An-Najah National University

Faculty of Engineering & Information Technology

# E-Governance in Palestine and the MENA Region

# (INDIGO) Project

## Project #4

## Kahrabaii (كهربائي)

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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# Contents

# 1 Disclaimer

This report was written by Mohammad Mubaslat and Hamzeh Saleh from the Department of Computer Engineering at An-Najah National University, as a requirement for Bachelor degree completion. It is worth noting that this report may contain human errors, and is for educational purposes only, so An-Najah National University does not bear any responsibility for this.

# 2 Acknowledgment

First and foremost, we have to thank Allah our creator and our master, who gave us the determination and the strength to complete this work. Such accomplishment would not have come true without his great blessings.

We would like to take this opportunity to deliver our sincere thanks to our doctors especially Dr. Anas Toma for giving us the confidence to work and reach our goal while providing his heartfelt guidance and sparing his invaluable time, from the beginning until the completion of this journey. And for Dr.Ihab Hijazi, Eng.Saleh Qanazi and Dr. Samah Abu Assab from Urban planning department for their valuable information and accurate feedbacks.

Also great thanks to Tulkarm's Municipality Employees for being helpful, supportive and providing us with all data and information needed to come up with this project.

And finally, the deepest thanks to our families, friends, and to every person who contributed in making this project come into real by a word or an idea.

# 3 Abstract

Nowadays electricity has become one of the mandatory things that no one can live without, and has entered all aspects of life. But unfortunately, we at Palestine do not have the ability to generate electricity, because of many constraints and one of them the political issues we have. So it is bought from external resources but with limited amounts. This caused real problems for many municipalities, one of them is Tulkarm which suffers a severe crisis in the matter of electricity, which leads to an imbalance in productivity, whether from individuals, factories, companies, and quarries.

This project presents a real solution to this problem, which is a smart mobile application and a website that can be used by citizens and municipalities' employees. The project allows the citizens to have a fully managed service, starting from submitting a new electricity subscription, reporting electricity faults, showing them the location of available charging points, calculating the consumption and keeping them up to date about electricity news. The project also provides the employees with all citizens' consumption, citizens' data and subscriptions numbers, controlling the charging points' working hours. With these features and information, the employee would have clear decisions and can make the correct actions. As for the Technical support for this solution, there is a special controlling dashboard for the Admin from IT department, so the Admin can add employees to the system, block employees and citizens from the system, and review the feedbacks of users.

Flutter programming language was used to build this project, and because it is considered as a cross platform framework we used it for both the mobile application and the website. NodeJs was used to build the server, and MongoDB was used for database utilization.

# 4 Introduction

## 4.1 Problem

The city of Tulkarm suffers from many problems in the electricity sector such as:

- Large demand for electricity compared to the limited supply capacity available to the municipality. Where the amount of demand reaches about 47 megawatts, while the total quantity supplied is about 39.5 megawatts, as there is a current deficit of 7.5 megawatts.

- The city has a huge growth in urban population, and this growth is increasing continually from year to year. This will increase the demand in return to the same quantity of electricity.

- The continuous faults that occur in the network make the transformers to cut the electricity to relive the pressure. which causes an unfair distribution of electricity in many areas, whether they are residential or industrial areas

- Significant shortage of spatial data on the electricity network entered on Geographic Information Systems (GIS), such as data for electricity poles, pressure lines and subscriber information.

- Citizen's lack of awareness to make wise use of electricity and to move towards using the available alternative smart solutions.

## 4.2 Objective

Our main objective is to offer a software application that helps the citizens to have a quick service and reduce their consumption, also to give the municipalities a basic database to store all the necessary information and data.

## 4.3 Project Scope

In this project we focused on electricity department on Tulkarm Municipality, and the citizens of Tulkarm city.

## 4.4  Report Organization

In general, the report has 9 phases, starting from Disclaimer, then Acknowledgment, Abstract, Introduction, Constraints, Literature review, Methodology, Results and Discussion , finally is the conclusion

# 5  Constraints, Standards and Earlier course work

## 5.1  Constraints

### 5.1.1  Data Collection

Collecting the data was a little bit difficult and took some time to finish, beside the interviews and meetings with citizens and municipality's employees for the aim of having a clear understanding for the problem and give an efficient and suitable solution.

### 5.1.2  Time Limit

In our case we were racing against time to finish all the requirements. On one side, the encountered problem is critical and needs a real, and a practical solution. And on the other hand, building the front-end and the server's database required a very hard work and patience.

### 5.1.3  New Experience

As we are still students, working on this project was a challenge for us. Because it's the first time we deal with real customers and official sides, so we weren't having the enough experience at the beginning.

### 5.1.4  Responsive App

Building the app to work on both Android and IOS devices, taking into account the difference in screen sizes required a lot of testing, adjustments and refactoring the code.

## 5.2 Standards

### 5.2.1 Client Server Model

The Client Server Model is utilized to construct this project, which has three tiers: The project is divided into three stages, as shown below.

- **Client**: It is the interfaces that the user sees (the website and mobile app GUI), it is making queries to the backend and displaying the results
- **Server**: It is responsible for the application logic and is written in NodeJS. Sending queries to the database and serving incoming requests from the frontend (the client)
- **Database**: It is created with Postman and MongoDB. It is accountable for serve the request from the back-end server

## 5.3 Earlier Coursework

We did our best to apply all what we have learned in university's courses, such as Object Oriented Programming, Database Course, Web Programming. Also we took alot of online courses in Udemy and Youtube to learn Flutter, NodeJs and MongoDB.

# 6    Literature Review

The high demand for electrical energy and the decrease in supply caused major crises on the productivity of the region [3]. While reducing the total electricity usage can result from the implementation of more efficient technologies, decreasing wasteful consumption of resources via behavioral change is an additional measure [2]. For a successful and persistent change in behavior to occur, a supportive contextual setting, which can be created through an intervention, can facilitate this change.
Electricity companies face many challenges to remain competitive and enhance customer's satisfaction [1]. On the other hand, a number of government electricity organizations have developed general mobile phone applications to meet the needs of customers.

Meter's reading services have improved considerably, where energy's data could be collected remotely per user through telemetry[4]. In many developing countries where most electrical energy meters are still postpaid or non-smart devices, the utilities continue to rely on physical inspection and recording the user energy consumption for billing. This method is tedious, prone to error and delays in customer's bill preparations. This project proposes a mobile application solution that involves taking real-time pictures of energy meter readings using a mobile device and transmitting the data to a central server to process and extract the user consumption.

# 7    Methodology

This part shows some detailed information about the project, starting in choosing the idea then applying what we have learned from Human Centered Design to come up with the final idea.

## 7.1   Human Centered Design

Human Centered Design is a creative approach for problem solving, it depends on the users and citizens to find the perfect solution, and it focuses on understating the perspective of the person who has a problem. Moreover, Human Centered Design has three lenses which are Desirability, Feasibility and Viability
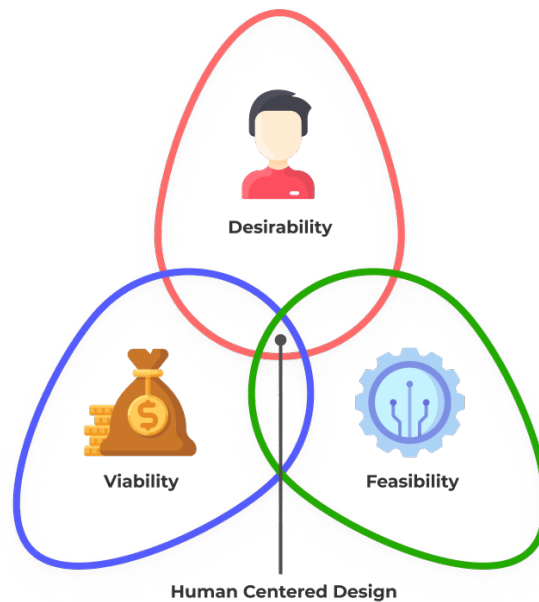


Figure 1: Human Centered Design

Also, Human Centered Design has three phases that we followed during the project. And they are discussed in details in the next coming sections.

### 7.1.1 Inspiration Phase

In this phase, we were preparing for the project so we went to the municipality to have clear ideas about their problems and we have discussed with them the possible solutions.

Our first meeting was with the head of the electricity department Eng.Mohammad Jallad and his secretary Eng.Rana. And after a long discussion we realized that their main problem is the big difference between the demand and the supplied amount of electricity, so the power will be cut continually because of the pressure, especially in summer times (July - September).

So they shared with us all the available information that would help to go forward and to start looking for the perfect solution. Our next step was to collect reviews from the community, to include their ideas in our suggested solutions. So we did in person interviews, in addition to sharing google forms.

The below table shows the of interviews that were done with different categories of citizens.

| Num. of all interviews | Num. of interviewed citizens | Num. of interviewed municipality employees | Num. of interviewed youth(20-30) |
|---|---|---|---|
| 17 | 11 | 6 | 5 |

Table 1: Number of interviews per each category

Figure 2: Interviews

Figure 3: Interviews

### 7.1.2 Ideation Phase

In this phase, we started to put the ideas together and working on the main features of the project, by designing the front-end interfaces and making a virtual project for testing purpose.

So, we asked the municipality to arrange for a meeting so that we can listen to their complaints and have some feedback, to start making the required improvements.

### 7.1.3 Implementation Phase

It is the final phase. In this part, the project was ready and all possible features were added after listening to users, employees and the Admin from IT department. Although, the project has been modified more than once to fit in with the requirements, because we believe that the customer's satisfaction is the most desired purpose for us.

## 7.2 Technologies

The field of developing websites and smartphone applications is very large, and in this part we will discuss everything we have used to accomplish this work.

### 7.2.1 Database

We have used a high-performance database, which is non-relational for many reasons. First, it provides a higher speed of data entry compared to relational databases, and allows handling of individual tables more easily and with a high security. Second, NoSQL databases provides a very high speed data handling, we used MongoDB. And it's worth noting that we used an additional tool to handle the database easier, which is called Postman

### 7.2.2 Server Side

On the server side, we used NodeJS, an asynchronous event-driven JavaScript runtime. NodeJS was a good fit for our project because it makes programming more efficient. It also provides a number of libraries, such as mongoose, that make it simple to connect your

MongoDB model to your documents. We designed the structure of the back-end server as a layer structure, in which we have multiple layers starting from the routers then to middle-ware authentication used to reach the model that we can enter the database from it.

### 7.2.3 API

We built a RESTful API with NodeJS and ExpressJS. We also used Google Maps API. An API is primarily used when integrating other services outside of your project. It facilitates communication by providing clear paths to take. The reasons behind using RestAPI are it's single responsivity, micro services and a trendy technique.

### 7.2.4 UI Design

In the first stages of implementing this work, we searched for the best technology that is compatible with all operating systems, to provide an intelligent solution capable of addressing problems. We used the Cross Platform programming language so that any user can use the application, whether from a device running Android, web, Mac OS, Windows or Linux. And this language is a flutter language developed by Google and is subjected to continuous development and improvements.

## 7.3 Emails And Notifications

We used an email API from SendGrid, which is a based email delivery platform. Emails are used for helping the users to Reset their passwords if they forgotten it, and for sending cancellation emails if the admin want to delete a user in case of any violations.

For pushing notifications, we used Firebase Cloud Messaging (FCM), because it provides a reliable connection between the server and the devices that allows sending messages and notifications.

## 7.4 Application Architecture

The structure of the application consists of many parts. The following images show how the application integrates with these parts smoothly.

## 7.5    Application Design

### 7.5.1    User pages
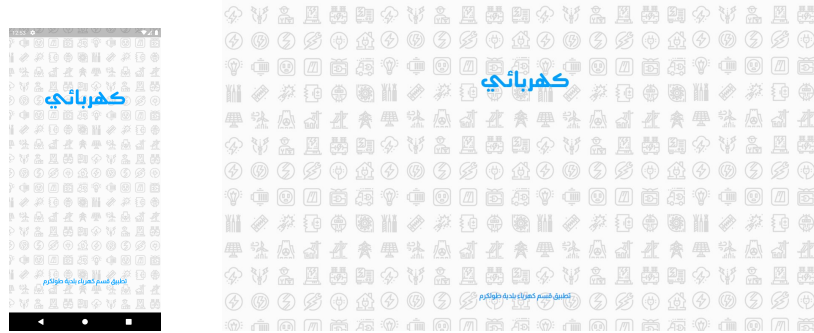


Figure 4: Splash Screen
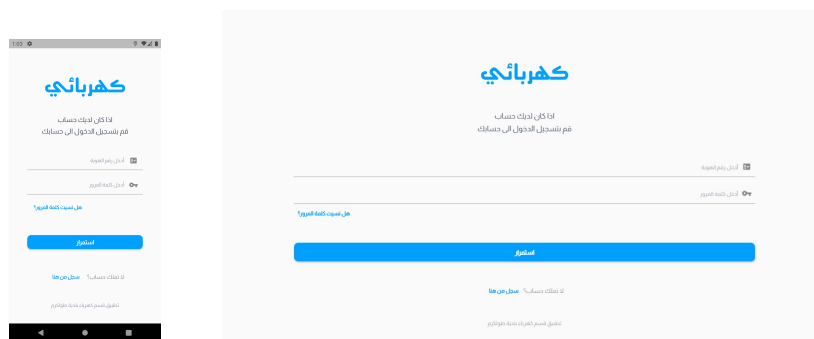


Figure 5: Login Screen
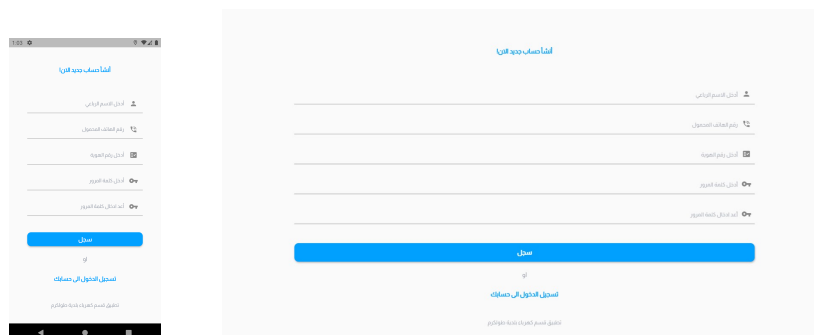


Figure 6: Sign up Screen

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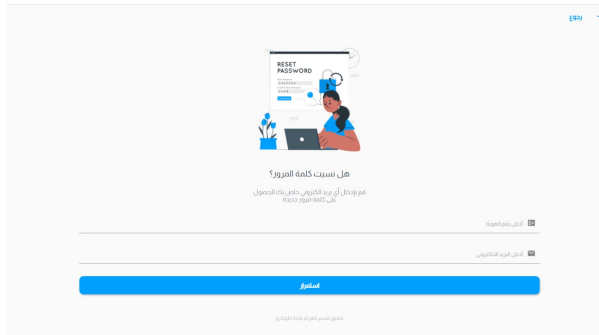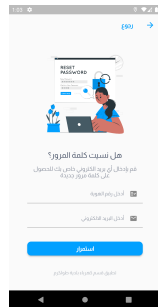
Figure 7: Reset password screen
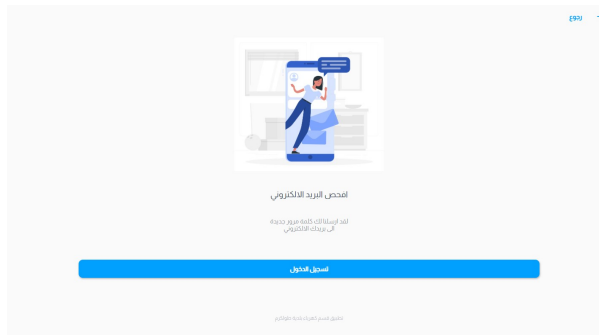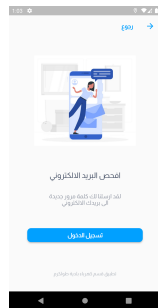


Figure 8: Check email Screen
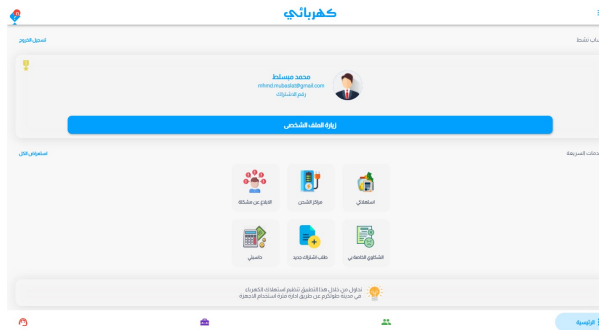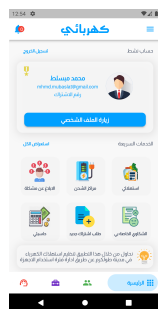


Figure 9: Main Screen

15
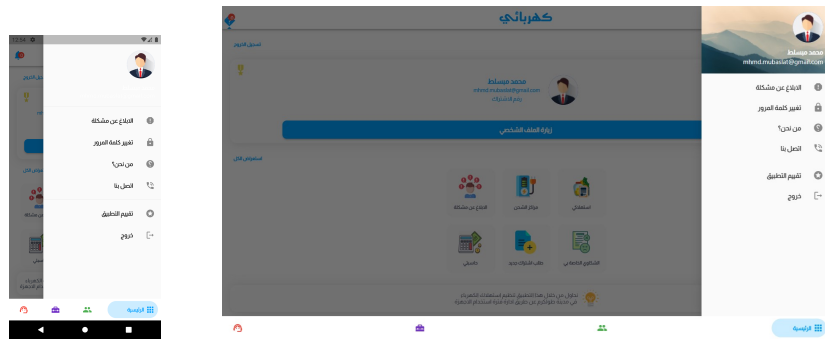
Figure 10: Navigation bar Screen
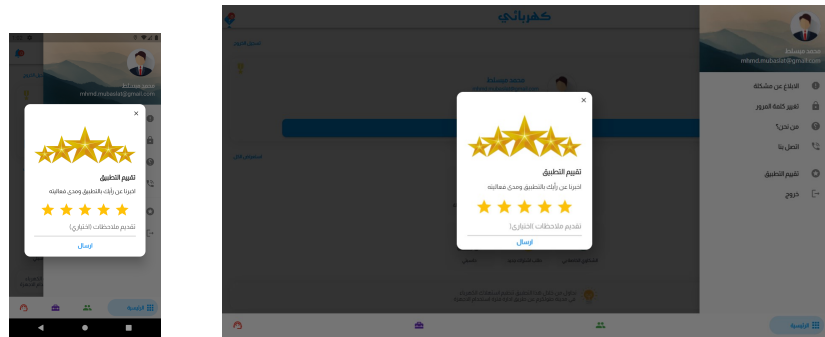


Figure 11: Rate Screen



Figure 12: Consumption's Screen
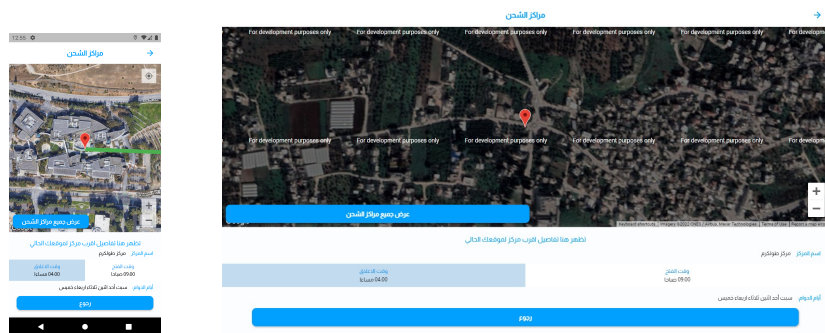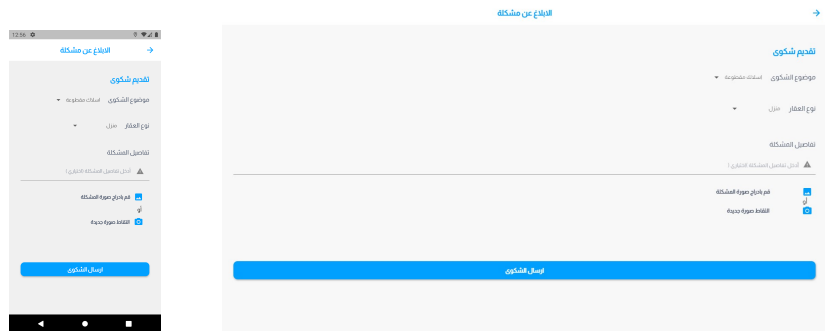
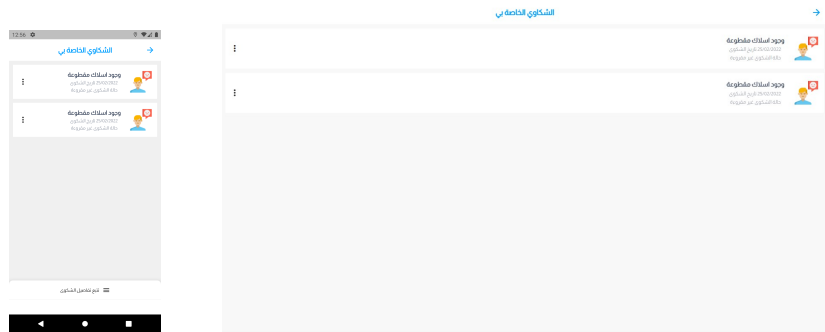Figure 13: Charging points Screen



Figure 14: Report problem Screen
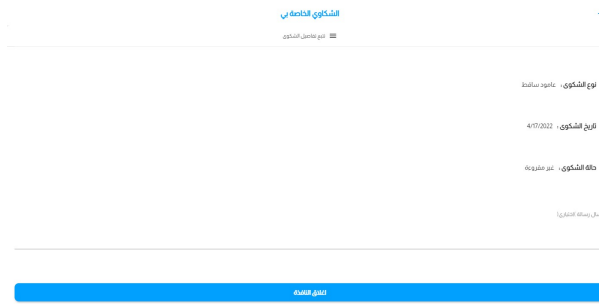


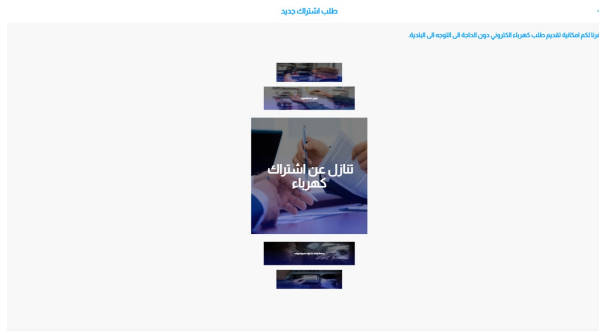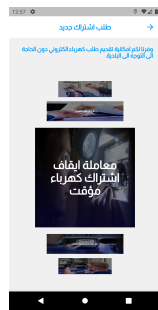Figure 15: Problems Screen

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Figure 16: Problem Slider Screen



Figure 17: New subscription Screen
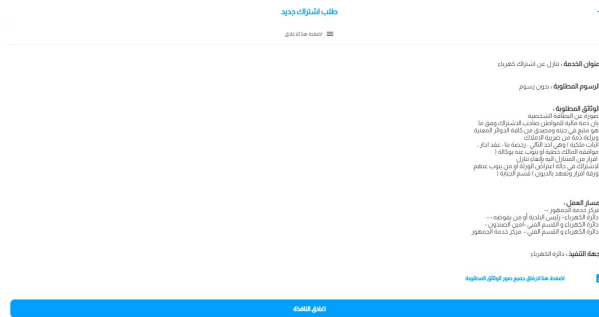


Figure 18: subscription slider Screen

Figure 19: Kitchen devices Screen
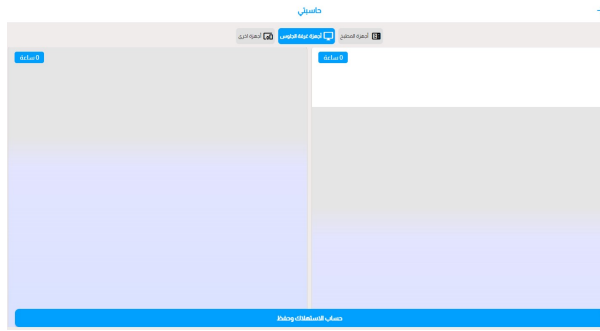


Figure 20: Living devices Screen
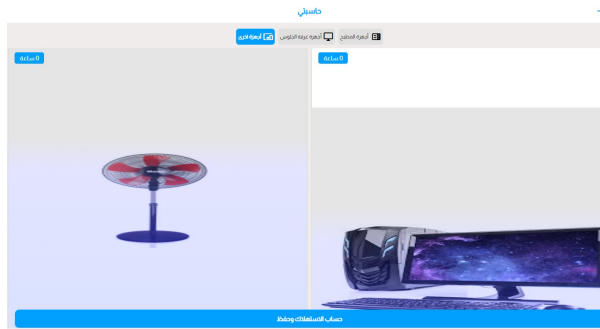


Figure 21: Other devices Screen
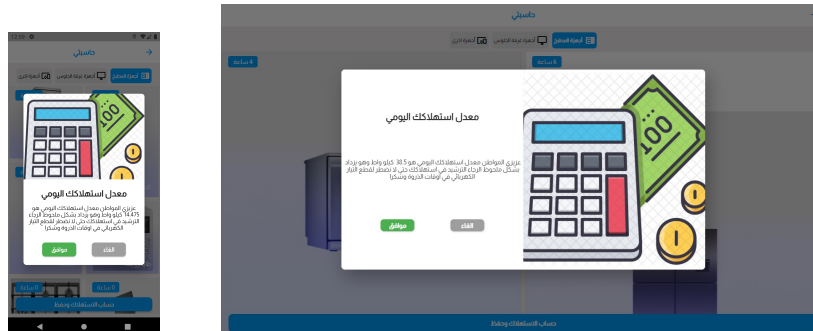
Figure 22: Calculator dialog
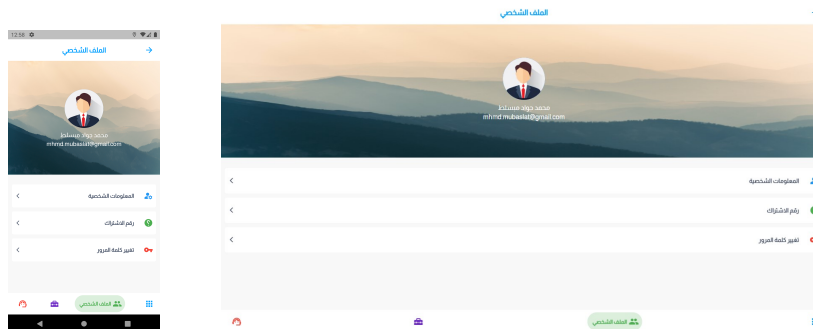


Figure 23: Profile Screen
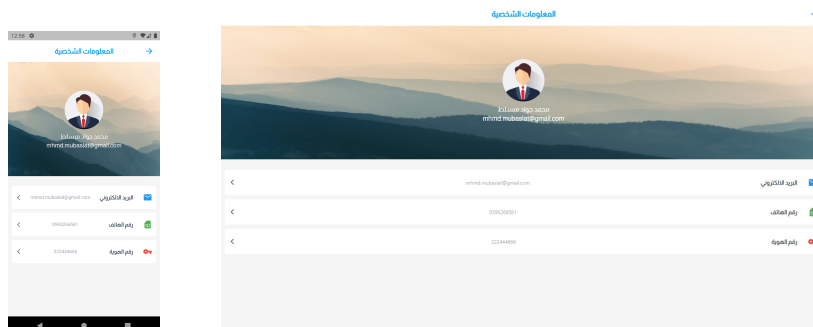


Figure 24: Personal information Screen
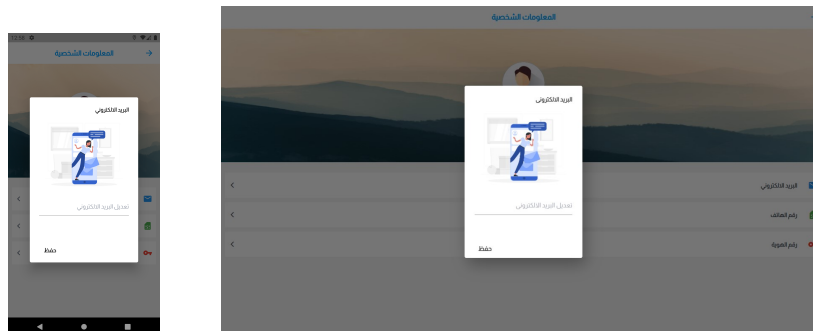
Figure 25: Change email Screen
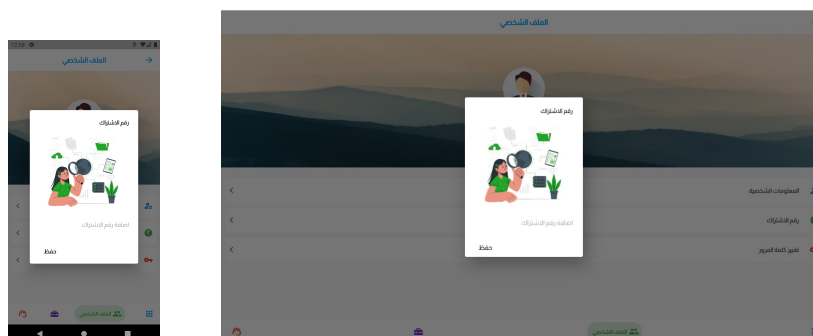


Figure 26: Add subscription number Screen
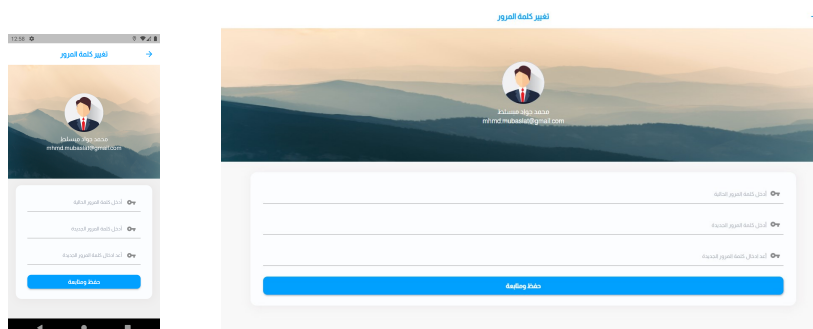


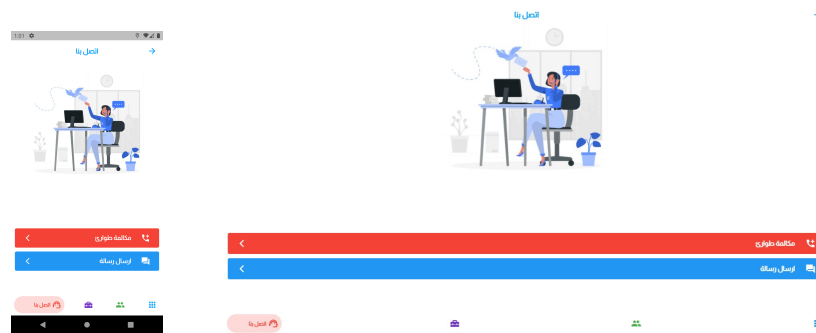Figure 27: Reset password Screen
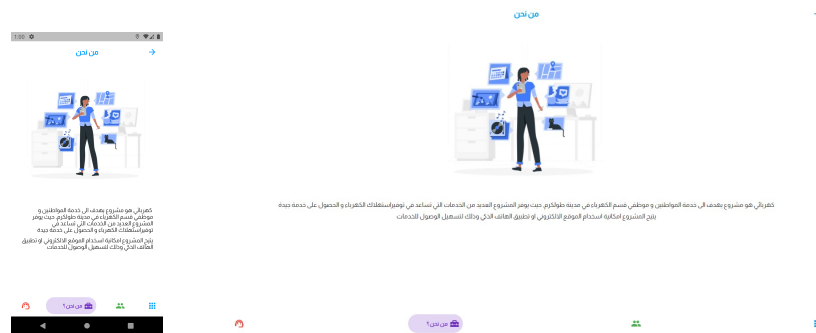
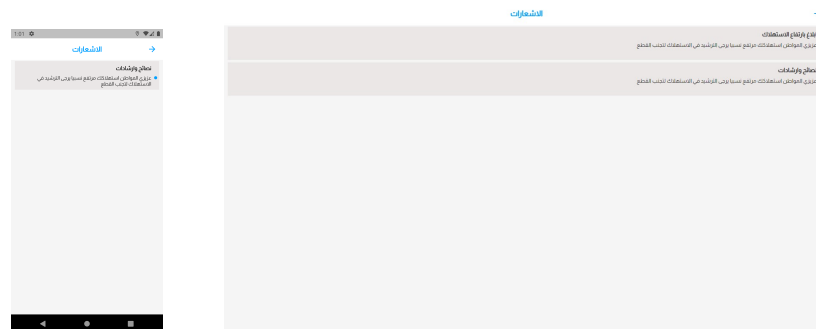Figure 28: Who us Screen



Figure 29: Contact us Screen
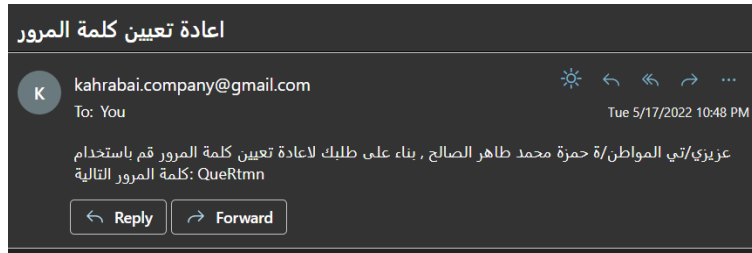


Figure 30: Notifications Screen

اعادة تعيين كلمة المرور

K kahrabai.company@gmail.com
To: You                                    Tue 5/17/2022 10:48 PM

عزيزي/تي المواطن/ة حمزة محمد طاهر الصالح , بناء على طلبك لاعادة تعيين كلمة المرور قم باستخدام
كلمة المرور التالية QueRtmn:

Reply    Forward

Figure 31: Reset password email Screen



حذف الحساب الخاص بك

Translate message to: English | Never translate from: Arabic

K kahrabai.company@gmail.com
To: You                                    Tue 5/17/2022 10:51 PM

عزيزي/تي المواطن/ة  حمزة محمد طاهر الصالح , بناء على مخالفتك قوانين استخدام التطبيق و
استخدامه بشكل خاطئ قامنا يؤسفنا حذف حسابك وذلك حرصا على عملية سير التطبيق.

Reply    Forward

Figure 32: delete account email Screen

### 7.5.2 Employee pages
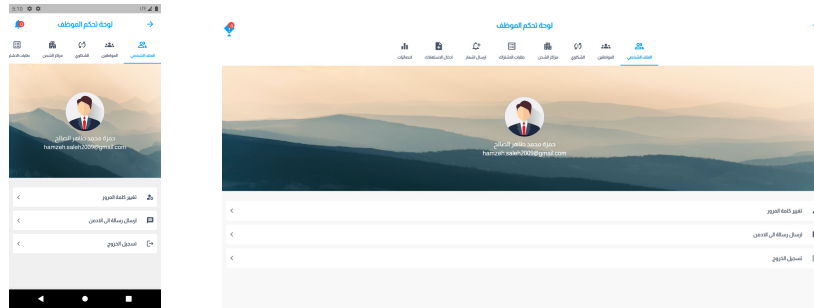


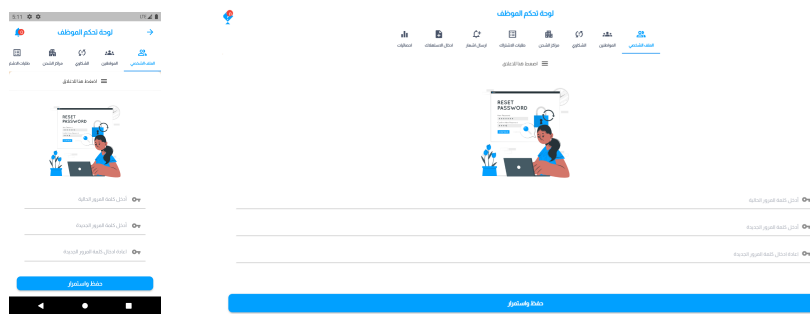Figure 33: Employee profile Screen



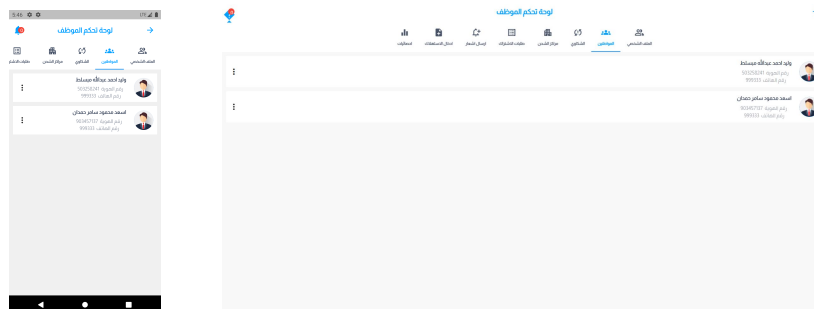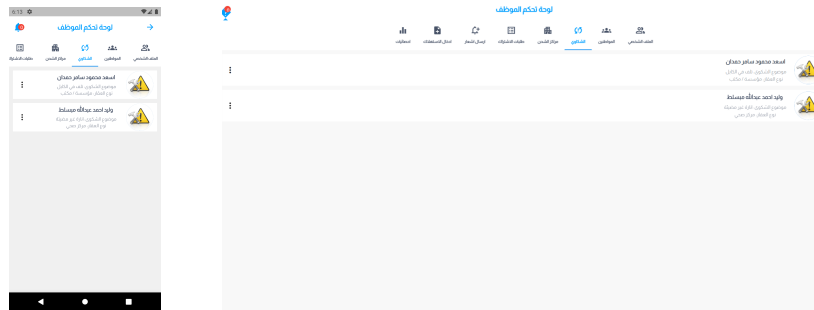Figure 34: Change password Screen



Figure 35: Users Screen
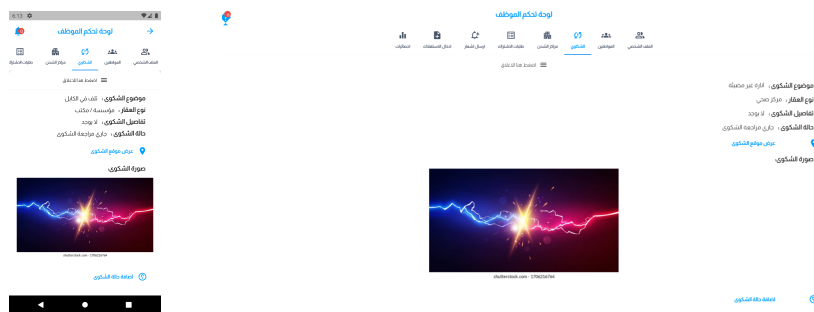
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Figure 36: Problems Screen
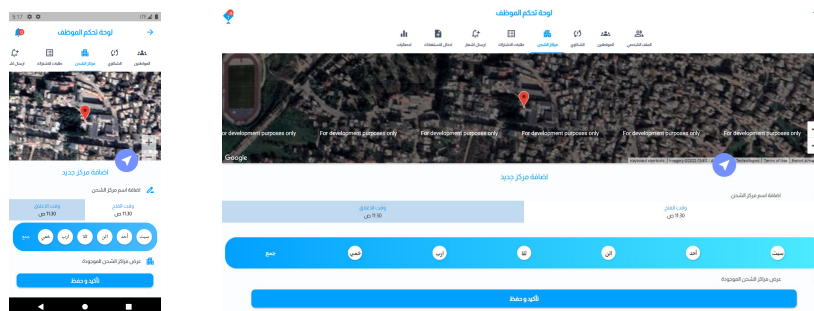
Figure 37: Problems slider Screen

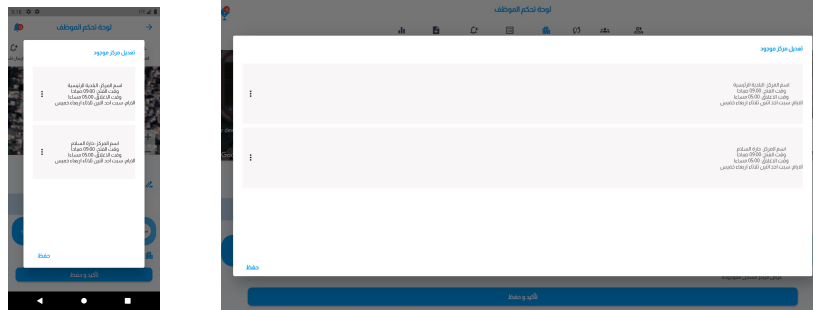Figure 38: Main charging points Screen
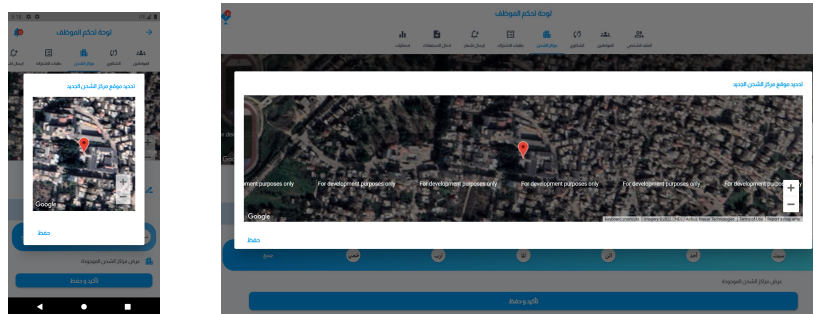
Figure 39: Show charging points Screen



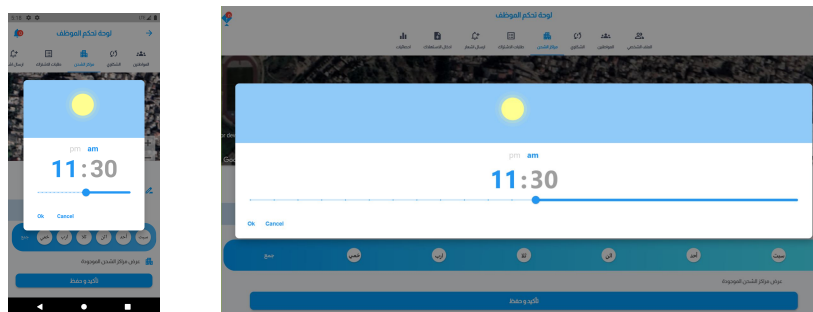Figure 40: Pin charging point location Screen



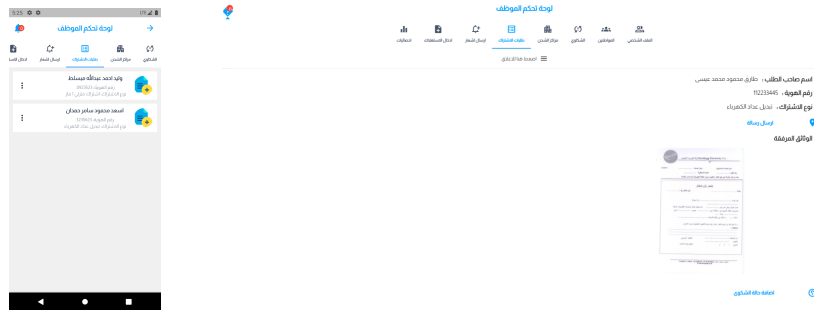Figure 41: Charging point start and end time Screen
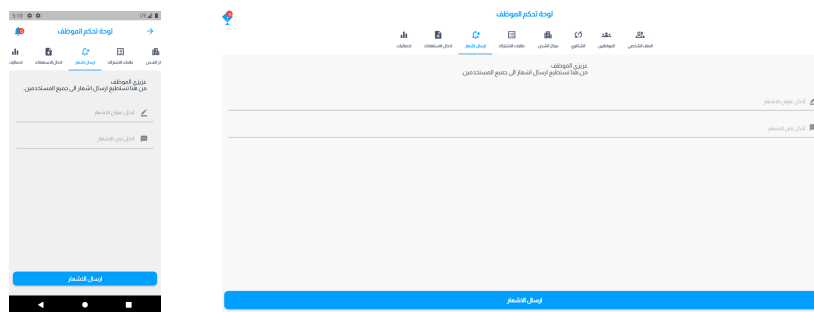
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Figure 42: New subscription requests Screen



Figure 43: Send notifications Screen



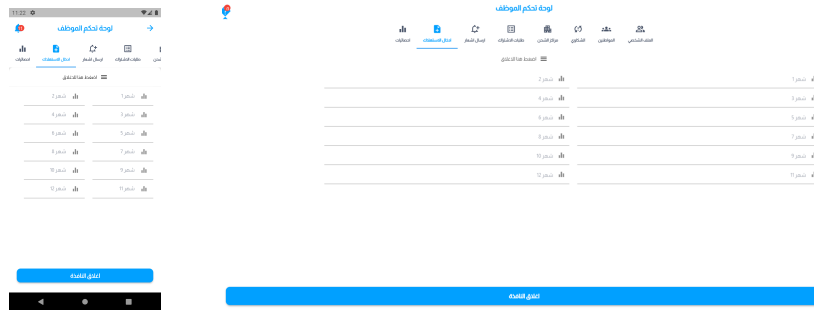Figure 44: Enter consumption Screen

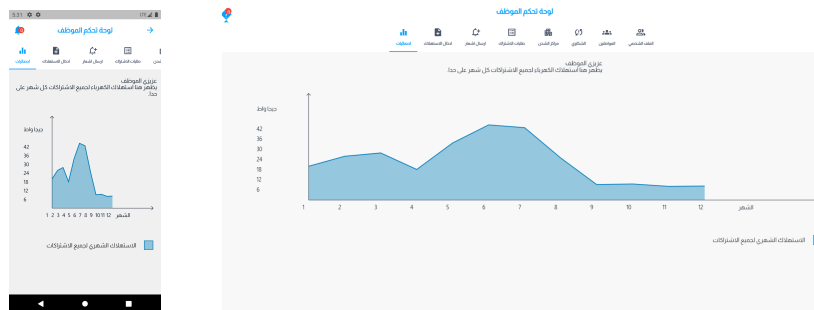Figure 45: consumption's Data Screen



Figure 46: consumption's Screen
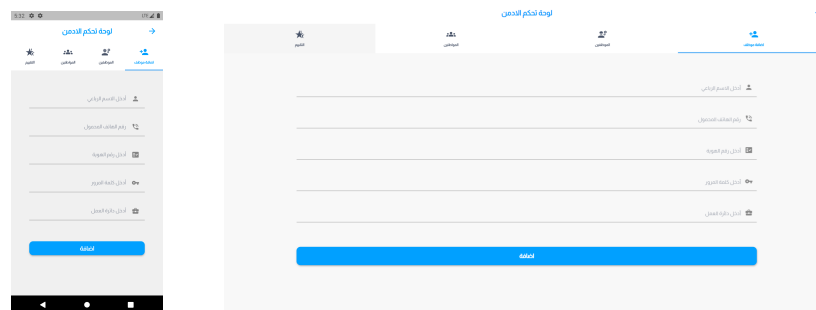
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### 7.5.3 Admin pages
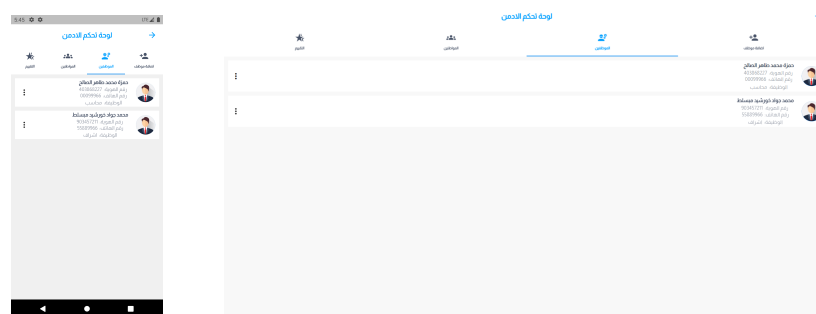


Figure 47: Add employee Screen
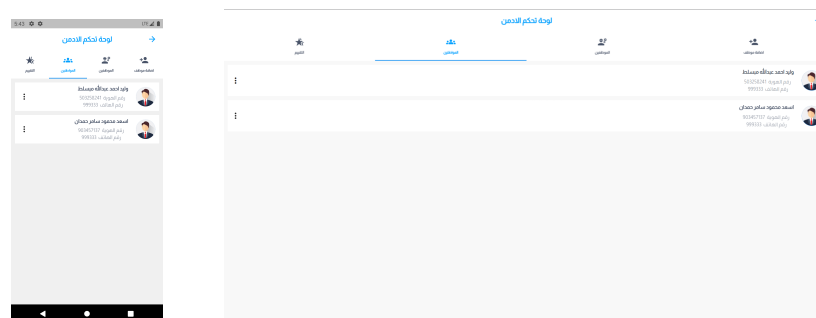


Figure 48: Employees Screen
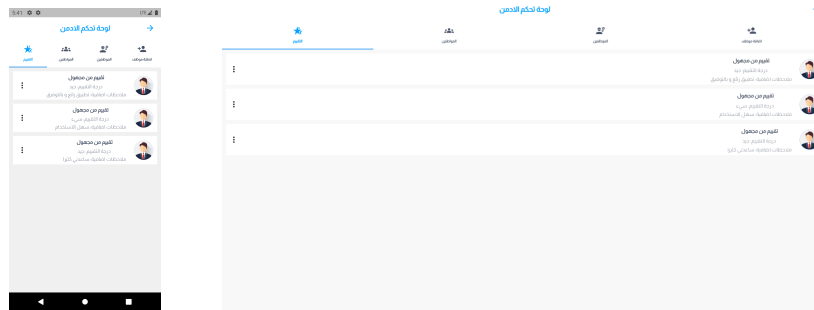


Figure 49: Users Screen

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Figure 50: Rates Screen

# 8 Results and Discussion

We succeeded in implementing mobile and website applications that work primarily on providing solutions to the electricity problem. By using smart ways to collect information about their daily and monthly consumption, also rates of fall and rise in the past month. All of these information are processed and sent as notifications to the users notifying them about their behavior and direct them to rationalize their consumptions.

In addition to providing services to citizens so that they can conduct transactions and communicate with the municipality remotely without having to go there. These services include requesting a new electricity subscription, reporting a problem, charging service, opening and closing times, and inquiring about any other information through the application.

As a result of applying the steps of the principle of human-based assessment, starting with meeting people in the city of Tulkarm from different age groups of both sexes, and listening to their complains about the problem to address it accurately, we drew a road map to start finding the appropriate solution that satisfies everyone. In addition to creating an electronic questionnaire from Google to know people's opinions.

The application addresses all the residents of Tulkarm, whether the person is a subscriber or not. Also the municipality employees have their own pages in the application to deal with the citizens (users). And there is an admin for the system that provides support for both the citizens and the employees, and he has his own pages and privileges.

Google Maps is mainly used in the application to suggest all the available paths, when the citizen chooses one of them, a path will be drawn from the citizen's location to the targeted point once the citizen confirms his own location. And a notification system was adopted to inform citizens about any updates raised from Employee if there is any emergency about electricity.

# 9 Conclusion and Future Work

In conclusion, we have succeeded in implementing a multi-use station that provide a smart solution regarding rationalizing electricity consumption in Tulkarm and reducing the cut-off periods that the city suffers from, until it is stopped permanently. Each citizen can create his own account on the application of electricity department, and there will be employees to contact the users and answer their requests.

As for future work, we are planning to make a chatbot between the citizen and the employee and provide a smart notification system connected to the municipality's Facebook page, in addition to making an integration between the application and the municipality's website.

Finally, we hope that our application will be available to people of Tulkarem in the soonest possible, and receive positive feedbacks from both the citizens and municipality employees that it is a great step to implement and it is a good fix for their problem.

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