneficial for the user.
Global factors	6	The product should be able to be used for various of the vehicle categories and models.
Cultural factors	0	
Social factors	0	
Environmental factors	5	The modules that cause damage to the environment should not be used.
Economic factors	7	The cost of the production should be as low as possible.

4.1.2 Standards

- The UML 2.5.1 is used for modelling.
- Android Studio Iguana 01.02.2023 for developing android application
- Xcode 15.1 is used for developing IOS application

4.2 Risks and Alternatives

Since the product will travel in vehicles during use, it may face some risks. Situations where the internet does not work are one of these risks. Since our product will transmit driving and vehicle information over the internet via the GSM module, information transfer to the remote server will be interrupted in cases where there is no internet. As an alternative to this situation, if the data we transfer from the internet is interrupted, our module will save the data that cannot be transferred within itself and will share the data recorded with our remote server when the internet connection is restored. Thanks to this alternative plan, there will be no data loss in cases where the internet connection is interrupted. One of the problems that may occur is the signal of the GPRS module being interrupted. In such cases, the last location information received will be shared with the user and the estimated location of the vehicle will be displayed on the application. The product will return to its previous operation as soon as the GPRS signal is activated. Another risk is the possibility of damage to the product in case of vehicle accident. In such cases, since the last information sent by the product contains abnormal data, our software will detect the possibility of the vehicle having an accident and the user will be informed.

Table 2: Risks

	Likelihood (out of 10)	Effect on the project	B Plan Summary
Risk of the Internet Connection	4	The driving information transfer may be stopped.	The information which cannot be transferred to the servers will be stored on local storage.
Risk of the GPRS Connection	3	The location information may not be available.	The last location information will be shared with the estimated location information.
Risk of Car Crashes	7	The software must understand crashes to inform the user.	The software automatically checks the abnormal data to understand if there is a crash or not.

4.3 Project Plan

Table 3: List of work packages

WP#	Work package title	Leader	Members involved
WP1	Academic Literature Review	Gökberk	All Team
WP2	Determining the Functions of the Product	Asım	All Team
WP3	Market Competitor Analysis	Asım	Alp and Emrehan
WP4	Research and Determination of Methods and Tools	Emrehan	All Team

WP5	Mobile Application Development	Gökberk	All Team
WP6	Data Collection of Artificial Intelligence Model	Alp	Asım and Berkay
WP7	Training of the AI Model	Berkay	Alp, Gökberk and Emrehan
WP8	Model Testing and Improvement	Alp	Berkay, Asım and Emrehan
WP9	Product Testing and Improvement	Emrehan	All Team

WP 1: Academic Literature Review			
Start date: *06.10.2023* **End date:** *30.11.2023*			
Leader :	*Gökberk*	**Members involved:**	*All Team*
Objectives: The main objective of this work package is researching previous works about the problems that our project presents solutions to.			
Tasks: *Task 1 Researching similar problems* **:** *Researching the problems about driving profile can be seen in the world.* *Task 2 Researching the solutions to the found problems* **:** *Researching the academic solutions about classifying the driving profile.* *Task 3 Researching the solutions based on AI* **:** *Researching the academic solutions about AI based classifying the driving profile.*			
Deliverables *D1: Project Innovation Form*			

WP 2: Determining the Functions of the Product			
Start date: *06.10.2023* **End date:** *30.11.2023*			
Leader :	*Asım*	**Members involved:**	*All Team*

Objectives: The main objective of this work package is determining the functions of the Product. Making eliminations and some additions to the functions of our product happened in this part.

Tasks:

Task 1 Brainstorming about problems **:** *To find innovative and useful solutions to the problems, several meetings were set up.*

Task 2 Checking the possibility of our solutions **:** *To check the solutions if they can be implemented*

Deliverables

D1: *Project Information Form*

WP 3: Market Competitor Analysis			
Start date: *01.11.2023* **End date:** *31.11.2023*			
Leader :	*Asım*	**Members involved:**	*Alp and Emrehan*

Objectives: The main objective of this work package is researching the other companies that tries to present solutions to the problems of the driving profile

Tasks:

Task 1 Researching similar applications **:** *Researching the applications about driving profile*

Task 2 Evaluating the solutions of other applications **:** *Distinguish the useful solutions and useless solutions.*

Task 3 Brainstorming about useful solutions: *To understand the engineering behind the useful solutions and make them a part of our project.*

WP 4: Research and Determination of Methods and Tools			
Start date: *01.11.2023* **End date:** *31.12.2023*			
Leader :	*Emrehan*	**Members involved:**	*All Team*

Objectives: The main objective of this work package is determining the methods and tools used for the development stage.

Tasks:

***Task 1 Hardware Research and Determination* :** *To find all the appropriate modules to use it*
***Task 2 Determining Software Tools* :** *To determine the tools used for the software development stage (Github, Android Studio etc.).*
***Task 3 Determining Appropriate AI Methods* :** *To determine the methods used for the AI development stage (AI Classification, Tensorflow libraries etc.).*
Deliverables
D1: *Project Specification Document*
D2: Analysis and Requirements Report

WP 5: Mobile Application Development			
Start date: *01.12.2023* **End date:** *31.03.2024*			
Leader :	*Gökberk*	**Members involved:**	*All Team*
Objectives: The main objective of this work package is developing the mobile application			
Tasks:			
***Task 1 Hardware Tests* :** *To be sure about functionality of the modules.* ***Task 2 Backend* :** *To make a connection between the hardware, the database and mobile application* ***Task 3 Frontend* :** *To make our application be able to be used*			
Deliverables			
D1: First *Presentation and Demo*			

WP 6: Data Collection of Artificial Intelligence Model			
Start date: *01.01.2024* **End date:** *28.02.2024*			
Leader :	*Alp*	**Members involved:**	*Asım and Berkay*
Objectives: The main objective of this work package is collecting enough driving data to train the AI models.			
Tasks:			
***Task 1 Researching data types* :** *Researching the specific data types that the AI models needs to analyze a driving profile*			

Task 2 Developing algorithms for training : *To find most efficient and useful algorithms for AI training process*
Task 3 Collecting data : *Collecting enough data to train the AI models.*
Task 4 Classifying data : *Classifying the data to make them ready for training.*
Task 4.1 Removing unnecessary data
Task 4.2 Labeling the data

WP 7: Training of the AI Model			
Start date: *01.02.2024* **End date:** *31.03.2024*			
Leader :	*Berkay*	**Members involved:**	*Alp, Gökberk and Emrehan*
Objectives: The main objective of this work package is training the AI models to analyze the driving profile			
Tasks:			
Task 1 Checking the sustainability of the algorithm : *To be sure, the developed algorithm will be considered again and changed, if necessary.*			
Task 2 Researching different AI libraries : *To find most efficient AI library, a research will be implemented*			
Task 3 Starting the training process			
Task 3.1 Distinguishing the data for train, validate and test process			
Task 3.2 Make estimations about optimal situation for AI models			
Task 3.4 Transfer Learning : *To be able to add new data which was gathered while training process*			

WP 8: Model Testing and Improvement			
Start date: *01.03.2024* **End date:** *30.04.2024*			
Leader :	*Alp*	**Members involved:**	*Asım, Berkay and Emrehan*
Objectives: The main objective of this work package is testing the AI models and according to results, making improvements about our AI models.			
Tasks:			
Task 1 Test AI Model : *Testing AI models with the data that is not included in training data. Also, real time data will be used for testing process*			

Task 2 Analyze Problems : *According to test results, the sources of the problems will be detected*

Task 3 Find Solutions : *While this task, the subtasks will be repeated until the end time of the work package*

Task 3.1 Proposing Solutions : *Proposing theoretical solutions to the problems about AI models*

Task 3.2 Implement Solutions

Task 3.3 Test New Solutions

WP 9: Product Testing and Improvement			
Start date: *01.04.2024* End date: *31.05.2024*			
Leader :	*Emrehan*	Members involved:	*All Team*
Objectives: The main objective of this work package is testing the development stage production and making improvements			
Tasks: *Task 1 Test Whole System*: *Testing all the hardware modules, the software, the AI models and the connection between them.* *Task 2 Analyze Problems* : *According to test results, the sources of the problems will be detected* *Task 3 Find Solutions :* *While this task, the subtasks will be repeated until the end time of the work package* *Task 3.1 Proposing Solutions* : *Proposing theoretical solutions to the problems about the development stage production* *Task 3.2 Implement Solutions* *Task 3.3 Test New Solutions* *Task 4 Be Ready For Production :* *Final controls will be implemented and the final production will be ready.*			

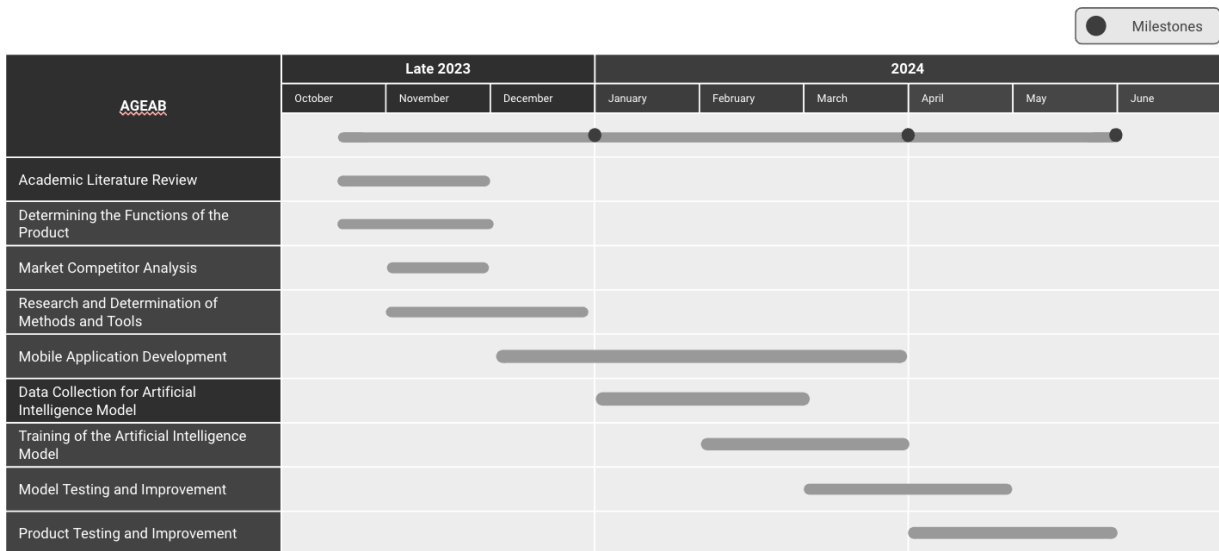| AGEAB	Late 2023			2024					
	October	November	December	January	February	March	April	May	June
Milestones			●				●		●
Academic Literature Review	█	█							
Determining the Functions of the Product	█	█							
Market Competitor Analysis		█							
Research and Determination of Methods and Tools		█	█						
Mobile Application Development				█	█	█	█		
Data Collection for Artificial Intelligence Model				█	█				
Training of the Artificial Intelligence Model					█	█			
Model Testing and Improvement						█	█		
Product Testing and Improvement							█	█	█

Figure 1: The Chart of the Project Plan

4.4 Ensuring Proper Teamwork

Beginning from the semester and the project, we tried to distribute the workload equally among the team members. Everybody has a busy schedule, and we respect each other's needs and responsibilities. In the report stages, we initially determine the headers and subheaders; later, we divide these headers equally among the team members by calculating the workload of each header. In terms of coding, we want to produce and develop as fast as possible and safely. Thus, we try to optimize the coding process. Accordingly, we try to distribute the workload by looking at the team members' knowledge and experience on the technologies we use. However, If one team member is keen to learn a technology that we use and has hands-on experience, we value these takes and let him/her do it if it will not block any other person's work. More specifically, our team roles are nearly fixed, as in the table above; however, as stated before, there may be some changes or demands in the future. Regarding tracking, Github Commits gives us the data on who did the job. If there is an overload on one team member, we distribute the work again if the field is related to others. Even though GitHub commits are an effective way to track the coding stage, sometimes it might be misleading due to manual merges done among group members by sharing code to bypass possible conflicts during "pull" and "push" actions.

4.5 Ethics and Professional Responsibilities

Our application does not store any serious personal information regarding ethics and responsibilities. Nevertheless, in terms of responsibility, we will ensure that there will be no data leak. Live location may be seen as not confidential information in general. However, in terms of ethics, it may be discussed. When a business owner has the complete information and location and the driving data instantly, the business owner may be obsessed with this data after some time. This situation may create a toxic work environment and cause possible unintentional mobbing in the workplace. However, overlimiting the driver's data may prevent our application from losing its functionality. So, we want to ensure business owners that their demands will be satisfied and the workers' job conditions will not worsen.

4.6 Planning for New Knowledge and Learning Strategies

As a whole team, we want to learn the knowledge itself rather than just implementation of it. Hence, our primary sources of learning will be the documentation of the technologies and online text or videos that explain the knowledge elaborately. Before starting the project, we needed to gain knowledge of mobile application development, and we acquired that knowledge using these methods. In terms of implementation details or syntax issues, checking the documentation may take significant time; thus, we want to leverage our speed by using AI models that are publicly accessible. In the classification part, we rely on articles and then take steps on the documentation and implementation. We are currently taking relative courses; however, we are new in the field and have yet to acquire the experience we had on other development parts of the project. Thus, we need to have more profound knowledge by checking contemporary articles on classification, specifically the ones related to our project

5. Glossary

AI (Artificial Intelligence): The simulation of processing of human intelligence.

Android SDK: A set of development tools used for Android.

Android Studio: The program which Android applications are developed on.

API (Application Programming Interface): A way of communication between two computer programs

Arduino: Open Source electronic prototyping platform

Big Data: Too large or too complex data set

CAN (Controller Area Network): A protocol that enables the devices to exchange data on a car.

GPRS (General Packet Radio Services): A communication standard for that can be processed on 2G and 3G

GSM (Global System for Mobile): Digital cellular technology for mobile communication.

G-Force: A measure of acceleration.

IDE (Integrated Development Environment): A software application that helps programmers to develop.

ML (Machine Learning): A branch of Artificial Intelligence focused on building computer systems that can learn from data.

OOP (Object Oriented Programming): A programming model that organizes software design around objects.

Swift: A programming language that helps the developer create iOS/macOS/watchOS applications.

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