



## **Development of Road Damage Report Application (Road Repair)**

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**Abstract:** Road maintenance is essential to establish a safe and sound road for citizens to use in their daily life. Due to the frequently used and natural causes like water flow or flood, there will be some damages occur which need the care from the road authority. Unfortunately, only a few are willing to spare their time in lodging the damaged road report as it is time-consuming. All smartphones have a Global Positioning System sensor which will be used to determine the exact location of the problematic zone for this application. The camera can be utilized to capture the damaged road visual proof. The system generates a form consisting of all data entered by the user along with the location and visual proof and sends that to the central server notifying the concerned authority. Thus, helping citizens to easily lodge the damaged road complaint. This application is developed using Flutter and Dart environment and Firebase as the database.

**Keywords:** Complaint Management System, Android, Road Maintenance

### **1. Introduction**

Road is a line of communication that is travelled by primarily road motor vehicles that are using a stabilized base other than rails or strips and in which that is open to public traffic [1]. Malaysia is an emerging and developing country, on track to becoming a developed country. Road networks adequacy, in terms of quality and maintenance, of federal roads, state roads, and expressways reflects a major component of the infrastructural readiness of a country to be esteemed as 'developed' [2]. Thus, the development of satisfactory road facilities plays an immense role in trade and transportation planning, rapidly increasing

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the pavement infrastructure developments in Malaysia [3]. Hence, ensuring that the roads are well developed and are in good condition are crucial to the economic growth of the country [4]. Currently, all the road in Malaysia is developed by and maintained by the Malaysian Public Works Department (JKR).

As of now, there are several ways people can voice their complaint to the JKR regarding damaged roads such as through phone call, letter addressed to the JKR, the JKR Care website, or even through social media. The responsible within the JKR division will then consider the complaint and respond in writing within 10 working days of the complaint being received in the department. The complaint will be entered into the JKR database along with the reporter information and JKR will then assign the contractors to inspect the damaged road and proceeds to plan the maintenance. The maintenance will have a deadline accordingly to the scale of the maintenance. Once the maintenance is concluded, the contractor will then send proof of the maintenance is completed thoroughly, only then the complaint will be marked as resolved in the JKR database by the administrator. However, when the complaint has been resolved, there will be no follow-up by the JKR to the complainer, thus they will not know whether the issue has been resolved or not. The main idea for proposing this idea is to help people lodge a road report easier and less time-consuming. Moreover, time has always been a common excuse to neglect this matter. Hence, Road Repair a location-based mobile application system is suggested to help people connect with the authority in just one click away. Road Repair app's purpose is to facilitate the end-users to lodge a report on damaged roads and view the report progression. Upon this, a cost-effective plan is to use the GPS (Global Positioning System) within the smartphone itself as most people these days own a smartphone. GPS originally known as NAVSTAR GPS is a satellite-based radio navigation system and has a wide range to be applied from especially from a smartphone [5]. The radio waves from the satellite will be transmitted to the receiver in the phone and give access to the current location. GPS is needed to navigate the submitted location and proceed to the administrator then shall be passed onto the contractor.

## 2. Related work

### 2.1 Mobile Based Application

Mobile devices, such as smartphones, and tablets have been much more popular than traditional desk-based devices such as personal computers and laptops. Since iOS has release with iPhone smartphone in 2007, and Android has released with various smartphones and tablets in 2008, the most popular Operating Systems running on the computing devices has become mobile Operating Systems. Native code is usually compiled, meaning it is faster than interpreted languages such as JavaScript [6]. A native mobile app is a smartphone application written in programming language appropriate to the operating system, such as Objective C for iOS or Java for Android. Native mobile apps have a high level of performance and dependability. This project will use Flutter framework for its development. Flutter is a framework that is developed by Google for the development of native mobile-based application. Flutter framework utilizes Dart language for the application development. By using Dart language, Flutter is written in object-oriented programming [7].

### 2.2 Comparison with Existing System

Table 1 summarizes the comparison of 3 existing system with proposed system. Three existing systems have been examined to obtain more useful information for the proposed system development. The comparisons are between modules and features of the proposed system. The systems that have been chosen to be observed is the i-Tegur application [8], Fix My Street website [9], and eComplaint Management System application [10].

**Table 1: Comparison of 3 Existing System with Proposed System**

<b>Systems</b>	<b>i-Tegur</b>	<b>Fix My Street</b>	<b>eComplaint Management System Road Repair</b>	
<b>System Type</b>	Mobile-based	Web-based	Mobile-based	Mobile-based
<b>Registration and Login Module</b>	Using ICNum as unique identifier	Uses mobile number as identifier	Uses email to register new user	Using email as unique identifier
<b>Complaint Module</b>	Form and detail of complaint	Form and detail of complaint and Pinpoint on map	Form and detail of complaint	Form and detail of complaint and Pinpoint on map
<b>Task Management Module</b>	Does not have task management feature	Does not have task management feature	Multiple Task allocation for a single complaint.	Multiple Task allocation for a single complaint.
<b>Contractor Management Module</b>	Does not have task management feature	Does not have task management feature	Does not have task management feature	Edit contractor information.
<b>Statistic Report Module</b>	Number of complaints completed based on the user history	General overview of complaint solved and new complaints.	Report on task done, resolved complaint, and number of complaints	Complaint overview with report on task done.

### 3. Methodology/Framework

This chapter explain the use of prototype model in this project and the activities that had been carried out in each phase. The development of damaged road report application, Road Repair are using the system prototyping methodology which consists of phases from planning, analysis, design implementation and prototyping. Each of the phase have its own deliverables that show the progress of the project itself. There are many other types of system development methodology, but for this project the methodology chosen is the system prototyping methodology solely because it is the suitable one to be used in this system development. Table 2 show the task and output of each phase.

**Table 2: Software development activities and their task**

Phase	Task	Output
Planning	<ul style="list-style-type: none"> <li>Proposed the project</li> <li>Determine the project schedule, activities, and output</li> </ul>	<ul style="list-style-type: none"> <li>Proposal of Road Repair</li> <li>Develop Gantt chart</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>Analysis the requirements and specifications of the system</li> </ul>	<ul style="list-style-type: none"> <li>Functional and non-functional requirements</li> <li>Software and Hardware requirements</li> <li>Use Case Diagram</li> <li>Sequence Diagram</li> <li>Activity Diagram</li> <li>Requirement Traceability Matrix</li> </ul>
Design	<ul style="list-style-type: none"> <li>Design system database</li> <li>Design user interface</li> </ul>	<ul style="list-style-type: none"> <li>Class Diagram</li> <li>Database and user interface design</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Program/implement system code</li> </ul>	<ul style="list-style-type: none"> <li>Flutter programming</li> <li>Database management system.</li> </ul>
Testing	<ul style="list-style-type: none"> <li>Test the functionality of the developed system</li> </ul>	<ul style="list-style-type: none"> <li>System frontend test</li> <li>System backend test</li> <li>System and hardware test</li> </ul>
Prototype	<ul style="list-style-type: none"> <li>Detect error and polish prototype system until becomes final version</li> </ul>	<ul style="list-style-type: none"> <li>System prototype</li> </ul>

### 3.1 System Requirement Analysis

In system development, requirement analysis is the process of determining requirements that developed system needs to fulfill, or user expectation outcome from the proposed system. System requirements include functional and non-functional requirements, user requirements and system requirements. Table 3 summarizes the functional modules provided in the damaged road report application (Road Repair).

**Table 3: System functional module**

No.	Module	Function	User
1.	Registration and Login Module	Allows user to register account and login into their account	Road Users Administrator Contractor
2.	Complaint Module	Allow user to lodge complaint and manage it	Road Users Administrator Contractor
3.	Task Management Module	Allow the user to allocate task and view them	Administrator Contractor
4.	Contractor Management Module	Allow administrator to make changes to contractor information	Administrator
5.	Statistic Report Module	Allow user to view the statistical report.	Administrator Road User Contractor

### 3.2 Functional Requirement and Non-Functional Requirements Analysis

Functional requirements define the function of the developed system, while function is described as specific behavior that convert input to output. Table 4 shows the functional requirements of the proposed system.

**Table 4: Functional requirements**

No	Module	Description
1.	Registration and Login Module	<ul style="list-style-type: none"> <li>• The system should allow road user to register new account with their email as their unique identifier.</li> <li>• The system should allow administrator to create new account for new contractor.</li> <li>• The system should alert user if their email is already in the database</li> <li>• The system should allow user to login into the system using registered email and password.</li> <li>• The system should only allow a user to log in into their account with valid email and password</li> <li>• The system should alert the user if the credential is invalid</li> </ul>

**Table 4: (cont)**

No	Module	Description
		<ul style="list-style-type: none"> <li>• The system should redirect user to their respective dashboard upon successful login.</li> </ul>
2.	Complaint Management Module	<ul style="list-style-type: none"> <li>• The system should allow user to fill up detail of road damage.</li> <li>• The system should allow user to upload image of the road damage.</li> <li>• The system should allow user to pinpoint the location of the damaged road on the map feature.</li> <li>• The system should allow user to see their uploaded complaint.</li> <li>• The system should allow user to see their complaint status.</li> </ul>
3.	Task Management Module	<ul style="list-style-type: none"> <li>• The system should allow administrator to assign task for filed complaints to contractors</li> <li>• The system should allow administrator to create events</li> <li>• The system should allow administrator to delete events</li> <li>• The system should allow user to view task progression</li> <li>• The system should allow contractor to update task progression</li> <li>• The system should allow administrator to verify completed task</li> </ul>
4.	Contractor Management Module	<ul style="list-style-type: none"> <li>• The system should allow administrator to update contractor information</li> <li>• The system should allow administrator to view contractor information</li> </ul>
5.	Statistic Report Module	<ul style="list-style-type: none"> <li>• The system should allow administrator to see the total of reports lodged, and total fulfilled reports.</li> </ul>

Non-functional requirements define the criteria that is used to judge the operation of a system, rather than the specific behavior or function of the system (Pohl, 2010). Table 5 shows the non-functional requirements of the developed system.

**Table 5: Non-functional requirements of the developed system**

No	Requirements	Description
1.	Performance	<ul style="list-style-type: none"> <li>The system should be always usable</li> </ul>
2.	Operational	<ul style="list-style-type: none"> <li>The loading time required for the application should be less than 1 minute</li> </ul>
3.	Security	<ul style="list-style-type: none"> <li>The system should be user friendly</li> <li>The system should have login credential checker</li> </ul>
4.	Cultural and political	<ul style="list-style-type: none"> <li>The system should be able to work on any phone that has android 8.1 and above.</li> <li>The system should be in English language</li> </ul>

### 3.3 User Requirement Analysis

User requirements define the expectation of user from the functionality of the system. Table 6 shows the user requirements of the developed system.

**Table 6: User requirements of the developed system**

No	User Requirements
1.	All users must be able to enter a valid id and password to enter the system.
2.	User should be able to upload image and detail of report.
3.	The system should allow administrator to create new account.
4.	User should be able to use GPS to pinpoint location on the map feature.
5.	Administrator should be able to create, update, and delete contractor information.
6.	User should be able to view nearby complaint in nearby area in map feature
7.	User should be able to view assigned task.
8.	Administrator should be able to assign task to contractor
9.	User should be able to update the task status
10.	Administrator should be able to view unreviewed complaint.
11.	Administrators should be able to view the total complaints, unreviewed complaints, ongoing complaints, and completed complaints.

### 3.4 Use Case Diagram

Figure 1 shows the use case diagram that represents the overall activity of the damaged road report application (Road Repair). The purpose of this diagram is to illustrate the dynamic parts of the system

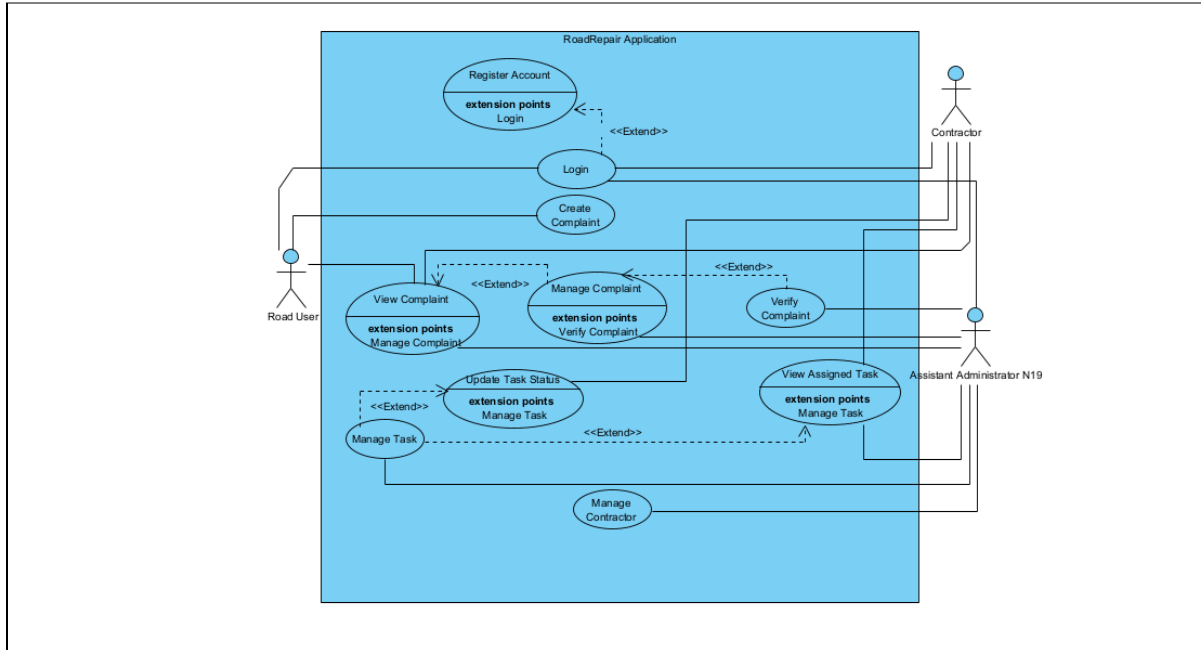


Figure 1: Use Case Diagram of Proposed System

### 3.5 Class Diagram

Class diagram is a visualization or graphical notation that is used to create and visualize object-oriented systems. Since in this project the approach chosen is object-oriented approach, therefore class diagram is used to model the class in this project. Generally, there are 6 classes in this system which are displayed in **Appendix A**.

### 3.6 TO-BE Swimlane Diagram

The flow chart describes the overall process of the system from registration until logging out the system. **Appendix B** describe the swim lane diagram of proposed application.

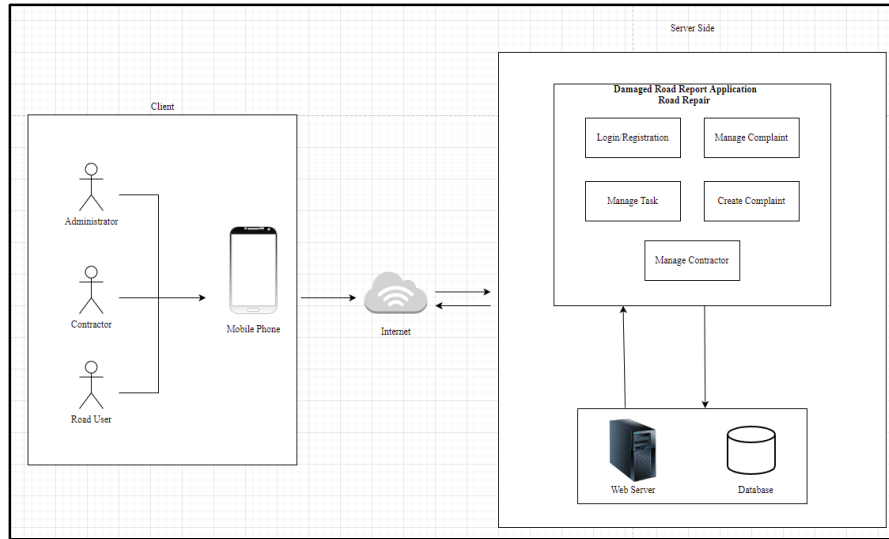
### 3.7 System Design

Software design encompasses the set of principles, concepts, and practices that lead to the development of a high-quality system or product [8]. System design on the other hand is the process where components of a system like modules, architecture, system components and their interfaces and data for a system based on the specified requirements. Usually, the main goal during system design is to produce a model or representation that exhibits firmness, commodity, and delight [8].

#### 3.7.1 System Architecture

System architecture in its simple terms have a similar definition with building architecture which is the structure of the system that are made up of its smaller component and how the components interconnected with each other. Figure 2 demonstrates the system architecture of the road report application





**Figure 2: System Design Architecture**

### 3.8 Database Design

A database is a mechanism that is used to store information, or data [9]. Database design purpose is to create, implement and maintain a complaint management application system. The sole purpose of designing a database is to create physical and logical models of designs. In this section, the database design of Road Repair application is to be design based on the class diagram in Appendix A

#### 3.8.1 Schema

A schema is a group of related objects in a database [9]. The database schema of database scheme for Road Repair application is examine in this section.

The database scheme for Road Repair application is listed as follows:

- i. Road User (Email, password, phone, name)
- ii. Administrator (adminID, adminName, password, email, phone)
- iii. Contractor (contractorId, contractorName, password, email, phone)
- iv. Complaint (complaintId, complaintTitle, locationAddress, locationMap, complaintPhoto, details, status, userId)
- v. Task (TaskId, TaskName, time, duration, priority, proofWork, complaintId, adminId, contractorId)

## 4. Result and Discussion

### 4.1 System Implementation

The result and discussion of the section, represent the data and analysis of the Road Repair application. The objective of the project is to develop a road reporting application and test the developed system. The scope of the Road Repair application is specifically made for the Android platform including for the administrator to manage complaint, task and contractor. The application is developed by utilising Dart with Flutter alongside Firebase as its database.

#### 4.1.1 Registration and Login Module

This module allows users to register new account or log in by filling in their email and password to enter the system. The application will alert the user if the email or password is wrong. User can only create a new account as road user by registering their email and password.

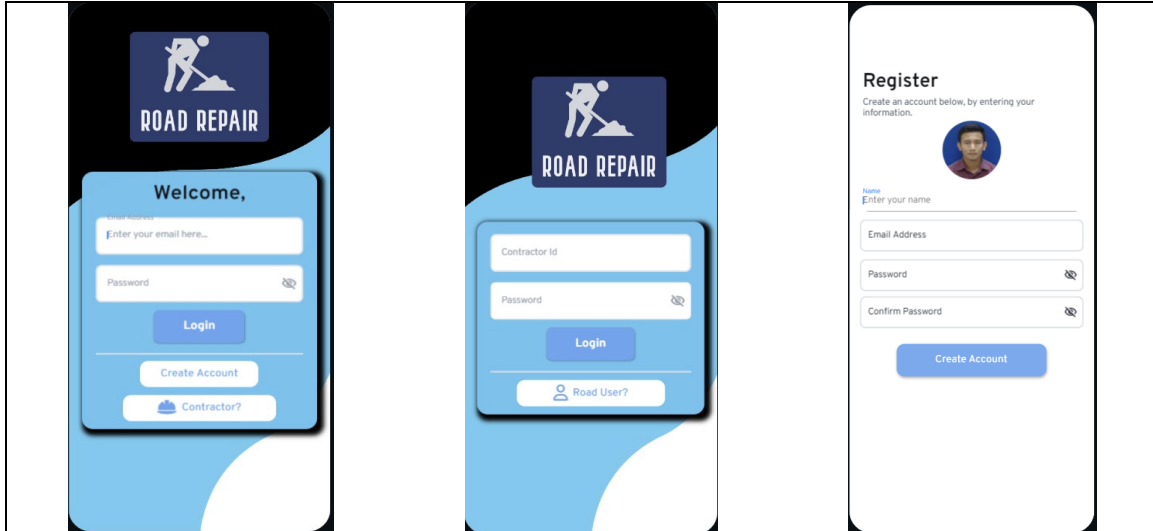


Figure 3: Road User Login

Figure 4: Contractor Login

Figure 5: Road User Registration

#### 4.1.2 Complaint Module

This module allows road user to lodge where user will fill up the detail of the road damage such as the brief name of the damage and the description of the damage. This module also allows the user to use their own location to lodge complaint or by entering the address of the complaint. This module will also allow user to see the nearby complaint lodged by the user in a map feature. The complaints will be pinpointed as marker.

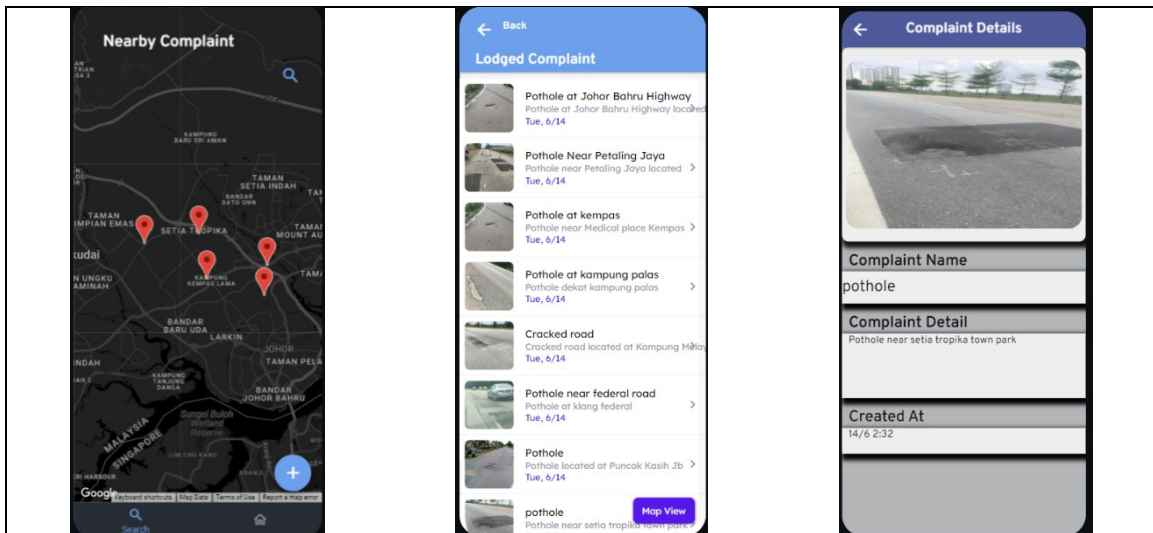


Figure 6: Nearby Complaint

Figure 7: User Lodged Complaint

Figure 8: Complaint Details

#### 4.1.3 Manage Complaint Module

In this module, administrator can view the lodged complaint and see the details of the complaint. Administrator also can update the complaint status. Users are also able to see the status of the complaint in a listed view.

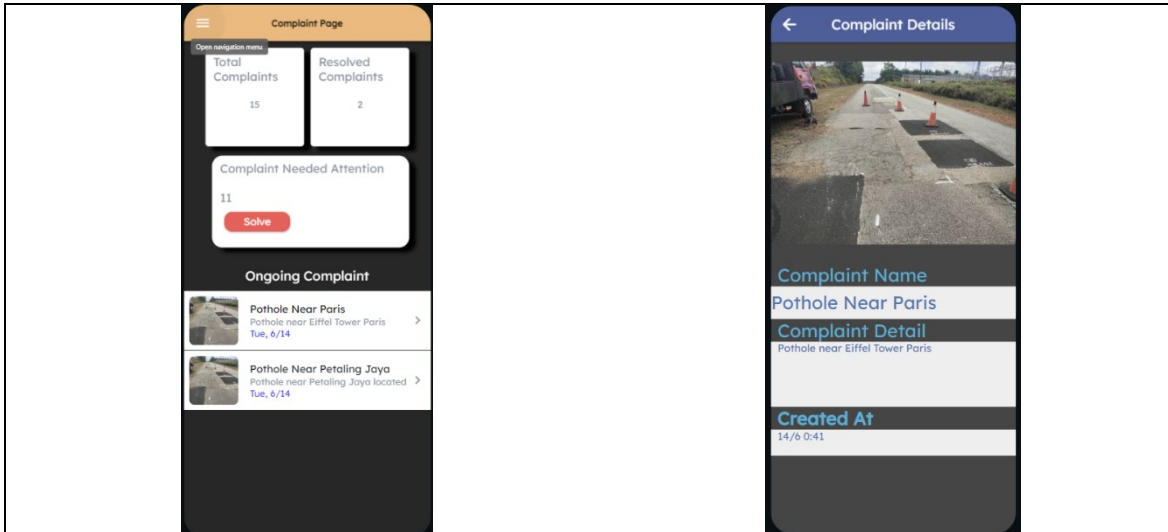


Figure 9: Complaint Management Page

Figure 10: Complaint Details Page

#### 4.1.4 Manage Task

In this module, administrator can assign task to contractor by referencing the respective complaint. User which are contractor and administrator can also update the task status. By the time the task is finished, the referenced complaint will be marked as completed.

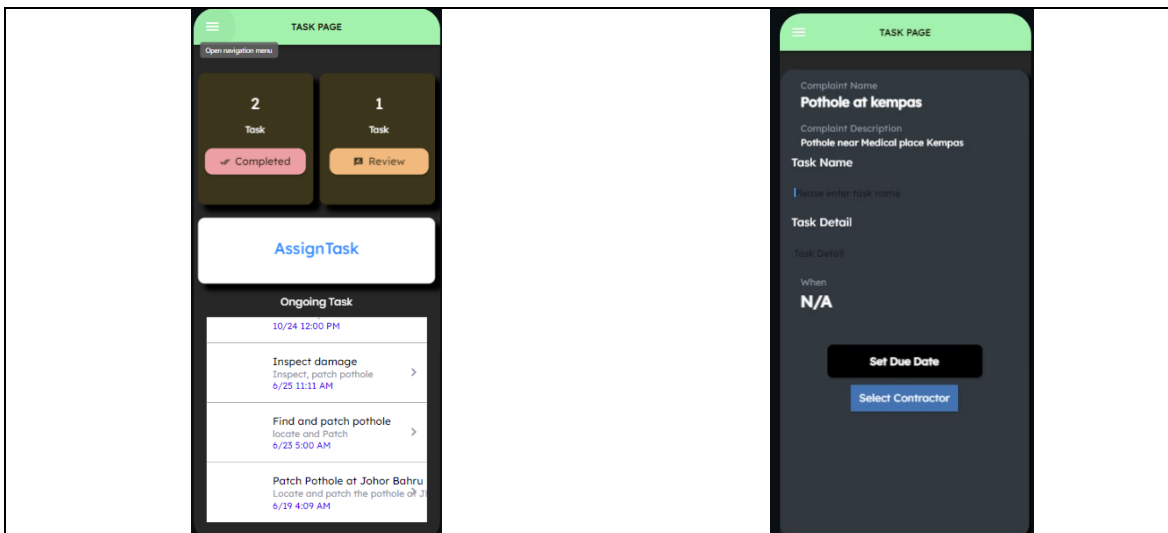


Figure 11: Task Management Page

Figure 12: Task Assignment Page

#### 4.1.5 Manage Contractor

In this module administrator can create new contractor. Administrators are also able to updates the contractor information such email, password, and phone number. Administrator and contractor can also view the details of the contractor.

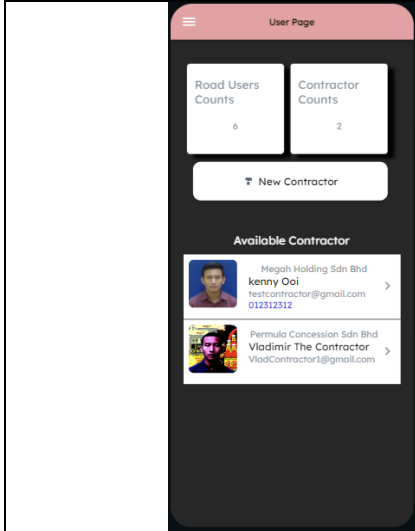


Figure 13: User Management Page

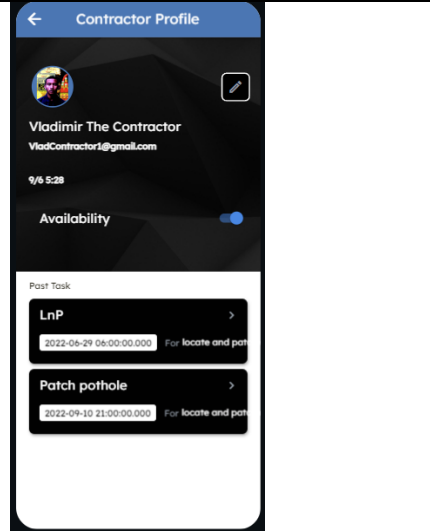


Figure 14: Contractor Information Page

#### 4.1.6 Display Statistic Report

In this module, users can view their statistical information such as the total lodged complaint or total task. The system will gather information by referencing the authenticated user’s module or by collecting the whole collection of data to display the total amount of it.

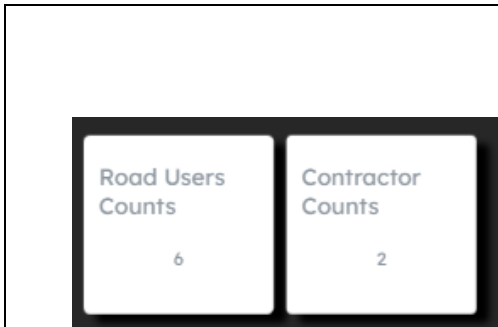


Figure 15: Statistic from User Management Page

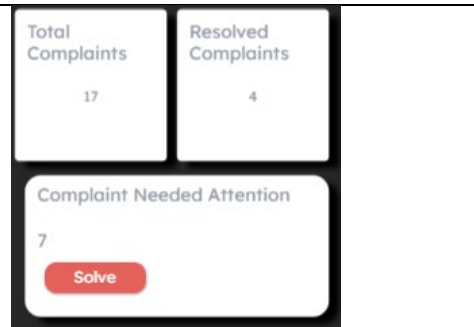


Figure 16: Statistic from Complaint Management Page

#### 4.2 System Testing

The testing phase will begin once the system prototype has been developed. This phase is one of the most important parts of the whole development phase to ensure the quality of the prototype. The test cases for every use case are shown in Table 8 while the overall result is in Table 7 below.

**Table 7: Test Performed**

Test Case	Requirement	Description	Result
<b>Registration and Login (TEST 100)</b>			
TC_100_01	SRS_REQ_101	System login page view	PASS
TC_100_02	SRS_REQ_102	User sign into the system with valid information	PASS
TC_100_03	SRS_REQ_103	System display error message if login is invalid	PASS
TC_100_04	SRS_REQ_104	Road user register with input personal data	PASS
TC_100_05	SRS_REQ_105	System display error message if the registration is not successful.	PASS
TC_100_06	SRS_REQ_106	System store user information in database once registration successful	PASS
TC_100_07	SRS_REQ_107	Only administrator can login into administrator side	PASS
TC_100_08	SRS_REQ_108	Only contractor can login into contractor side	PASS
<b>Create Complaint (TEST 200)</b>			
TC_200_01	SRS_REQ_201	System can display user lodged complaint	PASS
TC_200_02	SRS_REQ_202	System should allow only road user to create complaint in the lodge complaint page.	PASS
TC_200_03	SRS_REQ_203	System display error message if submitting complaint is not successful.	PASS
TC_200_04	SRS_REQ_204	System synchronises with the database	PASS
TC_200_05	SRS_REQ_205	Display message upon successful complaint lodged	PASS
TC_200_06	SRS_REQ_206	Display lodged complaint marker on Google Map feature	PASS
<b>Manage Complaint (TEST 300)</b>			
TC_300_01	SRS_REQ_301	Only administrator can verify complaint and display message upon successful update	PASS
TC_300_02	SRS_REQ_302	Only administrator can create complaint in this module	PASS
TC_300_03	SRS_REQ_303	Administrator and contractor update complaint status and display message upon successful update	PASS
TC_300_04	SRS_REQ_304	System can display list of complaints	PASS

**Table 7: (cont)**

Test Case	Requirement	Description	Result
TC_300_05	SRS_REQ_305	System categorized the user complaints according to the complaints status	PASS
<b>Manage Task (TEST 400)</b>			
TC_400_01	SRS_REQ_401	Only administrator can assign task to contractor only	PASS
TC_400_02	SRS_REQ_402	User able to update task status	PASS
TC_400_03	SRS_REQ_403	System display user assigned task view	PASS
TC_400_04	SRS_REQ_404	Administrator can assign task to nearby contractor near the location of the complaint	PASS
TC_400_05	SRS_REQ_405	Administrator can only assign task to available contractor only	FAIL
TC_400_06	SRS_REQ_406	Upon assigning complaint to task, complaint automatically become ongoing.	PASS
TC_400_07	SRS_REQ_407	Upon assigning complaint to task, task automatically become ongoing.	PASS
<b>Manage Contractor (TEST 500)</b>			
TC_500_01	SRS_REQ_501	Administrator can edit contractor information	PASS
TC_500_02	SRS_REQ_502	System display list of contractors	PASS
TC_500_03	SRS_REQ_503	System display contractor details with their own task history.	PASS
<b>Statistic Report (TEST 600)</b>			
TC_600_01	SRS_REQ_601	Only administrator can view all statistic	PASS
TC_600_02	SRS_REQ_602	System should be able to display total complaint, task, and users to their respective module.	PASS

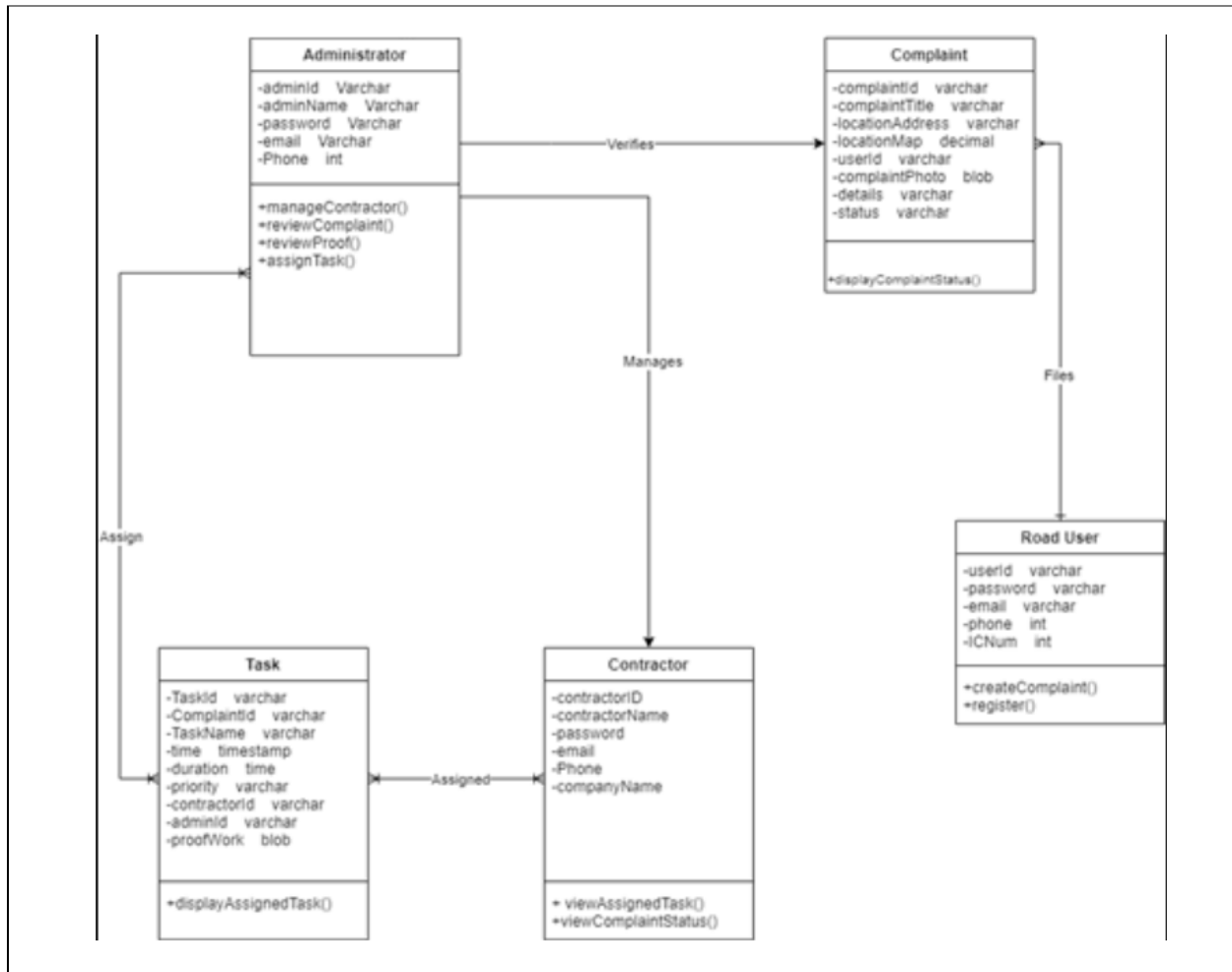
## 5. Conclusion

Based on the findings, it is concluded that this road report application, Road Repair may have a positive impact in encouraging average road user to contribute to the betterment of our infrastructure maintenance. By developing this application system, road user is able to lodge complaint directly into the system, eliminating the need to call, send letter or email to the authority to notify or lodged a complaint. This application also eases the administrator to verify the complaints and assign task for the available contractor, making the flow of complaint management and task management as seamless as possible. However as of now, this application is in an extremely rudimentary state, as it is advised that improvise features, design and even new functions can be implemented in order to accommodate future growth.

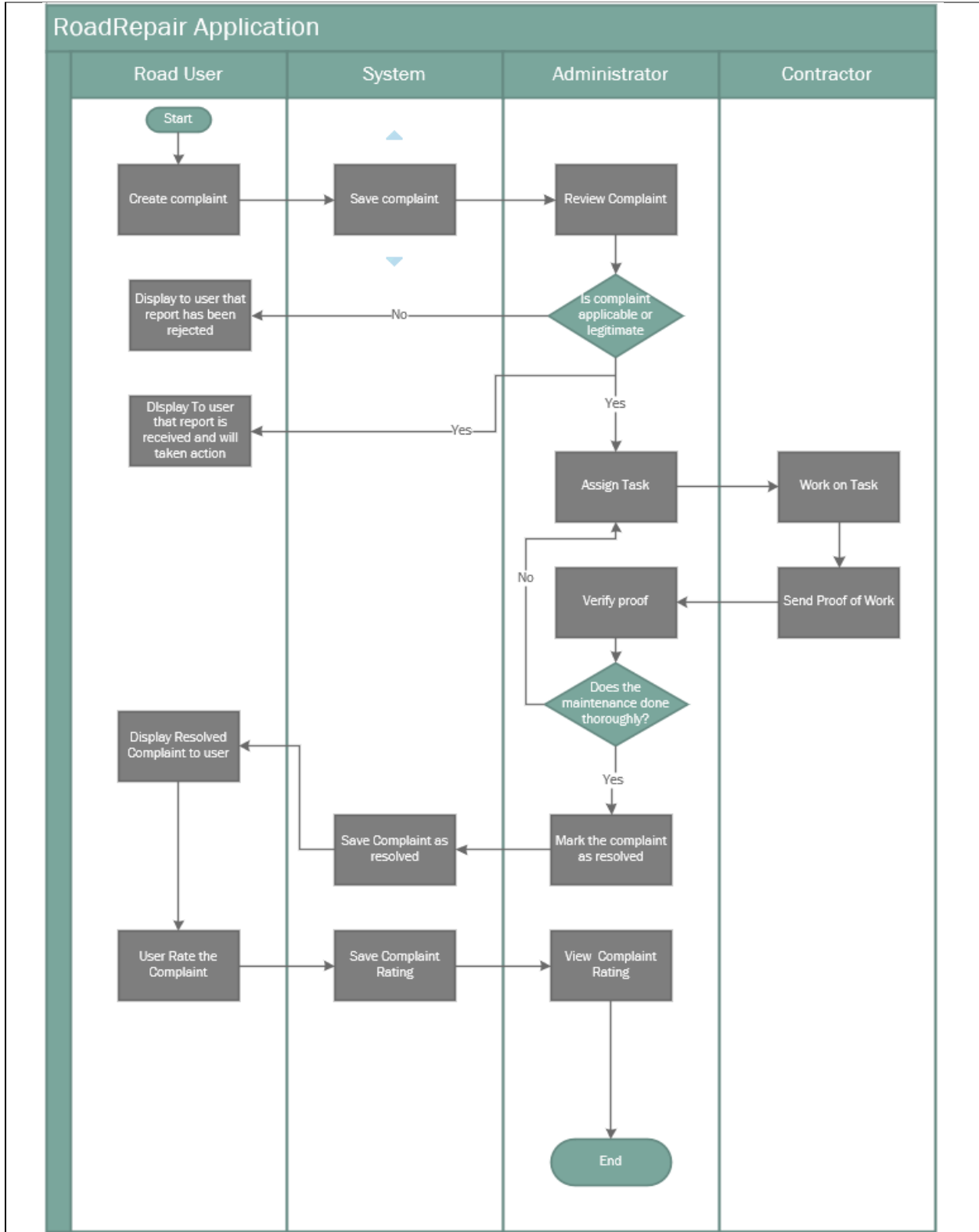
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## Appendix



Appendix A: Class Diagram



Appendix B: Swimlane Diagram of Road Repair Application



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