An-Najah National University

Faculty of Engineering & Information Technology

E-Governance in Palestine and the MENA Region

(INDIGO) Project

Project #7

طريقك

This Project done in cooperation between:

Computer Engineering Department
Urban Planning Department
Urban & Regional Planning Unit
Jamma'in Municipality
GIZ

IND'GO **Towards Citizen-Centered and Inclusive Digital Governance in Palestine**

التعاون الألماني
DEUTSCHE ZUSAMMENARBEIT

Implemented by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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Disclaimer

This report was written by Amna Khdair and Aya Ghazal, in the Department of Computer Engineering, College of Engineering, and An-Najah National University.

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Abstract

Many towns and cities in Palestine suffer from obvious problems in the road sector, so we chose the community town as an example for the rest of the towns and cities in the road sector. The idea of our project is to solve a major and fundamental problem in Al-Jumayn municipality revolving around the lack and lack of data available for this purpose. The idea of our project came to provide an application on the smartphone that citizens use to upload their various complaints about the condition of the roads, such as bumps, pavement problems, or even abuses, in addition to the feature of recording through the sensor on the phone that is activated by the citizen to record the state of the roads he takes, where the display is displayed. This data is provided through a website for the relevant municipality employees so that all complaints are displayed and all data is collected. Citizens are analyzed so that the municipality has a clear view of the problematic roads and streets, where there are many bumps or potholes, and the roads that citizens take. By collecting data on priority roads that can be repaired, as well as the most important factor in strengthening citizens' relations with the municipality, because our project is based on human-centered design.

Mobile app built with *Flutter* framework written in *Dart*, website built with *Reactjs* framework, we are talking about front end interface, and for backend we used *Nodejs* and *express*, with shared *Mongo* database. In addition, our application relies heavily on maps, as we used *Google Maps* for the smartphone and the website, and among other things used that contributed to monitoring the places of bumps, potholes and vibrations are: the *accelerometer sensor* in smartphones, and we used it to know the streets most used by citizens. Second: The *Geolocation* feature to monitor the places of citizens to send notifications. Finally, one of the fundamental things in our project is the algorithms used in data analysis. Everything together shaped our project.

1 Introduction

1.1 Problem

Above all, our main goal was to identify the main problem that we strive to solve through our project. When we chose the road sector, we initially understood the direction we would go, of course, this was only the beginning, as our initial steps were to meet the citizens and the municipality and hear their opinions, problems, and pain on this subject. Yes, opinions were different and differed from one citizen to another, but there was always a point on which they would meet, which is the poor condition of the roads due to the presence of bumps designed in a way that is different from engineering standards, or even the presence of potholes and some unpaved streets. It is famous for the presence of many quarries in the town, and this means that there are heavy trucks present in abundance in its streets, which in turn becomes a major factor in the poor condition of the town's roads. These opinions were on the part of the citizens we interviewed and heard.

As for the views of the municipality's engineers, they were about the difficulty of collecting data from the streets, as it was difficult for them to go down to every street and inspect it to get to know its status. That is, and one of the opinions that we also heard is that they want a way to facilitate this for them, to consolidate their relations with the citizens, and to share with them the solution. Since the municipality's problem in collecting data regarding the condition of roads and streets is also common with the citizens' problem of bad roads, here we knew that our problem revolved around that.

Now we can summarize the problem with the poor condition of the town's roads, the poor relations of citizens with the municipality, and the lack of communication, which led to a weakness in collecting data about this sector, as this data forms part of the solution to start repairing and improving roads.

1.2 Objectives

Our goal is to create a program that forms a link to communicate, bring together citizens and the municipality, listen to their complaints, and participate with them in solving the problem by recording road conditions through the sensors on their phones. Where all this data is collected in a common database to make it easier for the municipality to benefit from it to clarify the condition of roads and the priority of repair, and the municipality can send any notification to citizens about any repair or pavement of streets in the area.

1.3 Project scope

We dealt and focused in our project on the Jamma'in municipality about the road sector, so we met its citizens and the engineers of its municipality, and we saw and walked in its streets to get a more understanding of the condition of the road sector in it.

1.4 Importance

Our project contributes to finding a smart solution to the problems of the municipality and citizens. Our project includes the complaints feature that citizens raise about any problem they see about the condition of the roads. Through this feature, we gave citizens the opportunity to convey their voices and hear their problems to the municipality, as for the road condition reports feature, which is done through the acceleration sensor found in smartphones. It is a feature for collecting data for the municipality about the presence of burrs, potholes, etc., as well as complaints. And the reporting feature helps the municipality to know the most used streets by citizens, where this information is important, to help them understand the priority of repairing its streets. In addition to all this, the municipality is also able to send notifications to all or some of the citizens of any street or pavement repairs. This feature will help both parties to improve their relationship together and avoid any crises at the time of paving and repair. And do not forget that our application is also able to collect points for citizens who participate in the municipality in collecting data and assistance, which in turn also benefits the citizen, who takes in exchange for a set of points on services from the municipality, encouraging them to participate and collect data.

1.5 Report Organizing

The report is divided into several sections, the first of which is the introduction, then talking about the limitations, standards, codes, and courses that we learned before starting the project, then moving to the literature review section, which in turn explains to us the collection of previous experiences and opinions on the topic of our project, then moving to the section on the core of the problem that explains By defining and describing the problem in full, then we start with the methodology used for our project from the group. From the data and interviews that we conducted at the beginning, then the method of implementing and presenting the project by explaining each feature with the attached pictures, then we talk about the languages and tools used in the project, and finally, we touch on the results and a summary of our project.

2 Constraints, Standards, Earlier Coursework

2.1 Constraints

During the period of work on the project, we faced several difficulties, including:

1- Gathering the necessary data to identify the problem and hear the suggestions and opinion of the citizens was the first difficulty, as it took time and effort.

2- Choosing the appropriate solution that can be applied and has high expectations in solving the problem also took a great deal of time.

3- All the techniques and languages used were self-taught during this period, which required teaching and implementation at the same time.

4- But the most difficult thing was to find sources of learning that were clear in the combination of *Flutter*, *NodeJS* and *Mongo DB Atlas.* Which required additional time and effort.

2.2 Standards

MVC (Model View Controller)

The model view controller style was used in our system. We can

Divide the entire project into three phases to make it easier to follow the flow work. These components are as follows:

1. Model: Represents the database we used, *Mongo DB.* Will respond for both view request and console request to continue updating itself.

2. Presentation: represents the GUI that citizens will use to file complaints or new registrations as well, and the GUI for municipality employees to deal with them.

3. Console: It represents the backend server created with *NodeJS*, Facilitates coordination and collaboration between the model and Opinion. It is also responsible for managing application logic.

2.3Earlier Coursework

In terms of previous courses we have used our knowledge from the Software Engineering & Advanced Software Engineering course to write clean code, highly cohesive and lowly coupled. Critical Thinking and Research Skills The research and the writing report were all taught in this course.

And the online course for leaning *ReactJS*, *Flutter* and *NodeJS.*

3 Literature Review

The road sector is one of the most important urban forms to express the development of society, and its continuous maintenance is of great importance to the municipality, and the municipality needs a plan to give priority to its maintenance. In Palestine, it is not based on systematic scientific approaches. Most municipalities use one criterion to prioritize maintenance, which is

The standard is "worst first", so current practices in defining road maintenance plans do not deal with known phases that are generally followed [1].

Here there was an urgent need to provide technology to facilitate the wear and tear of data collection required to prioritize route processing.

The data was collected in two ways. The first is an electronic complaint submitted by the citizen by uploading a picture and some details to the concerned party as in many applications implemented and used around the world including Harpathy Haryana application, Harpath is an initiative of the Haryana government to make the roads in the country a free pit through an application based on GIS For road-related complaints by citizens using the Harpath app and their closing by the relevant engineers in the road-owning departments [2].

As for the second part of the data, it is done by reading from Sensor Acceleration and recording it for us for later analysis within a specific algorithm.

4 Problem Core

4.1 Description of the problem

The town suffers from a bad relationship between its citizens and the municipality, in addition to a lack and weakness in the data collected and its lack of connection in the spatial dimension, and a limitation in geographic information systems, and the impact of the well-known quarries in the town on the condition of the roads, herein lies the main problem represented in the poor condition of the roads. Potholes or even dirt or unpaved, as well as roads that contain bumps out of place. A time lag in the preparation and approval of the organization charts also resulted in methods not being proposed in the plan. The town also has a program or system to prioritize road maintenance and pavement, and this has led to the citizen's dissatisfaction with the municipality when it paves streets of less priority and importance than others within the citizen's vision.

4.2 Implementation

The creation of a mobile application, aimed at improving the condition of the roads, as it contains many features, the most important of which are: the citizen’s ability to inform the municipality of the location of any potholes on the roads by photographing and submitting them to the competent authorities, in addition to studying and analyzing the road vibrations on the citizen’s way to examine the street If it needs to be paved or there are bumps in the wrong places, we can also know the most used methods to determine the priority of maintaining and paving streets and to know whether these roads are added and proposed to the scheme or not.

5 Methodology

5.1 Human Centered Design

Our designs and solutions provided by the application revolve around human-centered design, which is explained in more detail in this part of the report, in the process of selecting the problem title, solutions provided, designs, and the application development process until it reaches its final form.

5.1.1 Inspiration Phase

In the beginning, we conducted interviews with the municipality's engineers, as they are the main stakeholders for our project, in addition to hearing their views and discussing the most important problems they face in the road sector, their causes, and possible solutions. First, problems in the structural plan and land leveling, poor data and poor road conditions, lack of sufficient specialized staff and sustainable systematic plans, a bad relationship between citizens and the municipality and poor communication between them, and finally, the constant movement of trucks, illegal cars, and heavy machinery through the town's streets.

In our next step, we interviewed citizens of all ages and groups, where we heard their opinions, complaints and problems about the road sector, as they declared their dissatisfaction with the poor condition of the roads, such as the bumps that do not comply with engineering standards, or the presence of potholes and worn roads due to trucks transporting stones that are famous By the city most of the time, in addition to the abuses carried out by some citizens without the supervision of the municipality. Now, in the table below, we will present an overview of the numbers and categories of citizens we interviewed.

# of people Met	# of Municipality Members	# of Citizens	# of Women	# of Youth (20-30)
27	5	22	14	7

Table.1: This table show the numbers of people that we met.

Then to the field stage where we checked the condition of the roads and noticed how bad their condition was, and the situation was identical to the story of the citizens. Based on all these steps, we have identified the main problem address of our project, which is to provide real-time street data from citizens to help the municipality, to bridge the highway condition change gap. And the lack of staff available in the municipality to collect data.

5.1.2 Ideation Phase

After defining the problem, we set out to create several prototypes, which we relied on to develop the opinions of the citizens and municipal engineers we interviewed, to ensure that our project was headed in the right direction from satisfying stakeholders to having the best version of the project based on a human-centered design methodology.

Among the developmental opinions that we took into account is the points system proposed by the engineer to encourage citizens to use the application to upload their complaints and record the condition of roads through the sensor, and it also requested that the identities of new citizens be uploaded in advance to the database, to facilitate the process of creating a new account for citizens without resorting to Municipal approval. One of the important issues that I touched on is the priority of street maintenance, as it asked us to follow the strategy they use that facilitates their work in data collection and analysis together.

In addition to some notes from citizens and the municipality about the user interface, some of them asked to change some of the colors used and specific suggestions about the exterior design, and the engineer also asked to provide some illustrative tables next to the maps on the data analysis page for easy access to and understanding of all the displayed data.

In the following table, an explanation of the number of people involved in the prototyping development phase.

# of people Met	# of Municipality Members	# of Citizens
17	3	14

Table.2: This table show the numbers of people that we met to asked them about prototyping.

5.1.3 Implementation phase

This stage is the last stage of the project, where all opinions were taken into account in the development and improvement of the project until reaching the final outputs that contain solving the problem we identified from the beginning and providing all the features that we discussed with the municipality, which in turn helps and facilitates the work of the municipality, which reflects on the satisfaction Citizens about the condition of the roads.

5.2 Technologies

To build the website and the application, we needed to use several different technologies, tools, and programming languages, so now in this part, we will talk about everything we used in the project.

5.2.1 Server side and API

We used *NodesJS* and *Express JS*, *NodesJS* is an open-source, cross-platform server environment that runs on different platforms, and an asynchronous event-driven Backend JavaScript runtime. *ExpressJS* is a minimal framework from *NodeJS* that provides a set of features for a web and mobile applications. The reason for choosing it was that it was easy, scalable, and efficient for our project, also had a mongoose library that we used which made it a lot easier to link with the mongo database.

As for *API*, our choice of both enabled us to make a fast, scalable proxy cable of a huge number of *API* requests at the same time, with high throughput.

5.2.2 Database

As for the database, we chose *MongoDB Atlas*, which is a non-relational, open-source, non-relational database that provides flexibility, scalability, and this information for *MongoDB* in general, as for *Atlas* it is the database service that you use without worrying about physical space For your device or software updates, the cloud provides you with all these details, as it is responsible for managing all these complexities, as it is one of the best options for programming, development, and scalability that deals with the growth of our data in a flexible and optimal way.

5.2.3 UI Design

For a mobile application, we used a *Flutter* framework that was written using a dart language, is open-source from google, and cross-platform using a single code base, free, fast testing, and it’s most powerful in terms of performance.

As for the website we have used *React JS*, a frontend framework also is an open-source javascript library, used to build UI for a single page, we choose it because it's efficient, flexible, and declarative.

5.2.4 IDEs

For both the mobile app and the website, we use *Visual Studio Code*, which is a code editor with support for development processes such as debugging, playback, and version control, it's lightweight, easy to use, and available for any preferred operating system, so we chose it. Also, we used an *Emulator* to test the mobile application code as the Andriod app.

5.2.5 Maps

Our project on both of mobile app and website we relied heavily on maps, and for that, we chose *Google Maps that* provides detailed information about geographical regions around the world.

Important note: we used our own google API KEY, so if the application generalizes then need to change the API KEY.

5.3 Project Architecture

In this section we are talking about the architecture of our project, so the type of architecture we used is *Model-View-Controller (MVC),* which separates the project into three main logical parts, and is the most widely used web development framework in the industry, to achieve a scalable project.

Now let's talk about the details of each part of this structure, in the first part the model that makes up the data part as it contains all the data in the project which is transferred from the view or console, as for our project it forms MongoDB This part of the structure is common in Both the app and the website deal with a different view and controller for each. Secondly is the view, which shows the user interface of the project, so in our project, we have two different views, one for the app (*Flutter app*) and one for the website (*React JS*). Finally, the Controller forms a link between the View and Model, where it performs all operations between them, sends requests and responses between them and processes data. We have 2 different models for each app and the web, and the two models used *(NodeJS & ExpressJS).*

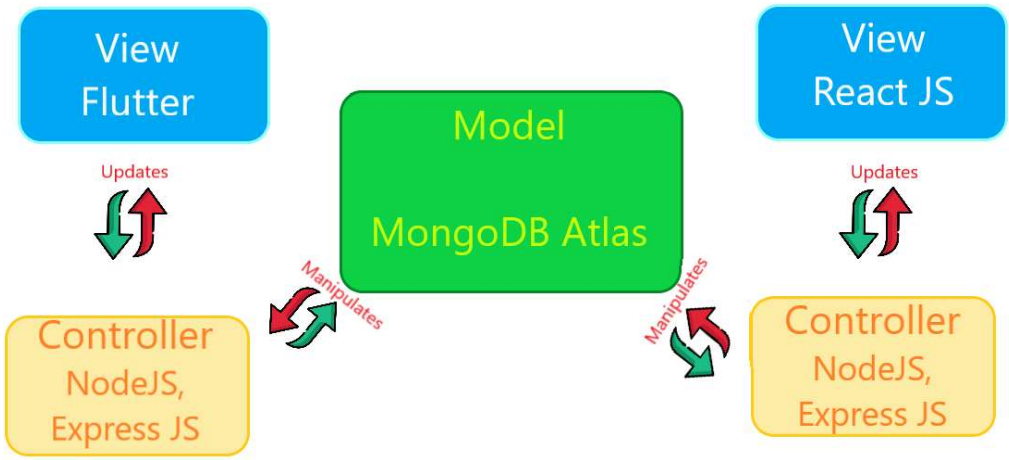

Fig.1: This figure show our Project architecture.

5.4 Project Design

5.4.1 Admin Website

Now we will display the municipality's website with all its pages and a brief explanation of it.

Fig.2: Welcome Page when open the website.

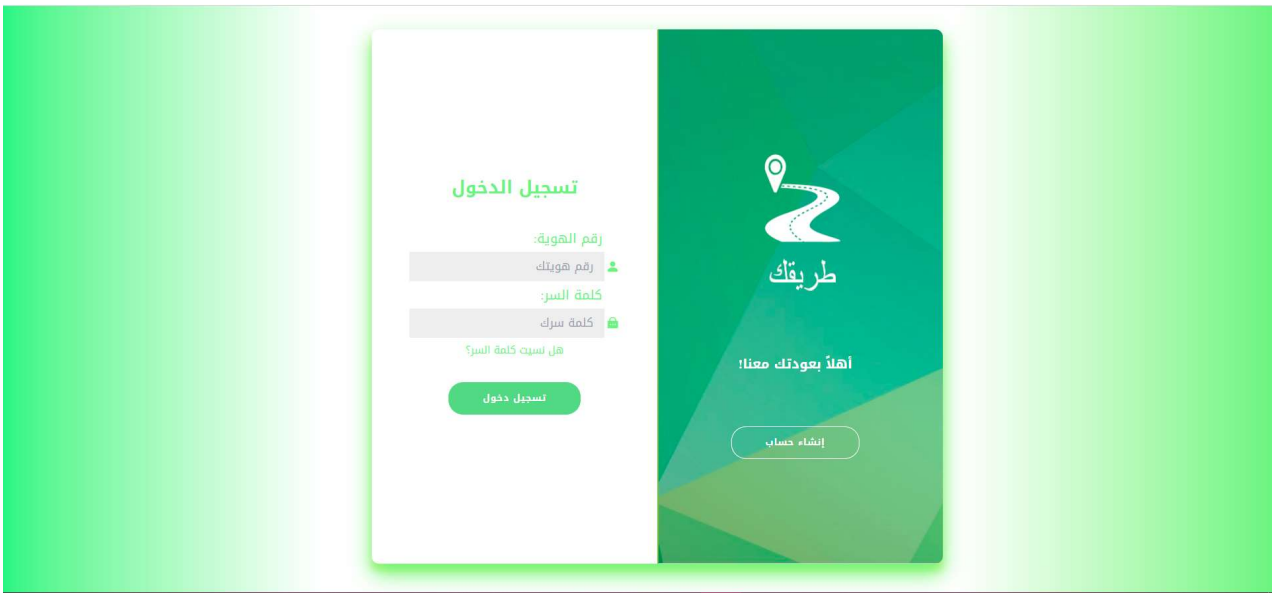

Fig.3: Login page for the Admins.

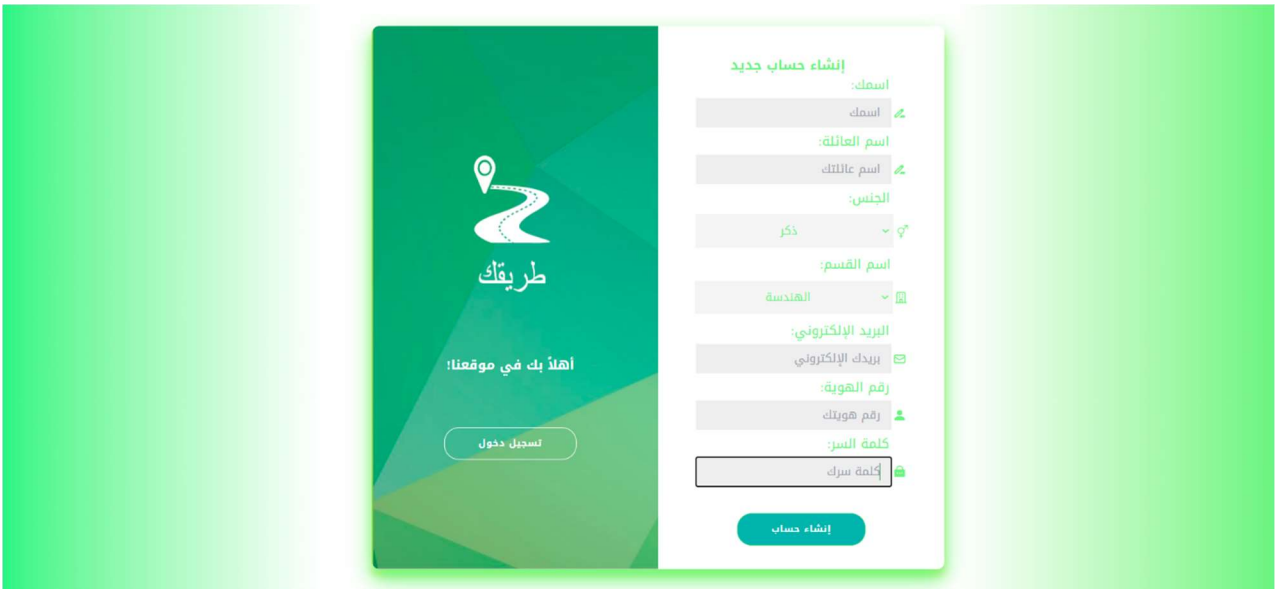

Fig.4: Signup Section that switched when pressing the button "إنشاء حساب".

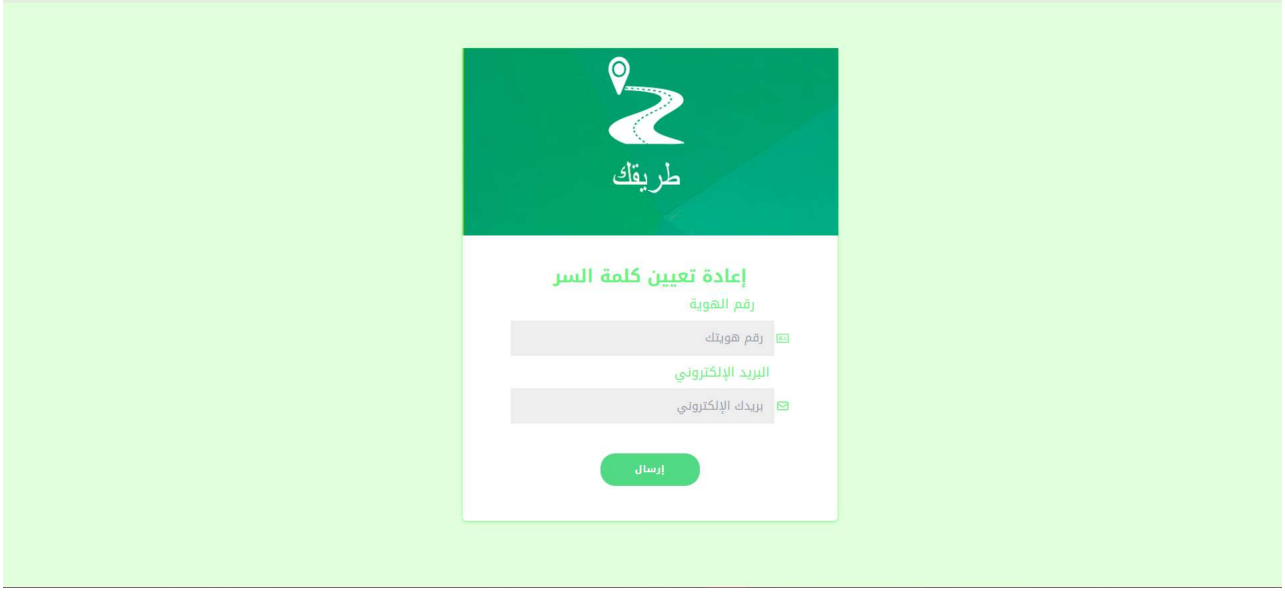

Fig.5: Restart Password page.

Fig.6: The message that appear when sending email to restart password.

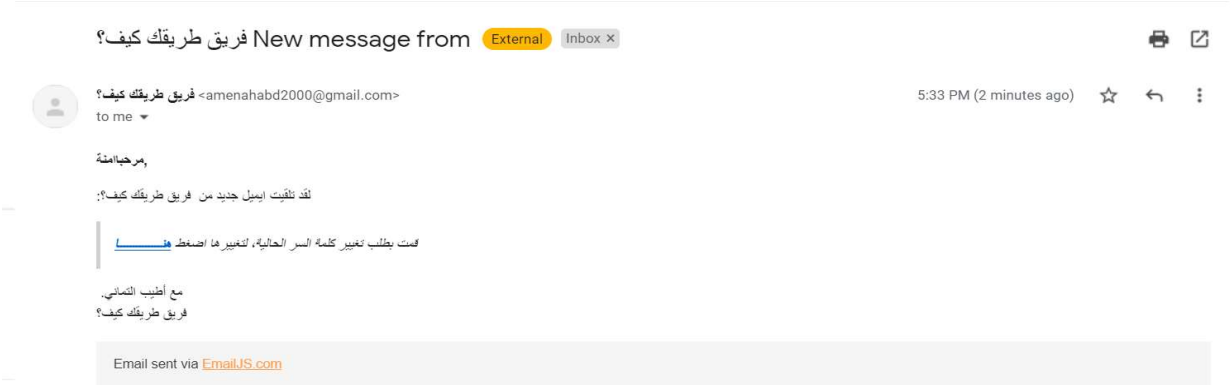

Fig.7: The Email that you receive to restart password.

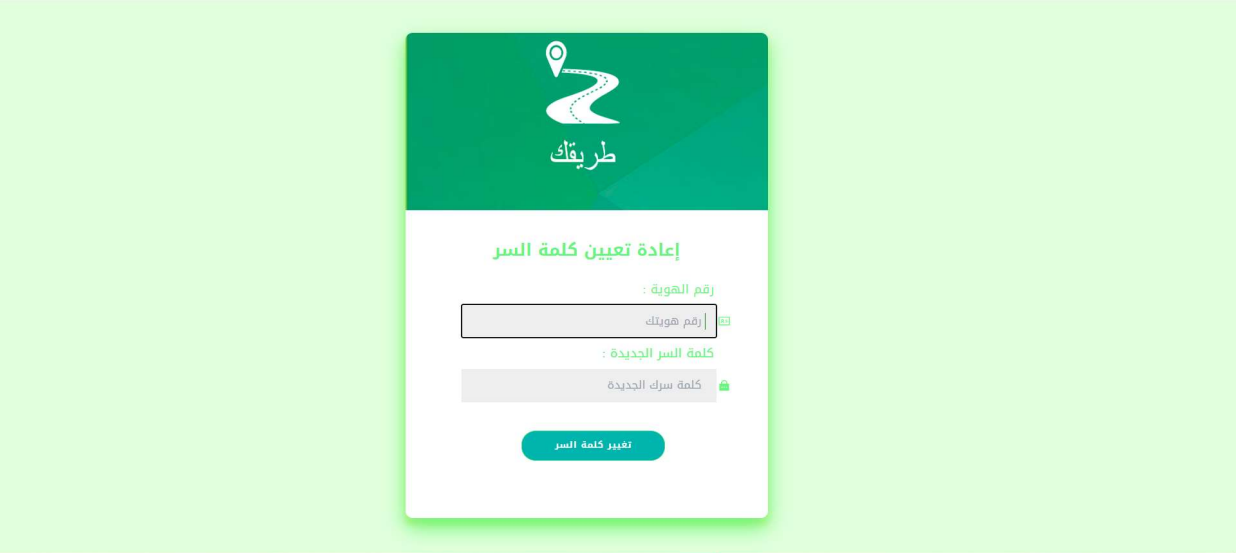

Fig.8: Change the Password that appears when pressing"هنا" on email.

Fig.9: Dashboard Page for the Admins for recent updates.

This page shows a quick summary of the responsible person for the number of complaints opened and the number of reports processed. It also displays charts about it with another chart for the number of each type of complaint, in addition to it displays new complaints quickly to make it easier for the administrator to view them the first time. Once he opens it goes to the complaints page.

Figure 10: Popup showing recent complaints.

Fig.11: Compliments Page for the Admins.

Complaints page. This page displays all the resolved and unresolved complaints uploaded by citizens and displays all their details, with the possibility of filtering them according to the type of complaint based on the day, month, or year, in addition to setting a date for resolving the complaint and sending a notification to the citizen who uploads the complaint, and displaying The remaining days for resolving the complaint whose date has been set, or the number of days that have been exceeded, in addition to all that, graphs are displayed showing the number of complaints for each type of complaint for the current month.

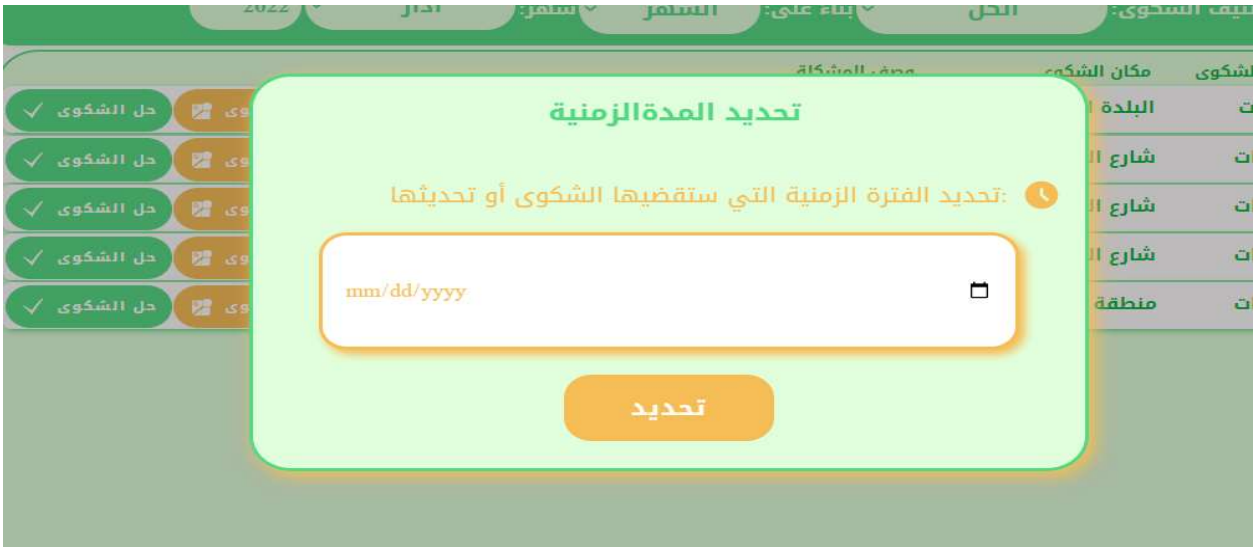

Fig.12: Popup message that appears when pressing the"تحديد الفترة" button, to set the time for compliments, and record who the admin that set time.

Figure 13: The image of the complaint uploaded by the citizen, which is opened when the "فتح الصورة" button is pressed.

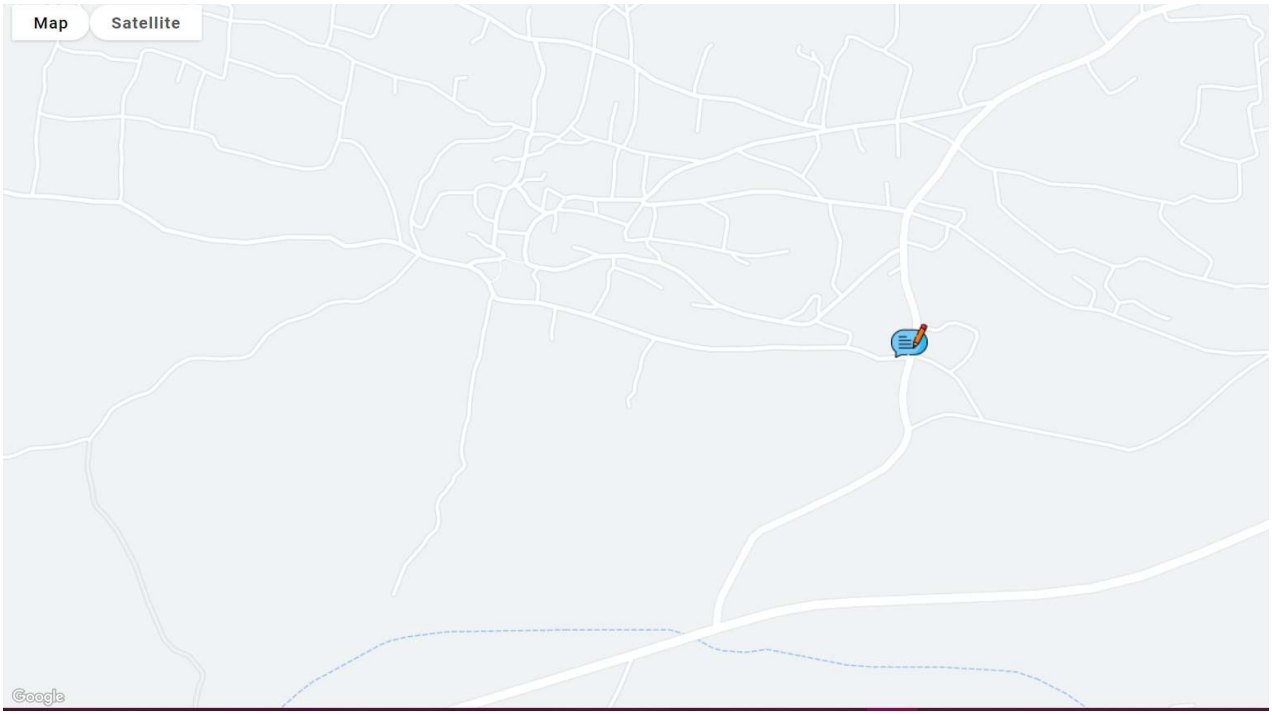

Figure 14: Complaint location on the map, which opens when you press the “Open Complaint Location” button.

Figure 15: A pop-up that opens when clicking on the "حل الشكوى" button. It allows the admin, after resolving the complaint, to write a report on the mechanism he used to solve it, in addition to sending a notification to the citizen who uploaded the complaint.

Figure 16: Resolved complaints table which changes when switching to solved complaints.

Figure 17: A pop-up that shows the report of solved compliment, when pressing the "فتح تقرير الشكوى"button.

Figure 18: Analysis page that analyzes all data coming from citizens.

The analysis page analyzes complaints of all kinds, in addition to road condition reports that are read through sensors and submitted by citizens. Where five priorities are presented to the streets that contain a greater number of bumps, vibrations, and violations, which were monitored through reports and complaints. The first table displays the name of the street and its priority with the total number in detail. The second table shows the most used streets, which were analyzed through the readings of the reports. As for the map, it displays all the data mentioned above and colors each street according to its priority, with the possibility of filtering the map according to the need.

To build this page, we first identified all Jamma'in streets whose locations and names were taken from the municipality and displayed on our map, where we determined the beginning and end of each street on the map, in addition to taking 10 points from each street to be used in the algorithm for determining each complaint or report on which street it is, The algorithm used for this calculates the distance between the place of the complaint, for example, and between the beginning and end of the streets, and the result of this is the inventory of the streets close to the place of the complaint. The distance between them is the street in which the complaint is located.

For the most commonly used road algorithm, we take the sensor reading location every 10 seconds, calculate the distance between this point and the beginning and end of the street, then calculate again the distance between this point and all the 10 points of the confined streets, and the minimum distance determines which street the point is located in. And if there is a repetition of one reading on the street, we do not take it, all these points are summed up and the five most common streets are counted.

We chose a duration of 10 seconds because we measured the time we traveled on the city's shortest street named "شارع الحبلة", and based on that we took it.

Figure 19: Citizens page that shows all Citizens info who signed up on the app.

Figure 20: Record the interactions done by the citizen from the road condition reports.

Figure 21: Roads condition reports page.

This page displays all the readings uploaded by citizens through the acceleration sensor, explaining all its details and whether it was analyzed or not, in addition to the feature to filter it based on the day, month, year, or view all.

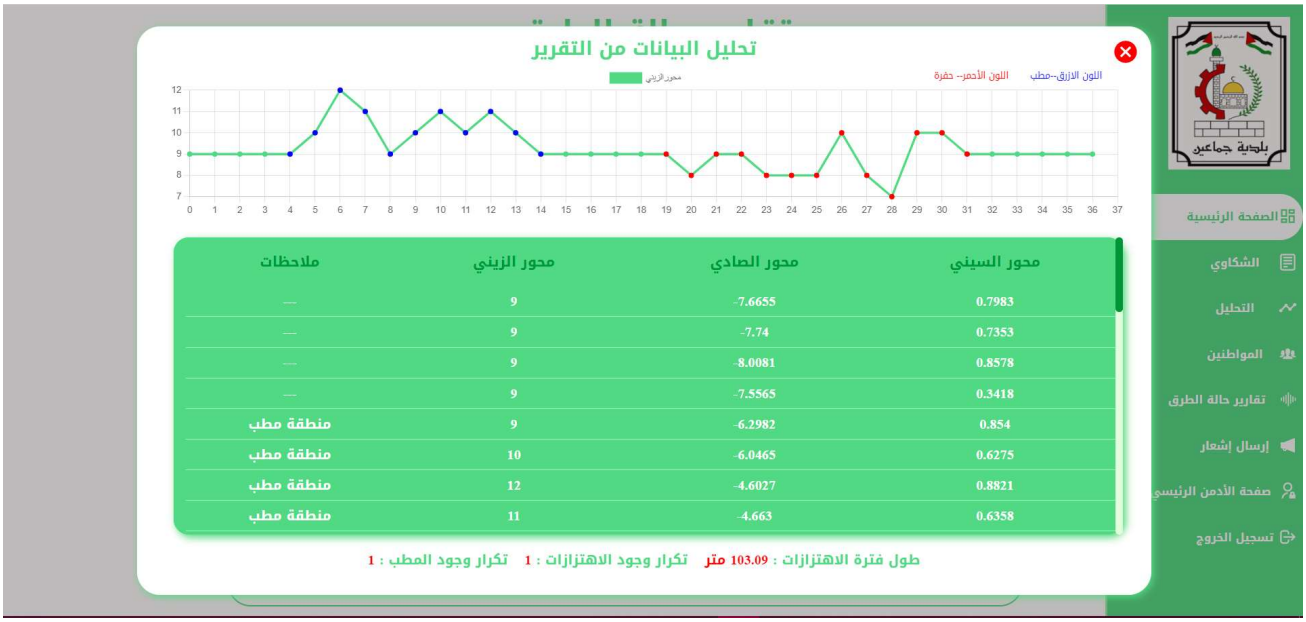

Figure 22: Analyzed data from the Road Condition Report that showed readings from sensors, as well as bumps and potholes on the road.

It is noteworthy that we added the distance of the period of vibrations, if any, in addition to that, the number of repetitions of bumps or vibrations from previous reports that were analyzed.

Figure 23: The map shows the path that the citizen followed while recording the sensor readings, as well as the location of the terrain and the analyzed holes on the path.

The algorithm that we followed to analyze the sensor readings is as follows: We made many attempts and experiments until we finally concluded that the sensor readings when there are bumps do not go down from the starting point unless it is one point, as for the vibrations, they range above and below the starting point, based on So we built the algorithm.

Figure 24: Notification Page.

The notifications page is a page that enables the admin to fill in all the necessary information with the notifications while specifying the location of the notification on the map, and when sending, the choice is made to send it to all citizens or to select a specific area and send it to citizens in that area only.

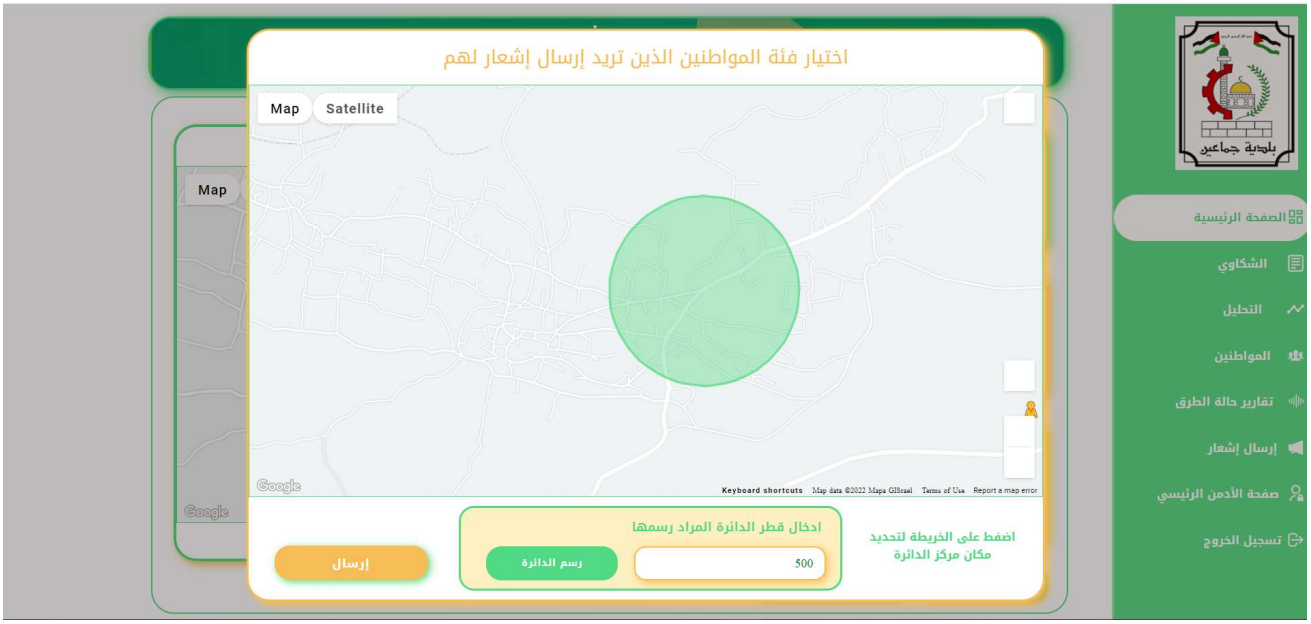

Figure 25: Specify a specific area to send notification to citizens in that area only.

Figure 26: Main admin Page that show the compliment section.

This page displays all the complaints that the supervisor is working on, or the complaints he has resolved, in addition to displaying his information and the ability to modify his email and password, in addition to the feature of uploading the identities of new citizens to the database. To the site, display their information and details, and he can delete any admin he wants, or accept an admin's request to register.

Figure 27: Main admin Page that show the Admins Section.

There is also an admins page, like the Main admin Page that shows all the compliments that he solved, or works on there, in addition, he's information.

Figure 28: Logout Page.

5.4.2 Citizens application

Figure 29: First Page.

The first page that enables him to see the name of the application and choose whether this is his first visit to create an account or it is not like that to log in to his account.

Figure 30and 31: Sign up Page.

The first steps required to create an account on the application is that the citizen is a citizen of the town, where their identity numbers were previously stored in the Database, and non-citizens are not allowed to own an account.

The citizen enters his identity number, his e-mail, his geographic location and some other information. Then, the creation of the account is not approved before making sure that his identity number is among the previously registered identity numbers.

Figure 32: Login Page.

The login step comes after verifying the existence of the identity number and verifying the identity of the person. Here, it is required to enter the previously entered email and the account password to ensure the security

Figure 33: Home Page.

This page is a window overlooking the services provided by the application, as it provides the registration of a new complaint or the creation of a new road registration, the profile feature and the feature of notifications coming from the municipality.

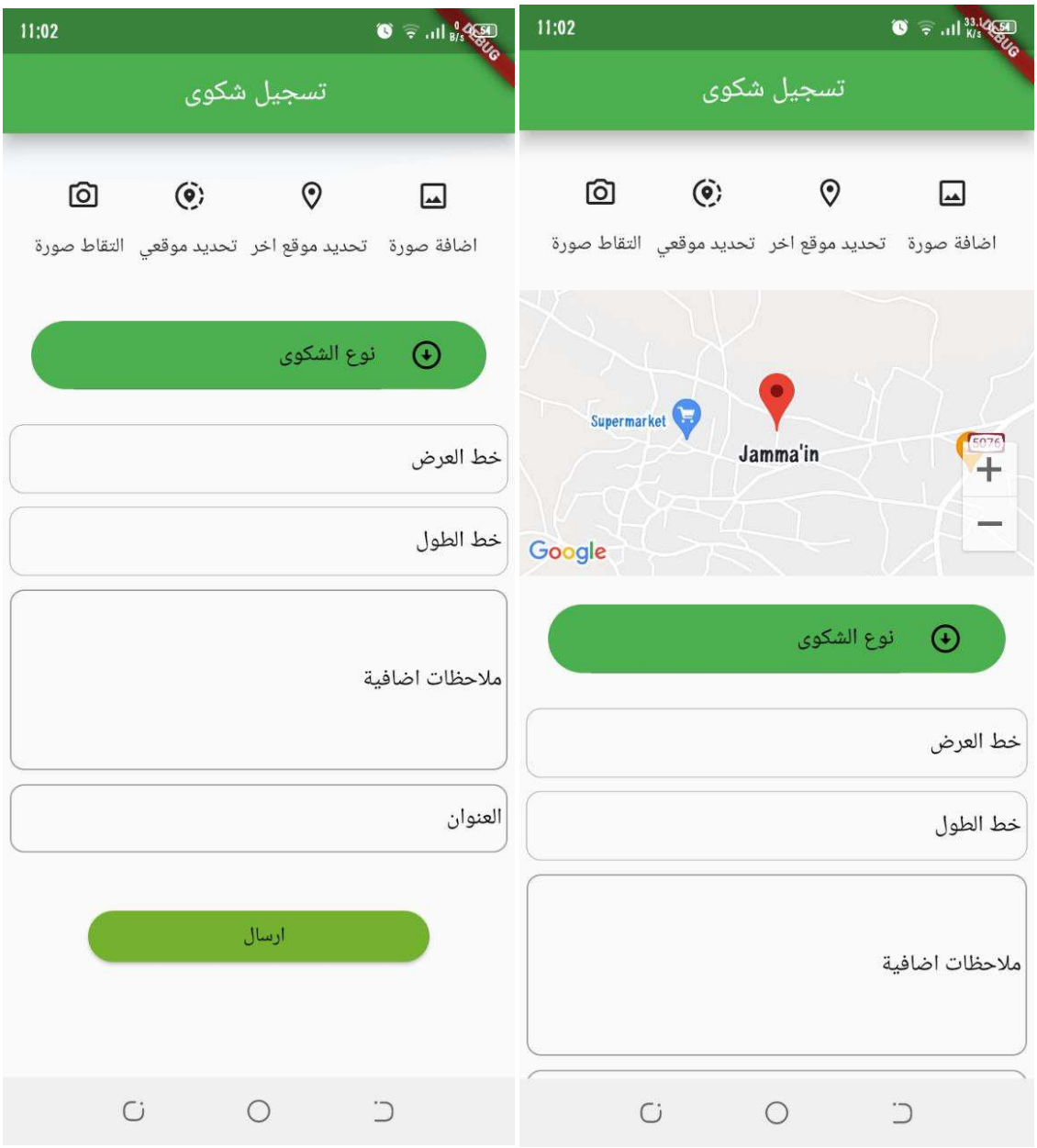

Figure 34 and 35: Complaints Page.

The first feature provided by the application is the possibility of submitting a complaint to the municipality in the form of an image, where the image is taken of the desired complaint and the geographical location is determined when this image is taken, or it is possible to upload a previously saved image and enter its geographical location by pressing the select another location button to show a Google map and then Click on the desired site, and file a complaint requires entering other details, including the type of complaint submitted. Is it a complaint about bumps, potholes, or even infringements on the sidewalks. In addition to entering the name of the street, it allows the possibility of entering some notes before pressing the send button to be sent in turn to the municipality and there The feature of responding to this complaint by the municipality.

Figure 36: Recoded Page (road aunt registration).

The next feature provided by the application is to operate the Acceleration sensor and the geographical location by pressing the start button for registration. The command allows a chart displaying the resulting values of this sensor and the possibility of noticing any change in the road condition. When you press the stop button, the registration is completed and sent to the municipality. To benefit from the readings taken in two areas, the first is to analyze the condition of the road and distinguish the presence of bumps and potholes, and to determine the road taken by the geographical location that was monitored during registration.

Figure 37: Profile Page.

The profile feature where the data entered by the citizen is displayed except for his identity number, in addition to displaying the number of points the citizen has collected by submitting a complaint or providing readings.

Where every time a citizen files a complaint, a point is counted for him, and the same is the case when submitting a new registration.

If the citizen wants to change any information about him, can by these pages:

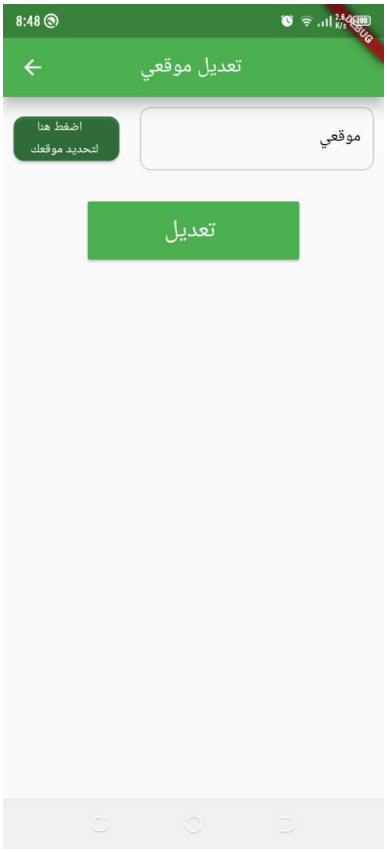

Figure 38: Change location Page.

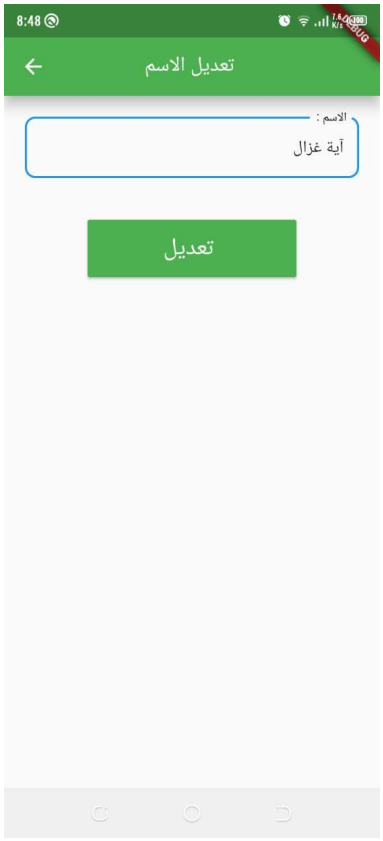

Figure 39: change name Page.

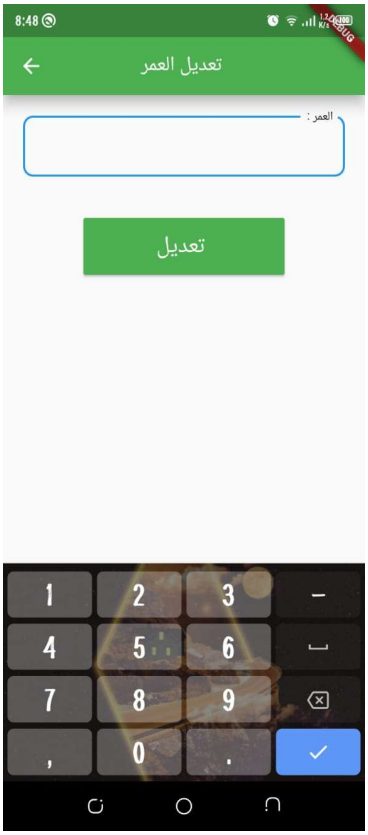

Figure 40: change age Page.

Figure 41: Notifications Page.

Notifications feature, which is one of the most important features in reaching between the municipality and citizens, as the citizen will receive a notification stating any repairs or modifications to the condition of the road close to the geographical location that he entered when creating a new account, or it is possible to receive a notification for all citizens who have accounts on the application, and this Depends on the municipality to choose the target group of the notice

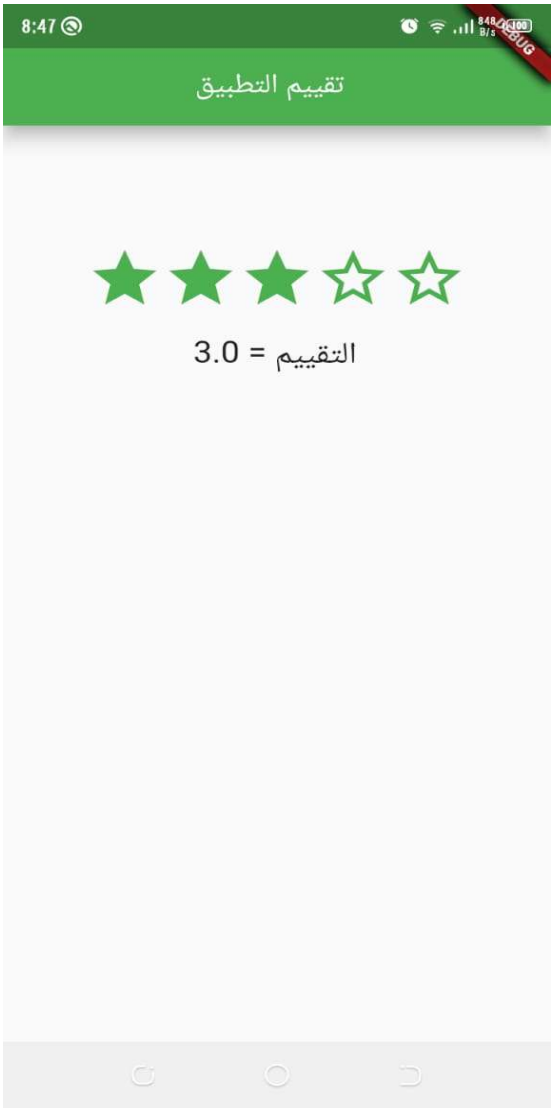

Figure 42: Rating Page.

In this page, allow to user to make rate for our project, which allows us to take his vote into account to improve it as much as possible and make the project best.

6 Result and Discussion

Your Path Project is an application directed to the municipality of Jamma'in and its citizens, and it consists of a multi-platform application for smartphones that constitutes a tool for collecting data about the road sector by citizens, to be used on the website of the municipality's engineers, which in turn analyzes this data and presents it to them to facilitate their work as much as possible. The app and website constitute a project that aspires to improve the relationship between the two sides, collect and analyze data, and prioritize street and road repair.

We learned a lot and gained many experiences in a short period of time, as our project relied on the design of the Human Center, where we learned in the field to interview citizens of different ages male and female, municipal engineers, and most importantly, we learned how to ask the right questions that helped us hear the problems that The town suffers from it and then reduced it to a basic and basic problem that was the title of our project, and we learned both technically and programmatically a lot of things, such as using the sensors available in smartphones and learning how to read them and identifying the algorithms adopted in the presence of bumps and potholes and identifying the most frequently used streets.

7 Conclusion and Future View

In the end, we made an application that works on several different platforms and a website, as the project facilitates the work of the municipality in discovering and knowing the condition of the roads. It also relies on a methodology that takes care of the interests and needs of both the citizen and the municipality and consolidates their relationship together.

Any citizen in the commune town will be able to download the application so that he can upload all his complaints, record road reports, and keep up to date with the latest notifications issued by the municipality, and the municipality can now use the site that analyzes all the data provided by citizens.

Our project is private in the town of Jamma'in but we hope to expand the project and generalize it in both towns and cities and improve its algorithm to be more accurate and assured, and listen to all opinions and constructive criticism to improve the project and provide the best version of it, as much as possible.

8 References

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