



An-Najah National University

Faculty of Engineering & Information Technology

E-Governance in Palestine and the MENA Region

(INDIGO) Project

Project #5

Your Nearest Path App



This Project done in cooperation between:

Computer Engineering Department

Urban Planning Department

Urban & Regional Planning Unit

Nablus Municipality

GIZ

IND'GO

Towards Citizen-Centered and Inclusive Digital Governance in Palestine



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2 Disclaimer

This report was written by Dalia Omar and Roaa Barq in the Department of Computer Engineering, College of Engineering, An-Najah National University. It has not been modified or corrected, as a result of the evaluation, and may contain errors in the language as well as the content. The opinions expressed in it together with any findings and recommendations are only those of Dalia Omar and Roaa Barq, and An-Najah National University assumes no responsibility or liability for the consequences of using this report for a purpose for which it was assigned.

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3 Abstract

Technology nowadays takes a large space in our lives, especially in applications that aim to solve a problem. It is good that recently technology has been added to find modern technological solutions for municipalities with the support of e-government for Palestinian municipalities through the design of digital services and solving these problems with the involvement of citizens as actual users of these solutions through a collaborative creative process spanning from identifying the problem to developing and testing solutions and increasing the possibility of access and participation.

This project relied on a human-centered design methodology to create an application that solves the problem of waste accumulation in the city of Nablus, targeting citizens and drivers of municipal cars affiliated with the Solid Waste Department.

Users (citizens) will be able to log in and sign up, track the municipal cars of the solid waste department. As for the municipality car drivers, the shortest way to unload all the area's containers will be shown at a lower time and cost. This project includes a mobile application. The Flutter framework, which is based on the Dart programming language, was used to create a mobile app. It also provides an API, which is an open source server environment that Node.js uses to enable core features of applications and handle the two types of databases used, "Mongo DB".

Finally, the project went through the entire development process from start to finish, starting with database development, then design, then implementing everything, and putting it all together.

4 Introduction

4.1 Problem

The main problem is the accumulation of solid waste in commercial areas, which affects the citizens who use the area, in addition to the occurrence of traffic congestion during the waste collection process by municipality employees due to the lack of specific paths that take into account the shortest path, priority streets and waste collection times, which increases the collection cost on the municipality.

According to Nablus municipality's interviewed, The city of Nablus suffers from many problems related to the solid waste sector due to commercial activity and its large population, which generates very large quantities of solid waste that accumulate in and around containers and on the edges of the streets, which affects the citizens who use the area and the owners of shops, in addition to the large traffic congestion in the main streets, which are the commercial and service artery and the city center, in which administrative, commercial and service services are concentrated, which causes a large accumulation of waste due to the difficulty of collecting cars in them and the randomness of the waste collection

process by municipality employees. This large accumulation of waste is due to the lack of an efficient system for managing the waste sector and its collection process according to the appropriate times (peak times - day and night) and following the shortest roads and priority areas (commercial - industrial - service - residential), which increases the cost of waste collection on the municipality and citizens themselves.

4.2 Objective

The main goal is to organize the process of collecting waste throughout the day with the least possible time, effort and cost, and to help determine the paths of solid waste collection vehicles and determine the shortest path.

4.3 Scope Of the Work

Your Nearest Path application focuses on the citizens of Nablus Governorate, the municipality of Nablus, Waste collection vehicles drivers and Owners of commercial and industrial stores (traders).

4.4 Importance

Finding a smart and technical solution to the municipality' s problems contributes to:

1. The process of solid waste collection management in a good way will raise the level of beauty and purity of the city, improve the general appearance and relieve stress and diseases among citizens, which reflects a clean environment for tourists and city residents.
2. Providing the municipality with citizens' information.
3. Improving digital services saves time and effort.
4. Organizing and managing the waste collection process in the city.

4.5 Report Organization

In general, the report is divided into seven phases, beginning with the introduction,

Then constraints, standards, and codes, then an emphasis on the previous coursework used in the project and the main challenges, then a chapter on literature review, and after that, the methodology chapter, which will include work and the tools and technologies used to develop this project.

Following that, we will highlight the obstacles we overcame and the accomplishments we obtained in our results and discussion. Finally, we conclude with our recommendations and future work development goals with the conclusion chapter.

5 Constraints, Standards and Earlier coursework

5.1 Constraints and Limitations

In each project, the constraint can appear during each stage of the project, starting with the selection of the title of that project. The following are the constraints encountered during the completion of this project:

1. The problem:
Determining the problem correctly required a great deal of effort and time, because of the different regions in terms of population density and geographical location.
2. Limited Resources:
It was very difficult to access some resources Related to the programming languages used, which necessitates a double effort To learn from different sources.
3. Lack of time:
4 months is not enough to complete such projects, starting with the search for a problem.
4. Fixed cost:
canceling some uses because of its cost.

5.2 Standards

5.2.1 MVC (Model View controller)

The entire project has been divided into 3 main phases using the Module View Console style in our system. These components are as follows:

1. The Model: Represents the database we used, Mongo DB. will respond For both view request and console request to continue updating Itself.
2. The View: It is a graphical user interface that citizens will use to track the location of a municipal vehicle, a graphical user interface for municipal employees to allow porters to track a vehicle.
3. The Controller: It represents the backend server created with NodeJs, Facilitates coordination and collaboration between the model and the view. It is also responsible for managing the application logic.

5.2.2 Agile Model

The agile model is the scope and requirements of the project at the beginning of the development process. Plans for the number of iterations, the duration of each iteration and its scope are clearly defined in advance. It was divided into five categories, which are:

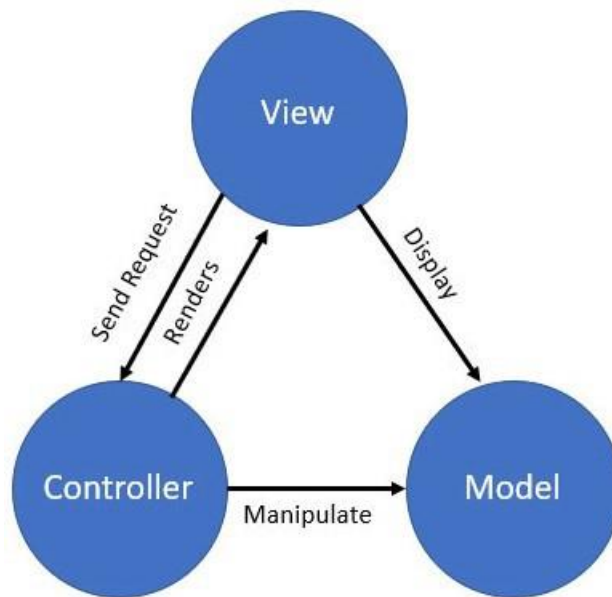


Figure 1: MVC Structure of the system

1. Meet and Plan : meet citizen to find problem and brain storming to get all the needed requirements.
2. Design: We designed the UML diagram to demonstrate the functionality of new features and how they will interact with our system.
3. Code and Test: we started writing the code for the front end and back end of each page and connect them in each other and make sure that every page works correctly.
4. Release: we issues the project for the user' s work environment.
5. Feedback : we kept getting feedback from the GIZ team and the municipality if the project we built satisfied their requirements.

5.3 Earlier coursework

During the last 4 years, we studied many courses in the Computer Engineering Department that added a lot of knowledge and Skills like programming. Some of these courses helped us with this project:

- Object-Oriented Programming .
- Web Programming .



Figure 2: Agile model

- Artificial intelligence .

Plus, we' ve taken online courses at:

- Node.js.
- Flutter.
- MongoDB .

that helped implement and develop our project.

6 LITERATURE REVIEW

The importance of smart phone applications in being one of the most important and latest modern technology software, which has been able with its capabilities and influences to affect all areas of contemporary life because it is based on solving many problems, and the most important of these problems is the problem of solid waste in the governorates. The Solid Waste Department in Nablus uses an electronic application to track the collection cars, but the application is not specific to the department and does not manage the collection process. It locates the cars and finds out which cars are working and which have finished their work and returned to their parking lot. It also identifies the name of the driver and the number of each vehicle in addition to alerts and conversations for workers. .The application contains container locations in the hidden neighborhood only. So, the application of your Nearest path to citizens was created in order to reduce the accumulation of waste in the city of Nablus, and to organize the collection process. It is the first application in this field in Palestine.

7 Methodology

Based on the results of the research and literature review conducted in this regard, We concluded that the idea of this project was an excellent idea that would benefit the municipality. In this chapter, we will Discussing data collection, analysis and processing, as well as methods and tools, The systems used in the development process and the results obtained.

7.1 Human-centered design methodology

In this stage, we have gathered the requirements using a human-centered design pattern, starting with interviewing citizens and identifying their needs, moving on to defining the problem and creating satisfactory solutions, then Apply and test it.

7.1.1 Inspiration phase

At this stage, the work team conducted several interviews with citizens, municipality employees, shop owners and employees in different areas of the city, including the university and hidden areas and the city center, by asking them about the problems they face during their day of waste and their opinion of the waste collection process in the city and suggesting some solutions To improve the process and facilitate work for the municipality and citizens alike Where the number of interviews reached 22, 7 were by municipal employees and 15 from citizens as shown in Figure 3 .

Number of people in the -20) age group (30	Number of women	The Number of citizens	Number of people from the municipality	Number of people interviewed
3	9	15	7	22

Figure 3: Interviews data

7.1.2 Ideation phase

After settling the problem, two prototypes were developed next Conduct another round of interviews with citizens and municipal staff for Survey how satisfied they are with the solutions or if they have any thoughts. To set the end result, which can be defined as a smart app with the extension The following features:

1. Determine the locations of the baskets and thus determine the path of waste collection vehicles based on the shortest possible route in order to reduce cost and time.
2. Postpone the collection of waste on the main roads until the evening or night times.

3. Organizing the waste management and collection process in an easy .



Figure 4: interviews with citizens and municipal staff

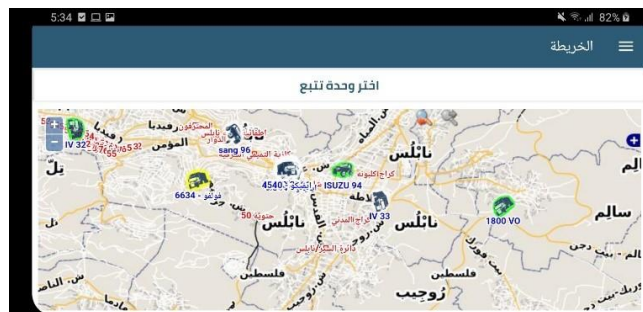


Figure 5: App used in municipality

7.1.3 Implementation phase

At this stage, work is done with Nablus municipality employees, including Track how satisfied they are with the output of any pages created in the project And get feedback to improve the project. Also included, identifying tools, The programming languages used in building this project.

7.2 Tools, Methods and Programming Languages

Many programming languages and frameworks had to be used when designing the app for mobile devices ,Here is an explanation for that:

7.2.1 Client Side

Design: We started working on the app after choosing an idea, preliminary templates were prepared for its implementation. Then we chose a file The color theme of the application, which was based on the color of the trash cans and cars for emptying, developed according to the content of the application,It used a simple, easy to use and basic design.

Frameworks: One of the frameworks was used that enables you to work on Android and iPhone applications. Through Flutter, which saved a great deal of time and effort in development across platforms. Apart from that, Flutter also provides several ready-to-use (UI) tools for creating a modern application. These tools have been improved as it maintains 1 pixel from the screen, ensuring that our design looks the same on any screen mobile device (including older ones), all in a short amount of time. Although it is a relatively recent language, it has a large number of library that makes code generation easier and adds elegance to the application.

7.2.2 Server Side

- Design of Servers: We used a server and client architecture. We used it like this Many of our clients (in mobile app), Each of the admin, the citizen and the driver will have a programming interface.
- Runtime environment and packages On the server side, we chose Node.js because of its speed while staying power, including simplicity to learn and excellent documentation, as well as impressive scalability and performance. This is why we chose it over alternatives like or ASP.NET. Node.js will be able to offer magical solutions for activities that require data exchange between different visitors in real time.

7.2.3 IDEs and Code Editors

To edit the code, we used Visual Studio Code. It offers exceptional capabilities through downloadable plugins, making the development process more adaptable. Debugging, code formatting, and code completion. Since we were developing for both Android and iOS, we needed Android Studio, and we only needed one IDE to do this. We have a problem with that Different functions of Android and iOS should be tested individually. On our computers, we can test Androidapps, but not iOS apps.

To make the municipal car move for testing, we used Ride with GPS.

7.2.4 Version Control

For a project of this size, such as ours, backup and version control are critical. We created one GitHub repositories, for the application , to which we regularly uploaded All code and its documentation live in one place by combined the work done by the two individuals on their respective devices to avoid any data loss or substantial conflicts.by Github makes easier for team members to collaborate and track code changes.

7.2.5 Server and API Testing

As we all know, we need to test portions of the server on a regular basis to determine if the API is usable and what happens when we submit the necessary data. All of this is done with Postman. Postman is often used to accept and display data to the user. Postman is an API platform for building and using APIs. Postman simplifies each step of the API lifecycle and streamlines collaboration so you can create better APIs—faster.

7.3 Database Design

We cannot develop a mobile phone or create a website without A database that saves and stores everything that is used in the application. MongoDB was chosen because the most important aspect of this genre Database It is a Dynamic and Flexible Schema. The database on The mongoose should not be forgotten it is an object document schema (ODM) that Simplifies the use of MongoDB by converting documents in the database for objects in the application.

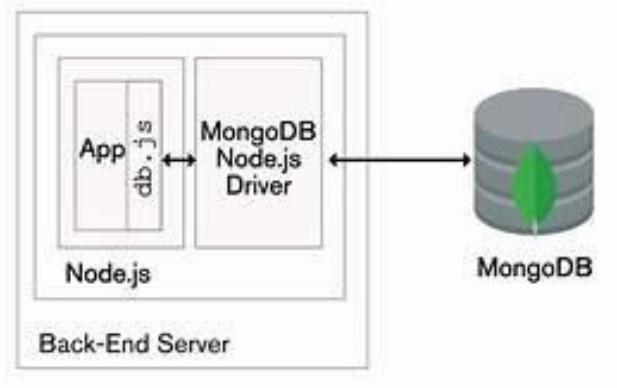


Figure 4: MongoDB Server

To create the database, we followed these steps:

- Split the entire application into a collections, then install a file Document attributes.
- Determine the relationships between collections.
- Implement each type of relationship in the right way using primary and foreign keys.

7.4 System Features and Implementation

They can be categorize in groups as the following:

7.4.1 Login and Registration feature

Starting with the splash screen which is the starting page of the project, Then to allow users to enter the system and take advantage of its features, they have To create an account on the registration page and add the required information Which includes your name, ID number, phone number, and The password. So this data has certain conditions. A citizen cannot create an account without These conditions are met, After that you can log in to the system via ID number and password.



Figure 6: splash screen



Figure 7: log in



Figure 8: sign up

7.4.2 user profile feature



Figure 9:show user profile

7.4.3 Admin feature

Adding and displaying trash cans feature: After successfully logging in, the first page that the driver sees is the home screen, Which includes all the features that they can do or show. The application allows the admin to add the waste basket based on its coordinates and the ability to track the municipality's cars.



Figure 10: Home screen for Admin



Figure 11: Adding waste Baskets feature



Figure 12: show waste Baskets feature



Figure 13: Adding officer feature

7.4.4 Driver feature

Adding the location feature to the municipal car: After successfully logging in, the first page that the driver sees is the home screen, Which includes all the features that they can do or show. The application allows the driver of the municipality car to allow the application to access his location and add it to the map, in addition to seeing the path that he should walk, which ensures the shortest distance for waste collector.



Figure 14: Home screen for driver

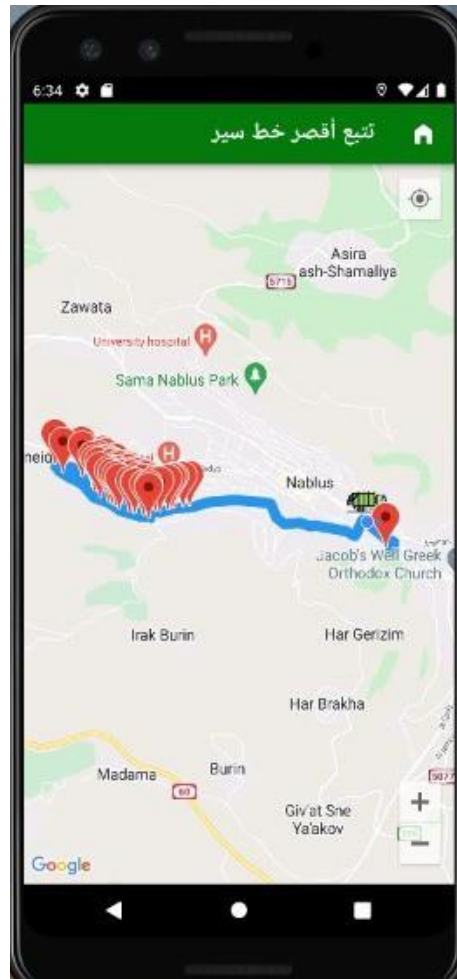


Figure 15: Shortest Path for driver

7.4.5 citizens feature

The user can see the collection solid waste Track.

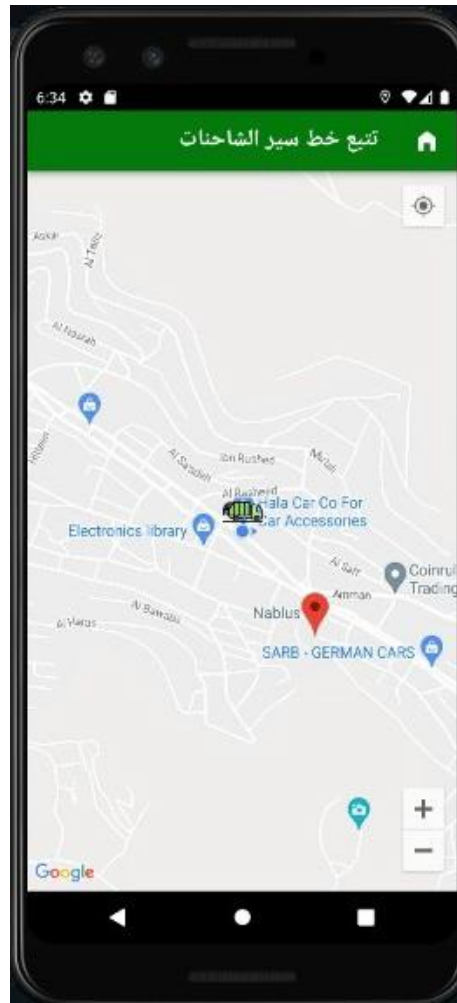


Figure 16: Tracking for citizens

7.4.6 Extra Features

To keep our users satisfied, another two features added:

1. **Bold font scalability:** This application supports text visibility, so the user may determine the correct font size to be shown from the settings. By go to the settings and selecting the accessible feature.



(a) The normal screen



(b) The screen after changing to large font

Figure 17: Large font feature

2. Rating application' s feature: With this feature, the admin will be able to track the satisfaction about the application by selecting one emoji from five.



Figure 18: Rating application' s feature

8 Result and Discussion

Your Nearest Path is a multi-platform mobile application that organizes the process of collecting waste throughout the day with the least possible time, effort and cost. It helps determine the routes of waste collection vehicles and determine the shortest path (Dijkstra's shortest path algorithm). We have gained and learned a great deal of experience. We were able to build Cross-platform app , as mentioned earlier.

9 Conclusion and recommendations

9.1 Conclusion

Building this project, gained us many skills and knowledge, including:

- Dealing with git and github.
- Creating a cross-platform mobile app with Flutter and the Dart programming language.
- Collaborating with many Flutter packages that important to achieve the project.
- Used Node.js to implement the back-end and dealing with MongoDB.
- Working with maps and learning more about open source maps.

9.2 Recommendations

With the spread and expansion of technology in the smart mobile phone industry, which helps the user and the service provider to overcome many barriers and provide the service to the fullest, it is necessary to develop it and continue to receive feedback and improve it for the better.

9.3 Future work

In the future, we will improve this project in different ways. For example, new features will be improved, such as the driver entering the state of Baskets, thus obtaining data on the amount of waste in the city and the absence of collecting cars in the same area, in addition to adding a special section to support recycling waste. And the method of separating and collecting it from the residents of the city, including the rest of the Palestinian cities, in addition to another feature that will be added, such as a feature to support people with special needs.

References

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