UNIVERSIDAD DE GRANADA

MÁSTER EN INGENIERÍA INFORMÁTICA

Desarrollo de aplicación móvil con Flutter para control de equipos IOT

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”Desarrollo de aplicación móvil con Flutter para control de equipos IOT ”

Hamada Bouhacida

Abstract:

The main purpose of this project is the development of an existing mobile application on Android to a version improved by Flutter that allows the execution on Android, iOS, Linux, macOS, Windows, Google Fuchsia, and the WEB from the same code.

The final project of the master's degree is addressed from an ambitious perspective because the purpose of this project is to learn a new technology in the world of application development, namely flutter, knowing that we are dealing with *Granasat* company, and this is what gains great experience in the practical field in the future.

Despite the great complexity involved in the project, because it is something new for me, and I faced it alone with the assistant professor supervising the project, this is what pushed me more to take up the challenge in this field.

This experience allowed me to learn and gain experience in several areas in a professional way, I learned to face problems myself and find solutions, and all this arose during the project that I did, so I gained a lot of knowledge in the field of application development with filters technology, which was difficult to learn at first, but now I feel that I am at a good level that I can move on to practical life.

”Desarrollo de aplicación móvil con Flutter para control de equipos IOT ”

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Summary:

The main goal of the final project of the master's degree is to develop an application that helps control noise levels by receiving data that comes through receivers that are placed in the specified place.

This application is one of the achievements of Granasat electronics group, which created this application on Android and wants to provide it to its customers on different platforms.

The purpose of this application project is to develop a fully functional and commercially competitive application in the market, where it demonstrates the author's knowledge and abilities to analyze, design and develop**.**

Acknowledgements:

First of all, I offer my sincere gratitude and thanks to my mother, who I have no other like her and who gave everything in redemption in order to be at the highest levels and levels, I extend my sincere thanks to my family, to my brothers and sisters, to all of my friends who helped me and give me a support to reach this day, today I see myself lucky with my loved ones who have never let me down.

I would like to send them a message of love, appreciation and gratitude, although this is not enough, I would also like to thank everyone who taught me the first letter since I learned pronunciation, everyone who wished even with his heart in order to be successful, thanks and the simplest thing I can offer as a beautiful letter.

Thank you, Mom, thank you brother thank you my sister thank you teacher thank you my friend thank to the whenever I see him, I smile. Special thanks also to the professor who is supervising this project, Andres Roldan Aranda thank you for everything he helped me.

At the end I would like to say that I am proud of where I am today.

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1. Introduction:

1.1. Context and justification of the work:

Often excessive noise can be inside some places such as nightclubs and gyms ... Be a source of inconvenience to the user, as well as the neighbors and the surrounding area as a whole.

It has become necessary for the owners of these stores to reduce the noise ratio when reaching the limit of inconvenience. Therefore, Heimdal has created an application that determines the noise levels and helps customers to control it.

Figure 1. Heimdal logo

Heimdal is a company belongs to the Granasat group that is dedicated to the acoustic sector. Specifically, he works with the maintenance and installation of noise limitation equipment. The owners of hospitality businesses under certain activity codes, must, by law, have a maximum level limitation equipment, to ensure that they do not exceed the maximum threshold that they have authorized. Heimdal has a system that allows to store and access the data obtained from the limiting devices (which capture the noise level in 5-minute intervals) remotely, the data can be consulted from a web application and a native Android application. Each client has their own password through which they can access the data of the limiters for which they have contracted the service. The applications show a graph with the noise level measurements in each interval, and allow to see the maximum allowed level for limiter, this is very useful for customers, who can see when they may be committing a violation.

Figure 2. Company logo

1.1.1. Motivation:

The main reason for choosing this project is my great interest in the field of multi-application development, especially mobile applications. I am also very inclined to businesses that benefit and provide community addition, this was what was proposed by Heimdal company, as it was suffering from the problem of providing the application to users on all platforms.

The other reason is that this application will be developed by Flutter, which is a modern and prosperous technology and especially it is in demand in many companies where it will serve as a preparation for me for a professional life.

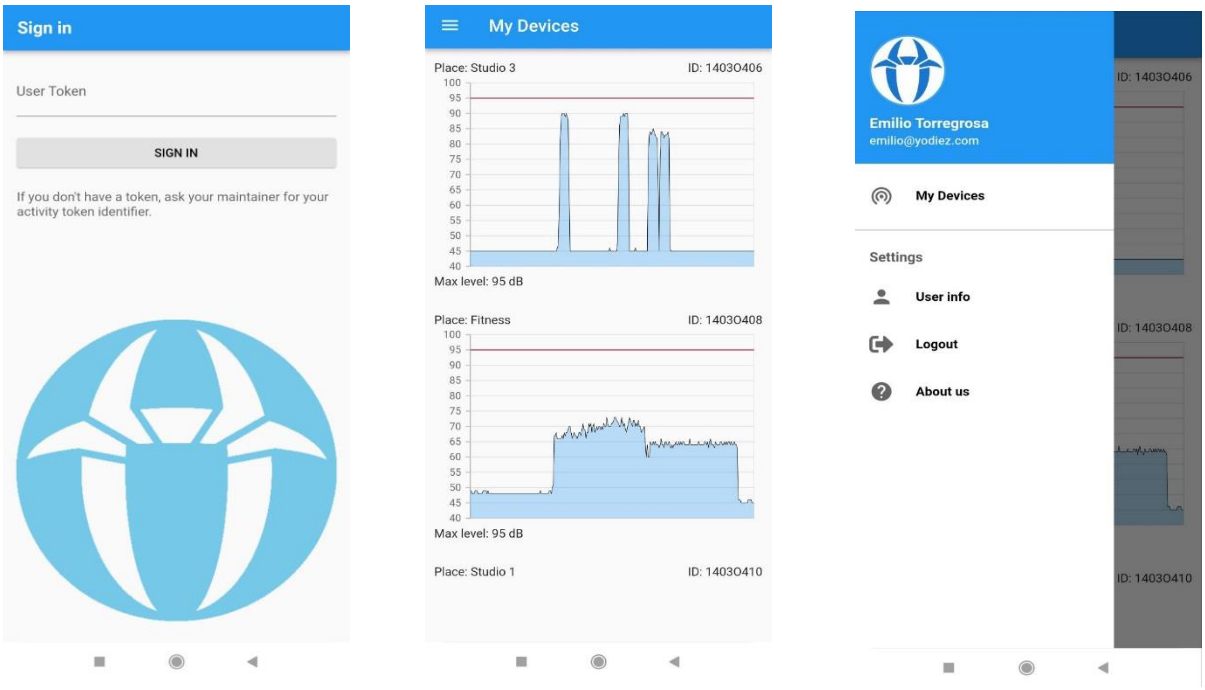
I see that this work is suitable for me in my TFM project, in addition to learning a new technology that is in great demand in today's market.

1.1.2. Expected impact:

It is expected that the application will be similar to the previous application format used by the company in terms of the service it provides.

Being the only product on the market available in this way will attract new users and thus increase user loyalty levels. As it is a dedicated application, it seeks to obtain user satisfaction and, if necessary, certain functions can be modified or added to meet more specific objectives.

The application will be designed to be easy to use and without ads and on several platforms, this is what is considered the strengths of the company as it provides the service professionally that helps it to lead the market in this field.



If you don't have a token, ask your maintainer for your activity token identifier.

Place: Studio 3 ID: 14030406

Max level: 95 dB

Place: Fitness ID: 14030408

Max level: 95 dB

Place: Studio 1 ID: 14030410

Emilio Torregrosa
emilio@yodiez.com

ID: 14030406

ID: 14030408

ID: 14030410

Figure 3. Expected results

The application will have an impact on several key aspects:

- ❖ Added value: Heimdal is expected to provide high added value to the services provided by the enterprise.
- ❖ Improve user interaction: Heimdall app aims to improve user interaction by offering an improved and personalized experience.
- ❖ Extension of applications in different environments: Heimdall's expertise and functionality can be applied in different environments, expanding the scope of application.
- ❖ User satisfaction: Heimdall application is specially developed to meet the needs of users. If necessary, adjustments can be made or specific functions can be added to achieve more specific goals and provide a personalized experience. This helps to ensure user satisfaction and improve their engagement with the app.

Overall, Heimdall is expected to have a positive impact by providing an improved and personalized experience for users, increasing loyalty and satisfaction levels, and standing out in a competitive market.

1.2. Objectives of the work :

Our main goal in this project will be focused on developing an application in a professional way that represents the company, while maintaining the same goals of the previous application available on the Android platform. These goals have been identified and classified into functional goals as the user's needs within the application (the functions that the application provides to the user) and non-functional, which in turn represent the requirements of the application to do its work resulting from the development itself.

1.2.1. Functional requirements:

- Display data in the form of graphs with automatic updating.
- View the details of each graph with the possibility of enlarging the image.
- Contain a Drawer to make it easier to navigate between pages.
- The possibility of asking for help in case of a problem with the application.
- View the user profile.
- Detect status information such as: loss of connection.
- Login by Token is obtained when registering with the company.
- The possibility of logging out and closing the application for protection.
- The application has adapted to several platforms.

1.2.2 Non-functional requirements:

- Facilitate navigation through an easy and intuitive interface.

- Ensure a secure login process.
- Connecting the application to a database by using the API.
- Reception of information by means of receivers provided by the company to each user.
- The company ensures a secure database and simultaneous updating of information.
- Create a final version of the application on several platforms (Android, IOS, Windows...).

1.2.3. Personal goals:

- Gain knowledge and experience upon completion of the master's degree.
- Acquisition of a new technology (Flutter) in the field of application programming.
- Enhancing skills and gaining experience in dealing with companies helps in professional life after graduation.
- Investigation of application users, development of usage scenarios and interaction flows.
- Training on adherence to a specific schedule.

1.3 Approach and method followed:

The application will be implemented using the Flutter framework. Flutter was developed by Google and is free and open source, allowing rapid development along with native performance. It is worth noting the way the compilation is done without using interpreted code or WebView directly to the binary system, thanks to the language used known as Dart.

React Native can also be used as an alternative solution to flutter, but development in it is very difficult, as everything starts without original components and developers will need to use a better template by default, as is the case with the web page does not contain any components. Therefore, I think it is better to program in flutter, it is easier as it can create a standard practice of dividing nested UI elements into separate and clear functions that do not appear on the web in the opposite side.

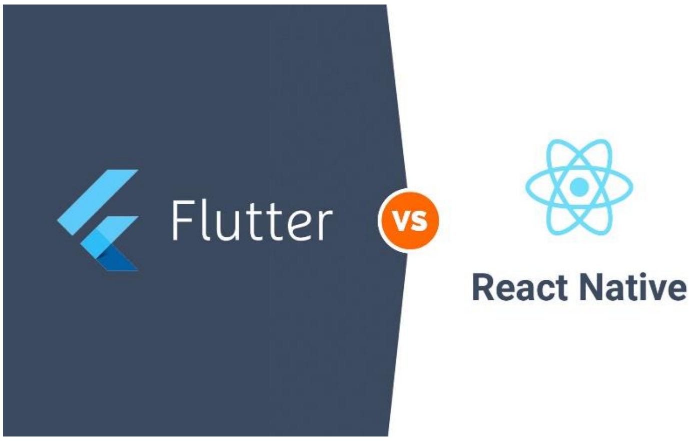


Figure 4 Flutter and React Native comparison

The application will be developed to work on all possible systems, but the focus in the simulations will be on the Android system because it is easy and fast and it buys us time compared to the IOS option, which turns out to be from payment or you need to have a Mac OS.

The most appropriate strategy to ensure the goals is to develop the project from scratch, focusing efforts on obtaining a final application for the Android system. In the same way, the mixed development with which the application can be obtained in different platforms will be from the same code only with settings that we make.

In this case, the most appropriate methodology is *waterfall methodology*, where we do not do two stages at the same time and we will not exceed one stage until we finish the first one, so that the work is sequential.

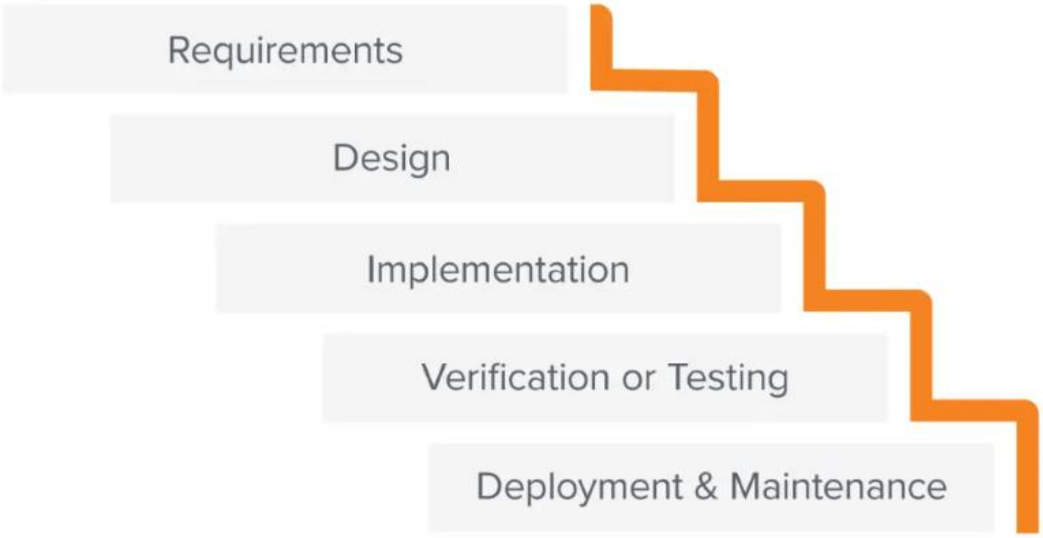


Figure 5. waterfall methodology

The project is divided as detailed below and the steps are carried out sequentially.

1. Start: definition and verification of the project.
2. Goals and planning: set goals, evaluate the scope of each of them, set tasks in time and cost.
3. Analysis and design: study of users, use cases and efficient prototypes of the interface.
4. Implementation: development and documentation of the code.
5. Tests: Specific tests are carried out and if any anomalies are found, they are corrected.
6. Deployment: The end user has the application and ensures that it meets his needs.
7. Maintenance: maintenance and optimization of applications.

1.4 Work planning:

First, the work period, which was around the month of March, was determined to coincide with the second semester, because of the lack of time in the first period, some subjects remained that had to be completed.

The work will be in a period ranging from 3 to 4 months, in which the time is divided equally to ensure the continuity of work. The time limit is 3 hours a day and may reach 4 hours on some days, the time cannot be extended more due to my presence at work in the morning.

After defining this scheme, I got a schedule that divides the work that I will do during this project, where I defined the tasks and for each task a specific time period of hours.

Task ID	Task name	Duration
T1	**Definition of the project**	**7 Hours**
T1.1	Definition of the proposal	5 Hours
T1.2	Validation of the proposal	2 Hours
T2	**Work plan**	**49 Hours**
T2.1	Context and justification	10 Hours
T2.2	Objectives	11 Hours
T2.3	Approach and method followed	8 Hours
T2.4	Work planning	16 Hours
T2.5	Risk analysis	3 Hours
T2.6	Delivery	1 Hours
T3	**Design**	**59 Hours**
T3.1	Study of user profiles	12 Hours
T3.2	Analyze the use cases	10 Hours
T3.3	Elaboration of usage scenarios and interaction flows	15 Hours
T3.4	Design and creation of a high-level prototype	21 Hours
T3.5	Delivery	1 Hours
T4	**Implementation**	**132 Hours**
T4.1	Setting up the environment	4 Hours
T4.2	Creation of screens	24 Hours
T4.3	Creating a drawer to move between the screens	6 Hours

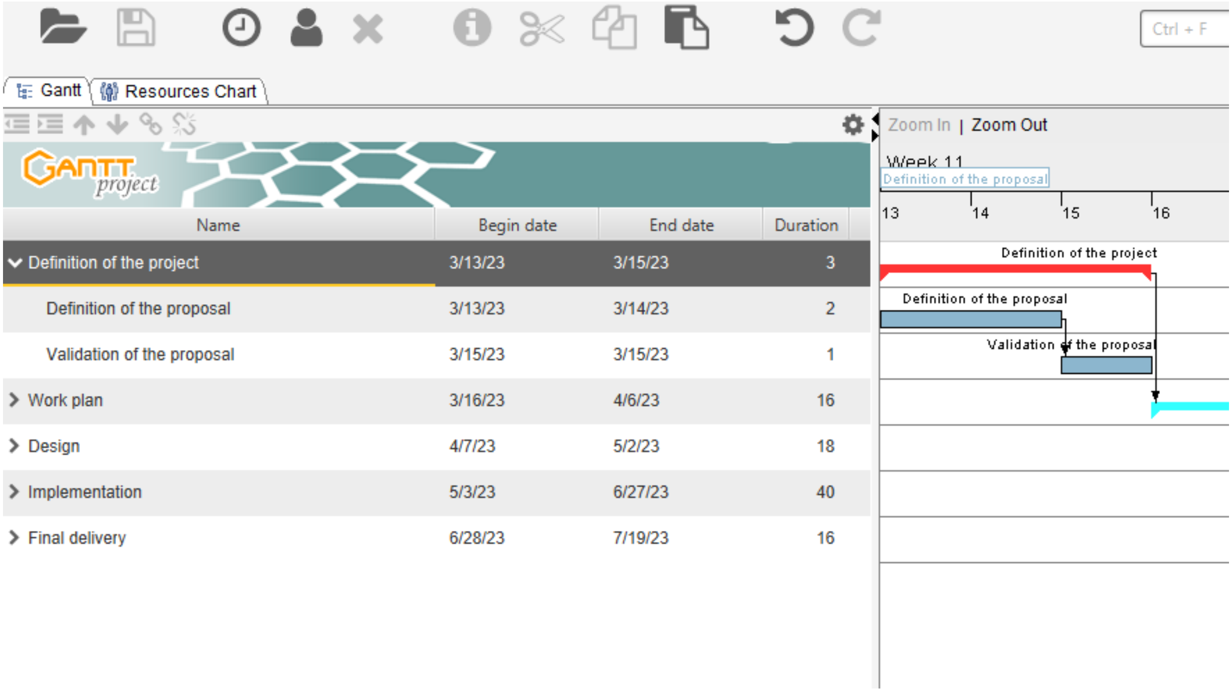
T4.4	Study of connection with the database	20 Hours
T4.5	Connection with the API	16 Hours
T4.6	Conexión a la base de datos	4 Hours
T4.7	Configuring the layout of the screens	27 Hours
T4.8	Testing	30 Hours
T4.9	Delivery	1 Hours
T5	**Final delivery**	**56 Hours**
T5.1	Results obtained	17 Hours
T5.2	Setting problems	28 Hours
T5.3	Get APK	6 Hours
T5.4	Finish and save the project	4 Hours
T5.5	Delivery	1 Hours

Figure 6. project planning table

After determining the layout, it became necessary to use a program that professionally organizes this information into a chart.

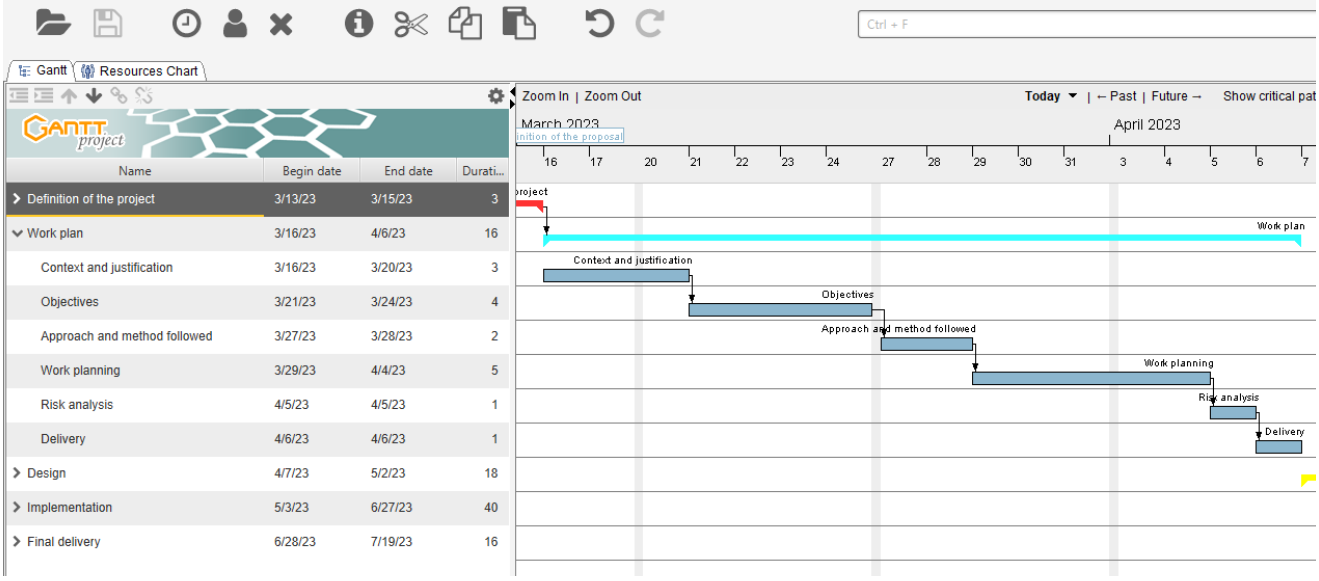
Using GanttProject makes the task much easier as it allows you to get a daily planner and in detail on the tasks that can be done every day, counting holidays and weekends.

The images below represent the tasks divided in the GanttProject program:


Ctrl + F
Gantt
Resources Chart
GANTT project
Zoom In | Zoom Out
Week 11
Definition of the proposal
13
14
15
16
Definition of the project
Definition of the proposal
Validation of the proposal

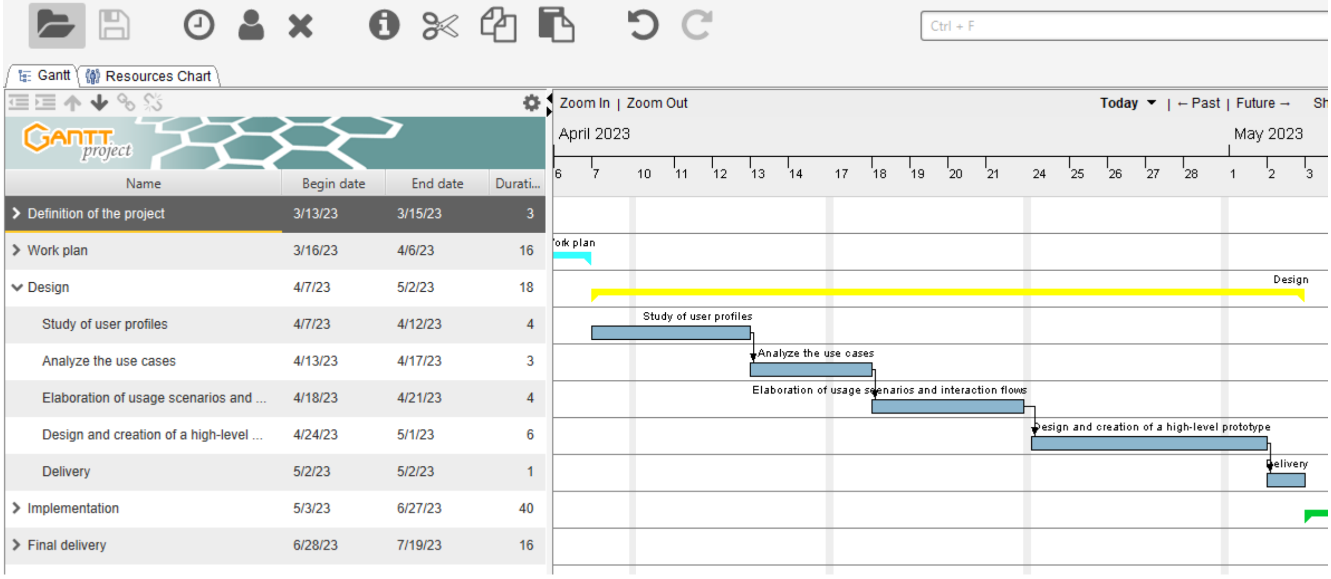
Name	Begin date	End date	Duration
Definition of the project	3/13/23	3/15/23	3
Definition of the proposal	3/13/23	3/14/23	2
Validation of the proposal	3/15/23	3/15/23	1
Work plan	3/16/23	4/6/23	16
Design	4/7/23	5/2/23	18
Implementation	5/3/23	6/27/23	40
Final delivery	6/28/23	7/19/23	16

Figure 7. GanttProject_Definition of the project



Name	Begin date	End date	Durati...
Definition of the project	3/13/23	3/15/23	3
Work plan	3/16/23	4/6/23	16
Context and justification	3/16/23	3/20/23	3
Objectives	3/21/23	3/24/23	4
Approach and method followed	3/27/23	3/28/23	2
Work planning	3/29/23	4/4/23	5
Risk analysis	4/5/23	4/5/23	1
Delivery	4/6/23	4/6/23	1
Design	4/7/23	5/2/23	18
Implementation	5/3/23	6/27/23	40
Final delivery	6/28/23	7/19/23	16

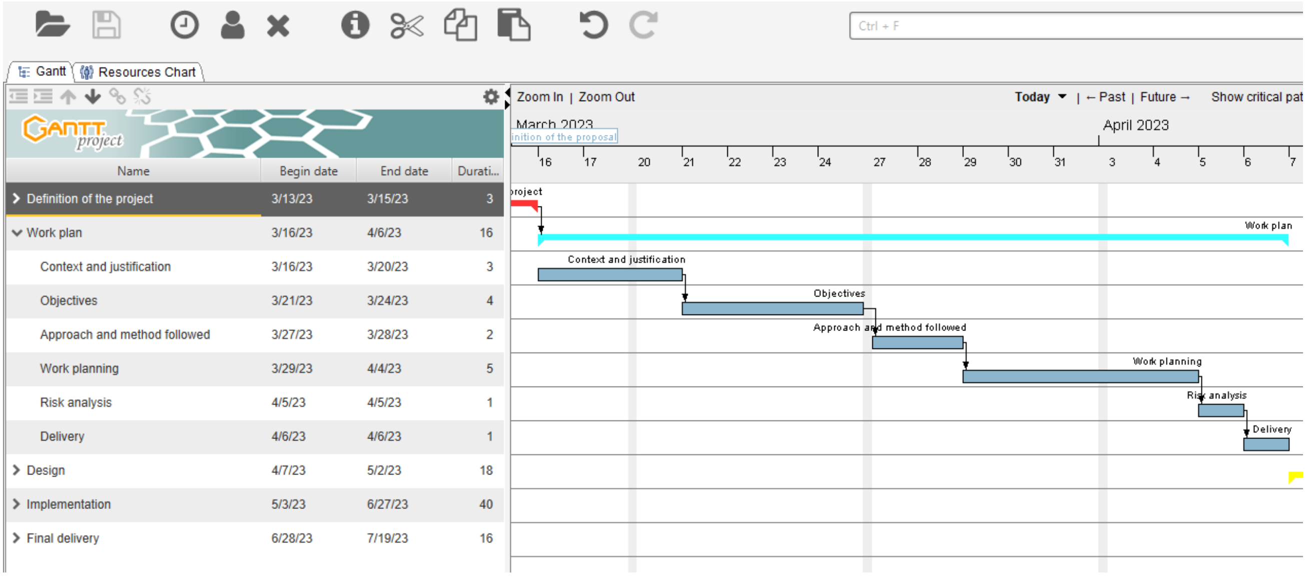
Figure 8. GanttProject_work plan of the project



Gantt
Resources Chart
Ctrl + F
Zoom In | Zoom Out
Today | ← Past | Future →
April 2023
May 2023
Design
Study of user profiles
Analyze the use cases
Elaboration of usage scenarios and interaction flows
Design and creation of a high-level prototype
Delivery

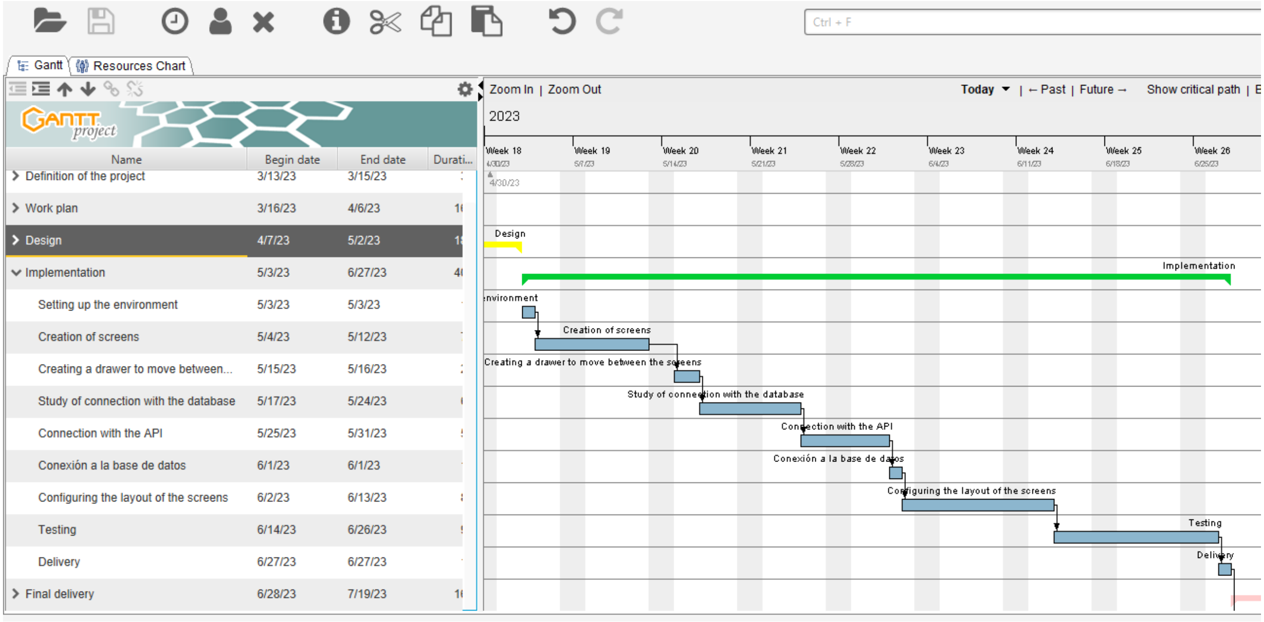
Name	Begin date	End date	Durati...
Definition of the project	3/13/23	3/15/23	3
Work plan	3/16/23	4/6/23	16
Design	4/7/23	5/2/23	18
Study of user profiles	4/7/23	4/12/23	4
Analyze the use cases	4/13/23	4/17/23	3
Elaboration of usage scenarios and ...	4/18/23	4/21/23	4
Design and creation of a high-level ...	4/24/23	5/1/23	6
Delivery	5/2/23	5/2/23	1
Implementation	5/3/23	6/27/23	40
Final delivery	6/28/23	7/19/23	16

Figure 9. GanttProject_Design of the project



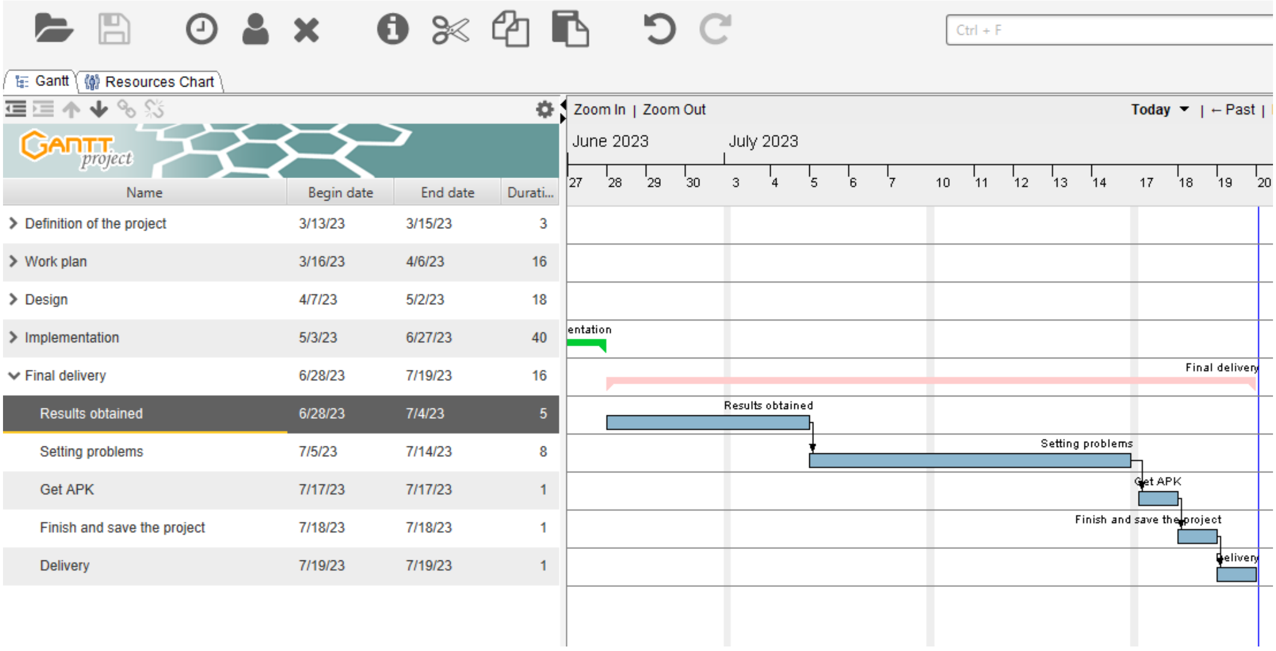
Name	Begin date	End date	Durati...
Definition of the project	3/13/23	3/15/23	3
Work plan	3/16/23	4/6/23	16
Context and justification	3/16/23	3/20/23	3
Objectives	3/21/23	3/24/23	4
Approach and method followed	3/27/23	3/28/23	2
Work planning	3/29/23	4/4/23	5
Risk analysis	4/5/23	4/5/23	1
Delivery	4/6/23	4/6/23	1
Design	4/7/23	5/2/23	18
Implementation	5/3/23	6/27/23	40
Final delivery	6/28/23	7/19/23	16

Figure 8. GanttProject_Work plan of the project



Name	Begin date	End date	Durati...
Definition of the project	3/13/23	3/15/23	
Work plan	3/16/23	4/6/23	1
Design	4/7/23	5/2/23	1
Implementation	5/3/23	6/27/23	4
Setting up the environment	5/3/23	5/3/23	
Creation of screens	5/4/23	5/12/23	
Creating a drawer to move between...	5/15/23	5/16/23	
Study of connection with the database	5/17/23	5/24/23	
Connection with the API	5/25/23	5/31/23	
Conexión a la base de datos	6/1/23	6/1/23	
Configuring the layout of the screens	6/2/23	6/13/23	
Testing	6/14/23	6/26/23	
Delivery	6/27/23	6/27/23	
Final delivery	6/28/23	7/19/23	1

Figure 9. GanttProject_Implementation of the project



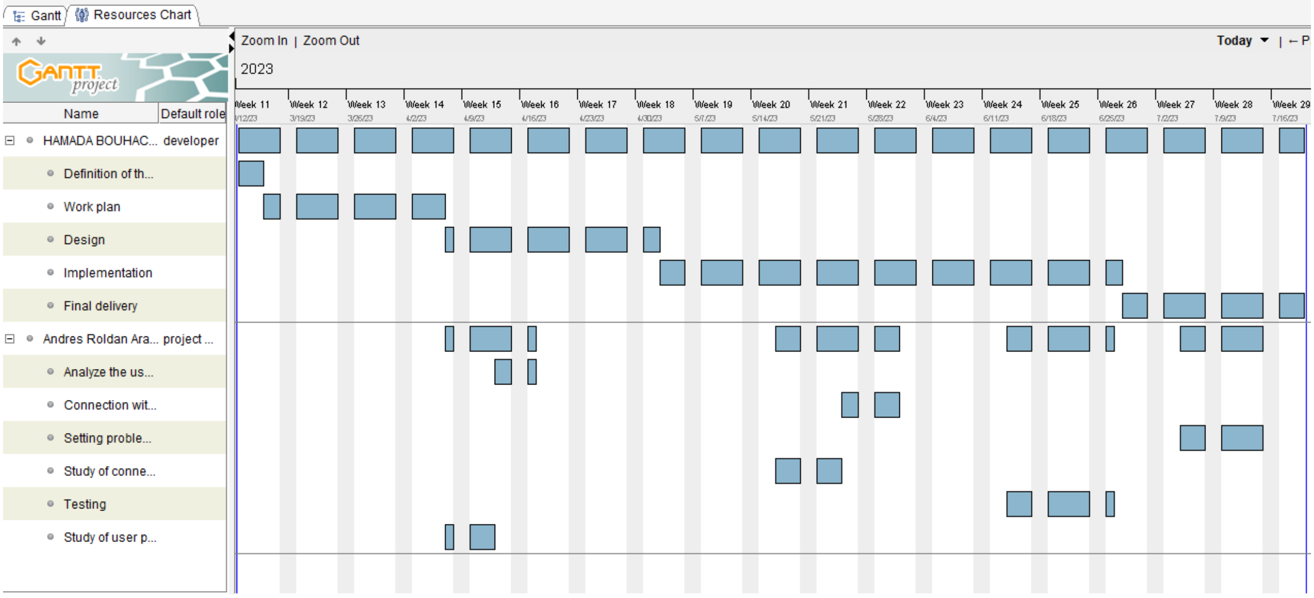
Name	Begin date	End date	Durati...
Definition of the project	3/13/23	3/15/23	3
Work plan	3/16/23	4/6/23	16
Design	4/7/23	5/2/23	18
Implementation	5/3/23	6/27/23	40
Final delivery	6/28/23	7/19/23	16
Results obtained	6/28/23	7/4/23	5
Setting problems	7/5/23	7/14/23	8
Get APK	7/17/23	7/17/23	1
Finish and save the project	7/18/23	7/18/23	1
Delivery	7/19/23	7/19/23	1

Figure 10. GanttProject_Final delivery of the project

As we note, the stage that requires more time is the implementation stage, as the application is programmed and especially facing problems for the first time requires us to research, and this takes more time compared to the rest of the stages where it requires less time and effort.

1.4.1 Resources:

Since I am the sole supervisor of this project, I have done all the functions in it and with the help of the tutor (Andres Roldan Aranda). The team consists of two people, as I registered that in the GanttProject program in the resource field.



Name	Default role
HAMADA BOUHAC...	developer
Definition of th...	
Work plan	
Design	
Implementation	
Final delivery	
Andres Roldan Ara...	project ...
Analyze the us...	
Connection wit...	
Setting proble...	
Study of conne...	
Testing	
Study of user p...	

Gantt
Resources Chart
Zoom In | Zoom Out
Today | ← P
2023
Week 11 Week 12 Week 13 Week 14 Week 15 Week 16 Week 17 Week 18 Week 19 Week 20 Week 21 Week 22 Week 23 Week 24 Week 25 Week 26 Week 27 Week 28 Week 29

Figure 11. GanttProject_Resources of the project

As for the working materials, there is an i5 computer with 16 GB RAM and Windows 10 64-bit and for physical tests we will do on the computer with a virtual emulator where the Android version can be controlled as we want.

The computer will have programs that we need to complete the work, which are :

- To organize work:
  - GanttProject-3.2.3240
- For application programming :
  - AndroidStudio2021.1.1
  - Visual Studio Code 17.6.2
  - Version Control: Git 2.33.0
  - Database: Connected with API
- To write the report:
  - Microsoft Office 2016
  - Justinmind 10.1.13
  - Tool Clipping for screenshots

1.4.2 Cost of the project:

The cost of developing an application can vary depending on several factors, including the complexity of the application and the range of required functions. Costs are reduced by using tools and resources that are available for free or at a low cost.

On the other hand, the costs will be calculated as a professional work submitted to a company, as the programmer needs to write and pay electricity and internet bills ...Etc.

We will not forget to mention the project tutor (Andres Roldan Aranda) that I worked some hours with him, which is estimated at about 15 hours.

CONCEPT	Cost
The cost of 303 hours of work	3636 €
the cost of tutor hours work (15 hours)	270 €
Other costs, such as electricity, internet for four months	1000 €
Earnings from work (+20%)	981.20 €
Taxes (+21%)	1236.31 €

Total costs	7123.51 €

Figure 12. Cost table

As shown in the table above, the cost has been calculated as a real project. A lower than average cost of 12 euros / hour was set, given that the level of knowledge is not too high.

As for the cost of the tutor hours, it is estimated at 18 euros, he is highly knowledgeable and is considered a professional developer.

Some other costs were also calculated in this project, such as paying electricity and internet bills, etc., and it costs a simple estimated 250 euros per month for four months, we find that it is 1000 euros in total.

We will also not forget that after the work of this project, the profits must be estimated, which has been determined at 20% of the work percentage, as well as the estimated tax rate of 21% must also be determined, and therefore all these costs will be collected to get the total, which is the cost of creating this application.

1.4.3 Risk analysis:

After planning to complete a perfect project and a well-done work, it should be taken into account that there are risks that will hinder its progress and success.

One of the biggest risks facing the programmer is the problem of time, in case of absence of any circumstance whatsoever and non-compliance with the plan listed at the beginning of the project study leads to a delay in completion and thus loss of credibility and professionalism necessary to deal with clients.

Therefore, the planning time was increased by calculating possible delays, as well as prioritizing some goals and functions to ensure the perfect work process.

The lack of knowledge on the Flutter framework is also a hindrance to the perfect progress of the project.

There is a possibility that the requirements of the project may change, which requires redoubling efforts to reach the desired goal.

If not enough attention is paid to usability and user experience, the application may be difficult and complex and may adversely affect user satisfaction.

Although Flutter and Dart are solid tools, there is always the possibility of bugs and glitches in the code. This could affect the functionality of the application and require additional time for resolution.

The database is connected to the application via the APIs, so the possibility of losing connection exists and these problems can affect the operation of the application.

1.5 Project structure:

This document is well organized to be clear, understandable and easy to understand where it consists of:

Introduction: The topic is discussed, the goals and motives for the completion of this project are clarified, and the method of completion is determined.

Theoretical foundations: This section contains definitions and concepts of some programs and tools that were used by the project.

Design: All aspects of the system interface are described, as well as the scenarios expected by users are specified.

Implementation: In this part, it is explained how to program and configure the application, as well as the devices used in it, and the technologies and functions that have been developed are specified.

Conclusions and future work: The conclusion contains the results that we reached after the end of this project and also identifies possible future works that could change the application.

2. Theoretical foundations:

2.1 Tools and technologies used:

2.1.1 Flutter:

Flutter is an open-source framework developed and supported by Google. Front-end and full-stack developers use Flutter to create the user interface (UI) of an application for multiple platforms (iOS, Android, macOS, Windows, Linux, and the web) with a single code base.

Figure 13. FLutter logo

This allows companies to reduce development time and costs, as they do not need to hire two separate development teams for each platform.

2.1.2 Dart:

Dart is a client-optimized language for developing fast apps on any platform. Its purpose is to provide the most productive programming language for cross-platform development combined with a flexible execution runtime platform for app frameworks.

Dart also forms the basis for Flutter. Dart provides the language and runtime that support Flutter apps, but Dart also supports many important developer tasks such as code formatting, analysis, and testing.

Figure 14. Dart logo

Dart is used to build powerful mobile and web applications. Main uses are: It is the underlying programming language of the Flutter framework.

2.1.3 API :

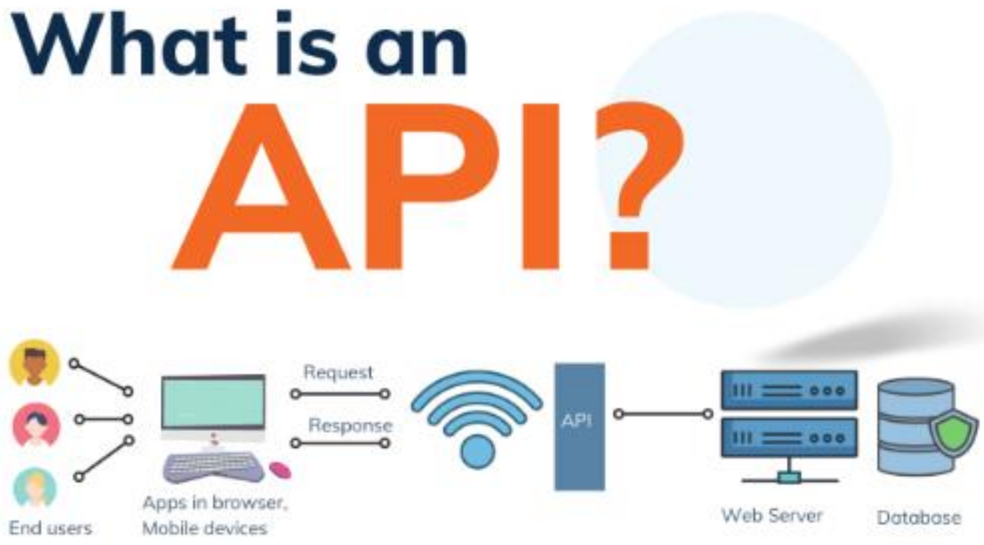


Figure 15. API logo

API is an acronym meaning "Application Programming Interface", which translates as "application programming interface”. Is an interface that connects software, services and applications to different environments so that they can connect their data., their services, their technologies. The API materializes as an access gateway to a functionality owned by an independent entity.

The different types of APIs:

- Open API or Open API, publicly accessible without restriction.
- Partner API, which requires an identification key provided by an authentication and authorization service.
- The internal, private or Private API, accessible only internally and designed for the specific needs of a company wishing to retain full control.

2.2 Environment and protocols

2.2.1 Android Studio

Android Studio is the official integrated development environment (IDE) for Android applications. Based on IntelliJ IDEA's powerful code development and editing tool, Android Studio offers even more features that improve your productivity when creating.

Figure 16. Android studio logo

Each project in Android Studio contains one or more modules with source code files and resource files. Here are the types of modules:

- Android application modules.
- Library modules.
- Google App Engine Modules.

2.2.2 Visual Studio:

The Visual Studio IDE is a creative launcher where you can edit, debug, build your code, and publish your application. In addition to the standard editors and debuggers provided by most IDEs, Visual Studio includes compilers, code completion tools, graphic designers, and many other features to improve your software development process.

Figure 17. Visual studio logo

2.2.3 GanttProject:

Figure 18. GanttProject logo

GanttProject is a project management software designed to help companies create calendars, assign tasks and resources, view project progress reports and more. The platform allows managers to create project plans, assign tasks to team members, track progress and meet deadlines.

3. Design:

Before starting any project, there is a stage that precedes the implementation stage, which is the analysis and design stage, where we analyze the opinions of users and take a comprehensive look at their requirements to reach the desired goal, after which the application design process is customized in terms of the interface as well as in terms of programming that we do.

3.1 Analysis:

The users are analyzed and their requirements and wishes are known, and also the focus is on the extent of user satisfaction after completion because it is an important factor in promoting the application to ensure its success.

3.1.1 Users and context of use:

The users we deal with will be the owners of shops and places full of noise, they may be new users or have the previous application from the company.

Therefore, we will interrogate the two categories to get answers that facilitate the application programming process and fulfill the wishes of users as much as possible.

We will send an email to some users with some questions that will help us in this process, we will ask them to be as honest as possible in choosing answers, although some answers will be out of place, as this will give a look and an understanding of what users are looking forward to.

Questions that have been sent to some users:

1. How old are you?

- Less than 30 □
- Between 30 and 65 □
- Over 65 □

2. Select your level of study

- Basic studies □
- Postgraduate studies □
- University level □

3. Do you have another job

- Yes □ No □
- Define it : □

4. What kind of system are you using?

- Android □
- IOS □
- MacOS □
- Windows □
- Linux □

5. How long are you connected to the internet?

- In hours □ Hours

6. The problems that you find in most applications ?

□

7. The kind of place where you have a noise problem?

□

8. Do you need to know the size of the noise inside the shop?

- Yes □ No □

9. Is a method used to solve some noise problems?

- Yes □ No □
- Define it clearly:

□

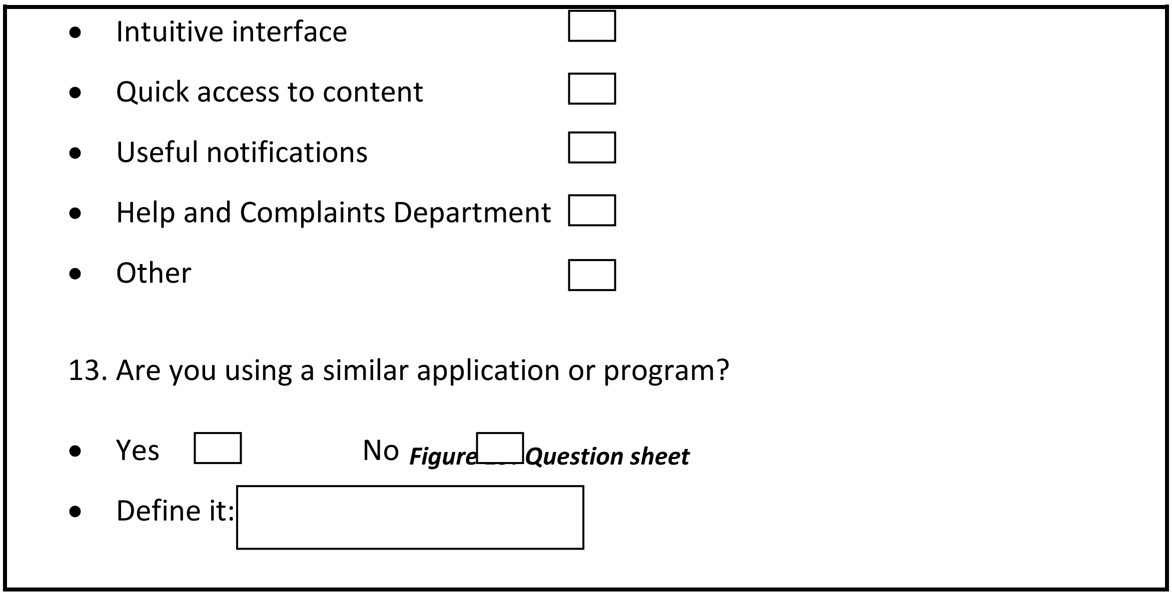
10. Suggest a feature you want to find in the application?

□

11. What do you think makes the app irrelevant

□

12. What do you consider necessary in the application



- Intuitive interface □
- Quick access to content □
- Useful notifications □
- Help and Complaints Department □
- Other □

13. Are you using a similar application or program?

- Yes □ No □ ***Figure Question sheet***
- Define it: □

Figure 21. Question sheet

Most of the respondents were between the ages of 30 and 65, representing the business-related category.

Customers use different devices and systems, which increased their interest and acceptance of the idea of the application.

Most of the shops that suffer from the noise problem are nightclubs and gyms, which are located in the city center where the noise is high, which requires them to control the noise level to avoid disturbing neighbors, especially at late hours of the night.

All new users welcomed the idea of the application, especially since it already exists in the market and has a good return.

While some old users have made several suggestions, such as sending a notification in case of exceeding the specified noise level, as well as the application sending an automated voice message directly to the desired place to request to reduce the sounds a little.

We review the file submitted by one of the users with the usage scenario:

User profile		
Name	Emilio	👤
Age	46	
Level of study	Basic studies	
Context of use		
When	When there are people inside the workplace	

Where	A Gym hall (Granada)
Type of device	IOS Phone (Iphone)
The scenario	
Emilio is a 46-year-old man who owns a gym in the city of Granada, where he is frequented by many people daily and the hall is always full of people and this has a problem that sometimes the voice of the athletes exceeds the maximum, which causes noise that disturbs the neighbors and so the neighbors will automatically after several alerts to complain to him. That's why Emilio is trying to get an application that allows him to determine the volume of sound and noise every time and so he can control and avoid frequent nuisance to neighbors. For this reason, our application has this feature where noise receivers will be installed, where the data is displayed on the mobile phone from time to time.	

Figure 20.Table of the usage scenario 1

User profile		
Name	Laura	👤
Age	36	
Level of study	Postgraduate studies	
Context of use		
When	When the club is open at night	
Where	Night club (Granada)	
Type of device	Android Phone	
The scenario		
The papers are a 36-year-old young woman who opened a nightclub in the city of Granada in the city center, as the club is located in the basement of one of the		

buildings where many residents are on the upper floors.

The problem that Laura suffers from is that the club is frequented by people late at night, where the noise is loud and the music is very loud, which leads to disturbing people while they sleep.

Laura is looking for an application that will help her get rid of this problem by controlling the volume of noise generated by music and the voices of people inside the club.

This is what you will find in our application that we are going to do and that identifies the noise by receiving information from receivers that are installed inside the club.

Figure 21. Table of the usage scenario 2

3.1.2 Features:

After updating the usage scenarios and collecting information from user profiles, I touched on maintaining all the basic functions present in the previous application, because it was a good enough application only its only problem was that it was not available on several systems.

The list of main features will consist of:

- Login with a token
- My Devices To view voice data.
- Consultation of the user profile.
- Browse information about us.
- Request for help by calling and emailing.
- Easy navigation through the drawer.
- Easy and quick exit.

3.2 System design:

3.2.1 System overview:

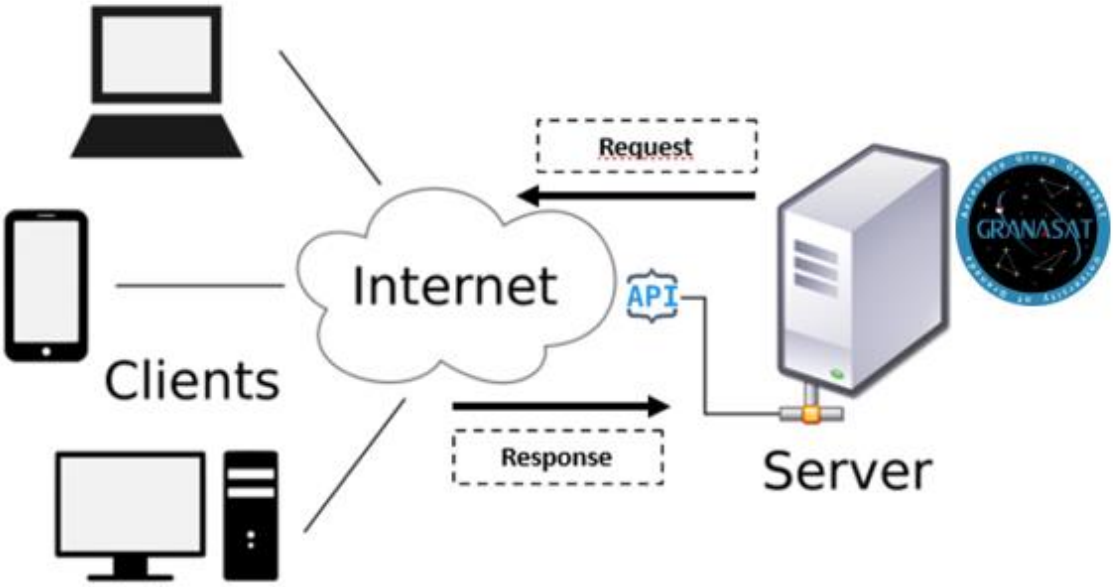


Figure 22. System Design

The application is linked to the database via the API, which in turn transfers information from the server to the application by supply and demand, and the application must be connected to the internet.

This process enables the client to obtain the necessary information that is displayed in the application interface, which we program how to display it and how to deal with it.

3.2.2 application prototypes:

After analyzing the user scenarios, we must come up with prototypes of the application pages that will be at the interface, where we will identify the elements, their tasks and their relationship to each other and get an easy-to-use and effective application.

First of all, we determine the interfaces and the elements they contain and determine all the tasks, then we determine the necessary colors and shapes that we need to be on the application interface, where we will use the *Justinmind* program to get semi-real models.

Sign in Screen:

When you open the application, the first thing that appears is this screen where you cannot enter the application unless you have a token that you get from the company where you may have registered before. This screen contains a tab where you can type a token, then click on Login, after that the information is verified and then you enter the application.

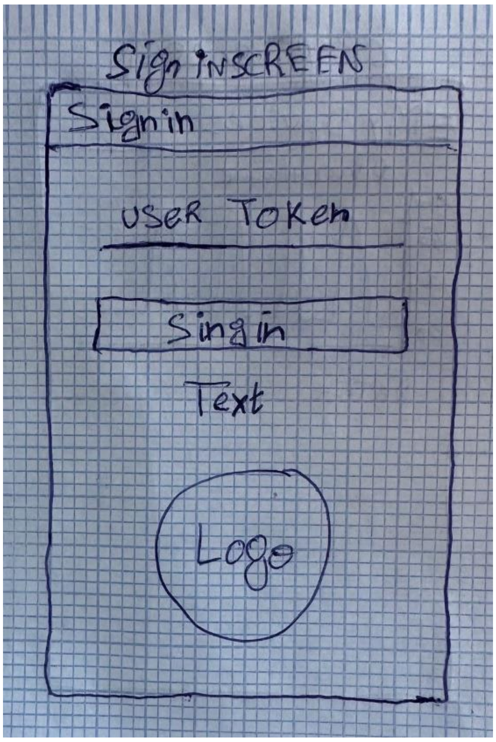


Figure 23. Paper Prototype_Sign in

Splash Screen:

This interface comes immediately after entering the token to occupy the time it takes while confirming the information and fetching it for display in the application, the estimated time is about three seconds, where it acts as a break in the registration process and the main application interface.

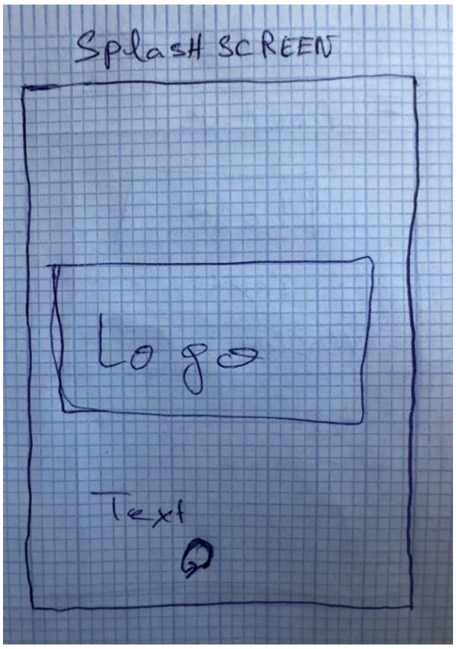


Figure 24. Paper Prototype_Splash screen

My Devices Screen:

It serves as the main interface of the application where the information fetched by the database is displayed in the form of curves.

From this page, you can also go to the rest of the pages that are browsing inside the application easily.

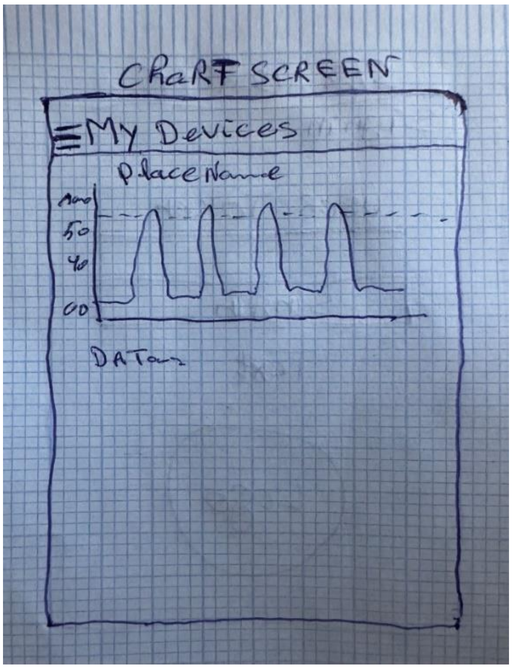


Figure 25. Paper Prototype_Chart screen

Drawer Screen:

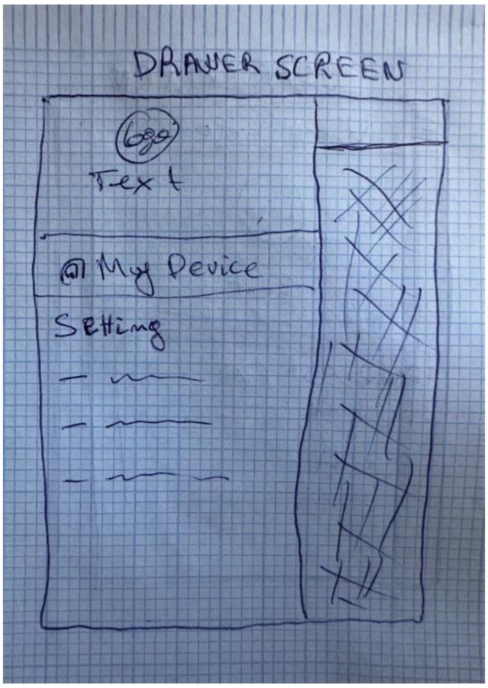


Figure 26. Paper Prototype_Drawer screen

It is in the form of a side menu through which you can navigate to all pages easily, as it facilitates this task and is present on all pages in the form of three dots at the top so that you can move from it to it.

It also has a tab to exit the application to close and the user's personal information is based at the top.

User Screen:

During this process, the client's personal information is displayed, which varies from one client to another, of course, by means of a token that leads us to his information.

This information is represented by the name of the client, his own number and the address of the place of work.

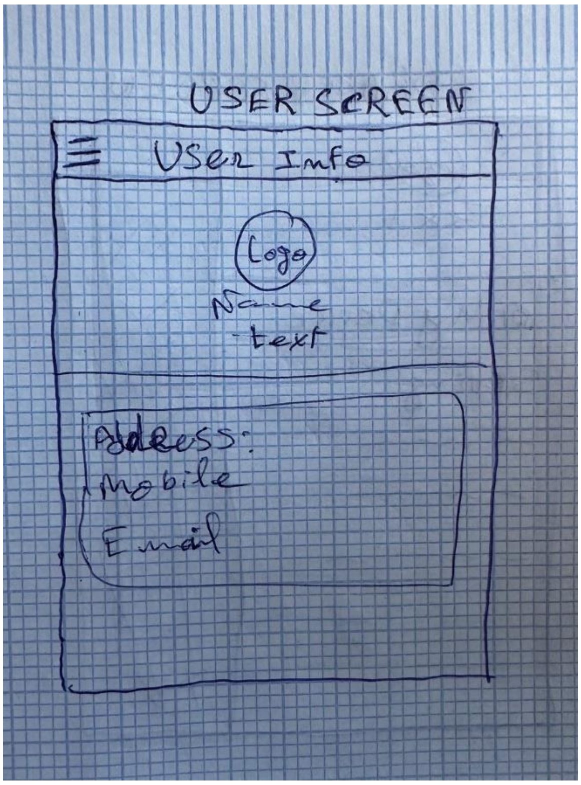


Figure 27. Paper Prototype_User screen

About Us Screen:

Through this page, you can view the company's information to communicate with it.

It contains the company's e-mail for communication, as well as it is possible to visit the company's official website, through which it is also possible to drip the application or put a comment in the Play Store.

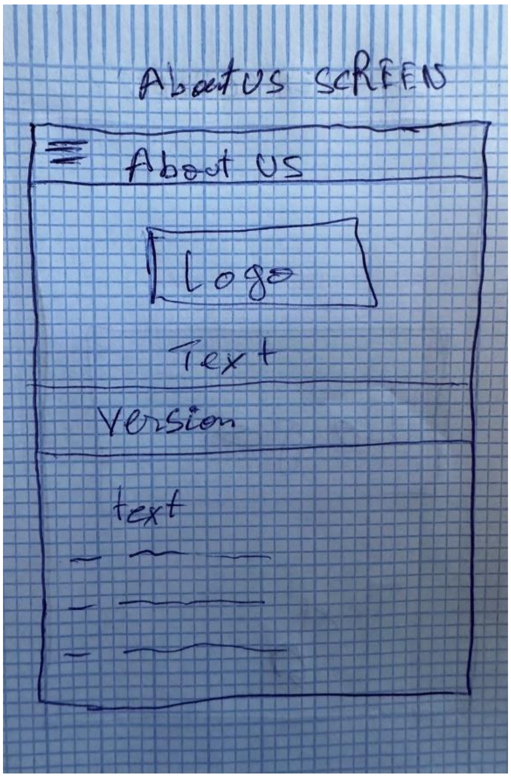


Figure 28. Paper Prototype_About us screen

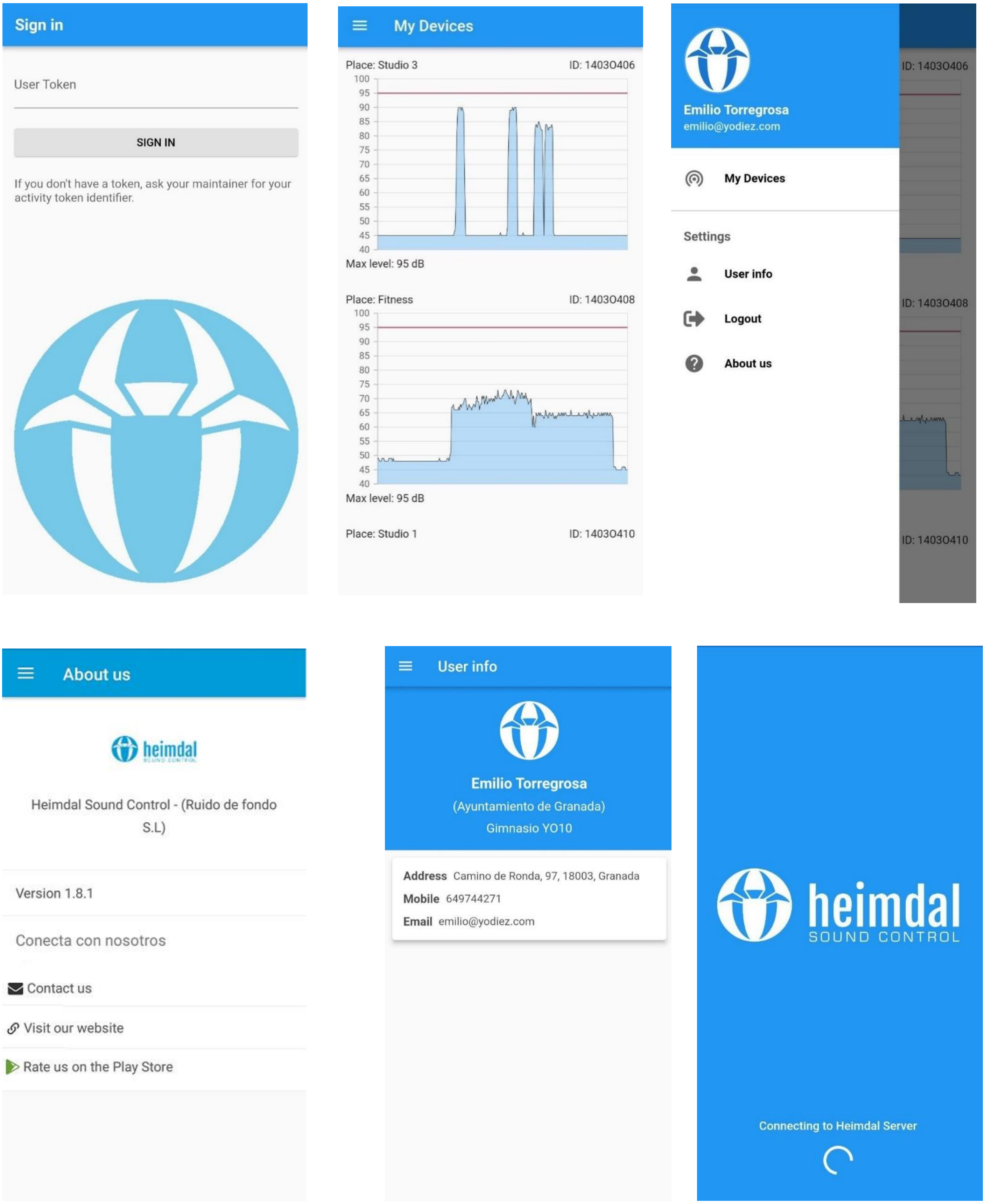
3.2.3 Justinmind prototypes:

After determining the prototypes of an application interface on paper, we move on to another stage, which is the stage of determining colors, icons and their shapes to be more realistic.

To do this I chose a program that is a free program and allows you to create forms in an easy way.

What I am doing is determining the colors of the bars and pages, as well as determining the shapes of the icons and their sizes to get a satisfactory model of the application in this case, we did not change the colors and shapes of the icons as the previous application because the users were more satisfied and see that this application is good from the interface side.

This stage makes it easier for us to program the process, we have time where you are aware of the required work.



If you don't have a token, ask your maintainer for your activity token identifier.

Heimdal Sound Control - (Ruido de fondo S.L)

Version 1.8.1

Emilio Torregrosa
(Ayuntamiento de Granada)
Gimnasio YO10

Address Camino de Ronda, 97, 18003, Granada
Mobile 649744271
Email emilio@yodiez.com

Figure 29. Justinmind prototypes

3.3 Application use case:

Determining the use cases of the application is no less important than the rest of the stages, where we must determine the tasks that the user performs that he can perform within normalization, in other words, Limits of its functionality within the application.

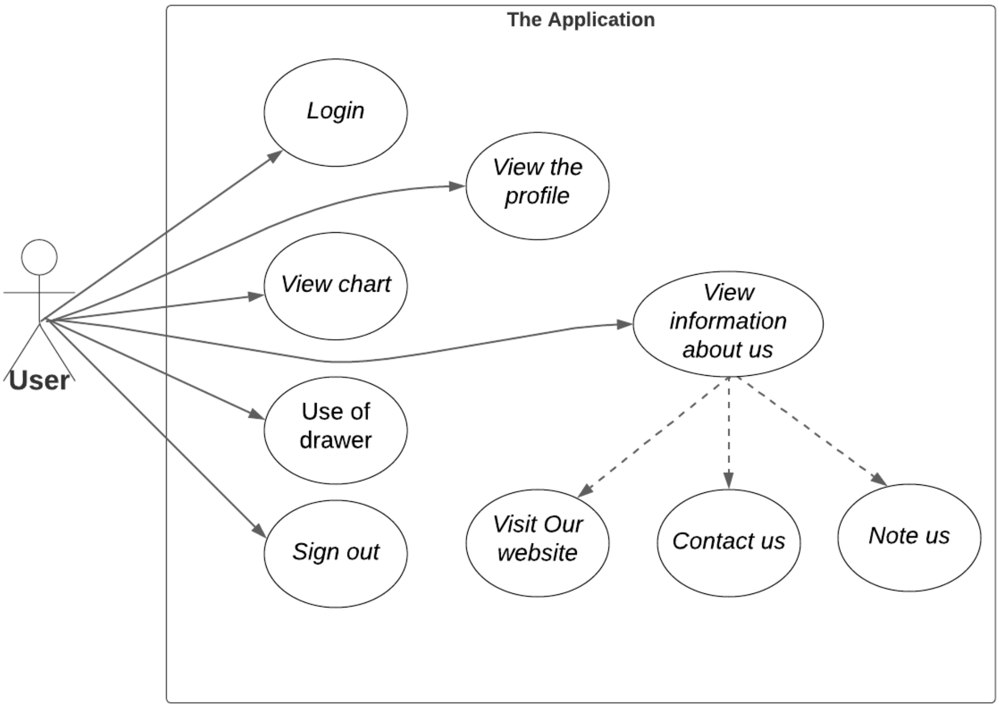


Figure 30. Case diagram

The image represents the top chart of use cases and functions that a user can perform within the application, the requirements will be determined by user stories. Some of these user stories have been broken down into sub-user stories.

The user has the ability to configure, delete or modify content within the application, he can only look at the information, browse it and benefit from it after it reaches the application, which is displayed in different forms.

The user will also not need a great knowledge of computers and programs, he only needs basic knowledge in the world of technology because it is an easy and intuitive application that can be browsed in a very easy way.

Unlike the illustration of use cases, we will do this in more illustrative tables:

US = User Story

US.1	log in
Description	As a user I can log in to the application.
Actions	A valid login allows the user to log in to the application. The user will be notified in case of wrong login.
Tasks	Add validations for login. Create a waiting Page during the verification process.

Figure 31. User story 1

US.2	Charts presentation
Description	As a user I can see the content of the charts.
Actions	The charts are displayed on the main page of the application. The user can see the charts. Display a text message where the scheme is located in case of absence of information. The user can enlarge the image of the chart. The user can navigate to the rest of the pages.
Tasks	Create all the charts on the page. Add a zoom feature to enlarge the chart. Create notification alerts. Add a tab to access the drawer. Linking the database via the API for displaying information.

Figure 32. User story 2

US.3	User information
Description	As a user, I can view personal information.

Actions	The application displays the user's personal information. The user can navigate to the rest of the pages.
Tasks	Display personal information on the user's page. Display personal information on the user's page. Add a tab to access the drawer.

Figure 33. User story 3

US.4	About Us
Description	As a user, I can access and contact the company's information.
Actions	The user can evaluate out the application. The user can visit the company's website. The user can contact the company by e-mail. The user can navigate to the rest of the pages.
Tasks	Adding The Play Store link. Adding the link of the company's website. Adding the company's email for contact. Add a tab to access the drawer.

Figure 34. User story 4

US.5	Drawer
Description	As a user I can navigate through the pages via the drawer
Actions	The user can navigate to any page with one click. The user can log out of the application.
Tasks	Create a drawer. Create buttons for all pages. Create an exit button.

Figure 35. User story 5

US.6	Log out
Description	As a user I can log out
Actions	The user can exit the application and close it with one click.
Tasks	Create an exit button in the drawer.
US.7	
Description	As a user I can use the application in multiple platforms.
Actions	The application should work on Android. The application should work on iOS. The application must run on Windows. The application should work on MacOS. The application should work on Linux. The application should work on the web.
Tasks	Programmable application on all platforms. Test the application on different devices.

Figure 36. User story 6

4.4 Diagrams:

4.4.1 Flow Diagram :

This chart is used to show the general activities within the application and how it works.

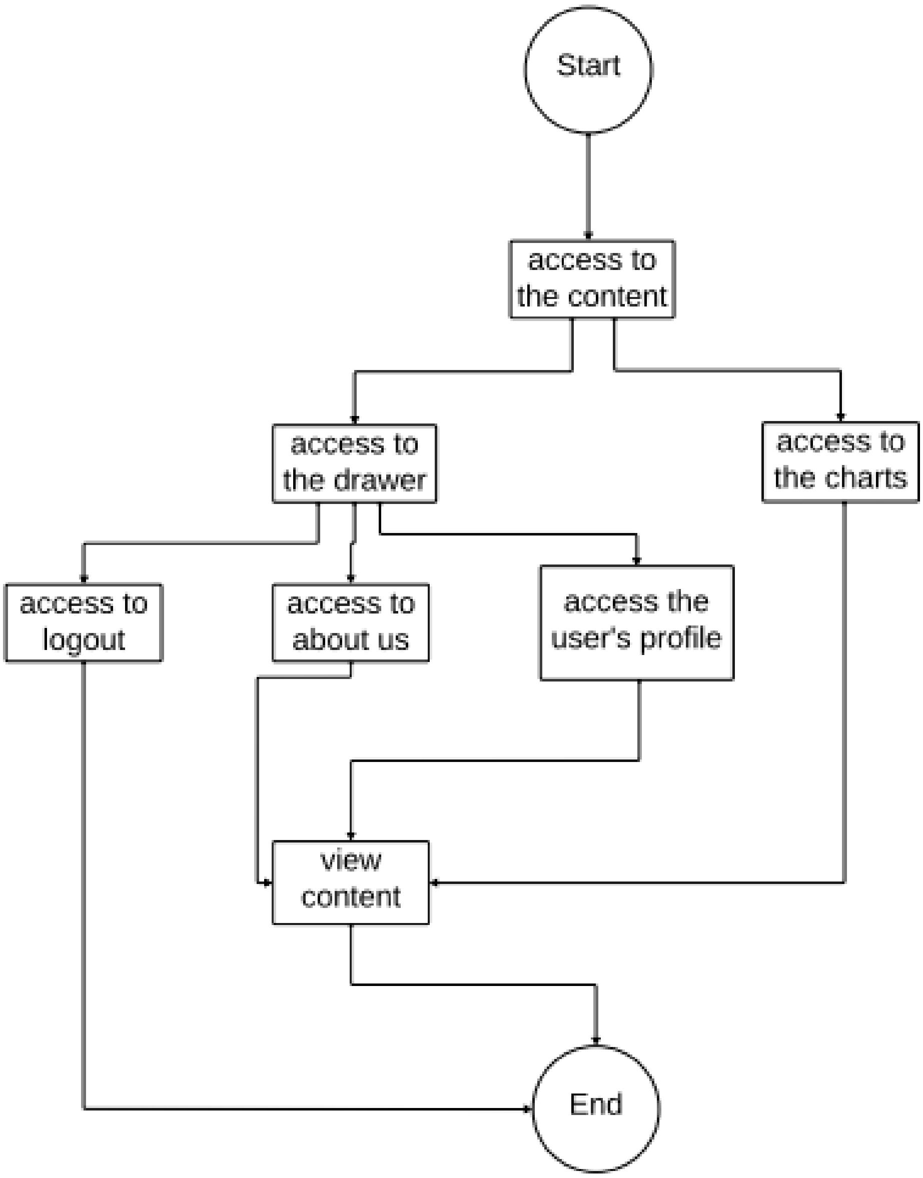


Figure 37. Flow Diagram

4. Implementation:

As the last stage in the project comes the implementation stage, which we write the code for our application with linking the application with the database, we also conduct experiments on the application every time to get the required results and modify some of the mistakes we make while writing the code.

It takes a lot of effort and time to achieve the desired results.

4.1 Database:

As a whole application, there should be a database in which information is stored and shared with the application itself.

In our case, the company is the one that controls the database and the information that reaches to the application through the API provided by the company to connect the application to the database.

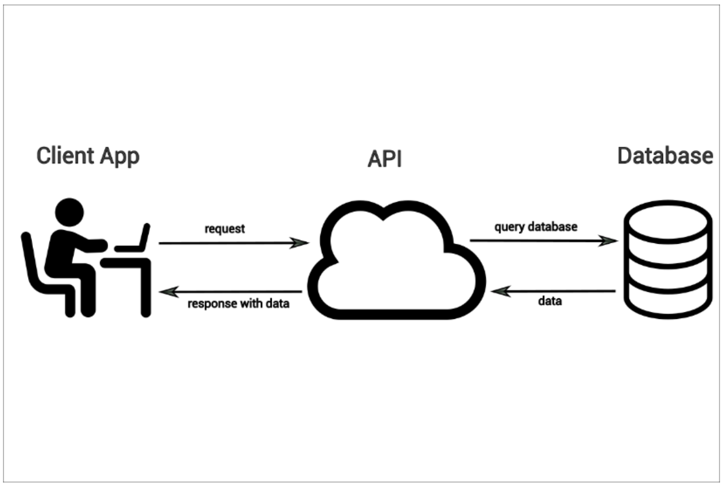


Figure 38. Database schema

The company is working on installing voice receivers at each customer at his workplace to capture the percentage of chaos he has and it is automatically sent to the database between a period not exceeding ten minutes when the database receives information, The application is connected via API which it can receive this information directly and display it inside an application and benefit from it.

In short, in our case we have nothing to do with programming and creating a database.

4.2 Tools:

4.2.1 Git:

The use of the Git tool is necessary to control the release of code. You also help to record and manage the various edits that are produced on any part of the project.

One of the best features of this tool is that in such large project as ours, it can fail at any moment and the inability to remember parts of the code, so this tool enables us to retrieve several serial versions.

Figure 39. Git logo

4.2.2 JDK:

The Java Development Kit (JDK) is a software development environment that offers a collection of tools and libraries necessary for developing Java applications. You need the JDK to convert your source code into a format that the Java Runtime Environment (JRE) can execute.

Figure 40. JDK logo

Flutter uses a flexible system that allows you to call platform-specific APIs in a language that works directly with those APIs:

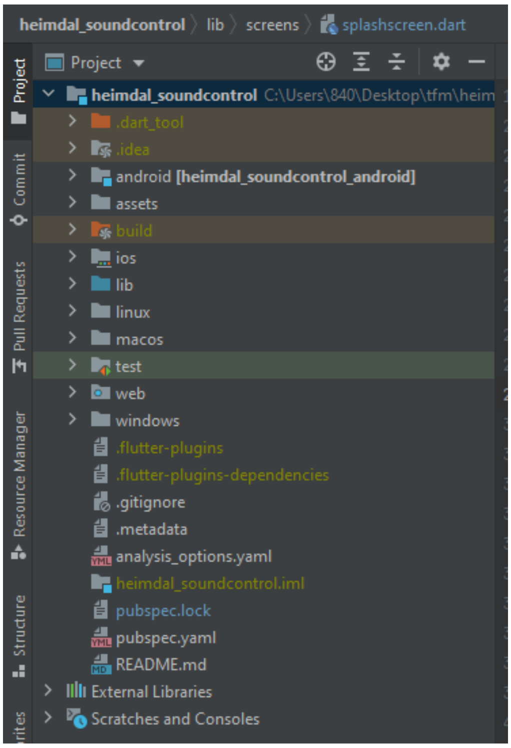
- Kotlin or Java on Android.
- Swift or Objective-C on iOS.
- C++ on Windows.
- Objective-C on mac OS.
- C on Linux.

In our case, I had to install the JDK tool because the application will be tried on Android and this requires many libraries provided by this tool.

4.3 Project structure:

The filters project consists of several irreplaceable basic files as well as secondary files, some of which are created automatically after opening any project, and some of which we create, program and fill with the necessary information for the operation of our application.

In our project, as we can see in the image below, the files that were created automatically after opening the project. Do not forget mentioning that we started the project from scratch, and these files are:

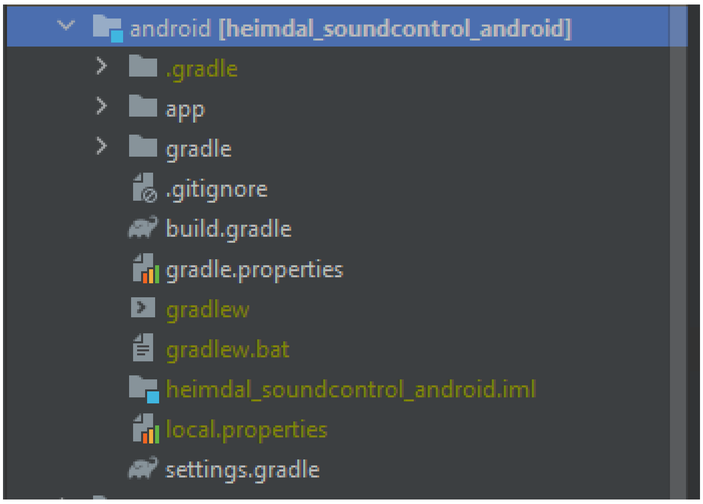


```
heimdal_soundcontrol C:\Users\840\Desktop\tfm\heim
  > .dart_tool
  > .idea
  > android [heimdal_soundcontrol_android]
  > assets
  > build
  > ios
  > lib
  > linux
  > macos
  > test
  > web
  > windows
    .flutter-plugins
    .flutter-plugins-dependencies
    .gitignore
    .metadata
    analysis_options.yaml
    heimdal_soundcontrol.iml
    pubspec.lock
    pubspec.yaml
    README.md
> External Libraries
> Scratches and Consoles
```

Figure 41. Project Folders

Android Folder:

After opening the project, the Android folder is automatically created in order to get an Android application, and this folder contains several basic files that cannot be erased or changed, you can only make light adjustments, such as changing the name of the application for example. If we erase these files, we have to recreate this folder anew and write it ourselves.

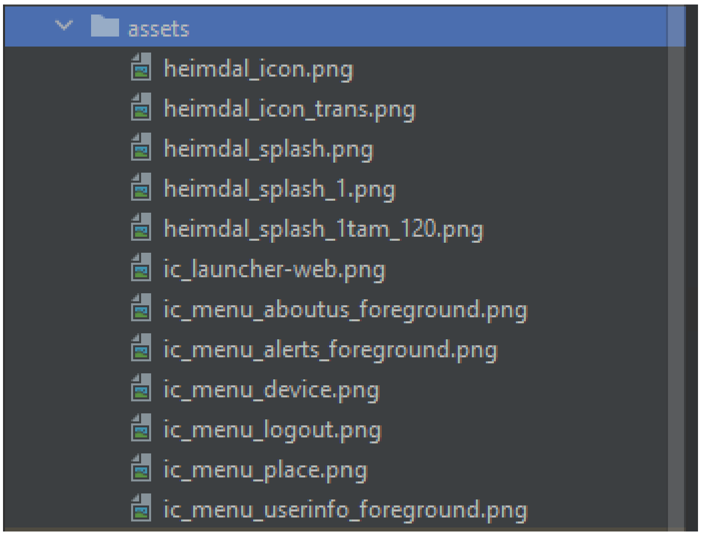


```
android [heimdal_soundcontrol_android]
  .gradle
  app
  gradle
  .gitignore
  build.gradle
  gradle.properties
  gradlew
  gradlew.bat
  heimdal_soundcontrol_android.iml
  local.properties
  settings.gradle
```

Figure 42. Android Folder

Assets folder:

This folder contains a set of images and icons that we use in our application and they have an internal source, that is, they are inside the application and we do not bring them from the outside.



```
assets
  heimdal_icon.png
  heimdal_icon_trans.png
  heimdal_splash.png
  heimdal_splash_1.png
  heimdal_splash_1tam_120.png
  ic_launcher-web.png
  ic_menu_aboutus_foreground.png
  ic_menu_alerts_foreground.png
  ic_menu_device.png
  ic_menu_logout.png
  ic_menu_place.png
  ic_menu_userinfo_foreground.png
```

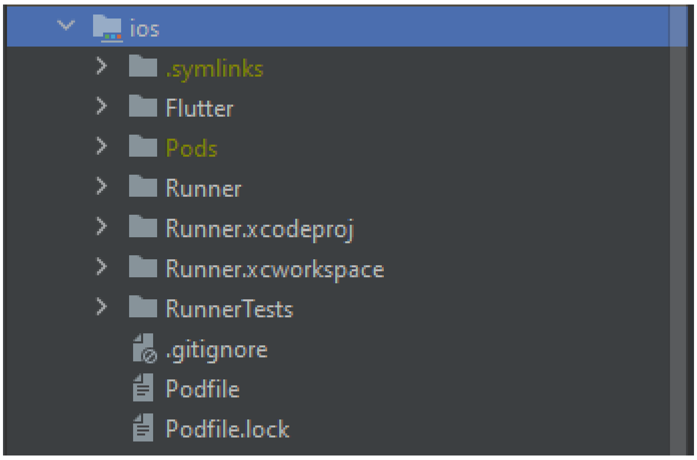
Figure 43. Assets folder

Build folder:

This folder is created by giving the command in the terminal and its role is to create the APK of the application after programming.

IOS folder:

This folder is also created automatically, as the Android folder was created immediately after opening the project, in order to get the IOS application at the same time in sync with applications on other platforms.

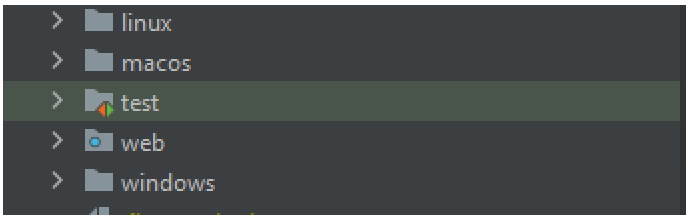


```
ios
    .symlinks
    Flutter
    Pods
    Runner
    Runner.xcodeproj
    Runner.xcworkspace
    RunnerTests
    .gitignore
    Podfile
    Podfile.lock
```

Figure 44. IOS folder

Linux, Mac, web, Windows, folders:

The folders of each of them are created automatically via the flutter program or they can also be created by giving the command in the terminal and we get the basic files in them automatically and these folders are used to get applications on each different platform, as is the case in Android and IOS.



```
linux
macos
test
web
windows
```

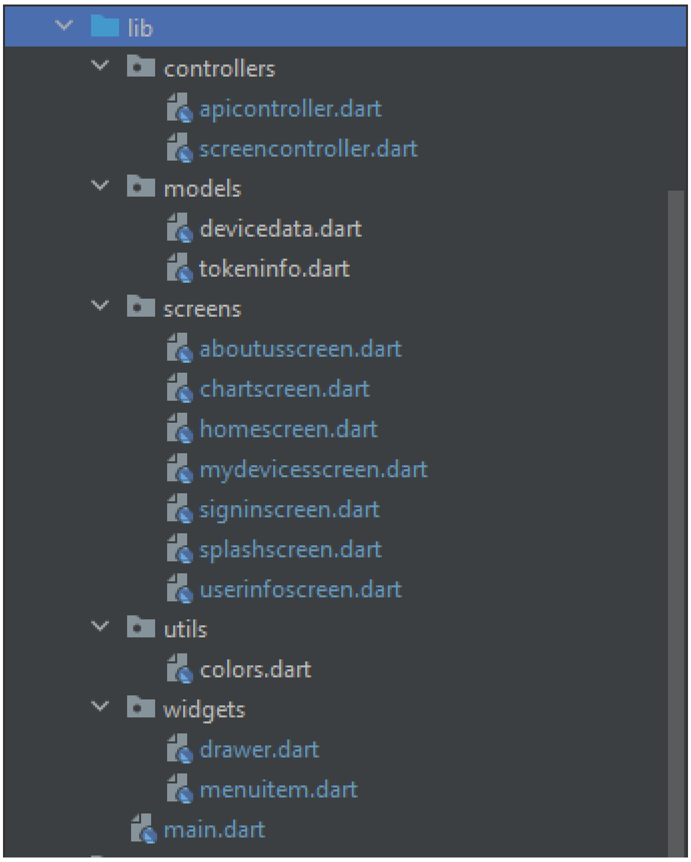
Figure 45. Linux, Mac, web, Windows, folders

Test folder:

You can create this folder by giving the command inside the terminal in the project. if you want perform testing your application for coding.

Lib folder:

In this folder the application is programmed and all the code is hosted and all the necessary modifications that the application needs are made in it.



```
lib
  controllers
    apicontroller.dart
    screencontroller.dart
  models
    devicedata.dart
    tokeninfo.dart
  screens
    aboutusscreen.dart
    chartscreen.dart
    homescreen.dart
    mydevicesscreen.dart
    signinscreen.dart
    splashscreen.dart
    userinfoscreen.dart
  utils
    colors.dart
  widgets
    drawer.dart
    menuitem.dart
  main.dart
```

Figure 46. Lib folder

This folder consists of several other files that have been divided as follows:

- **Controllers:**

This folder contains the Apicontroller that we use to fetch information from the database, as well as it contains screencontrol, which is a file used by all screens to get information from the API.

- **Models:**

We have to let the app know what kind of information we are going to get it. This folder defines the type of information where we have two types user-specific information that is fetched via the tokeninfo file and chart-specific information that is inserted via the devicedata file.

- **Screens:**

In this folder, all the possible screen files are created in this application, where the programming process is performed and all the necessary commands are filled for the application.

- **Utils**:

This folder contains the necessary utilities to specify the sizes and colors, for example, within the application, that is, if we want to change any of them, we come to this folder and change it without going to all the screens that have been programmed and changed.

- **Widgets:**

This folder contains some files that are used in several screens in order to avoid repetition, for example the drawer, which is used in all screens, so we avoid writing the function several times, only we can type it once and calling it when needed.

4.4 Development:

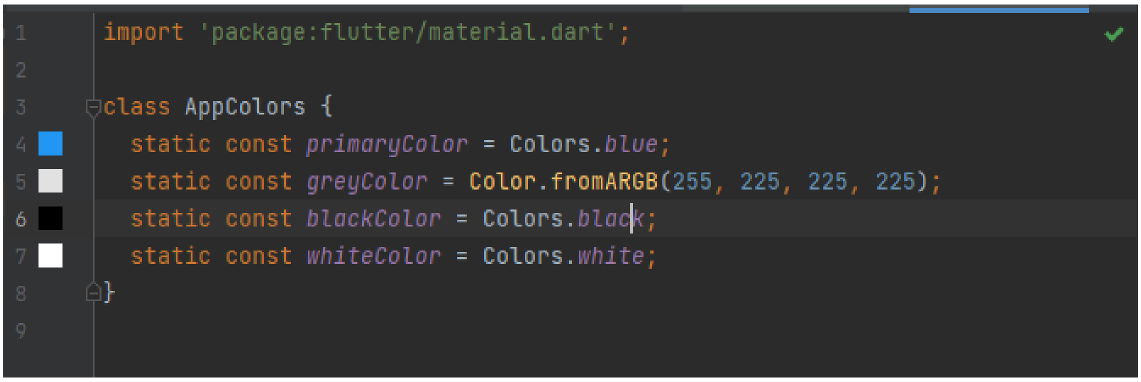
As mentioned earlier, the application is already existing in the company but works on Android only. What was provided by the company is java code for the application, so we had to study the whole code and analyze it to get the necessary information and tools in developing my application on filters, for example, extracting the API related to the database or taking some icons and images that I may need in development.

After conducting an analysis on some clients and talking with the company, we touched upon that the previous application should be taken into account, that is, we will not make any changes in terms of shape and colors, there will also be no new additions at the moment.

The first thing that was developed was the application's destinations and screens, where it was a dynamics screens connected to each other, but without external information, that is, not connected to the database, this is what we focused on at first to get a first model of the application to modify the colors and shapes that we want without going into the details of the data that takes time and special programming.

To link the database to an application, I created files inside a folder named Controller in order to facilitate the work and separate the programming of the screens with the connection software and there is no confusion in the code and it is easy for us to review the problems facing us easily.

The problem that we faced after connecting the application to the database via the API is that there are two types of information, namely the login confirmation information via the token and the second type, which is the charts information that is displayed on the screen inside the application. So, I created a folder named models that contains two files to determine the type of data and facilitates the process of reading it after it arrives by the API.



```
import 'package:flutter/material.dart';

class AppColors {
  static const primaryColor = Colors.blue;
  static const greyColor = Color.fromARGB(255, 225, 225, 225);
  static const blackColor = Colors.black;
  static const whiteColor = Colors.white;
}
```

Figure 47. Color function

During the programming process, I noticed that there are some functions that can be written in many places, so to avoid repetition, they were written in special files and can be contacted at the time of need, such as the function of the drawer that appears on all application screens or, for example, the use of colors that I specified in a special file to avoid rewriting them again.

These results were not from the first time, but we did many stages and each time we touch on the development, modification and improvement of the code in terms of organization and avoiding duplicates.

4.5 Tests:

During the creation of the project, experiments should be conducted on an application at every stage in order to ensure the correctness of the work, because in the progress of the project it is impossible to go back and we have taken a lot of time in the programming process, so the experience of each new code is better.

To gain time due to the short duration of the project, I used the emulator on Android Studio for the Android application every time during the progress of the project, and there was no need to try the application during programming on all platforms because automatically we will eventually get applications available on all these platforms.

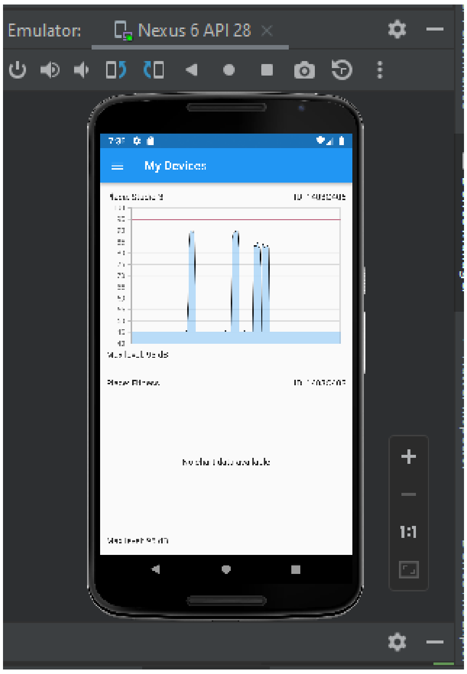


Figure 48. Android emulator

During the trial process, I chose the emulator with the old version (6.0) in order to make sure that the application is tried on all possible phones.

In each experiment I was touching on some problems that were fixed and it sometimes took time to reach the desired solutions and results.

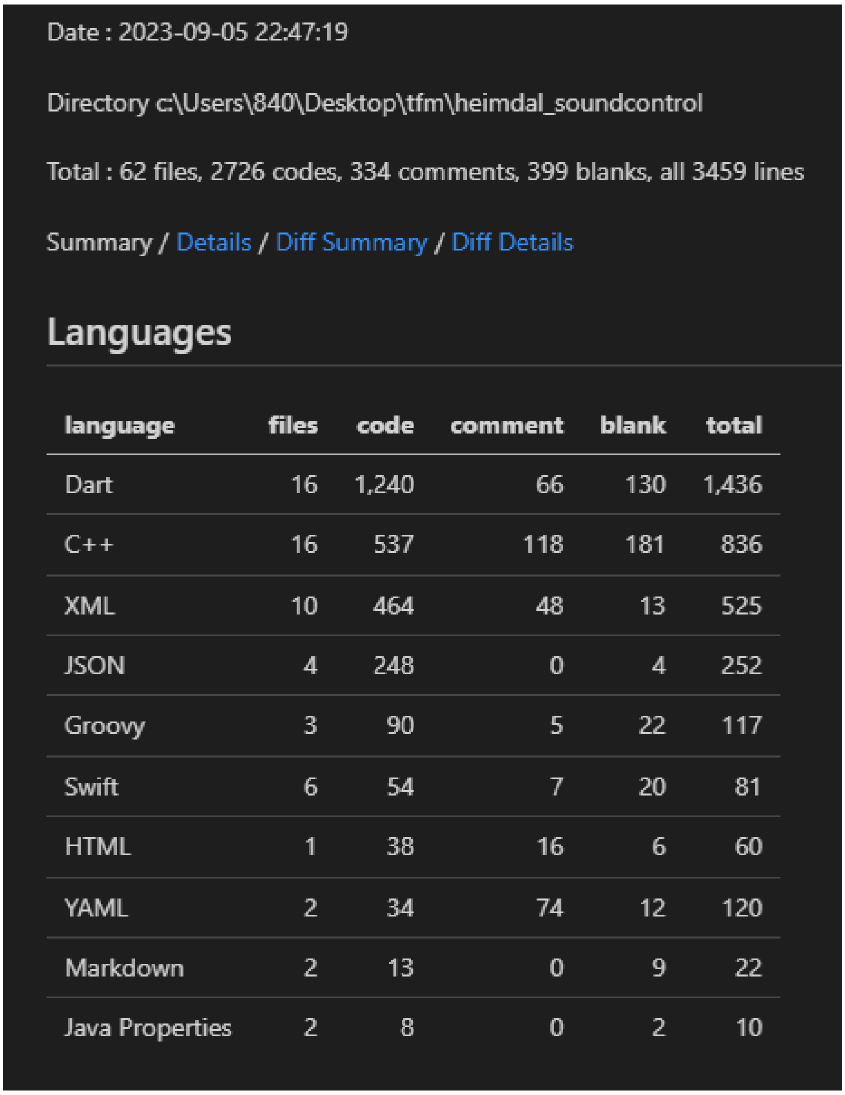
After the completion of the application, it was presented to some users to try it and hear some opinions and criticisms, and this was classified in the following table:

Task	User 1	User 2	User 3	User 4
Sign in	success	success	success	success
Logout	success	success	success	success
Detailed browsing of charts	success	success	success	success
Using of the drawer	success	success	success	success
Access to user information	success	success	success	success
Browse information about the company, contact it and drip the application.	success	success	success	success
Application design	success	success	success	success
Ease of use.	success	success	success	success

Figure 49. tests table

All the tests were perfect and there were no problems or errors that could undermine the success of the project.

4.6 Evaluation of the Project:



Date : 2023-09-05 22:47:19

Directory c:\Users\840\Desktop\tfm\heimdal_soundcontrol

Total : 62 files, 2726 codes, 334 comments, 399 blanks, all 3459 lines

Summary / Details / Diff Summary / Diff Details

Languages

language	files	code	comment	blank	total
Dart	16	1,240	66	130	1,436
C++	16	537	118	181	836
XML	10	464	48	13	525
JSON	4	248	0	4	252
Groovy	3	90	5	22	117
Swift	6	54	7	20	81
HTML	1	38	16	6	60
YAML	2	34	74	12	120
Markdown	2	13	0	9	22
Java Properties	2	8	0	2	10

Figure 50. Project evaluate table

This project contains 3459 lines of code and 62 files. As we can see in the table, what has been programmed is 1436 lines of code and 16 files, the rest is generated automatically in the project by flutter.

I think it's a good number for the final master's degree project and it was written from scratch, although my knowledge was very weak about Flutter at first, so I gained good knowledge and experience after completing this project.

5. Conclusions and future work:

At the end of this project, it can be said that our work was a success in all respects.

As for the application, I find it very useful for my users, as it is an easy-to-use application that does not require much knowledge of the world of technology to use it, as well as helps to deliver the service provided by the company to its customers.

We also find that the main goal has been achieved, which is that the application has become available on various possible platforms, that is, there is no problem with some users as before, and this gives a great possibility to market this application and does not find much competition at the moment.

Do not forget to mention that our application is developable and updateable I focused on leaving a very clear concept for the company, especially from the programming side, so we find that it is an understandable code and attached with comments to clarify all the points inside it.

It was very difficult to use the API to connect to a database provided by the company, especially since you must have a lot of knowledge in this area, most developers are used to building a database themselves and connecting it with the application, and this is easier.

As for the technical side, it was a very hard work because filters were used for the first time, and this required a lot of study and research and took time to learn, but this gained me a good skill and knowledge in the world of application development with flutter technology, which we see is in great demand nowadays.

In the end, I can say that the project is successful, the application is well used and ready for publication in app stores.

As for me, I was able to work on all stages of the project and benefit from them and enrich my knowledge because I worked with individual efforts and took a lot of time to solve all the problems of the project that faced me.

Personally, this project was a big challenge for me, I see that I passed it successfully, and this motivates me to work more in the future and gives me great potential in learning.

I feel that I have achieved the goal of the Master's Final Project and have reached the required level of knowledge to go into practical life and use the skills I have learned in the implementation of future projects.

5.1 Future work:

The final application has implemented all the requirements and functions that were identified at the beginning of the project, but there was always an idea to develop and improve the project in the future during the project implementation process, especially after interviewing some users who expressed their opinions to new developments.

We have identified some points that include new ideas in improving the application:

- Adding of special notifications when maximum noise is Exceeds in order to alert the user.
- The possibility of opening a new account for new users in the application without resorting to the company.
- At the design level added the option of dark mode for the application to change the color.
- The possibility of changing the language.
- Adding of a special messaging feature to talk with the support from within the application to solve problems.
- The possibility of sending an automatic voice message to the place where the noise level is high to ask users to turn down the sound.

All these suggestions will be under study and there will be other developments in the future after trying the application and listening to users ' complaints, as well as there will be constant contact with the company, there will be an exchange of ideas and reach better results in the future.

6. Bibliography:

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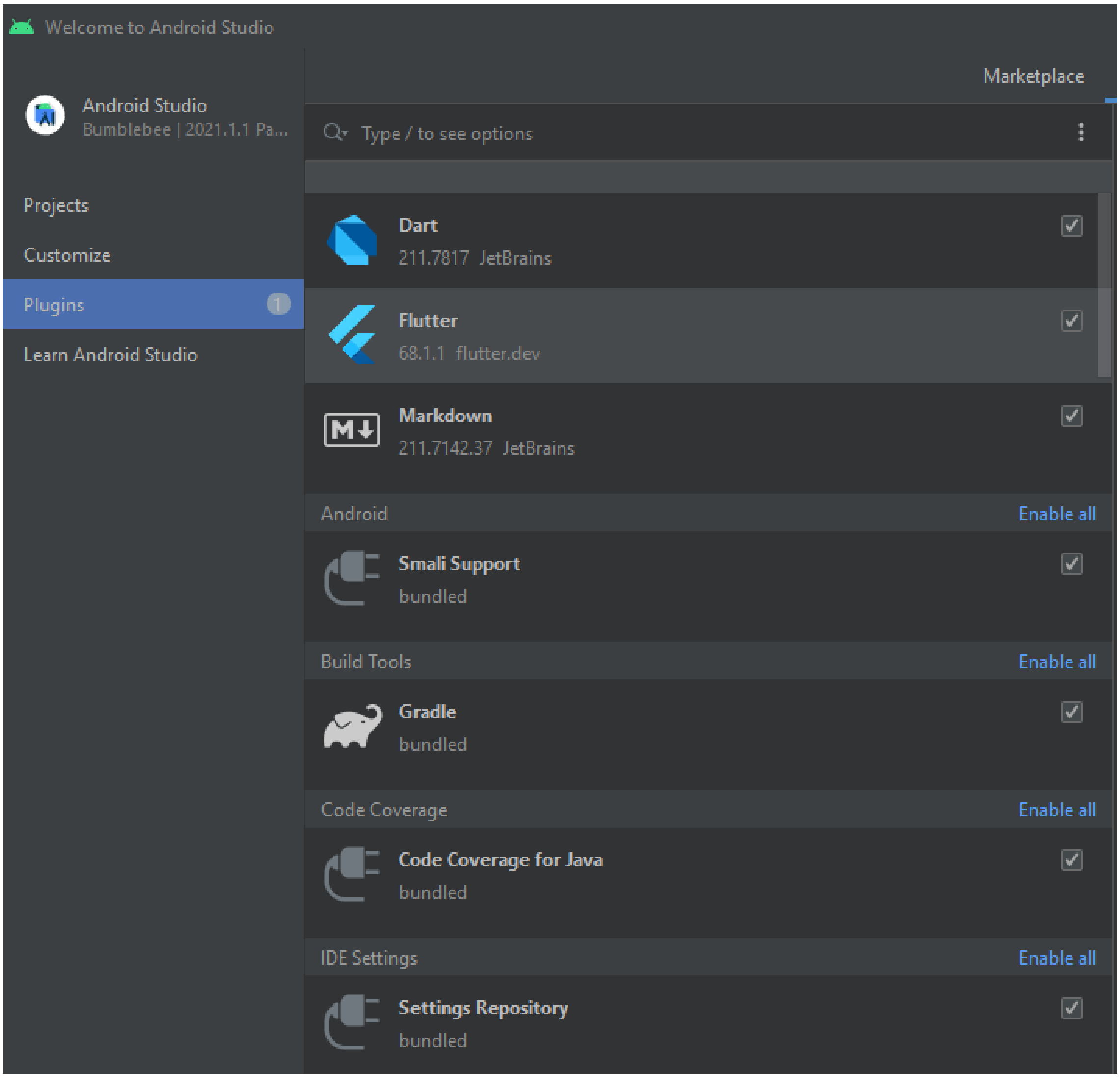
7. Annexes:

In this parte, we review some of the installations that we have done and some of the problems that we encountered during the creation of the project and how they were solved:

We install *Flutter* and *Dart* from the *"Plugins"* window so that we can open a new Flutter project, and restart the program after installation.



Dart ☑
211.7817 JetBrains

Flutter ☑
68.1.1 flutter.dev

Markdown ☑
211.7142.37 JetBrains

Android — Enable all

Smali Support ☑
bundled

Build Tools — Enable all

Gradle ☑
bundled

Code Coverage — Enable all

Code Coverage for Java ☑
bundled

IDE Settings — Enable all

Settings Repository ☑
bundled

Figure 51. Flutter installation

In this case, a new tab will appear that will allow us to open.

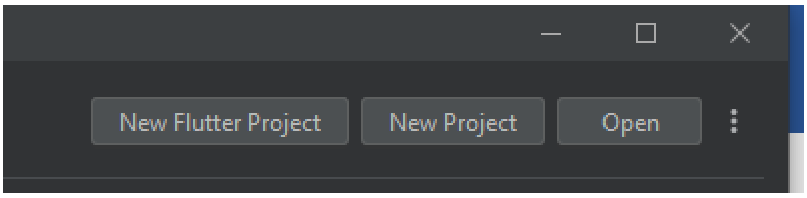
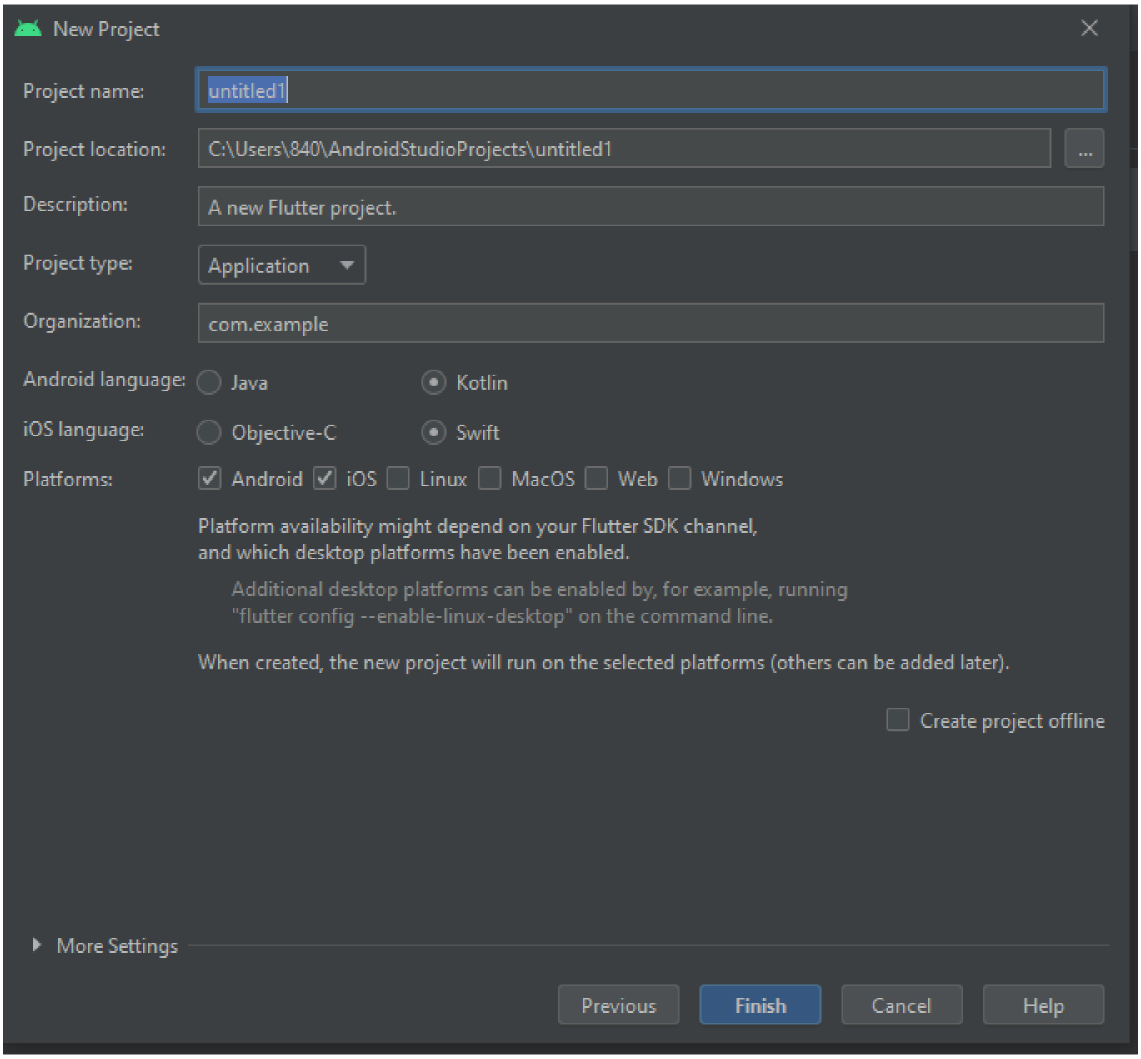


Figure 52. Opening a new project

When we open the new project, we can name it, choose where to save files, programming languages and many other settings.



New Project

Project name: untitled1

Project location: C:\Users\840\AndroidStudioProjects\untitled1

Description: A new Flutter project.

Project type: Application

Organization: com.example

Android language: ○ Java ● Kotlin

iOS language: ○ Objective-C ● Swift

Platforms: ☑ Android ☑ iOS □ Linux □ MacOS □ Web □ Windows

Platform availability might depend on your Flutter SDK channel, and which desktop platforms have been enabled.

Additional desktop platforms can be enabled by, for example, running "flutter config --enable-linux-desktop" on the command line.

When created, the new project will run on the selected platforms (others can be added later).

□ Create project offline

Figure 53. Opening Settings

Some problems encountered:

the first problem: *Error Failed to Install HAXM*

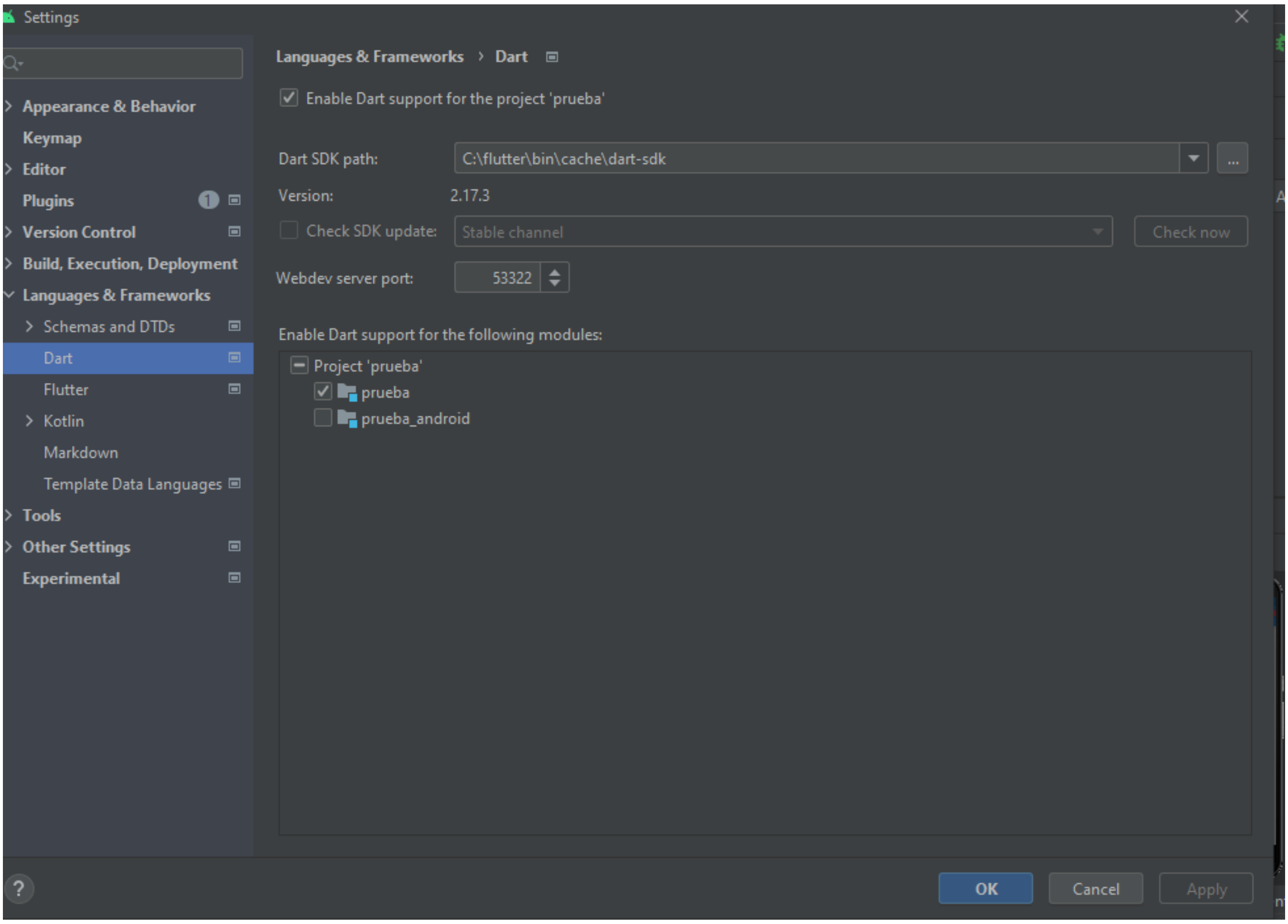
This problem is solved by entering the BIOS files when the computer is turned on, where we perform the *Vesualization* activation process and then restart the computer.

the second problem: *Dart SDK is not configured*

We solve this problem by searching for the correct *Path* of the *Dart file*, then copying it and clicking Apply.

Then we restart the program.

In some cases, you come across several other problems that can be solved depending on the situation.



☑ Enable Dart support for the project 'prueba'

Dart SDK path: C:\flutter\bin\cache\dart-sdk

Version: 2.17.3

□ Check SDK update: Stable channel

Webdev server port: 53322

Enable Dart support for the following modules:

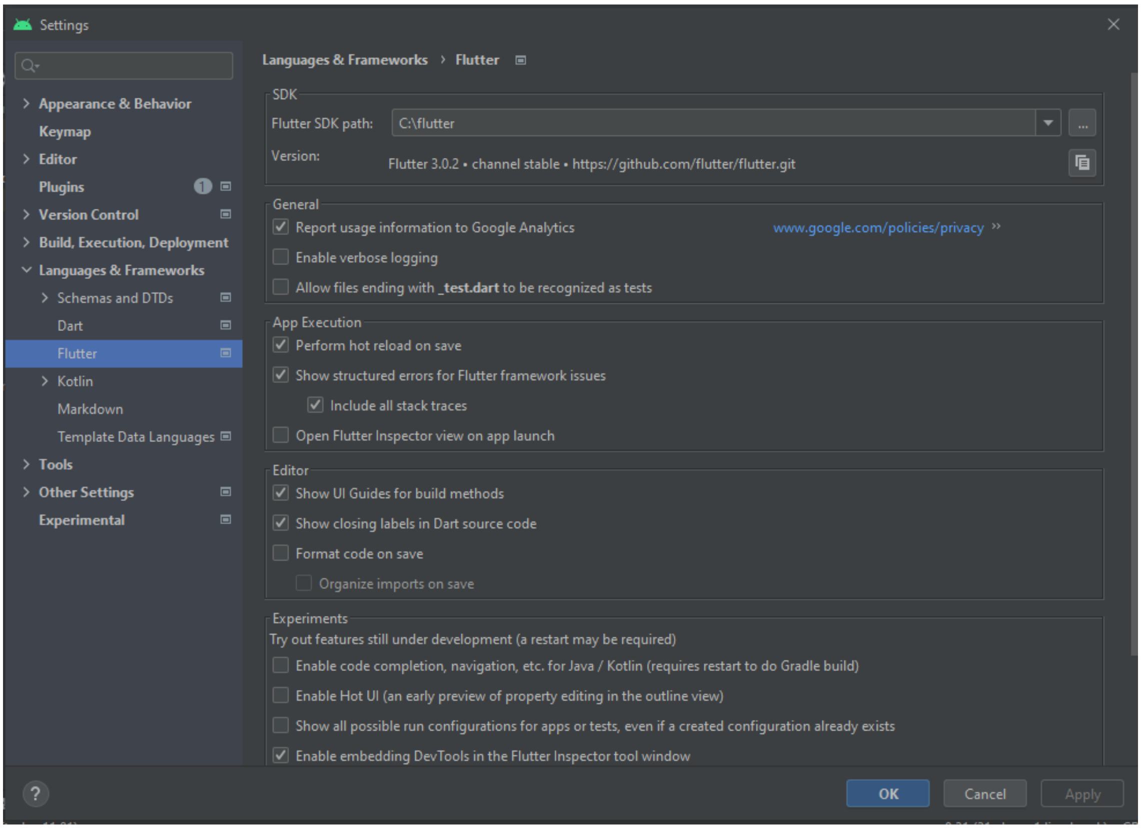
Project 'prueba'
☑ prueba
□ prueba_android

Figure 54. Dart SDK configuration

The third problem: *Error Flutter SDK is not found in the specified location*

We enter the *Flutter development* site to download *Flutter SDK*, where we choose the version according to the situation (Windows), after the download we install *Flutter SDK* with the selection of the installation location, then copy *the path* and click Apply.

Then we restart the program.



SDK

Flutter SDK path: C:\flutter

Version: Flutter 3.0.2 • channel stable • https://github.com/flutter/flutter.git

General

☑ Report usage information to Google Analytics www.google.com/policies/privacy »

□ Enable verbose logging

□ Allow files ending with **_test.dart** to be recognized as tests

App Execution

☑ Perform hot reload on save

☑ Show structured errors for Flutter framework issues

☑ Include all stack traces

□ Open Flutter Inspector view on app launch

Editor

☑ Show UI Guides for build methods

☑ Show closing labels in Dart source code

□ Format code on save

□ Organize imports on save

Experiments

Try out features still under development (a restart may be required)

□ Enable code completion, navigation, etc. for Java / Kotlin (requires restart to do Gradle build)

□ Enable Hot UI (an early preview of property editing in the outline view)

□ Show all possible run configurations for apps or tests, even if a created configuration already exists

☑ Enable embedding DevTools in the Flutter Inspector tool window

Figure 55. Flutter SDK configuration