

الجمهورية الجزائرية الديمقراطية الشعبية
République Algérienne Démocratique et Populaire
وزارة التعليم العالي والبحث العلمي
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique



N° Réf :.....

Centre Universitaire
Abdelhafid Boussouf Mila

Institut des Sciences et Technologie

Département de Mathématiques et Informatique

Mémoire préparé en vue de l'obtention du diplôme de Master

En : Informatique

Spécialité : Sciences et Technologies de l'Information et de la Communication
(STIC)

Development of a traffic information system based on Geolocation and mobile technologies

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Année Universitaire : 2016/2017

ABSTRACT

The road network in Algeria has known a perceptible progress these last decades. A modern road network helps better traffic support. It is considered as an important basis for economic growth. However, this evolution needs to be accompanied with new and automated tools and practices that make use of new ICT.

Providing traffic information is one of the important elements that help efficient use of the road network and increase road safety which still remain a big concern in our country.

This project fits in this area and aims to provide all the relevant information related to the road network status and traffic conditions to the entities that may need it. We'll try to focus on information quality and the speed of its delivery through the use of Geolocation, web and mobile technologies.

نُبذة

عرفت شبكة الطرقات في الجزائر تطورا ملحوظا في السنوات الأخيرة مما يسمح لا محالة بحركة أكثر سلاسة للبضائع و الأشخاص. يعتبر هذا العامل في الحقيقة مهما جدا لتحقيق التطور الإقتصادي في أي دولة. لكن و مع ذلك يبقى هذا الانتشار الإيجابي لشبكة الطرقات بحاجة ماسة لمرافقة وسائل و ممارسات حديثة تعتمد على آخر التطورات في مجال تكنولوجيا المعلومات و الاتصال و تتماشى مع الإتجاه السائد حاليا لدمج هذه التكنولوجيا في كل القطاعات.

يعتبر توفير معلومات حول حركة المرور و حالة الطرقات عاملا مهما و مساعدا على الاستغلال الأمثل لشبكة الطرقات. كما يساعد أيضا على دعم الوقاية المرورية و أمن الطرقات اللذان يشكلان هاجسا حقيقيا في بلدنا.

هذا المشروع يدخل في هذا السياق و يهدف لإنشاء أدوات تسمح بتوفير المعلومات المفيدة و الآنية لمستخدمي الطريق و كل الهيئات المهتمة. يدعم المشروع نوعية و سرعة تقديم المعلومات اعتمادا على تقنيات تحديد المواقع و تكنولوجيا النقال و الواب.

DEDICATION

*All praise and thanks to Allah whose blessings make possible all good deeds, and may His prayers, be upon the Prophet Mohammed
Peace be upon Him.*

Lovingly we dedicate this dissertation to our parents and families for their unconditional support and for giving us the chance to prove and improve ourselves through our walks in life.

*We dedicate it to our friends for being so close to us and those we found helpful whenever we needed them and have provided us with power to
finish this work*

ACKNOWLEDGMENTS

We would like to convey our thanks, our gratitude and to express our thanks to our supervisor Mr. Bilal DOUAS for his help, guidance, and innumerable advices. We are grateful to his encouragement and patience throughout the completion of this work.

We also owe special thanks to my teachers and colleagues at Mila University Center.

We would like to express our gratitude to our families, without their patience, emotional and material support, this work would not have been possible.

We also would like to thank Dr. Mohammed LALOU and Mr. Mohammed BOUBAKIR for accepting to examine our work.

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LIST OF ACRONYMS

2TUP	2 Tracks Unified Process
3G	3rd Generation Mobile Telecommunications
4G	4th Generation Mobile Telecommunications
ABS	Anti-lock braking system
API	Application Programming Interface
EEG	Electroencephalography
ICT	Information and Communication Technology
IDE	Integrated development Environment
IT	Information Technology
ITS	Intelligent Transportation Systems
LTE	Long Time Evolution
OBD2	On Board Diagnostic System v2
ONS	National Office of Statistics
SDK	Software Development Kit
SHFD	Smart Headband For Drivers
UMA	Arab Maghreb Union
VICS	Vehicle Information and Communication System
WHO	World Health Organization
XML	Extensible Markup Language

INTRODUCTION

We live in the era of high speed internet and advanced mobile devices. With this technology becoming so deeply rooted in our culture, and with people being out on the roads more often than they have ever been, be it on foot, in their cars or in public transport, it is essential to make the connection between those two subjects: the internet and mobile technology, and road information.

One way the internet and mobile technologies have affected roads usage is by providing real time maps navigation, which provides various services to all kinds of users, be it a user looking for a specific location or a service, or someone in an emergency trying to find the shortest path to reach their destination.

While this technological advance makes it seem like navigating the roads is a joy rather than a chore, mobile apps that provide road information services are still lacking in many areas. This lack manifests in several ways, the most important of which are the lack of coverage of rural places and even urban ones when it comes to developing and under-developed countries. Also, there are not any appropriate features that allow the users of the road to report incidents and share information about them in real time with the others.

A solution to this problem is a community-driven app, where the users are the source of information. This solution makes use of the tremendous increase of Smartphone and tablets usage, as well as the users will to share information about their surroundings in order to help others, and possibly themselves in the future. The major selling point for this type of solution is that the information shared on the map is real-time information. This provides the users with a great source for information while they are on the road.

Our intention is therefore to design and develop an application that allows the users to both share and receive instant information related to the roads they use, be it accidents, the state of the road, traffic information and even services that they can find while on the road.

DOCUMENT STRUCTURE

In addition to this introduction, which describes the context of our work, our document includes four chapters:

- The first chapter introduces the context in which this Master Thesis has been developed. It presents the road traffic and networks globally before to focus on the case of our country. In this part of the document, the main problems and solutions are exposed while the important link with technology is highlighted.
- The second chapter presents a study we conducted to define our final product. We made a survey to ask future users about what their perceptions and expectations.
- The third chapter is dedicated to the design of our system.
- The implementation of our solution is explained in the fourth chapter.

Chapter I

ROADS & INFORMATION TECHNOLOGY

Roads are the main infrastructure for transports in Algeria. It is estimated that 85% of goods and passengers rely on roads as their primary mode of transport. Algeria has an extensive though aging road infrastructure. As well as the road infrastructure being poor, there are insufficient resources to handle the growing number of vehicles in Algeria. Furthermore, unskilled drivers and Lack of awareness are considered to be key contributing factors to the growing incidences of road traffic crashes and resulting injuries. Mobile technologies make it possible to communicate with people around you passively and indirectly and the use of these technologies has grown in a huge way. Therefore, relying on these technologies to report road condition and facilitating the car services is an excellent idea. Moreover, this would reduce the impact of the accidents and more importantly would raise public awareness on the issue.

I.1. ROAD NETWORK IN ALGERIA

Algeria is the largest country in Africa with an area of 2.381.741 square kilometers. It is also the tenth-largest country in the world. This wide area definitely needs a big and spread road network. Indeed, the roads reach all the

regions of the country but the network's distribution is not homogeneous. Road development essentially follows human settlement patterns and the network is much more developed in the northern coastal region where economic activities and population concentrations are heaviest.

The south is served by a limited number of national roads linking the few populated areas. Road conditions can be variable, particularly in the south on the trans-Saharan corridor, as even newly paved portions of the road often disappear under immense drifts of sand that block the route for days at a time.

The east-west highway project is vastly changing the highway profile in the country. It is Algeria's most important road project and is now completed. The 1216 km highway, which runs between Morocco and Tunisia, connects Algeria's major coastal cities.

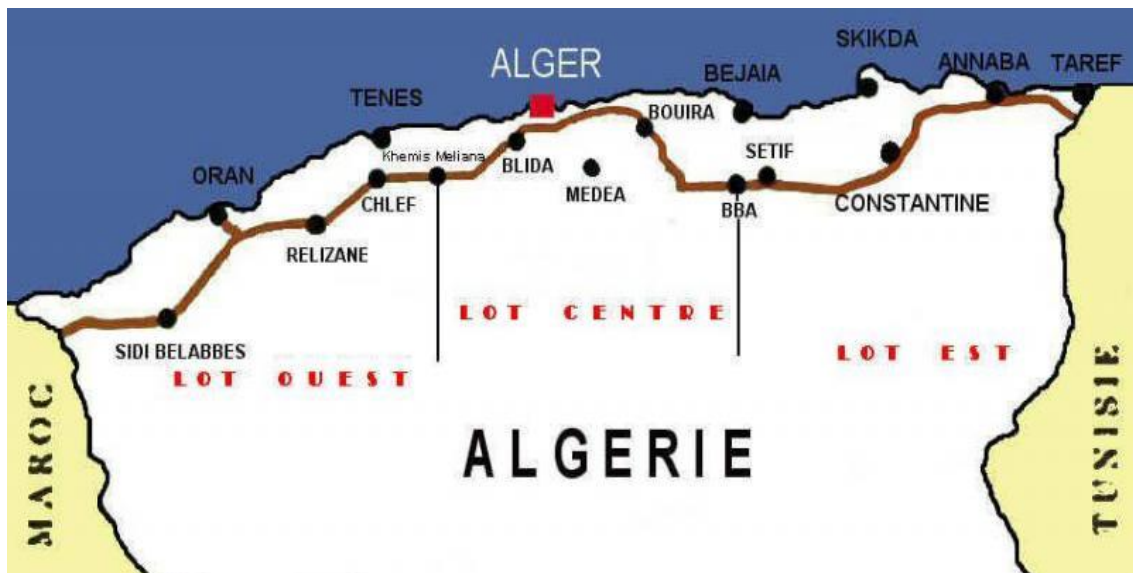


FIGURE 1: THE EAST-WEST HIGHWAY PROJECT

Future planned developments will, however, focus on the north-south highway in an attempt to realize greater connectivity for the more remotely situated populations in the south. Also these important roads need to be connected with the nearby departments to reach optimal use and take advantage of them.

I.1.1. CLASSIFICATION OF ROADS

I.1.1.1. ADMINISTRATIVE CLASSIFICATION

Roads in Algeria are classed into three categories from an administrative perspective:

I.1.1.1.a. NATIONAL ROADS

National roads connect the different departments. The total length of national roads in Algeria reached 29573 kilometers in 2013 [1].

I.1.1.1.b. PROVINCIAL ROADS

Provincial roads connect the municipalities and towns inside the provinces (departments). According to the ministry of public works [1], the total length of departmental roads is 24109 kilometers.

I.1.1.1.c. MUNICIPAL WAYS

Municipal ways are established inside municipalities to connect the different cities, agglomerations and public facilities. The total length of municipal ways is 60420 kilometers.

This makes a total road system of 114282 kilometers with more than 70% of paved roads. This doesn't include urban ways which are estimated at around 68000 kilometers.

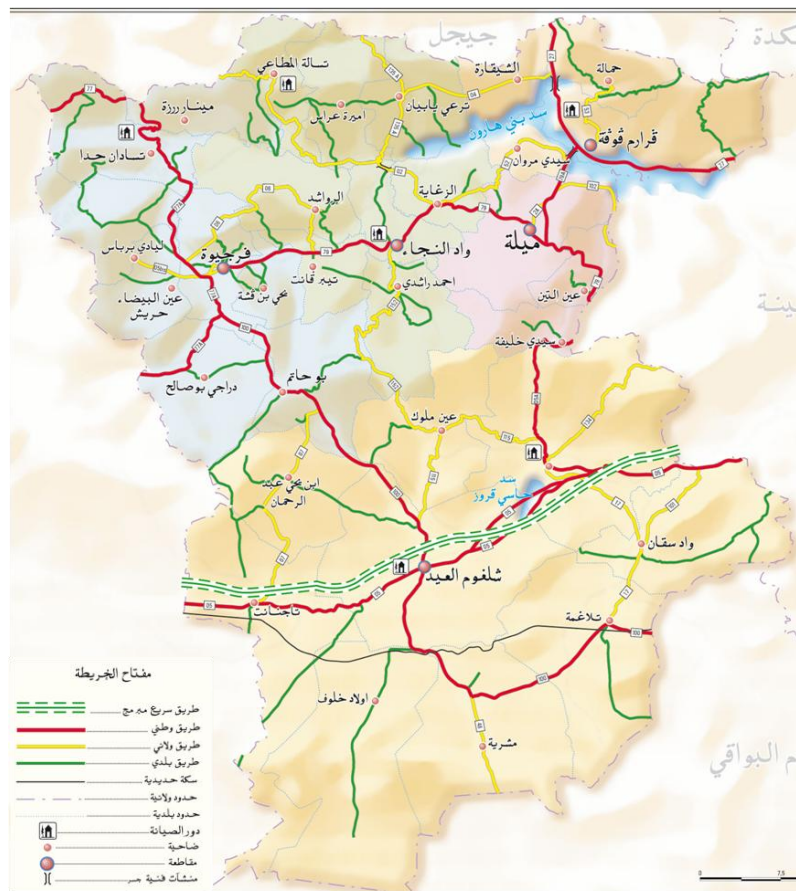


FIGURE 2: ROADS NETWORK IN MILA

I.1.1.2. TECHNICAL PERSPECTIVE

I.1.1.2.a. FREEWAYS

Freeways are roads specially designed for high speed traffic, which they not cross any other road, railway or pedestrian lane. They are accessible only at selected points [2].

Freeways are multi-Lane, divided roads with strict rules. The specifications of those rules are relative to the region they are built in but globally we may list the following:

- Freeways have no cross roads so no stop light or signs are required. Also, entrance ramps have an acceleration zone to allow the cars accelerating up to the tolerable speeds before they join the freeway's traffic. Exits are designed under the same principle too.
- Most of the maneuvers are not allowed: stopping, parking or moving back.
- Defined speed interval with the highest speed limits (120km/h)
- Restricted access where only complying vehicles are allowed. For example vehicles with low speed, bikes or bicycles are not allowed.

I.1.1.2.b. HIGHWAYS

A Highway (or express road) is a road or section of road that cannot cross other roads or railways and which may be prohibited to certain categories of users and vehicles. It comprises, in both directions of traffic, distinct one-way parts, each consisting of at least two lanes of traffic [2]. Traffic is allowed in relatively higher speeds. Speed limit is near to freeway speed limits (100 Km/h).

I.1.1.2.c. ROADS OR MINOR HIGHWAYS

An ordinary road a minor highway is a public highway open to vehicular traffic (2). It is a narrow road which usually has only two non separated lanes, one lane on each direction.

This class of roads comprises all the roads that don't comply with the rules of the two previous classes. This is the case of residential streets with stops signs, roads with numerous side streets, parking lot accesses, residential driveways, low speed limits, undivided, or shared center turn lanes [3].

I.1.2. EAST-WEST HIGHWAY

The East-West Highway project was launched in 2009 with an estimated costing of \$11.2bn. The final cost was clearly higher than that since it reached around \$17bn. It is a 1216 km highway linking Annaba in the east to Tlemcen in the west, passing through 24 Algerian provinces. This is not only the biggest road project in the country but also among the biggest public works project in the world. The project was completed in 2014.

The project is a six-lane highway, three lanes in each direction. It is being developed along Algeria's borders with Morocco and Tunisia. It connects most Northern provinces including the biggest one like Algiers, Constantine, Oran...

The East-West highway also has important implications for regional integration among the Arab Maghreb Union (UMA), which includes Algeria, Morocco, Tunisia, Libya and Mauritania. The project is part of the 7,000km-long Trans-Maghreb Highway, which stretches 7000 km north from Nouakchott to Rabat, and then east to Tripoli. It will connect the Maghreb states of Morocco, Algeria, Tunisia and Libya.

The final goal is to improve transport efficiency which helps increasing inter-Maghreb economic exchange, as well as tourism.

I.1.3. FUTURE PERSPECTIVE

Algeria has set an ambitious infrastructure plan that aims to build a widespread network of national highways and roads by 2025. As work on Algeria's East-West Highway has been completed, the government has turned its attention to the next stage of its program to strengthen national transport infrastructure – the improvement of urban and provincial road networks nationwide to ease congestion and improve end-user distribution services. A series of 10 north-south connector roads will provide access to main arteries from underserved areas in the interior, through a series of interchanges and access roads.

I.1.3.1. THE HIGH PLATEAUS RING ROAD

Another strategic project is the high plateaus ring road. The technical study is achieved and 1020-km road will run roughly parallel to the East-West Highway

farther to the south, linking the town of El Aricha, south of Tlemcen, to Bouchebka, near the border with Tunisia [4]. The road, with two or three lanes in each direction and the possibility of expanding to three will provide a second major east-west connection. The project, which the feasibility study has demonstrated profitability, will help meeting the needs of road transport in the High Plateaus area in order to contribute to the settlement of populations residing there. [5]

Also, studies are underway on some of the links, such as the planned connector to the port city of Ténès (Chlef) and the provincial capital of Tissemsilt, 220 km to the southeast.

I.1.3.2. NORTH - SOUTH HIGHWAY (5)

The aim of the project is to convert the main north - south road axes, to link between the East - West Highway and the high Plateaus By-pass, and canalize to them the traffic flow as soon as possible.

I.1.3.3. ADDITIONAL BYPASSES OF ALGIERS (5)

The increase in urban and peri-urban traffic intensity led that the current road network has reached its saturation limits. Facing this fact, the achievement of the second, third, and fourth bypasses, which start respectively from Zéralda to Boudouaou , from Tipaza to Bordj Menaiel and from Khemis Miliana to Bordj Bou Arreridj , has become an inevitable option.

I.1.4. ROADS QUALITY

A big part of the road network in Algeria is relatively new and has been realized under new standards. The last two decencies have seen the realization of many new roads. Also many old roads have been upgraded or maintained. The amount of unpaved roads has been noticeably reduced.

This means that the quality of the road network should be quite good. The road is reasonably good, however, it's subject sometimes to be blocked, due to the damages caused by floods as a result of heavy rain, especially from January to March and due to poor construction, however, the government usually act promptly to repair the damages.



FIGURE 3: DAMAGED ROADS

Even after few years from the construction, many roads get damaged due to many reasons. In many cases soil slips caused the roads to be completely closed for a long time. In some other cases the roads can operate on a single lane only with light vehicles allowed to cross because they were partially damaged. Road slip happens usually after heavy rains but natural factors aren't the only reasons behind such damages. The inaccuracy of the studies or realization processes is for some cases the main reason.

Another factor that affects the quality of the road network is the fact that many projects have been launched simultaneously in different sectors without the required collaboration and scheduling.

I.2. ROAD TRAFFIC

In Algeria, the number of urban passengers increased from 150m in 1970 to 530 million passengers in 2010, with an average annual increase of 2.85%, in suburban areas it increased from 80 to 650 million passengers over the same period which makes an average annual increase of 6.58% [30].

According to the same source, the tonnage of goods transported by road followed the evolution of the industry, from 32 million in 1970 to 51 million tons; the average annual trend is 1.45%. Since the first declines of the public industrial sector in 1986, the road transport of goods began a fall which intensified during the security events experienced by Algeria between 1991 and

1995. The recovery started in 1996, with the reforms in the sector and the establishment of private industrial units in the late 1990s.

A strong economy obviously generates big road traffic. However, most Algerian cities have chronic traffic problems. This is most perceptible in big cities where people pass long time to reach their destinations on a daily basis. When trying to find out the main reasons of this problem, we noticed three important factors.

1.2.1. NETWORK CAPACITY

The Algerian revenues increased considerably between 1998 and 2014. This is due to the strong Algerian oil and gas production in this period all along with their high prices in the international market during the same period. This had a clear effect on living conditions of the citizens and was revealed by the amplified purchase of vehicles. According to the report of the National Office of Statistics (ONS), the total number of vehicles almost doubled in the last 15 years. This had a negative impact on traffic flow and caused congestion in the network.

This explains why the roads are now overcrowded. It is clear that the number of cars exceeds the road network capacity. This is especially noticeable in big cities like Algiers which holds more than 25% of the national car fleet. According to last published report by the national office of statistics, by the end of 2014, the exact number of vehicles in the capital was 1.427.799 vehicles. The size of the national vehicle fleet was 5.425.558 in the same time [6].



FIGURE 4: FRUSTRATION OF THE RESIDENTS OF ALGIERS BECAUSE OF TRAFFIC CONGESTION

The first consequence of traffic congestion is the amplification of the road delays. Road delays are defined as the additional travel time comparing of that at free flow conditions. Congestion also pollutes the air and wastes energy.

While the government started now to take measures to reduce the import of cars on one hand and expand the existing road transport infrastructure on the

other hand, the best solution to this issue consists actually in the improvement of the management of the network.

1.2.2. TRAFFIC MANAGEMENT

Road congestion is a serious problem which is adding serious challenges to modern life. Since the response to such challenges cannot be limited to traditional measures. Innovation and technology have the main role to play in finding appropriate solutions. Efficient traffic management is important to reach optimal use of the road network and helps fighting traffic congestion. The simplest technique to control and manage traffic is the use of traffic lights which are hardly ever seen in the Algerian road network. But in this information and technology era, more sophisticated solutions are feasible.

Operators may monitor and control transportation assets through a centralized platform; who will then reduce congestion, increase mobility, and improve air quality [7].

The time spent on roads needs to be reduced by adaptive control methods: that is, the management of traffic more effectively through the implementation of traffic lights, speed bumps, speed cameras and pedestrian crossings. An information management system that displays data in real time, and collects future strategy developments from any mistakes in the current travel system is also required [7].

At a higher technology level, intelligent transportation systems (ITS) are expected to provide innovative solutions relating to traffic management.

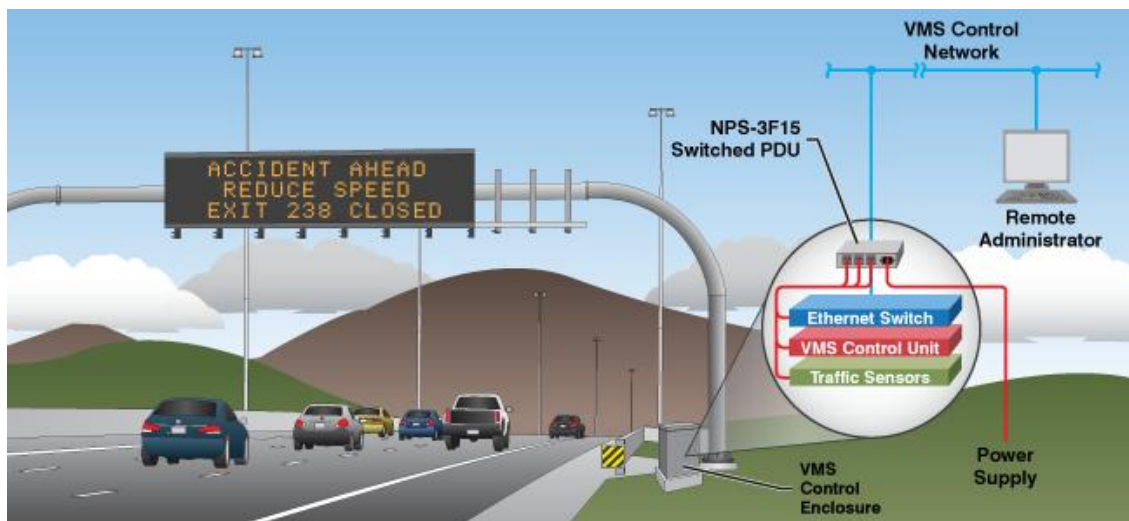


FIGURE 5: REALTIME NOTIFICATIONS IN ITS

ITS are systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport (8)

Intelligent Transportation Systems (ITS) provide two valuable services: they keep drivers informed regarding conditions on the road ahead and help to track traffic congestion levels across huge freeway networks. Given the size and scope of most Intelligent Transportation Systems, it's absolutely vital to allow the capability to remotely manage networked traffic monitoring and reporting devices spread throughout the system [9]. The development of ITS focus on the following applications:

- Optimal use of road, traffic and travel data
- Continuity of traffic
- Road safety and security applications

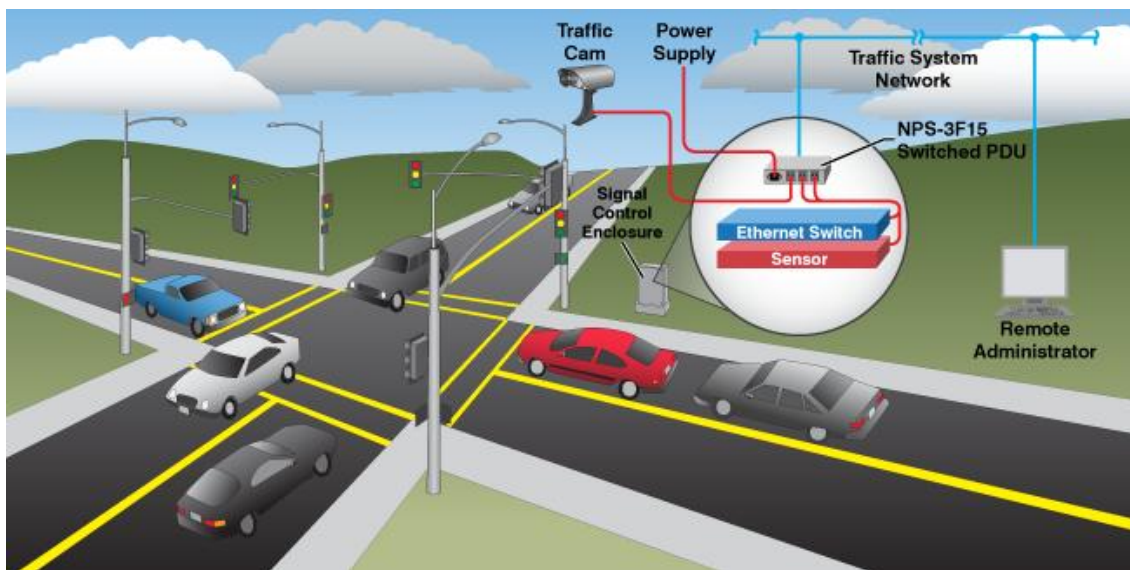


FIGURE 6: TRAFFIC SIGNAL CONTROL IN ITS

I.3. ROAD SAFETY

Road safety is the most important and sensitive topic related to road traffic because it deals with the human life and health. Traffic problems have resulted in an increase in the number of accidents, injuries and deaths on road. Every year, road traffic related accidents kill a large number of people all over the world. According to the (WHO), about 1.25 million people die each year as a result of road traffic crashes. Between 20 and 50 million people suffer non-fatal

injuries, with many incurring a disability as a result of their injury. Also, road traffic crashes cost most countries 3% of their gross domestic product [10]. Without sustained action, road traffic crashes are predicted to become the seventh leading cause of death by 2030 [10].

The concept of road safety takes account of the prevention of accidents on the road in order to protect the lives of people. Road safety is the set of standards, mechanisms and measures taken by the various entities with direct or indirect relation with the road such as road users and the ones who are responsible for the construction of road infrastructures and the management of road traffic.

Insecure roads thus represent all the dysfunctions generated by road traffic; it can be traffic accidents that can cause damage to property or body. The main indicators of road safety are the number of injuries, the number of fatalities, and the number of fatal accidents per kilometer.

I.3.1. ROAD SAFETY IN ALGERIA

In Algeria, the official reports reflect a very dangerous situation. In 2015, 4610 people died and about 45000 were injured. One year earlier, the recorded levels were slightly lower with 3.984 deaths and 44.546 injuries. According to the latest WHO (World Health Organization) data published in May 2014, road Traffic Accidents deaths in Algeria reached 3.55% of total deaths. The estimated death rate which is 22.3 per 100,000 of population ranks Algeria 54th in the world [10]. In both the Maghreb and Arab world, Algeria has the highest vehicular accident rate [11].

I.3.2. FACTORS THREATENING ROAD SAFETY

Road safety is determined by a set of factors. Dealing with these factors is the key to get to a good safety level. We can classify those risk factors into three main classes:

I.3.2.1. HUMAN FACTORS

This class includes mainly the factors related to the state and the behavior of the drivers and the pedestrians:

- Driving at high speed is a critical risk factor for road traffic incidences. The number and dimension of crashes are proportionally related to the applied

speed. If a crash does happen, the risk of death and serious injury is greater at higher speeds.

- Driving under the influence of psychoactive substances.
- Driving when exhausted, sleepy or in poor health states.
- Distracted driving: mobile phones are causing the most distraction on roads.
- Many drivers are causing disasters on the roads just because they are lacking the required driving skills. Sometimes it isn't all about skills. Driving requires also full care and attention. Many drivers haven't acquired the necessary consciousness for driving. This leads to improper, careless and reckless driving.



FIGURE 7: RECKLESS DRIVING

I.3.2.2. CAR SAFETY

Unsafe cars amplify the risk of crashes and also their damages. Manufacturing standards are constantly improving to produce safer cars. Today, cars are equipped with many safety systems like airbags; ABS brake system or electronic stability control. They also meet the international standards and regulations.

Another decisive factor for car safety is the maintenance and the use of adequate auto parts. The use of counterfeit or bad parts can lead to unpredicted behaviors of the car system.

I.3.2.3. ROADS QUALITY

Damaged roads can cause serious traffic problems. Roads should be designed keeping in mind the safety of all road users. Also they must be regularly maintained.



FIGURE 8: MISPLACED ROAD SIGNS

Another significant point regarding the state of the roads are road signs. Misplaced or missing signs can cause serious problems.

I.3.3. IMPROVING ROAD SAFETY

There is no magic solution to stop traffic accidents but still there are ways to improve road safety:

- Making roads safer by the integration of safety parameters in the design phase.
- Reducing the allowed speeds. Ease of mobility must not be at the expense of safety. Also it is important to use information technology to provide new ways of calculating variable speed limits. Those values should be sensible to the context: weather, time, traffic density ...
- Reforming driving schools by the use of IT in both teaching and test.
- Provide easy access to road and traffic information to help drivers deal with the difficulties they may encounter
- Enforcing laws and ensuring their application.
- Making cars safer is a critical factor to save more lives on the roads. Vehicle technology has advanced enormously, yet while cars in high-income

countries are increasingly safe; almost 75% of countries around the world fail to meet even the most basic international standards on vehicle safety [12]. Governments need to force the new safety standards like electronic stability control.

I.3.3.1. THE ALGERIA CASE

In our country, the motivation to reduce road harms is big. However, efforts to reduce road traffic deaths are clearly insufficient. First, we rely on traditional solutions like the multiplication of security checkpoints, the use of speed breakers or the enforcement of road safety laws. In the last decade, road safety laws have been amended three times. More rules have been added without getting significant results. It is even hard to get the law applied in many contexts.

Getting significant results regarding road safety requires involvement from multiple sectors such as education, police, health and industry. Also, the operators in the field of information and communication technologies can offer valuable help to revolutionize the traditional methods and offer new solutions adapted to our era.

I.4. THE IMPORTANCE OF ICT

With the big growth of road networks it has become hard to control and manage the traffic with traditional ways. Recently, modern equipments like radars and cameras have been added to our roads. This gave a big help but still it isn't sufficient to fix the problem.

The final hope to solve all traffic problems is to use the power of information and communication technologies (ICT). There are a wide variety of applications of information technology that are just beginning to be implemented that could be far more significant in our struggle to defeat traffic congestion than the building of new highways and transit routes or more government regulation [13].

In recent years, the cost of computers and mobile handsets has dropped notably. At the same time their processing power and storage capacity have increased spectacularly. The same thing is noticed with the growth of internet access and mobile communications. The lower cost and higher performance of

information and communication systems have had a decisive role in the spread of ICT in every field and every side of today's life.

In the transportation field, Intelligent Transportation Systems (ITS) like car navigation systems and VICS (Vehicle Information and Communication System), which provides drivers with traffic information, have begun to find their way into private vehicles. [14]

I.4.1. ICT IN ALGERIA

The position of ICT in Algeria has recorded an important delay at the continental scale as well as at the global scale. However, recently important efforts have been spent to catch up.

I.4.1.1. COMMUNICATION INFRASTRUCTURE

The introduction of mobile communications in Algeria had a tremendous impact on our economy and society. The deregulations of the telecommunication market at the beginning of the 21st century enabled a large proportion of the population to be finally connected to the global telecommunication network, and by the end of 2011; there were over 35 million mobile subscribers, compared to only 5 million in 2004 – a seven-fold increase.

The launch of the 3G high-speed network during 2013 had an even more far-reaching impact, as it opened up access to the Internet for anyone with a sufficiently capable mobile phone. Also, the decision to launch the 4G LTE, taken by the government in January 2016, shows a maturity of the market [15].

I.4.1.2. MOBILE DEVICES

Mobile devices have become very present in our daily life. On the market, there are several brands of Smartphone presenting their products with affordable prices.

In Algeria, the most popular handsets are branded Samsung and Condor. Particularly “Condor PGN518” with a market share of 4.1% and “Samsung Galaxy S3” with a 3.7% market share, according to AppBrain [16].

The most popular android versions used are Lollipop (5.1) with traffic of 25.48%, followed by KitKat with traffic of 21.3%.

Model	Market share
Condor PGN518	3.9 %
Samsung Galaxy S3	3.0 %
Condor PGN605	2.4 %
PGN611	2.1 %
Samsung Galaxy S5	2.1 %
Lenovo A1000	1.8 %
Samsung Galaxy S4	1.8 %
PGN528	1.8 %
Samsung Galaxy Grand Neo Plus	1.7 %
Oppo A1601	1.7 %

FIGURE 9: DEVICES MOST USED IN ALGERIA (16).

I.4.1.3. MOBILE APPLICATIONS

With the relatively ease of access to the Internet and mobile devices. The segment of mobile applications devices had the minimum requirements to start and emerge. However, in this segment too we can clearly notice an important delay comparing to both regional and global advances. The number of Algerian mobile apps increased considerably the last five years but only few of them provide an added value to the local user. The lack for reliable electronic payment is one of the main reasons of this slow evolution of mobile applications development.

I.4.2. APPS FOR ROAD TRAFFIC & SAFETY

Road traffic information and car Accident Reporting pre-built app makes easy the knowledge of road status and simplifies the entire claims reporting process by providing an easy-to-use interface that works great on every device, there are a lot of mobile application in this field we are going to give brief demonstration of a mobile application in this area:

I.4.2.1. WAZE

Waze is FREE and the world's largest community-based navigation app that join thousands of drivers in the same area who share real-time traffic & road information to save time, gas money, and improve daily commuting.

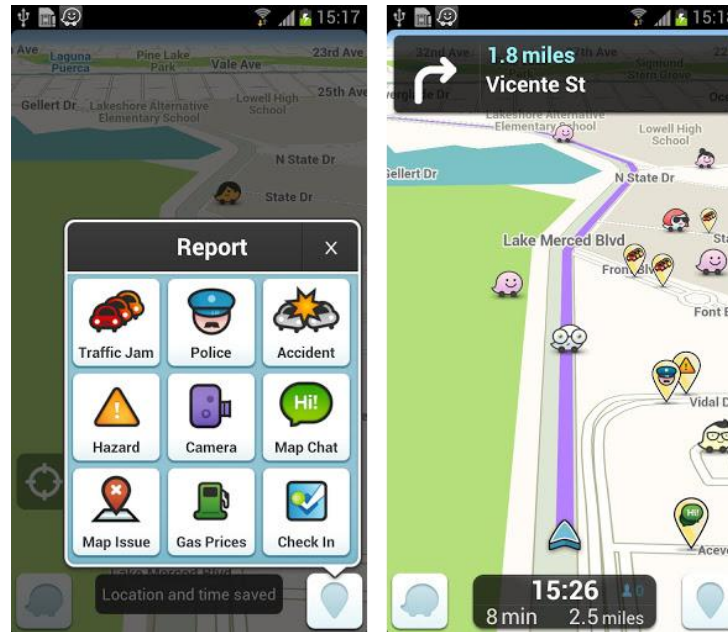


FIGURE 1 0: WAZE INTERFACE

Waze has the features described as follows:

- Live routing based on real-time traffic & road info shared by all drivers
- Community reported alerts including police traps, accidents, hazards, road closures, and more
- Turn-by-turn voice guided navigation
- Live maps always fixed and updated by real people in your area
- One tap navigation to your events from Facebook and your calendar

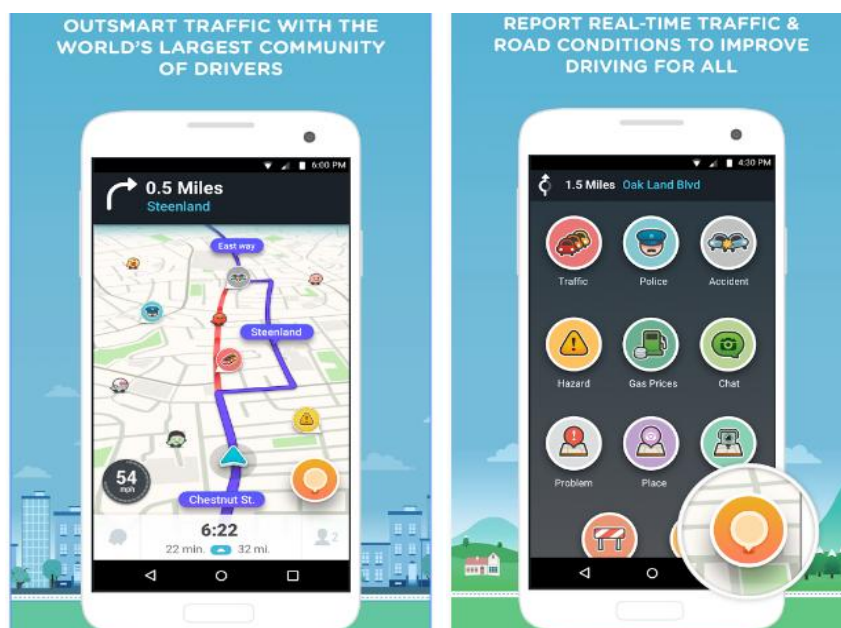


FIGURE 1 1 / USE CASES EXAMPLE OF WAZE

I.4.2.2. LOCAL PRODUCTS

I.4.2.2.a. TARIKI:

The National Gendarmerie, has developed a responsive web site dedicated to road traffic in order to help road users to be informed of the traffic situation in real time.

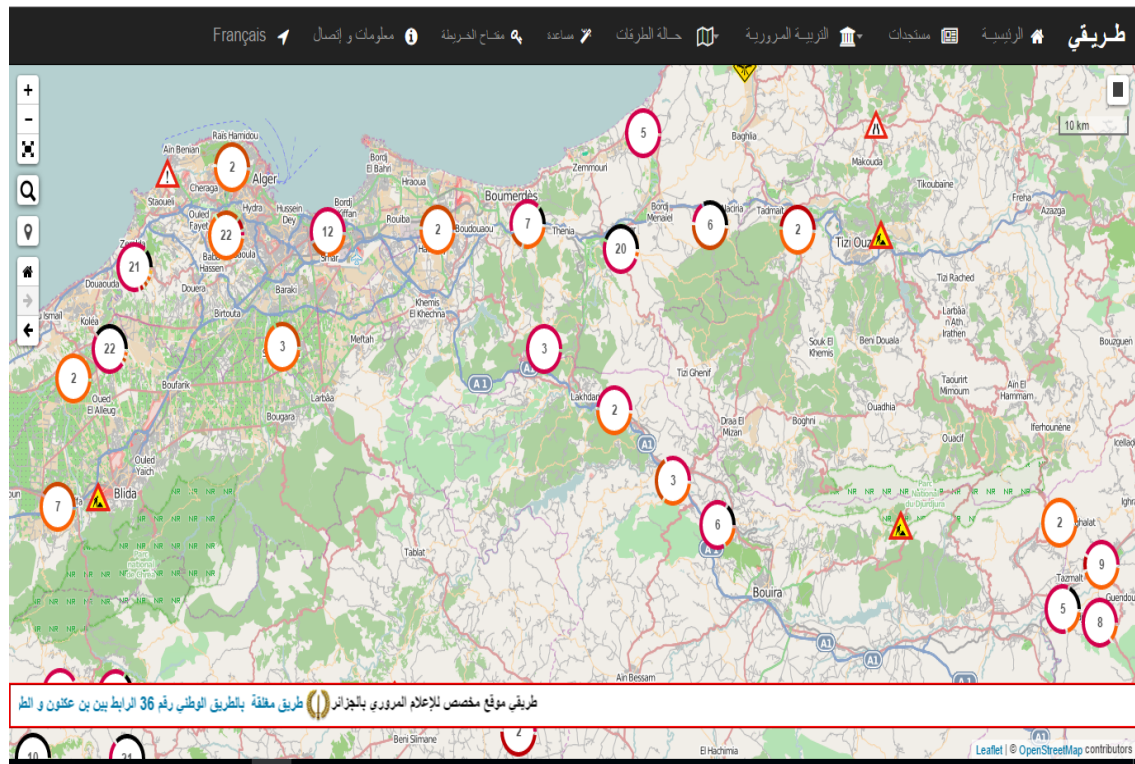


FIGURE 1 2:TARIKI INTERFACE

As shown the figure above this web site has map that geolocate Algeria in a way that the user can point to an event and brief on its details [17].

I.4.2.2.b. WINGO

Wingo covers on average more than 28,000 km of roads throughout Algeria: motorways, secondary roads (Wilaya and national roads) and main axes of cities. Updated real-time information provides good quality and accuracy.

Wingo can help you:

- View real-time traffic status
- View traffic events (accidents, roadworks...)

- Participate in the Wingo community by reporting all events on your route

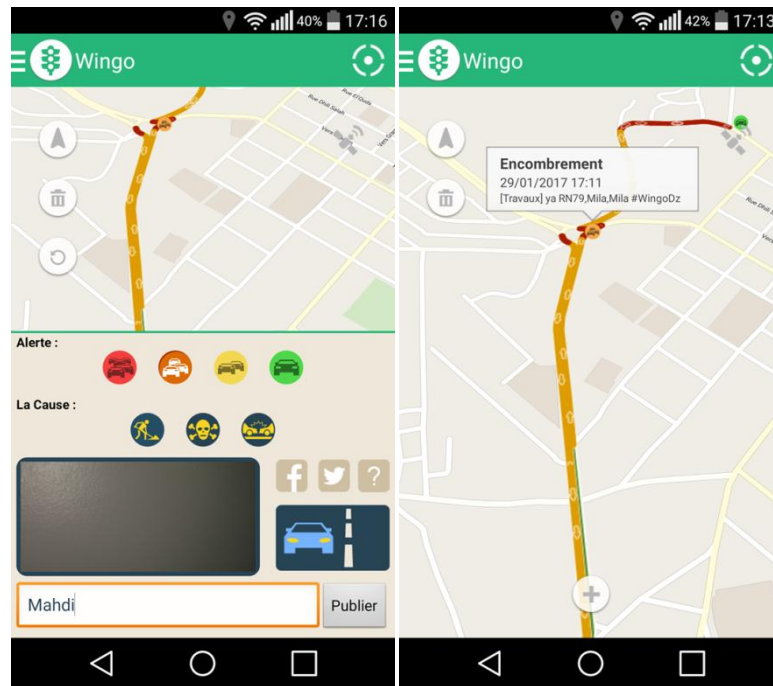


FIGURE 13: WINGO

I.4.2.2.c. SMART HEADBAND FOR DRIVERS

An Algerian researcher has developed a real-time alert system, consisting of an intelligent headband developed for the detection of drowsiness at the wheel, precisely and without the use of video sensors Smart Headband For Driver (SHFD) [18]. It is a real-time and mobile drowsiness detection and warning system using low-cost EEG sensors. The solution allows car drivers to receive a warning alarm and reducing the speed using OBD2 when drowsiness and low attention are detected.

I.5. CONCLUSION

The development of the road network plays an important role in the economic growth of our country. While much work still needs to be done, Algeria has already crossed important steps by strengthening the national road network and increasing connections to the main highways. However, we believe this is only a face of the global solution. Apart from working on infrastructure, information and communication technology can play a decisive role and help optimizing the use of the existing capacities.

Chapter II

PRELIMINARY STUDY

Preliminary study is the very first step in our development process. It occurs as a result of a project start-up decision and consists of a first identification of functional and operational requirements. In this context, we conducted a survey to verify the feasibility and determine the relevance of our future application.

II.1. PROJECT PRESENTATION

II.1.1. TEAM

This document describes the work undertaken in partial fulfillment of the requirements for the degree of Master in Computer Science at Mila University Center - Algeria. The work has been achieved under the direction of Mr. Bilal DOUAS – lecturer at the same institution – by:

- Mahdi BENNACEF
- Mouad CHERIAK

This project constitutes an end-of-studies project which will be certified by a Master's Degree in Computer Science under the option: Information and Communication Science and Technologies (ICST).

The total project duration is four months. That is to say from 25/01/2017 to 25/05/2017.

II.1.2. DESCRIPTION

Today's life has a high rhythm and people need to move more frequently. Using the road network has become a critical task in many regions and especially in big cities. Going to workplace can even cost you the same time you spend at there.

There are several reasons why traveling by road has become challenging, from which, is the exponential increase in the number of vehicles occupying the roads. This is causing different sorts of problems, from traffic jams to accidents. The road user needs to achieve more tasks in a short amount of time, and this is why road navigation is vital. Thus, something needs to be done to reduce the impact of road traffic.

On another hand, there is always a risk, even low, when on the road. Our project is related to these topics. We'll try to investigate and try to give help to the users of the road. We believe that in this era of information technology, every problem can be solved or lightened at least through the use of such technologies. This because getting information in the good place and at the good moment is very valuable.

The theme of our work is:

“Development of a traffic information system based on Geolocation and mobile technologies”

We'll be interested in the state of the road and the road users. We will try to get as much information about the roads as possible in order to improve the user's experience. Thanks to a device that everybody knows very well: The Smartphone. What is important to us in this scope is the relationship between the road users and mobile technologies, and whether it is really capable of helping them in their daily journeys.

To determine the list of functional requirements we conducted a survey on traffic information apps and safety needs

II.2. PRESENTATION OF THE SURVEY

To determine the functional requirements of our system, we have established an online survey of 8 quick questions related to the road network and safety and mobile technologies. We used Google Forms to create it then we published it in the Facebook page: Info Traffic Algérie, which is followed by 250000 users. The page posts about traffic information, crashes and the state of the roads.

استبيان حول استخدام تطبيقات معلومات المرور

نحن، مهدي و معاذ، طالبان جامعيان نود تطوير تطبيق للهاتف الذكي يساهم في التخفيف من مشاكل السير عبر تزويد المستعمل بمعلومات آنية و دقيقة عن حالة الطرقات و الاحداث الهامة المؤثرة على السير. لذلك نرجو منكم الإجابة عن الثمان أسئلة التالية لمساعدتنا على معرفة احتياجاتكم في هذا الصدد:



Enquête sur l'utilisation des applications d'informations du trafic routier et état des routes en Algérie.

Nous comptons développer une solution mobile pour contribuer à la réduction des problèmes de circulation et les accidents de la route à travers la fourniture d'informations pertinentes et instantanées sur l'état des routes et les événements en relation. Nous vous prions de répondre sur les 8 questions suivantes:

FIGURE 14: ONLINE SURVEY

The questions ware as follow:

Q1- أين ترى الفائدة من استخدام تطبيقات أثناء السير للحصول على معلومات حول حالة الطريق؟ / Dans quel contexte trouverez-vous cela utile de consulter des informations sur l'état des routes

- الطريق السريع - Autoroute
- الطرق السريعة - routes express
- داخل المدن - voies urbaines
- لا داعي لتطبيقات أصلا - pas besoin de telles applications

Q2- ما نوع نظام الهاتف الذكي الذي تستخدمه - / Quel est la plateforme de votre smartphone

- android
- iPhone
- Windows OS
- Aucune idée / لا اعرف
- Autre : _____

Q3- ما نوع المركبة التي تستعملها غالبا - / Quel type de véhicules vous conduisez souvent

- poids lourd / الوزن الثقيل
- poids léger / الوزن الخفيف
- piétant / راجل

Q4- ما هو التطبيق الذي تستخدمه لتحديد المواقع أثناء السير - / Quelle est l'application de navigation que vous utilisez souvent

- Google maps
- Waze
- Inrix traffic Maps & GPS
- je n'utilise pas ces applications / لا استخدم أية تطبيقات
- Autre : _____

Q5- هل تجد خلال السير مشاكل في الطريق تتمنى أن تبلغ عنها الآخرين لكنك لا تملك الوسيلة لذلك / Est ce qu'il vous arrive parfois de rencontrer des situations sur lesquelles vous aimeriez diffuser des informations sans trouver un moyen pratique pour le faire

- Oui / نعم بالتأكيد
- Jamais / لا

Q6- ما هي المعلومات الخاصة بموقعك والتي تحب أن تطلع عليها أثناء سيرك / Quelles sont les informations que vous aimeriez avoir lorsque vous prenez la route

- Accidents / حوادث المرور
- Voies fermés / طريق مغلق
- Encombremments / طريق مزدحم
- Tronçons de routes abimées / حفرة خطيرة أو طريق مهترئ
- Neige ou verglas / تلوج
- Services divers / مواقع خدمات
- Stations-service / محطات الوقود
- Autre : _____

Q7- هل تقبل بالإبلاغ عن موقعك لهيآت موثوقة كالحماية المدنية في حالة طلبك للنجدة / Est ce que vous acceptez que votre position géographique soit communiquée à des entités fiables comme la protection civile en cas ou vous appellerez au secours

- Oui / نعم
- Non / لا

شكرا

Q8- ماهي الخاصيات و الخدمات التي تحب أن تجدها في تطبيق كهذا / Quelles sont les services ou fonctionnalités que vous aimeriez voir dans une solution pareille

Votre réponse

ENVOYER

Page 1 sur 1

N'envoyez jamais de mots de passe via Google Forms.

FIGURE 1 5: QUESTIONS DU FORMULAIRE

After posting this survey online we got 178 responses. We suppose that the analysis of the result will help us know the requirements for this project.

II.3. RESULTS AND ANALYSIS

This section presents the obtained results from our survey and our analysis for each of the questions.

QUESTION 1: WHERE DO YOU FIND IT USEFUL TO CHECK FOR INFORMATION ON ROAD CONDITIONS?

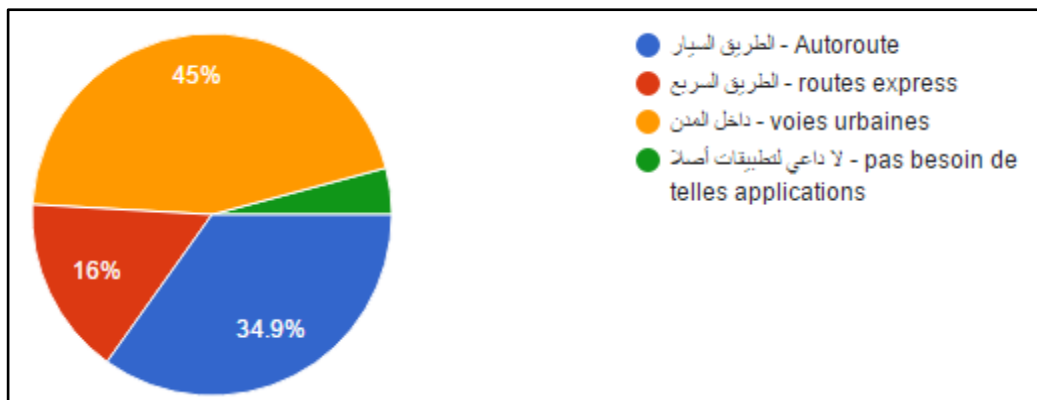


FIGURE 16: RESULTS FOR QUESTION N°1

The majority of users believe navigation apps are useful. A minority can't realize the need for this kind of apps. Exactly 4% of the users don't find any importance of such information. 45% of the users guess they will the app on urban roads. While 51% think it is more useful on highways (16%) or freeways (35%).

QUESTION 2: WHAT IS THE PLATFORM OF YOUR SMARTPHONE?

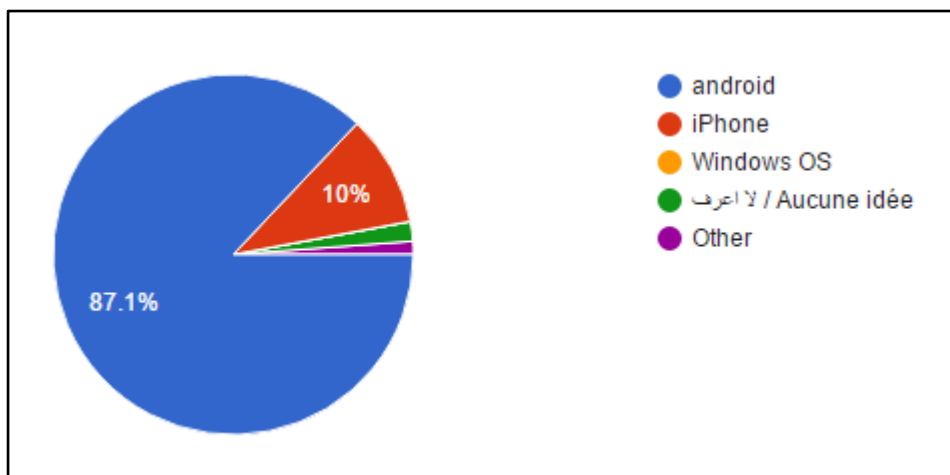


FIGURE 17: RESULTS FOR QUESTION N°2

The majority (87%) of devices owners use Android OS, which helped us decide later what operating system we're going to develop for first or exclusively.

QUESTION 3: WHAT KIND OF VEHICLES DO YOU DRIVE OFTEN?

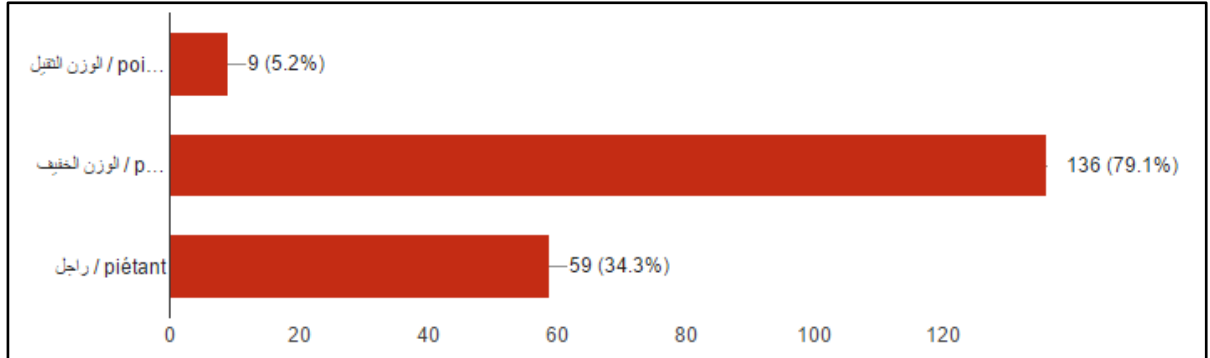


FIGURE 18: RESULTS FOR QUESTION N°3

This question intends to recognize the population interested by such services. The results show that most of the users are car or lightweight vehicles drivers (80%). Only 9% are trucks and heavy vehicles drivers. Pedestrians are also interested. To analyze this result we need first to know the distribution of car types in Algeria. According to the ONS (6) statistics cars represent 75% of the total number of vehicles. Coming back to our result, cars drivers represents $79 / (9 + 79)$ which gives a proportion of 87%. The difference is not important and can be explained by two elements:

- The first ratio doesn't exclude heavy vehicles that doesn't usually use the roads like those used in agriculture.
- Cars are more likely to be driven by multiple drivers than heavy trucks so the proportion of car drivers is more important.

QUESTION 4: WHAT NAVIGATION APPLICATION YOU USE OFTEN?

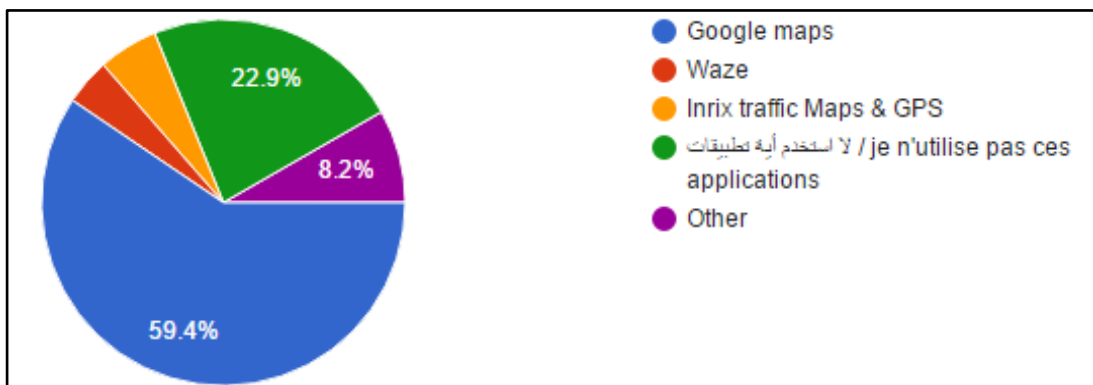


FIGURE 19: RESULTS FOR QUESTION N°4

The results show that Google MAPs is the most used navigation app. Also it is important to notice that an important proportion of the users don't use any application. This can't be for other than two main possible reasons:

- Google Maps and other apps don't fit the need of our local drivers
- A part of our drivers don't feel at ease with such technology products or even don't know them.

QUESTION 5: DO YOU SOMETIMES ENCOUNTER SITUATIONS ABOUT WHICH YOU WOULD LIKE TO SHARE INFORMATION WITHOUT FINDING A PRACTICAL TOOL TO DO IT?

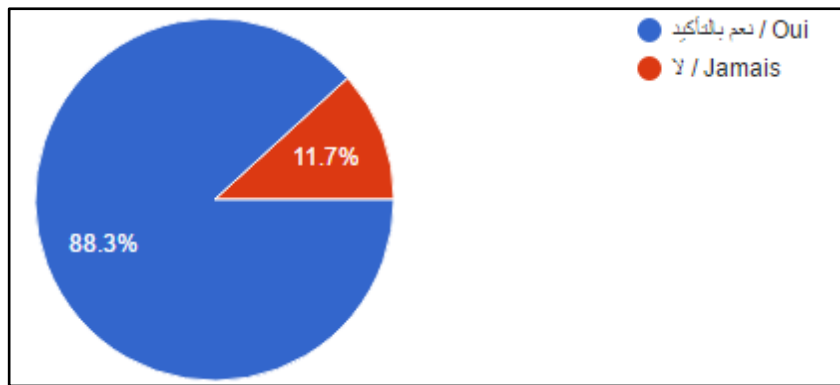


FIGURE 20: RESULTS FOR QUESTION N°5

Most people agree on the importance of sharing information about road traffic and safety by all the users. Unfortunately, still there is no way to do that according to most of the users. A minority doesn't see the need for such thing. This may be because they don't see an importance in sharing such information or just because they have other tools to do so like using social networks.

QUESTION 6: WHAT INFORMATION WOULD YOU LIKE TO HAVE WHEN YOU'RE ON THE ROAD?

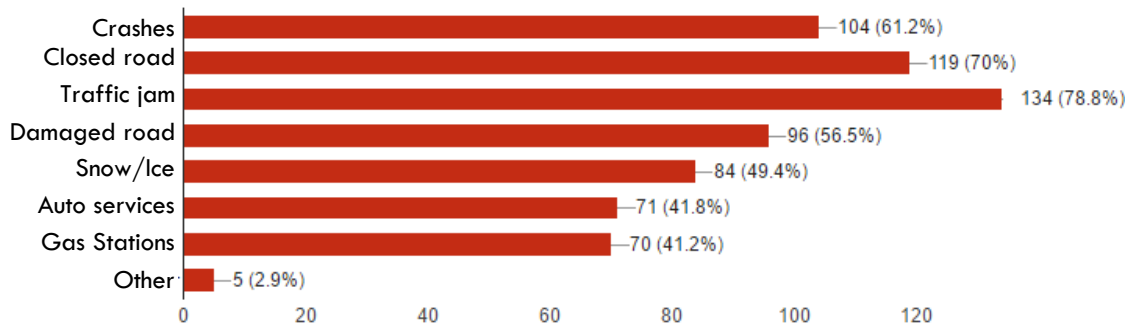


FIGURE 21: RESULTS FOR QUESTION N°6

In this question we tried to suggest a set of common information we collected in our surroundings to see if this fulfills the user's requirements or not. The question is also significant to determine the importance of every element of the set in the view of the road users.

The results show that only 3% of the users found that the suggested set doesn't cover their own interests. The rest expressed their interests to all the suggested elements.

While the most requested information was about congestion and traffic jams. Users would like to get all kinds of information from a navigation app, such as information about accidents, bad weather, nearby gas stations...

QUESTION 7: DO YOU ACCEPT THAT YOUR GEOGRAPHICAL LOCATION BE COMMUNICATED TO RELIABLE ENTITIES SUCH AS CIVIL PROTECTION IN CASE YOU NEED HELP?

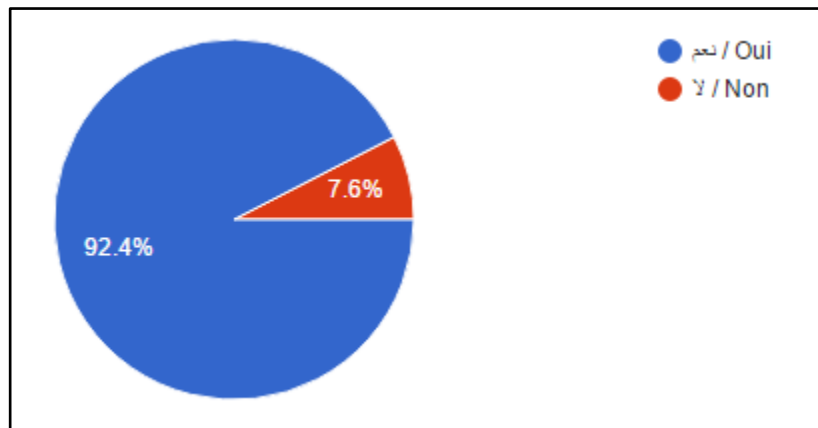


FIGURE 22: RESULTS FOR QUESTION N°7

Because the location of users is private information, we need to know if the users will accept to share this information in case they need urgent help. The answers show that the common opinion is that people agree to give up some of their confidential data (their geographical position in this case), in order to get help from reliable entities.

QUESTION 8: WHAT SERVICES OR FEATURES WOULD YOU LIKE TO FIND IN SUCH APPLICATION?

The last question asks the user to mention any features we possibly missed in our survey. This allowed us to gather valuable ideas. The main suggestions were as follow:

EVENTS

Roadwork	Heavy vehicles banned	Falling stones
High wind	Speed breaker	Radars
Fog/Smoke	Rain	Crimes

SERVICES

Car parts and accessories	Car Towing	Car mechanic
Vulcanizer	Auto electrician	Car washing service
Mosques	Hotels	Security checkpoints

FEATURES

Works offline	Ease of use	Parking guide
Voice guidance & recognition	Nearest services	Free app
Rate users	privacy protection	multimedia contents

Where most of the suggestions were inspiring and useful, some others couldn't be implemented because of objective reasons:

- Prevent malicious use of the app: some suggested features are breaking local laws: this is the case for the notifications about radars or security checkpoints.
- Some other features are not compatible with the design principle of the app. This is the case of offline use because the goal is to create a real time notification system which necessarily requires Internet access.
- Some features needs to rely on other service providers like the parking guide.
- Other features are fine but their implementation requires more time than allowed for the project. We'll keep them for future versions.

II.4. CONCLUSION

During the survey, we noticed a lack of culture on the use of mobile applications as an assistant in everyday life. We also noticed that a considerable part of the users don't use any kind of application to help them navigate the road network. Efforts are then required to market the idea especially among old drivers. On another hand, a lot of potential users already have ideas on what

services should be offered in navigation apps, and would like to see these features realized.

Analyzing the results of the survey, we believe that the context is motivating to launch this project. This survey allowed us to collect information about the needs and concerns of the road users. We will try to translate this through the realization of this project. Because most users (87%) use Android platform we'll start developing a version for android first.

Chapter III

ANALYSIS & CONCEPTUAL DESIGN

In this stage of the development cycle, we'll define the architecture of our system and its functional requirements. These requirements describe the expected behavior of the system with the different actors. We'll present a set of diagrams to better describe the different operations. We used UML as our modeling language.

III.1. SYSTEM ARCHITECTURE

The previous step helped us to better define the properties of the solution we have to put up. Looking back to study presented in the previous chapter we can clearly make the following conclusions:

- The volume of information managed by the system is huge and can't be handled by a mobile handset: pictures, wide area coverage...
- The source of the information managed by the system is the user itself. Only the users distributed on the different locations of the road network have the ability to supply the system with satisfactory information because there are no other centralized or distributed entities that have the ability or the will to cover such a large area. We saw in the preliminary study that most of the users like to share important events they come across while on the road.

This means that we need two levels in our logical architecture: A server that store and provide information and the clients who access the stored information but also feed the server data stores. This is kind of Client/Server architecture with two levels:

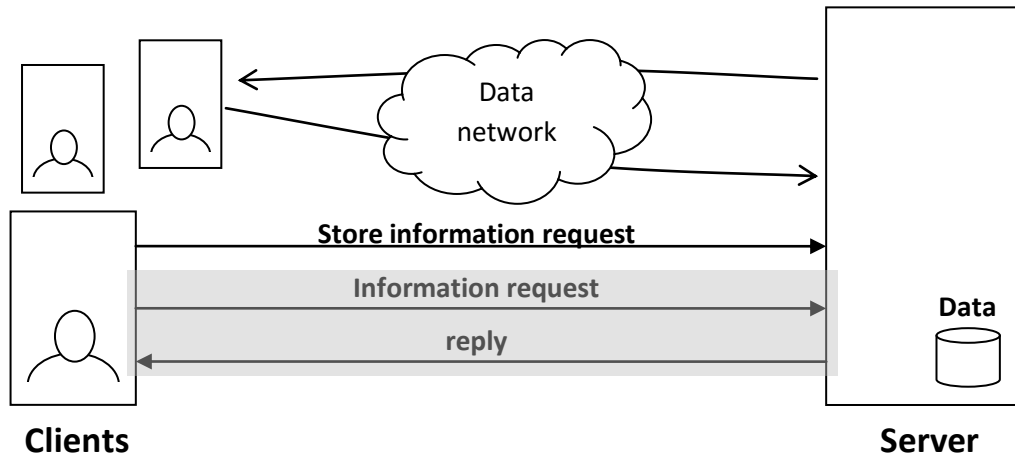


FIGURE 23: SYSTEM ARCHITECTURE

III.2. ACTORS IDENTIFICATION

An actor is an entity which acts on the system may interact. In our context we have two obvious actors:

III.2.1. THE USER

The first actor is the targeted user of the system. The user can get information from the system and probably have a reaction to it. Also, as we mentioned in the previous section; the users also feed the system with all its information. Some features of the system need the user to be identified to work properly. Accordingly, the set of features available to the users depend on whether the user is authenticated or not. The user acts on the client side of the system only.

III.2.2. THE ADMINISTRATOR

The users are responsible for feeding the system with the information. This makes a centralized control of the system obligatory to avoid any malicious or illegal manipulation. This is the reason why the system needs an administrator too. The main mission of the administrator is to review critical operations and act according to that by rejecting or validating them. The user acts on the client side of the system only.

III.3. NON-FUNCTIONAL REQUIREMENTS

These requirements include the technical requirements which don't cover apparent functions and features of the system. They are also called sometimes "Quality Attributes." For example, attributes such as performance, security, usability or compatibility aren't a "feature" of the system, but are a required characteristic [19].

The specification needs to describe any such attributes the user requires.

III.3.1. ACCURACY AND PRECISION

Road safety is a critical issue which needs to deal with it carefully. Publishing inaccurate information can cause serious damage to the users of the road. While reaching an accuracy and precision of the data of 100% is not always within the means, the system has to guarantee an accuracy rate greater than 95%.

III.3.2. BACKWARDS COMPATIBILITY

Android platform upgrade rapidly and more features are added every new release.

Supporting older versions means you can reach more devices but you'll have access to fewer features. At the opposite, supporting a higher version let you use more feature but your application can run on fewer devices. Thus, a tradeoff needs to be found depending on the context.

In our case, the system should support all Android versions down to 4.1 (Jellybean). This allows the client application to be used on about 98% of Android devices.

The following table shows the distribution of the different versions [20]:

Version	Nom	API	Distribution	
2.3.x	Gingerbread	10	01.0%	01.0%
4.0.x	Ice Cream Sandwich	15	01.0%	01.0%

4.1.x	Jelly Bean	16	04.0%	11.3%
4.2.x		17	05.7%	
4.3		18	01.6%	
4.4	KitKat	19	21.9%	21.9%
5.0	Lollipop	21	09.8%	32.9%
5.1		22	23.1%	
6.0	Marshmallow	23	30.7%	30.7%
7.0	Nougat	24	00.9%	01.2%
7.1		25	00.3%	

TABLE 1: ANDROID VERSIONS DISTRIBUTION

III.3.3. SECURITY

The client application needs to use the geographical location which is private information. This information shouldn't be shared or stored without the consent of the user.

III.3.4. USABILITY

Because the targeted population is much diversified on many dimensions (age, gender...), the application interfaces needs to be easy to understand. Audio control is a valuable plus.

III.3.5. RESPONSE TIME

When an important event is added to the system, the other users should be able to view it in a relatively short time.

III.4. FUNCTIONAL REQUIREMENTS

Use cases have become a widespread practice for capturing functional requirements. Use cases represent the things of value that the system performs for its actors [21]. Our functional requirements for both client and server side is captured in the following use cases:

III.4.1. CLIENT SIDE

III.4.1.1. USE CASE CATALOG

N°	Use case	
1	Sign up	
2	View profile	
3	Edit profile	
4	Manage emergency contacts	View emergency contacts Add emergency contact Delete emergency contact
5	View service	
6	Edit service	
7	Delete service	
8	Rate service	
9	Search service	
10	Browse nearby services	
11	Navigate	
12	Add service	
13	Add event	
14	Manage images gallery	View images gallery Add image Delete image
15	Browse events	
16	Search event	
17	View event	
18	Rate event	
19	S.O.S	

TABLE 2: LIST OF USE CASES << CLIENT >>.

III.4.1.2. USE CASE DIAGRAM

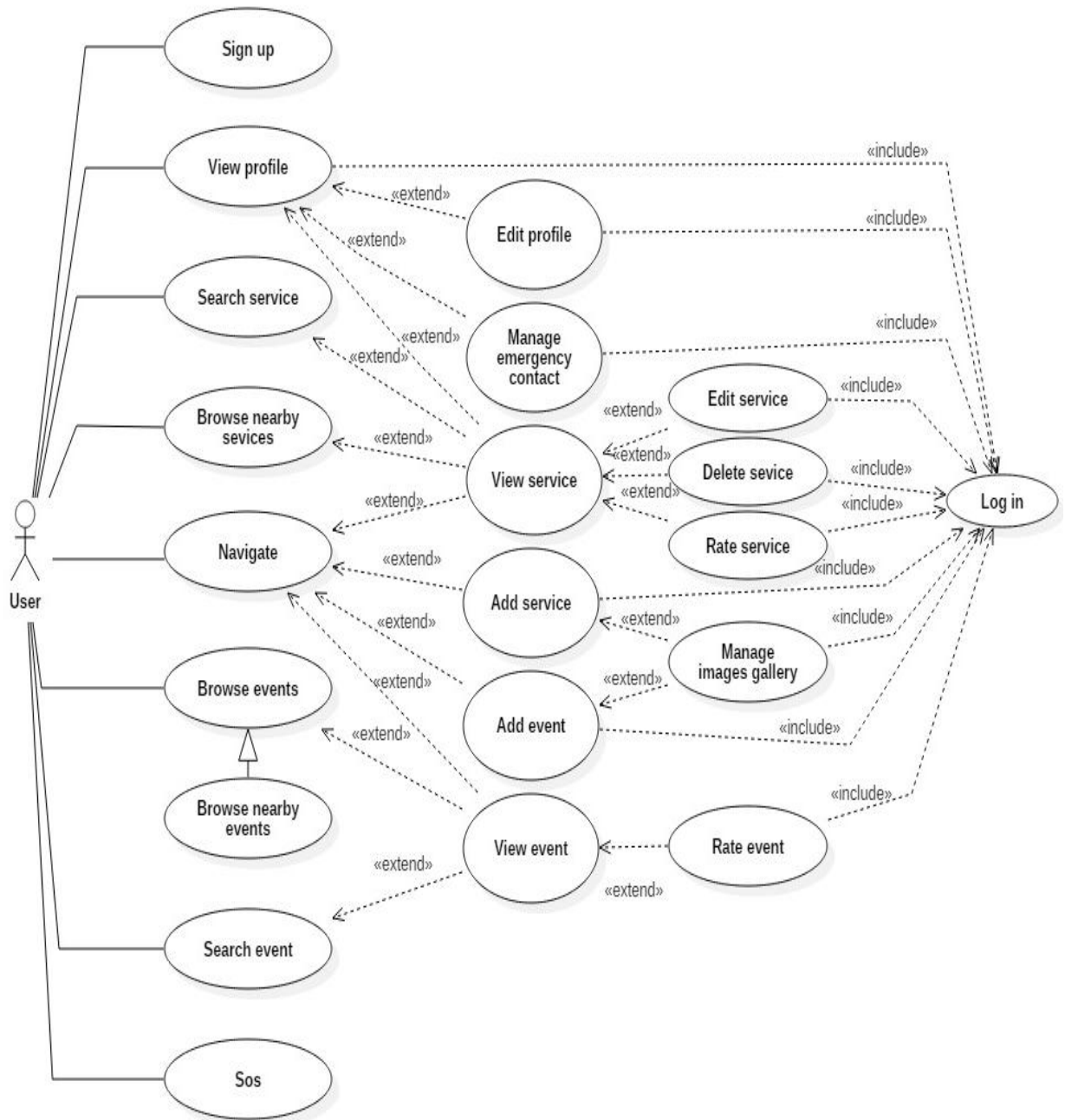


DIAGRAM 1: USE CASE DIAGRAM << CLIENT SIDE >>.

III.4.1.3. DESCRIPTION OF USE CASES

III.4.1.3.a. SIGN UP

Use case	Sign up
Actors	User
Description	Allow the user to Sign up
Pre conditions	/
Post conditions	User account created
Normal flow	The user selects sign up The system displays a form to fill The user fill the form The system checks the information and create the account The system displays welcome screen
Alternative flows	If the form is not filled in correctly, the system notifies the user about the related fields If the email is associated with an existing account, the system displays “This email is already registered”

TABLE 3: DESCRIPTION OF USE CASE << SIGN UP >>.

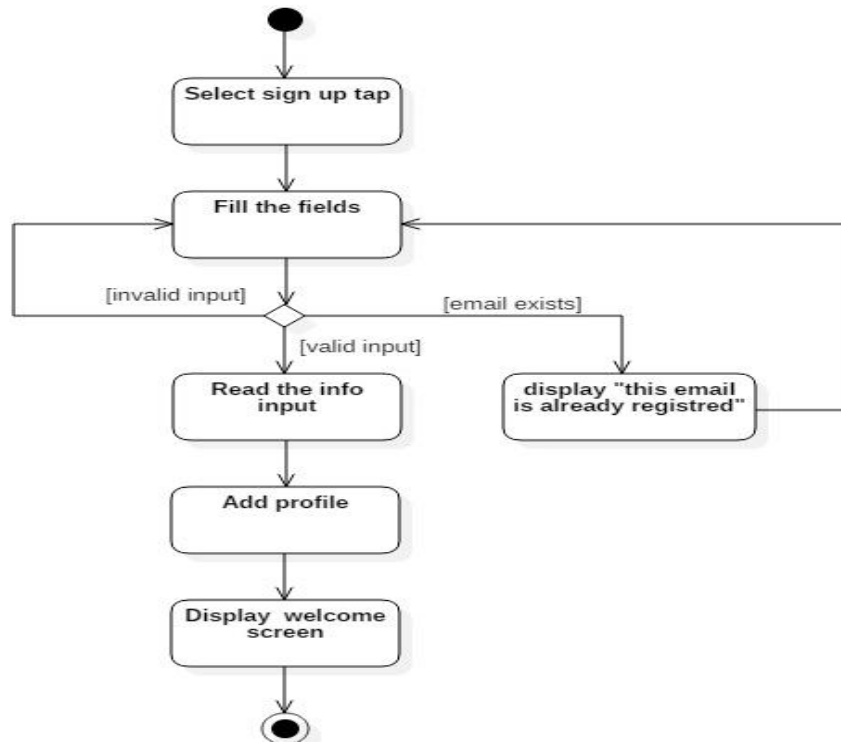


DIAGRAM 2: ACTIVITY DIAGRAM << SIGN UP >>.

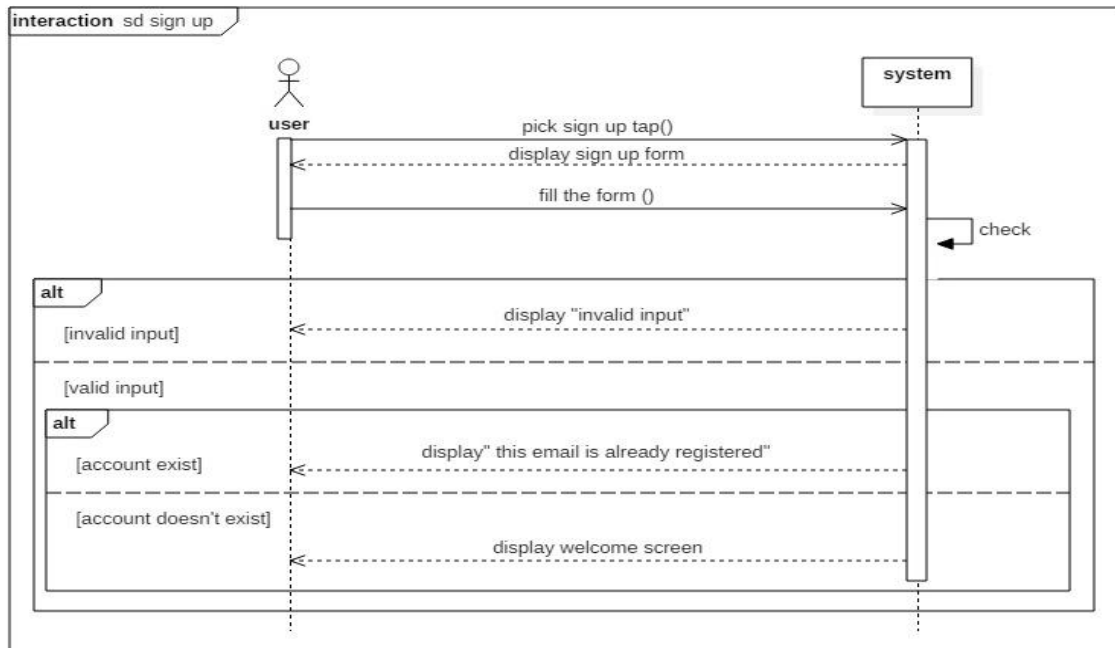


DIAGRAM 3: SEQUENCE DIAGRAM << SIGN UP >>.

III.4.1.3.b. VIEW PROFILE

Use case	View profile
Actors	User
Description	Allow to edit profile or view service
Preconditions	User is authenticated
Nominal Scenario	The user selects View profile The system displays profile

TABLE 4 DESCRIPTION OF USE CASE << VIEW PROFILE >>.

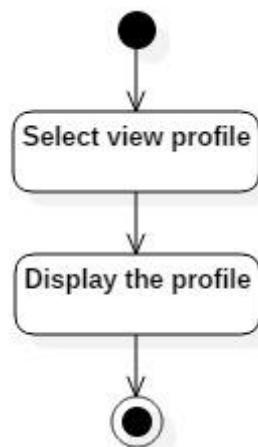


DIAGRAM 4 ACTIVITY DIAGRAM << VIEW PROFILE >>.

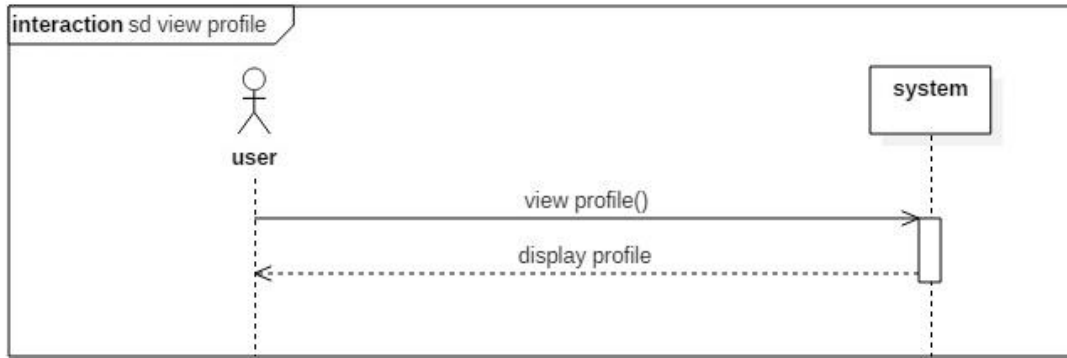


DIAGRAM 5 SEQUENCE DIAGRAM << VIEW PROFILE >>.

III.4.1.3.c. EDIT PROFILE

Use case	Edit profile
Actors	User
Description	Allow to edit profile
Pre conditions	User is authenticated
Post conditions	Profile edited
Nominal Scenario	The user views his profile and then selects edit profile The system displays a form filled with the user’s info The user modifies the desired information and confirms The system updates the profile The system displays “the profile has been edited”
Alternative Scenario	If the form is not filled in correctly, the system notifies the user about the related fields

TABLE 5 DESCRIPTION OF USE CASE << EDIT PROFILE >>.

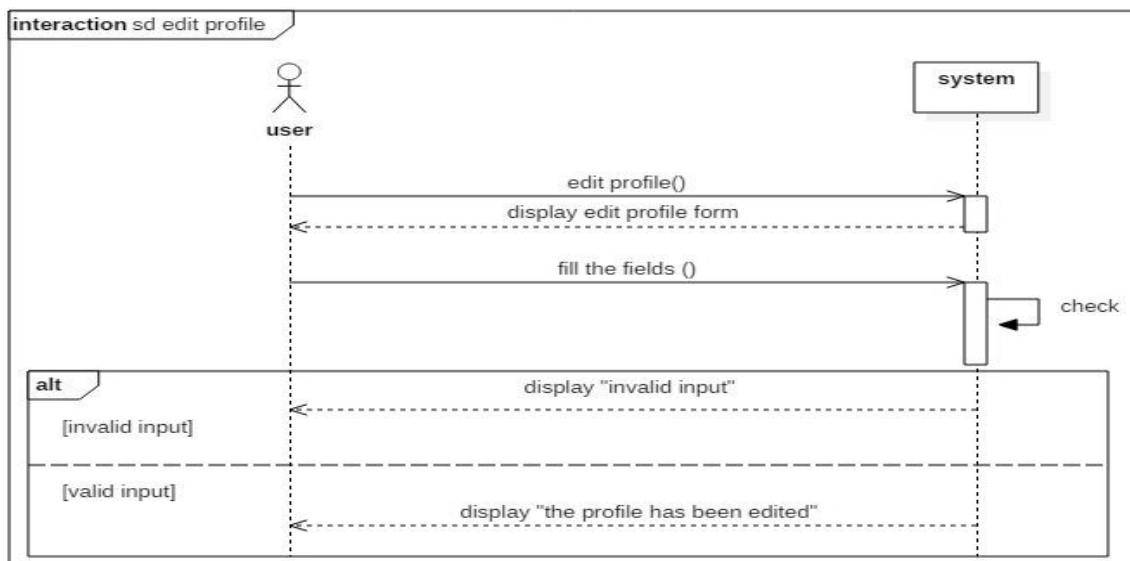


DIAGRAM 6: SEQUENCE DIAGRAM << EDIT PROFILE >>.

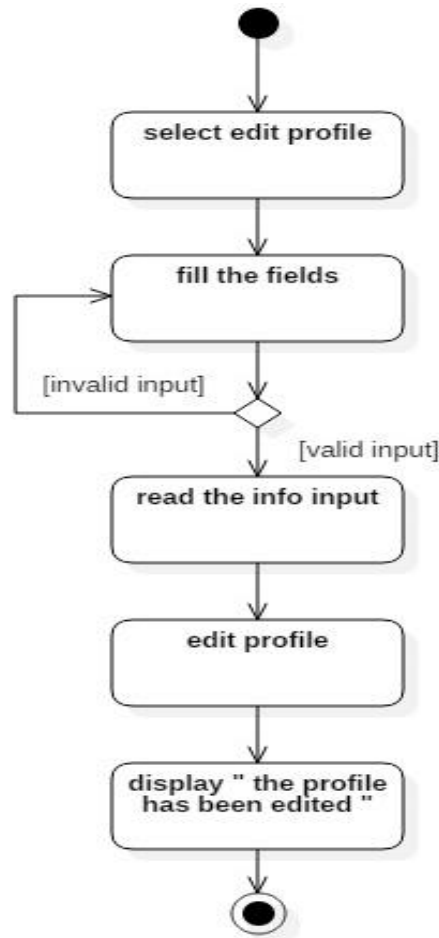


DIAGRAM 7: ACTIVITY DIAGRAM << EDIT PROFILE >>.

III.4.1.3.d. MANAGE EMERGENCY CONTACTS

In the case of Manage emergency contacts and Manage images gallery the edit process is realized by removing then adding a new item.

Use case	Manage emergency contacts
Actors	User
Description	Allow to view, add, delete emergency contacts
Pre conditions	User is authenticated
Nominal Scenario	The user selects one of the following actions: View emergency contacts Add emergency contacts Delete emergency contacts

TABLE 6: DESCRIPTION OF USE CASE << MANAGE EMERGENCY CONTACTS >>.

— View emergency contacts

Use case	View emergency contacts
Description	Allow the user to view emergency contacts
Preconditions	User profile is displayed
Nominal Scenario	The user selects view emergency contacts The system displays user’s emergency contacts

TABLE 7: DESCRIPTION OF USE CASE << VIEW EMERGENCY CONTACTS >>.

— Add emergency contact

Use case	Add emergency contacts
Description	Allow the user to add an emergency contact
Pre conditions	User profile is displayed
Post conditions	emergency contact added
Nominal scenario	The user selects ‘add emergency contact’ The system displays phone’s contacts. The user select the desired contact and validate the action The system displays “emergency contact has been added”

TABLE 8: DESCRIPTION OF USE CASE << ADD EMERGENCY CONTACTS >>.

— Delete emergency contact

Use case	Delete emergency contact
Description	Allow the user to delete an emergency contact
Pre conditions	User profile is displayed
Post conditions	Emergency contact deleted
Nominal scenario	The user selects 'delete emergency contact' The system displays a list of his emergency contacts The user select the desired contact The system displays a confirmation panel The user confirms the deletion and validate The system displays “contact has been deleted”

TABLE 9: DESCRIPTION OF USE CASE << DELETE EMERGENCY CONTACTS >>.

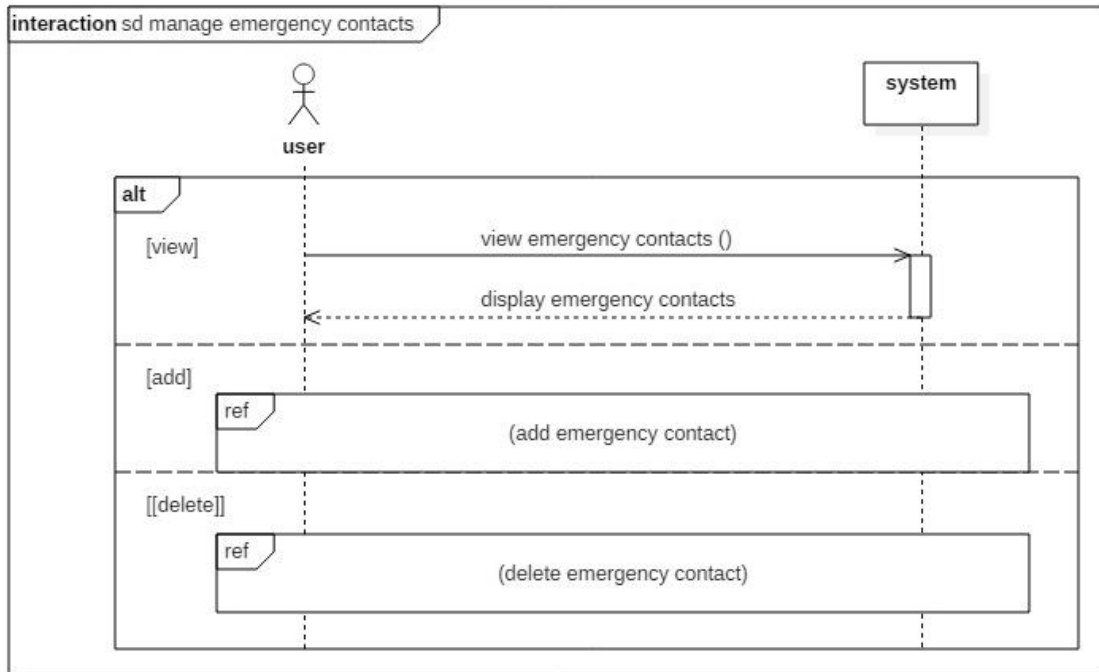


DIAGRAM 8: SEQUENCE DIAGRAM << MANAGE EMERGENCY CONTACTS >>.

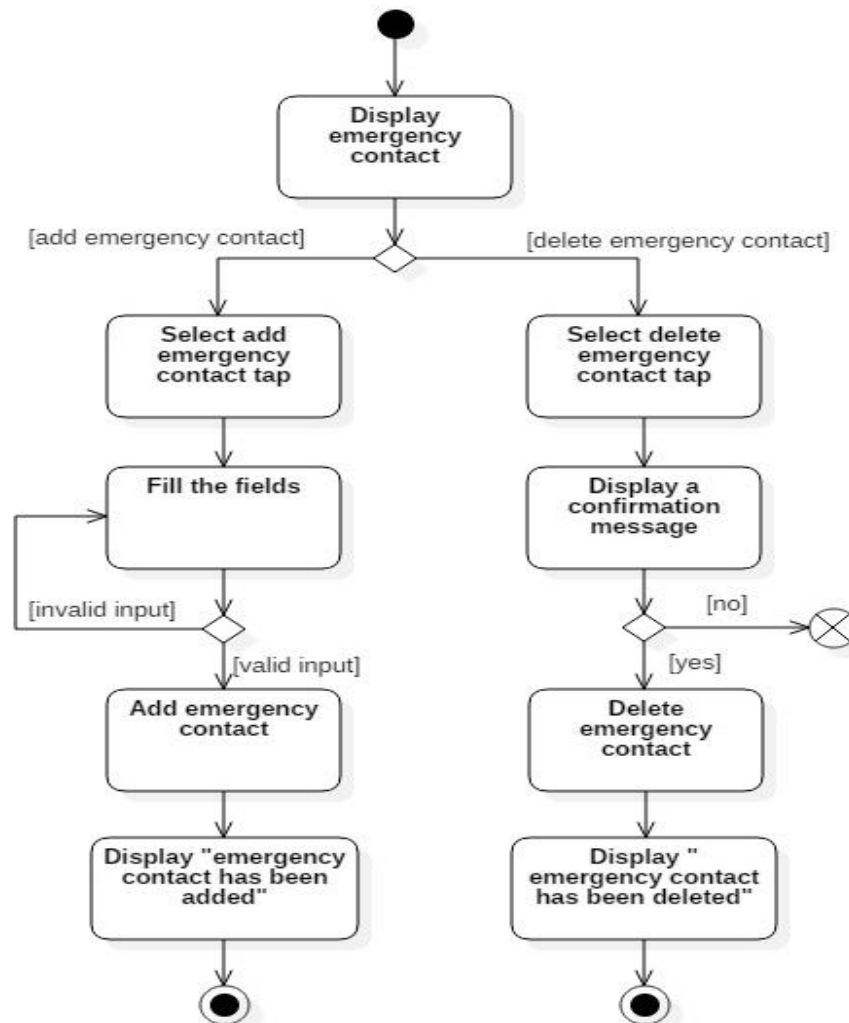


DIAGRAM 9: ACTIVITY DIAGRAM << MANAGE EMERGENCY CONTACTS >>.

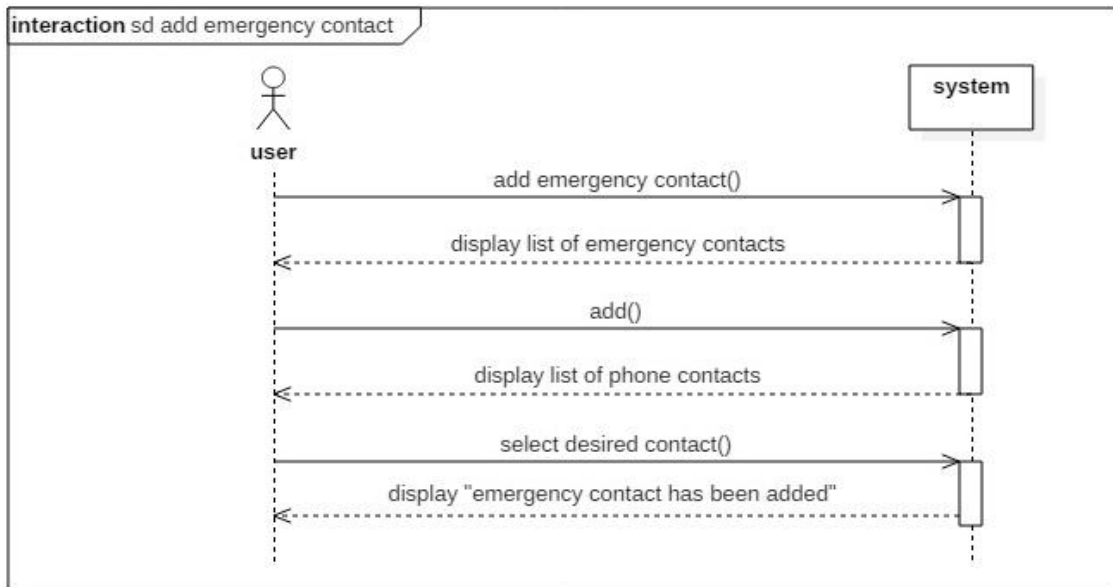


DIAGRAM 10 SEQUENCE DIAGRAM << ADD EMERGENCY CONTACTS >>.

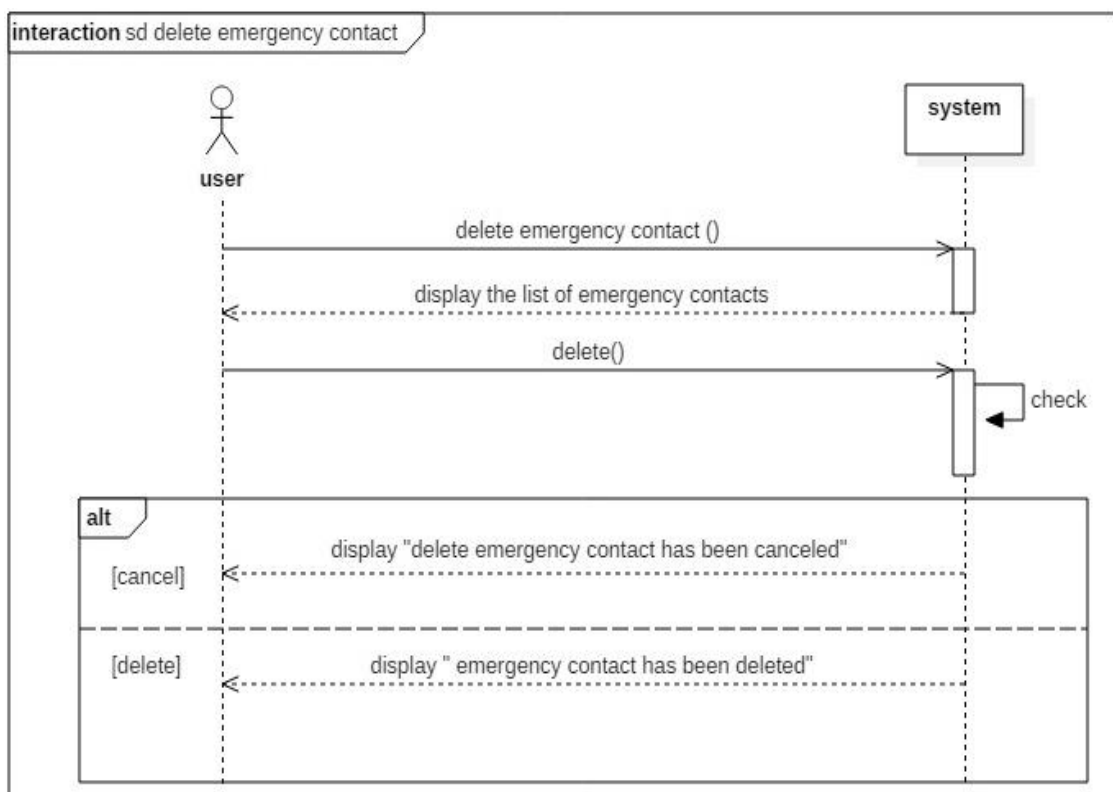


DIAGRAM 11 SEQUENCE DIAGRAM << DELETE EMERGENCY CONTACTS >>.

III.4.1.3.e. EDIT SERVICE

Use case	Edit service
Actors	User
Description	Allow the user to edit service
Pre conditions	The user viewed his service
Post conditions	Service edited
Nominal scenario	The user selects edit service The system displays a form filled with the current attributes The user modifies the desired information and confirms The system Updates the new information of the service The system displays “the service has been edited”
Alternative scenario	If the form is not filled in correctly, the system notifies the user about the related fields The user may cancel the operation

TABLE 10: DESCRIPTION OF USE CASE << EDIT SERVICE >>.

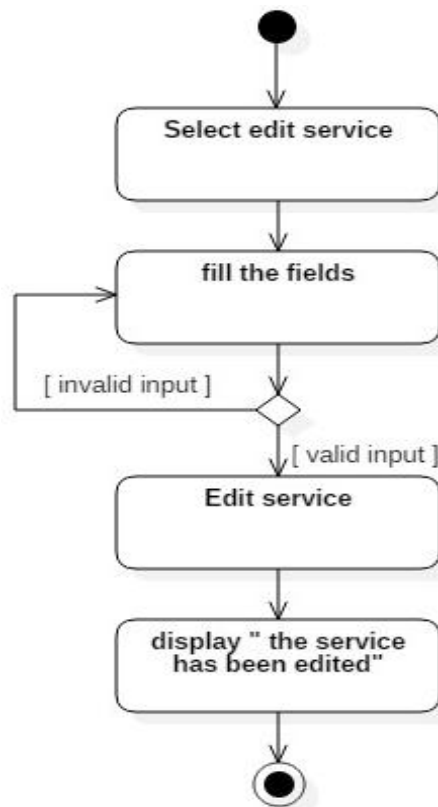


DIAGRAM 12: ACTIVITY DIAGRAM << EDIT SERVICE >>.

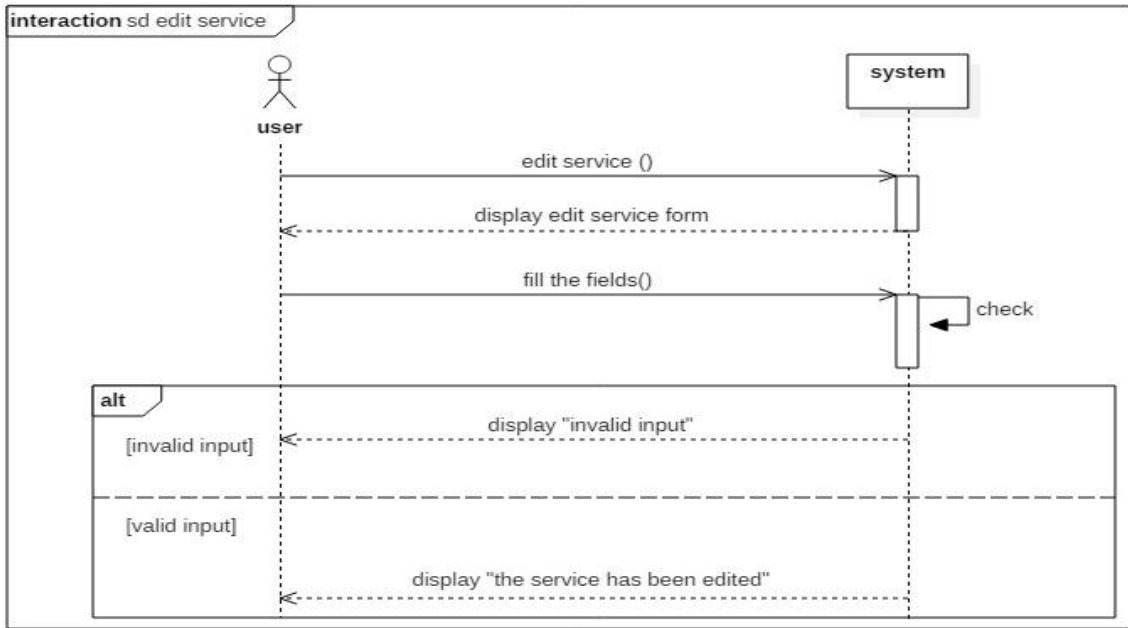


DIAGRAM 13: SEQUENCE DIAGRAM << EDIT SERVICE >>.

III.4.1.3.f. DELETE SERVICE

Use case	Delete service
Actors	User
Description	Allow the user to delete service
Pre conditions	The user viewed his service
Post conditions	Service deleted
Nominal scenario	The user selects delete service The system displays a confirmation message The user confirms the deleting of the service The system deletes the service The system display “the service has been deleted”
Alternative scenario	The user can cancel the operation

TABLE 11: DESCRIPTION OF USE CASE << DELETE SERVICE >>.

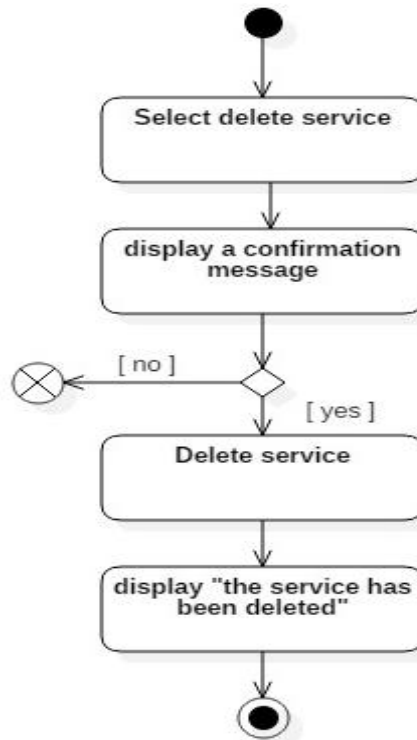


DIAGRAM 14: ACTIVITY DIAGRAM << DELETE SERVICE >>.

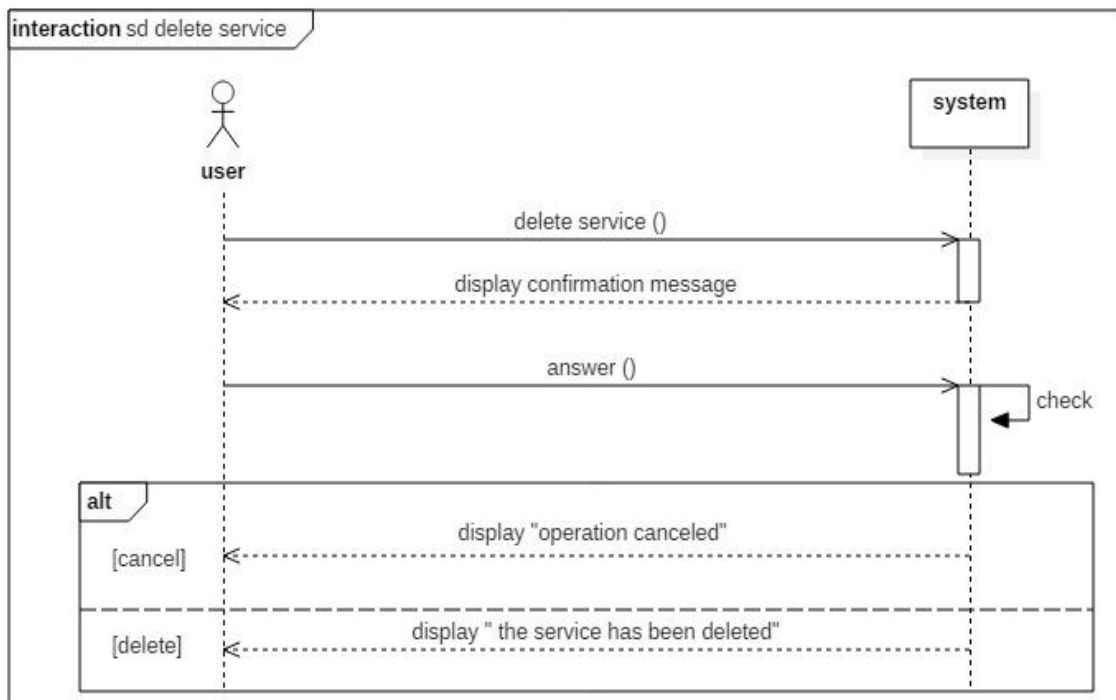


DIAGRAM 15: SEQUENCE DIAGRAM << DELETE SERVICE >>.

III.4.1.3.g. RATE SERVICE

Use case	Rate service
Actors	User
Description	Allow the user to rate a service
Pre conditions	The user has been authenticated The user viewed a service
Post conditions	A service rated
Nominal scenario	The user press rate button The system displays the rating panel The user rates the service and confirms The system displays a success message
Alternative scenario	The user may cancel the operation

TABLE 12: DESCRIPTION OF USE CASE << RATE SERVICE >>.

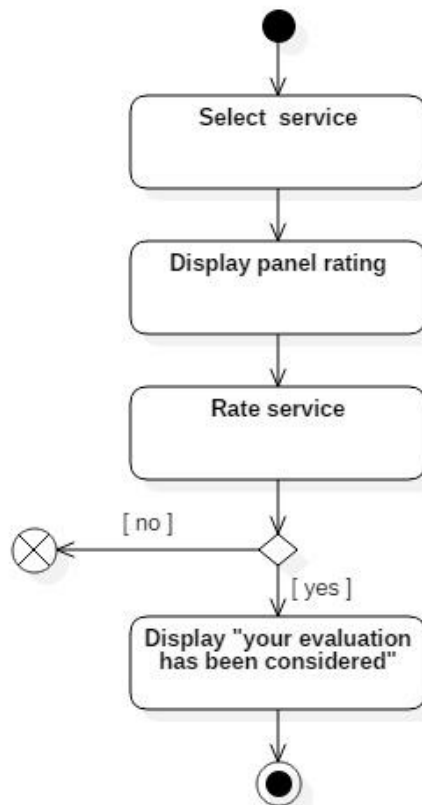


DIAGRAM 16: ACTIVITY DIAGRAM << RATE SERVICE >>.

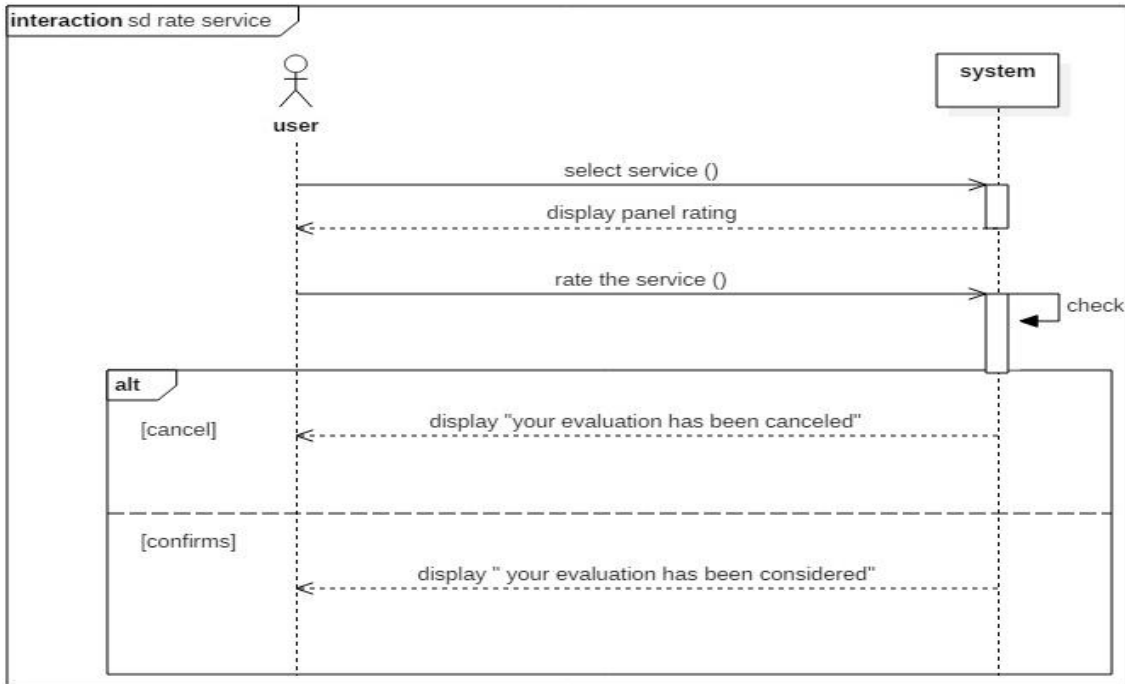


DIAGRAM 17: SEQUENCE DIAGRAM << RATE SERVICE >>.

III.4.1.3.h. SEARCH SERVICE

Use case	Search service
Actors	User
Description	Allow the user to find a desired service
Pre conditions	/
Post conditions	Service found
Nominal scenario	The user writes the service name The system searches for this name in the data base The system displays all services with this name The user selects a service The system displays information of the service
Alternative scenario	If the service name is wrong or does not exist the system displays “service not found”

TABLE 13: DESCRIPTION OF USE CASE << SEARCH SERVICE >>.

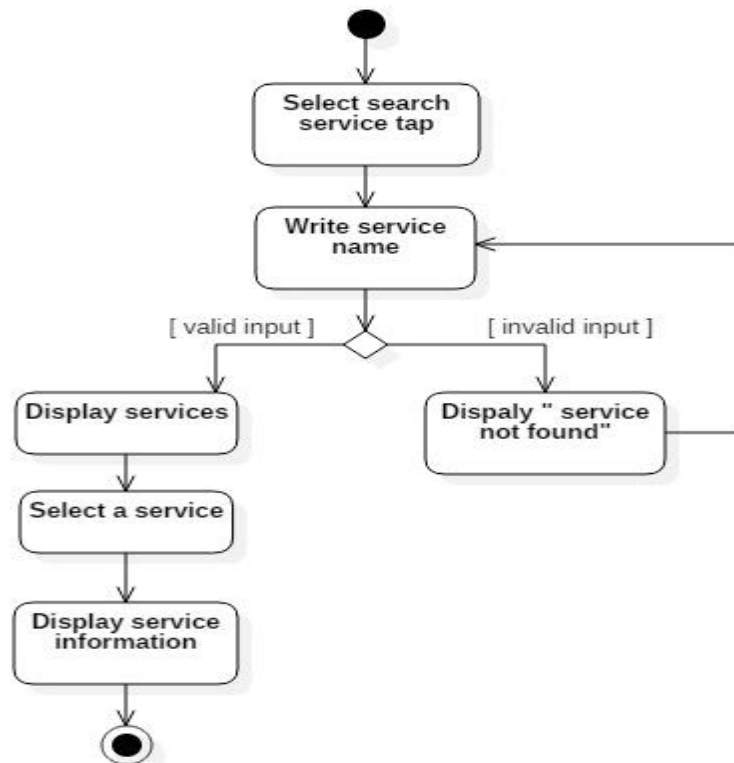


DIAGRAM 18: ACTIVITY DIAGRAM << SEARCH SERVICE >>.

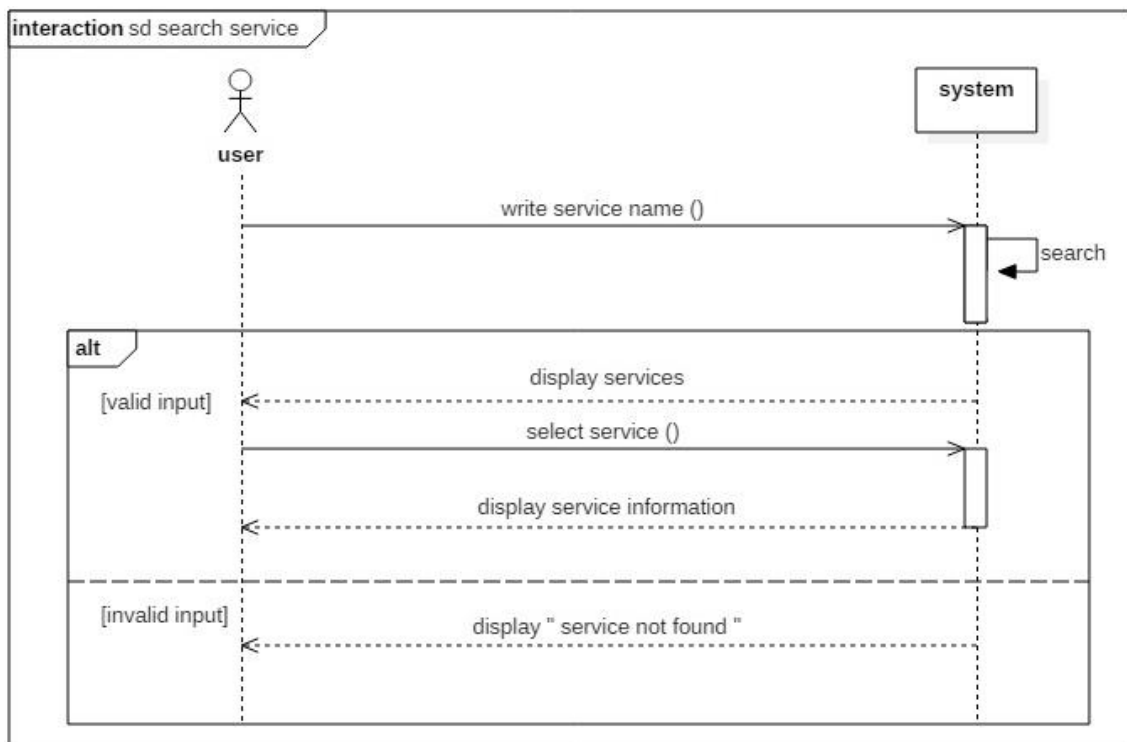


DIAGRAM 19: SEQUENCE DIAGRAM << SEARCH SERVICE >>.

III.4.1.3.i. BROWSE NEARBY SERVICES

Use case	Browse nearby services
Actors	User
Description	Allow the user to browse nearby services
Preconditions	/
Postconditions	Service found
Nominal scenario	The user press nearby button and select services The system search the services in the default zone The system displays the result to the user The user selects a service The system displays information of the service
Alternative scenario	If there are no services within this distance, the system displays “no service found”

TABLE 14: DESCRIPTION OF USE CASE << BROWSE NEARBY SERVICES >>.

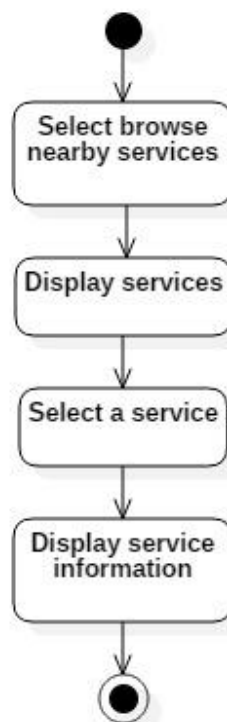


DIAGRAM 20: ACTIVITY DIAGRAM << BROWSE NEARBY SERVICES >>.

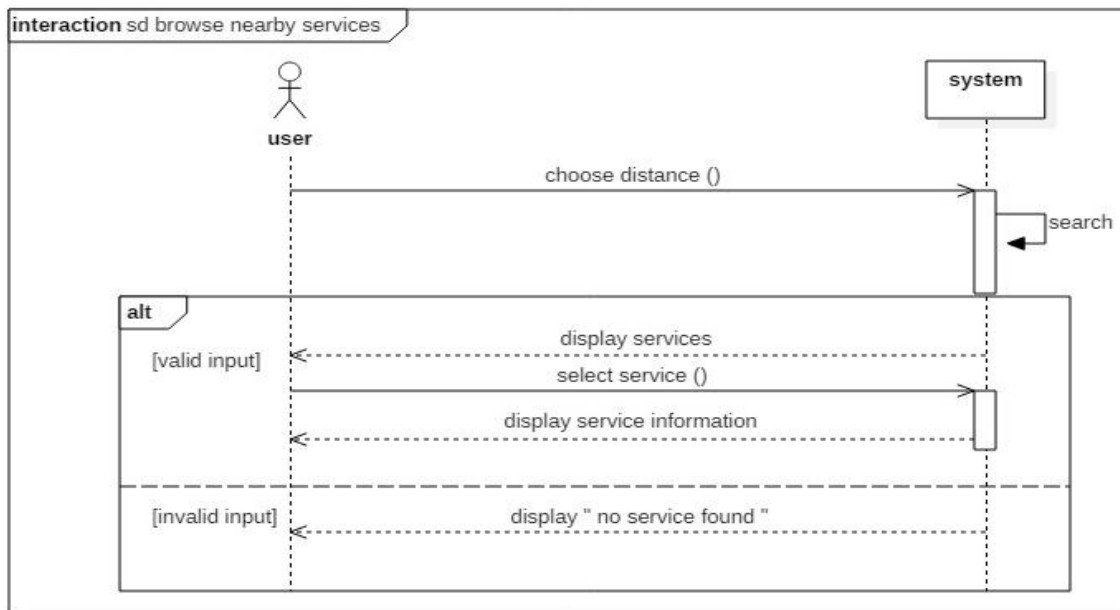


DIAGRAM 21: SEQUENCE DIAGRAM << BROWSE NEARBY SERVICES >>.

III.4.1.3.j. NAVIGATE

Use case	Navigate
Actors	User
Description	Allow the user to navigate in the map
Preconditions	/
Post conditions	
Nominal scenario	The user selects navigate button The system display the current position on the map

TABLE 15: DESCRIPTION OF USE CASE << NAVIGATE >>.

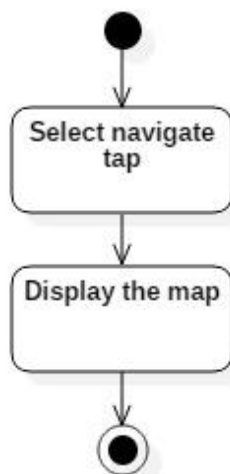


DIAGRAM 22: ACTIVITYDIAGRAM<<NAVIGATE>>.

III.4.1.3.k. ADD SERVICE

Use case	Add service
Actors	User
Description	Allow the user to add a service
Preconditions	The user has to be authenticated The user does not have a service
Post conditions	service added
Nominal scenario	The user presses a long press on the card The system displays a form to fill The user fill the form and validate The system displays "service has been added"
Alternative scenario	If the form is not filled in correctly, the system notifies the user and proposes to correct the fields.

TABLE 16: DESCRIPTION OF USE CASE << ADD SERVICE >>.

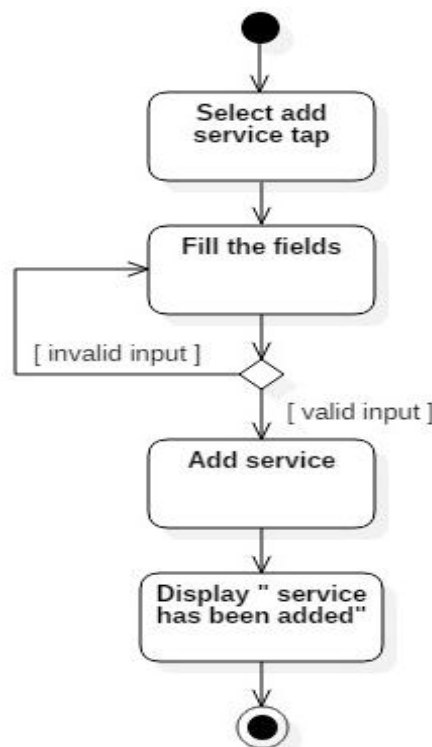


DIAGRAM 23: ACTIVITY DIAGRAM << ADD SERVICE >>.

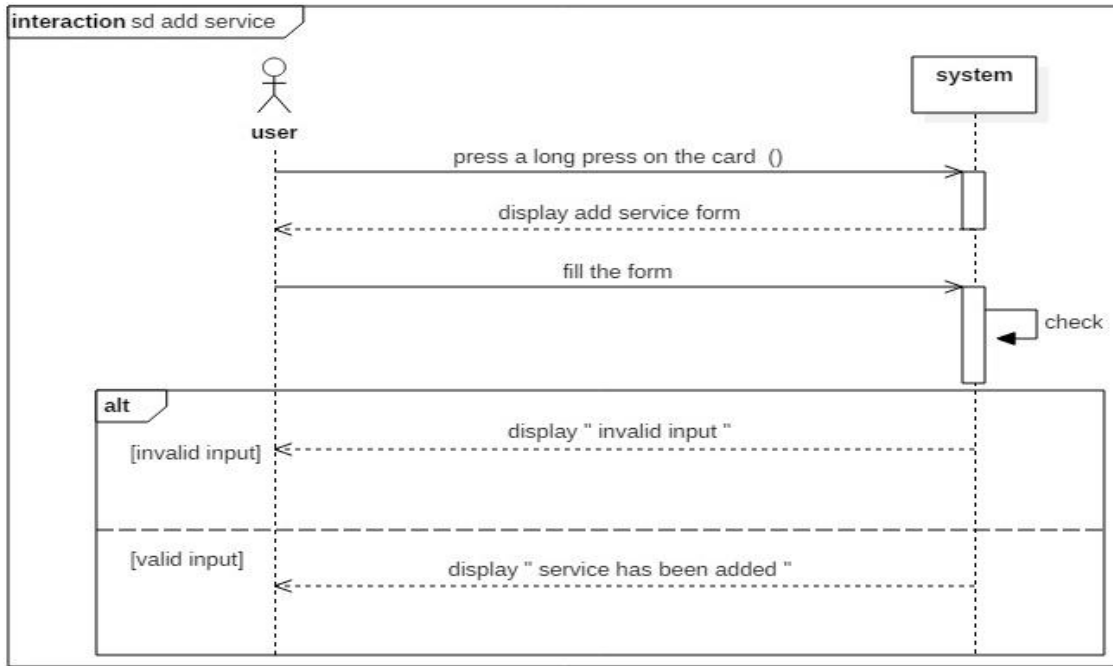


DIAGRAM 24: SEQUENCE DIAGRAM << ADD SERVICE >>.

III.4.1.3.1. ADD EVENT

Use case	Add event
Actors	User
Description	Allow the user add an event
Pre conditions	The user has to be authenticated
Post conditions	event added
Nominal scenario	The user presses a long press on the card The system displays a form addition The user fills the form and validate The system displays “event has been added”
Alternative scenario	If the form is not filled in correctly, the system notifies the user and proposes to correct the fields.

TABLE 17: DESCRIPTION OF USE CASE << ADD EVENT >>.

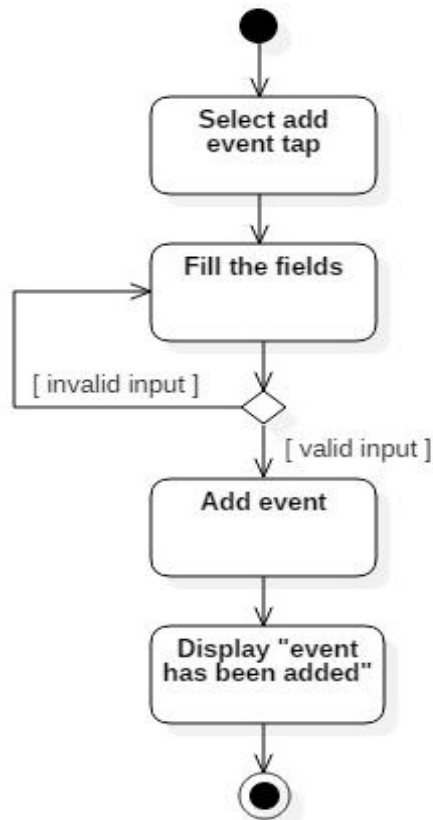


DIAGRAM 25: ACTIVITY DIAGRAM << ADD EVENT >>.

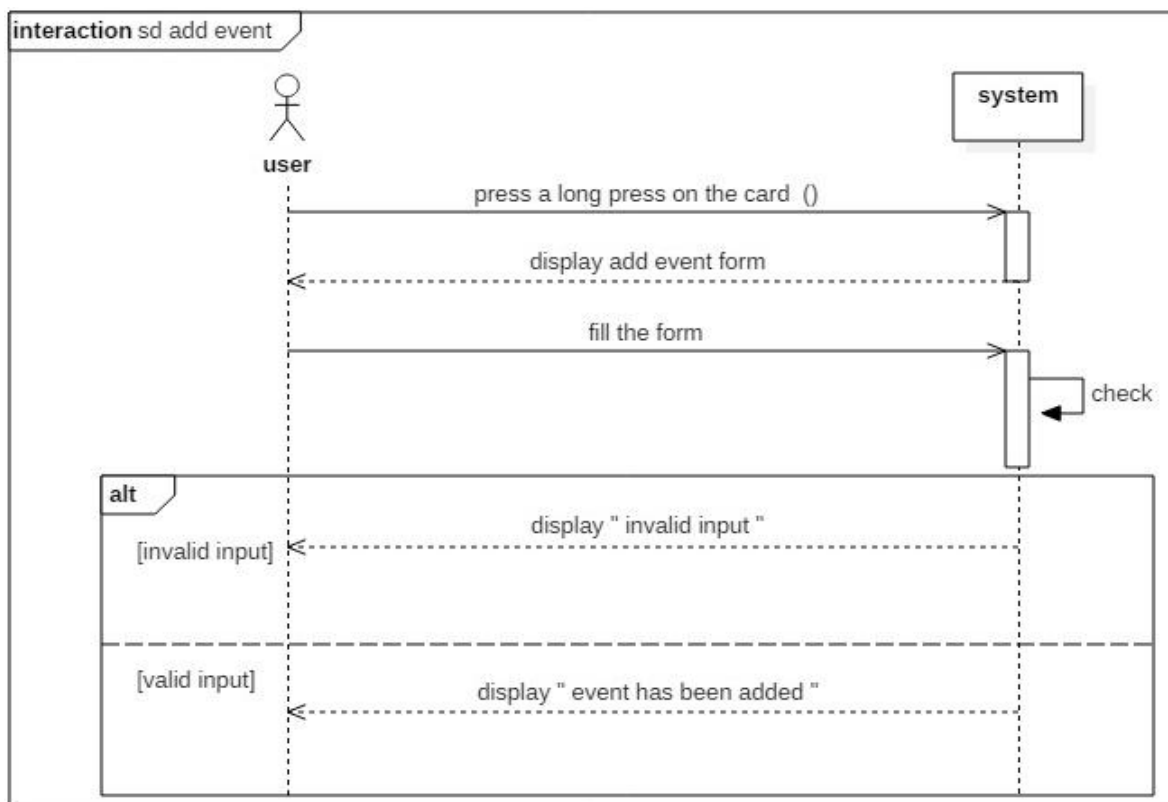


DIAGRAM 26: SEQUENCE DIAGRAM << ADD EVENT >>.

III.4.1.3.m. MANAGE IMAGES GALLERY

Use case	Manage images gallery
Actors	User
Description	Allow to view, add, delete images gallery
Pre conditions	The user has to be authenticated
Nominal Scenario	The user selects one of the actions: View images gallery Add images gallery Delete images gallery

TABLE 18: DESCRIPTION OF USE CASE << MANAGE IMAGES GALLERY >>.

III.4.1.3.n. VIEW IMAGES GALLERY

Use case	View images gallery
Description	Allow the user to view images gallery
Pre conditions	The user has to be authenticated
Nominal Scenario	The user selects view images gallery The system displays images gallery

TABLE 19: DESCRIPTION OF USE CASE << VIEW IMAGES GALLERY >>.

III.4.1.3.o. ADD IMAGES GALLERY

Use case	Add image
Description	Allow the user to add an image to gallery
Pre conditions	The user has to be authenticated
Post conditions	image added
Nominal scenario	The user selects 'addimage' The system displays a list of his phone images The user select the desired image and validate the addition The system displays "image has been added"

TABLE 20 DESCRIPTION OF USE CASE << ADD IMAGES GALLERY>>.

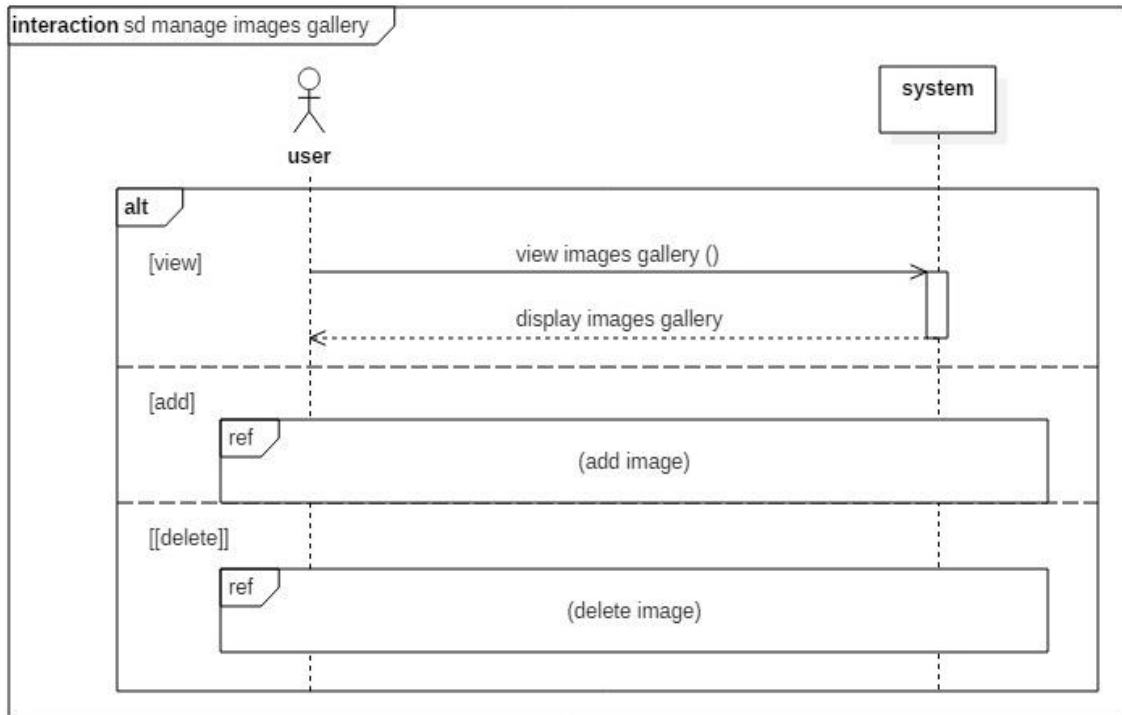


DIAGRAM 27 SEQUENCE DIAGRAM << MANAGE IMAGES GALLERY >>.

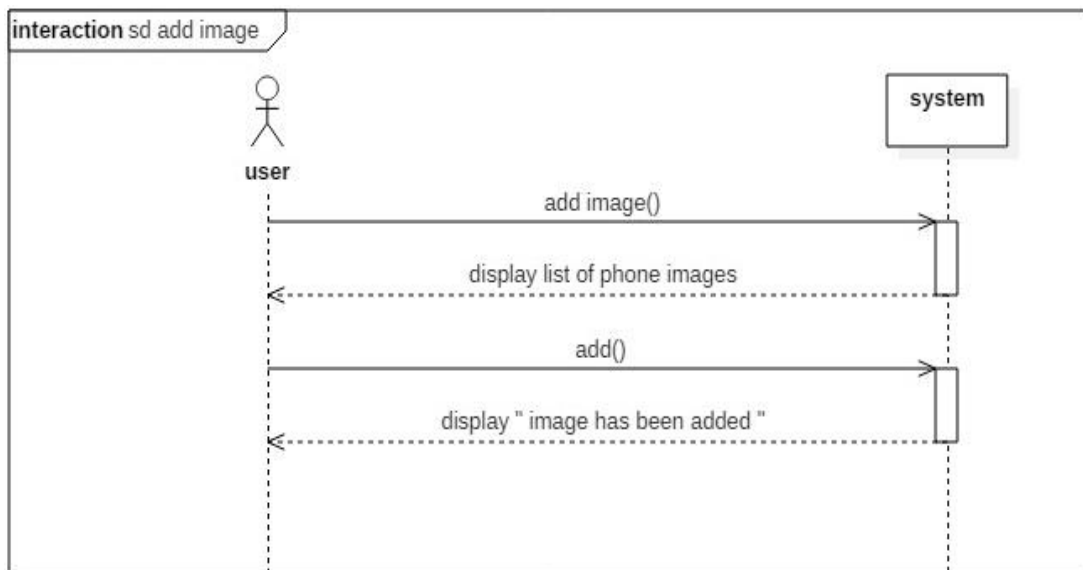


DIAGRAM 28 SEQUENCE DIAGRAM << ADD IMAGE >>.

III.4.1.3.p. DELETE IMAGES GALLERY

Use case	Delete images gallery
Actors	User
Description	Allow the user to delete image from images gallery
Pre conditions	The user viewed images gallery
Post conditions	image deleted
Nominal scenario	The user presses the delete button on the image The system displays a confirmation panel The user confirms the deletion and validate The system displays “image has been deleted”
Alternative scenario	The user can cancel the operation

TABLE 21 DESCRIPTION OF USE CASE << DELETE IMAGES GALLERY >>.

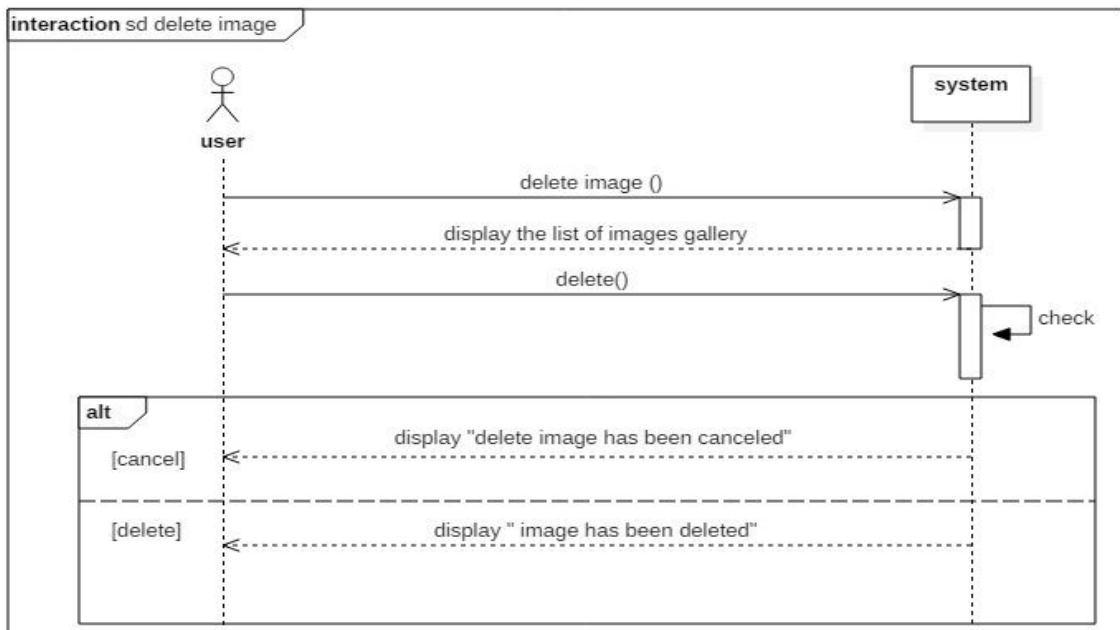


DIAGRAM 29 SEQUENCE DIAGRAM << DELETE IMAGE >>.

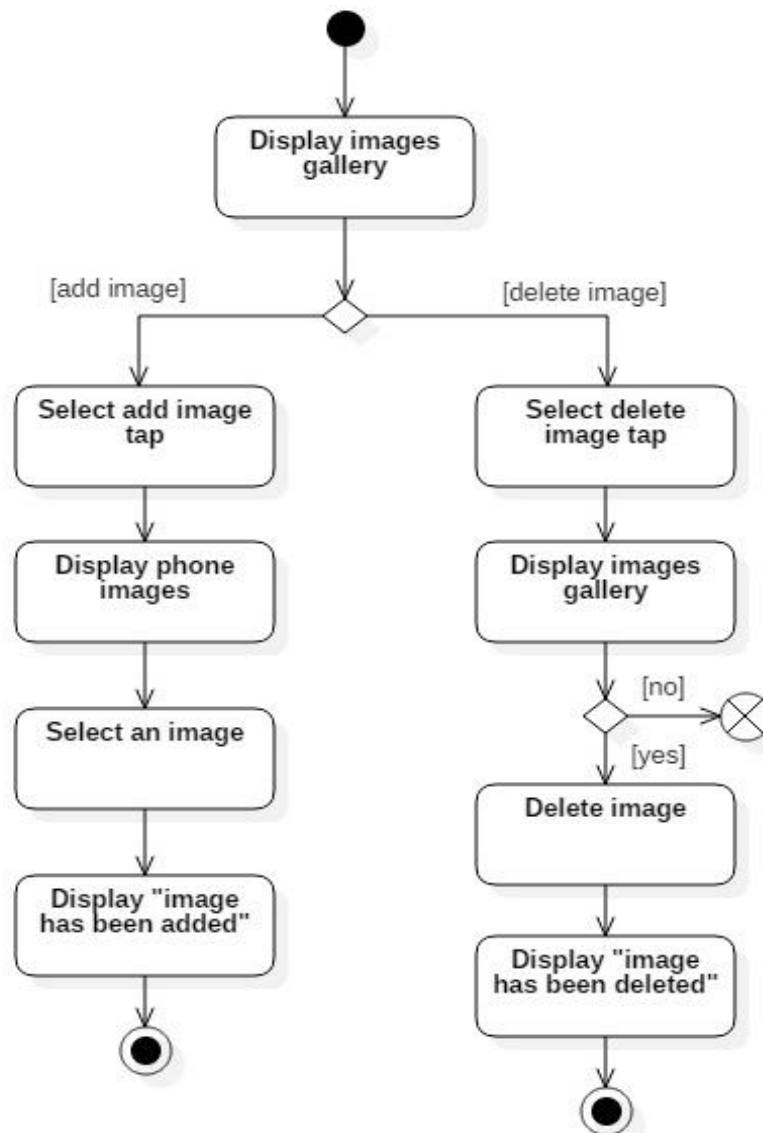


DIAGRAM 30 ACTIVITY DIAGRAM << MANAGE IMAGES GALLERY >>.

III.4.1.3.q. BROWSE EVENTS

Use case	Browse events
Actors	User
Description	Allow the user to browse events
Nominal scenario	The user selects 'browse events' The system displays last events The user selects an event The system displays information of the event

TABLE 22 DESCRIPTION OF USE CASE << BROWSE EVENTS >>.

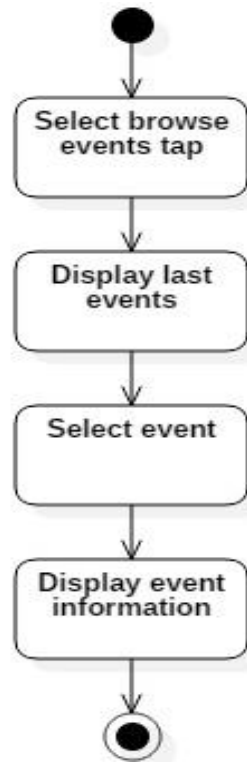


DIAGRAM 31 ACTIVITY DIAGRAM << BROWSE EVENT >>.

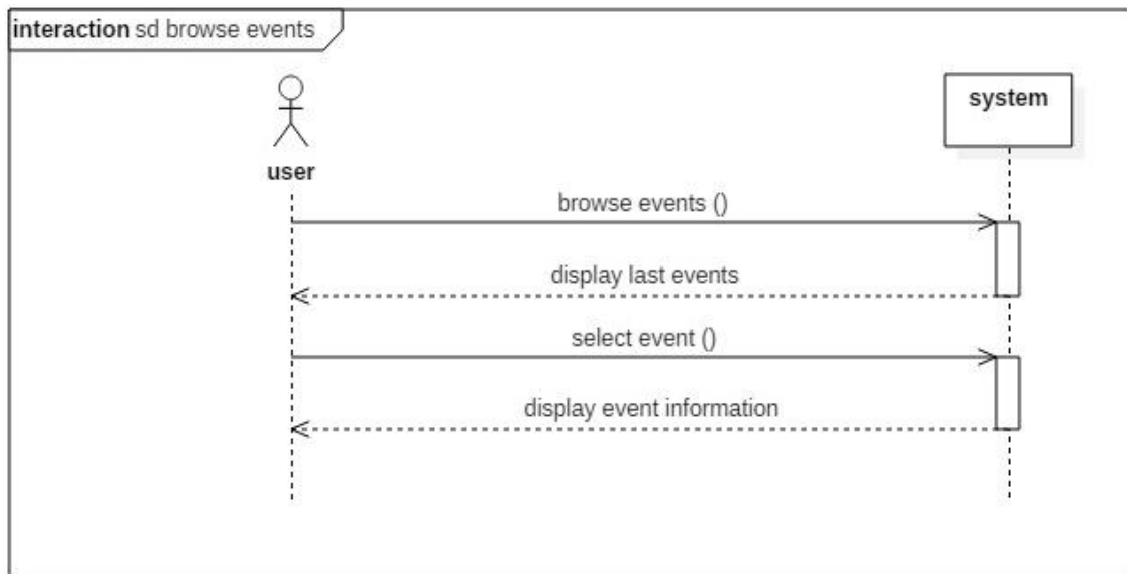


DIAGRAM 32 SEQUENCE DIAGRAM << BROWSE EVENT >>.

III.4.1.3.r. SEARCH EVENT

Use case	Search event
Actors	User
Description	Allow the user to find a desired event
Pre conditions	/
Post conditions	event found
Nominal scenario	The user writes the event name The system searches for this name in the data base The system displays all events with this name The user selects an event The system displays information of the event
Alternative scenario	If the event name is wrong or not exist, the system displays "event not found"

TABLE 23 DESCRIPTION OF USE CASE << SEARCH EVENT >>.

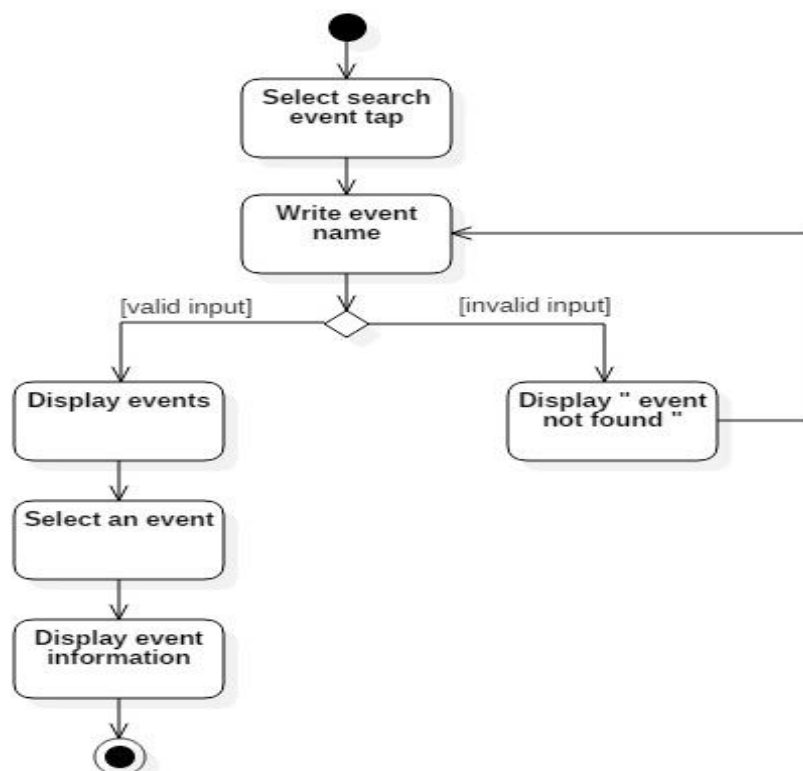


DIAGRAM 33 ACTIVITY DIAGRAM << SEARCH EVENT >>.

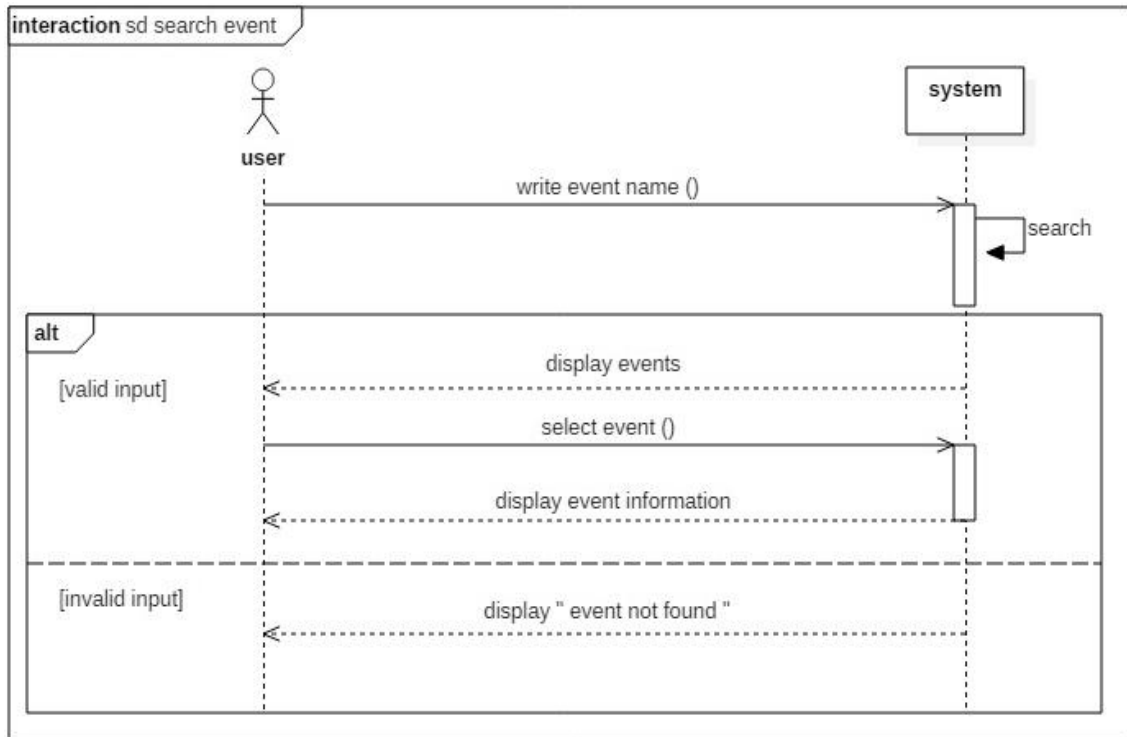


DIAGRAM 34 SEQUENCE DIAGRAM << SEARCH EVENT >>.

III.4.1.3.s. VIEW EVENT

Use case	View event
Actors	User
Description	Allow the user to view event
Pre conditions	The user select an event
Nominal Scenario	The user navigates and selects 'view event'

TABLE 24 DESCRIPTION OF USE CASE << VIEW EVENT >>.

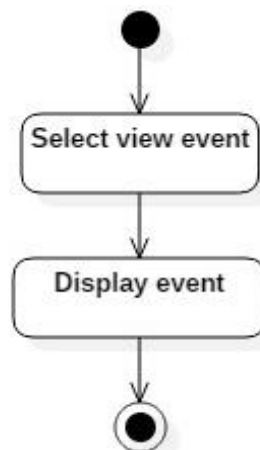


DIAGRAM 35 ACTIVITY DIAGRAM << VIEW EVENT >>.

III.4.1.3.t. RATE EVENT

Use case	Rate event
Actors	User
Description	Allow the user to rate an event
Pre conditions	The user has to be authenticated
Post conditions	event rated
Nominal scenario	The user select an event to evaluate The system displays the rating panel The user rates the event and confirms The system displays “your evaluation has been considered”
Alternative scenario	The user may cancel the current transaction at any time on condition he has not validated it.

TABLE 25 DESCRIPTION OF USE CASE << RATE EVENT >>.

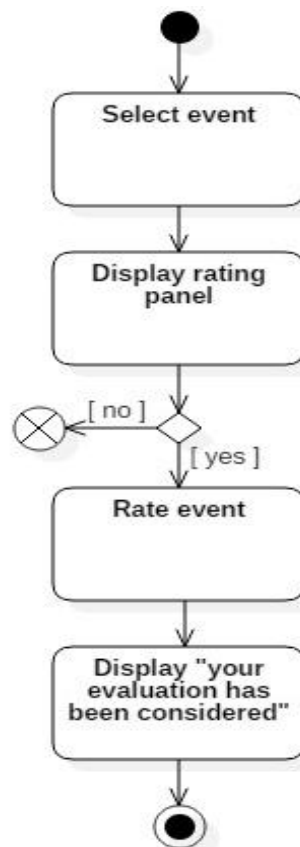


DIAGRAM 36 ACTIVITY DIAGRAM << RATE EVENT >>.

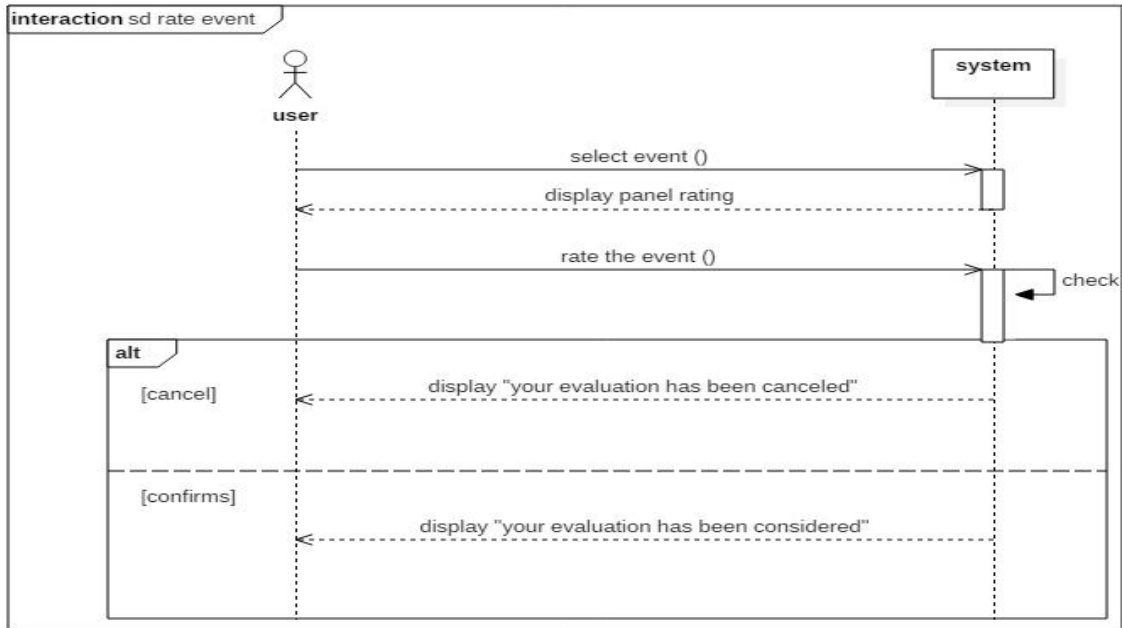


DIAGRAM 37 SEQUENCE DIAGRAM << RATE EVENT >>.

III.4.1.3.u. S.O.S

Use case	S.O.S
Actors	User
Description	Allow the user to send an emergency sms
Pre conditions	/
Post conditions	Message sent
Nominal scenario	The user presses 'S.O.S' button The system displays S.O.S panel The user select the sort of the emergency The user send the SMS to the emergency contacts The system display “sms has been sent”
Alternative scenario	If the user doesn't have an emergency contact he select a contact from phone contact list and sends the emergency message If the user selects S.O.S and doesn't send a message, an SMS will automatically be sent to emergency contacts after 30second

TABLE 26 DESCRIPTION OF USE CASE << S.O.S >>.

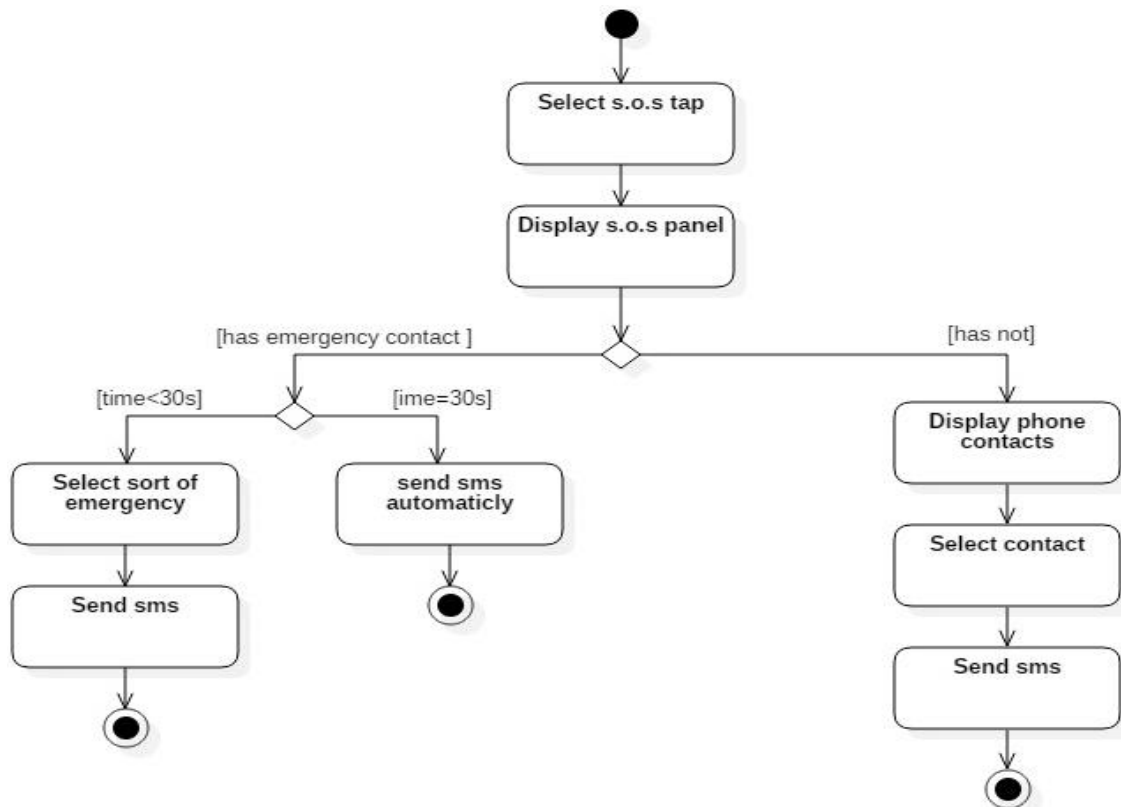


DIAGRAM 38 ACTIVITY DIAGRAM <<S.O.S >>.

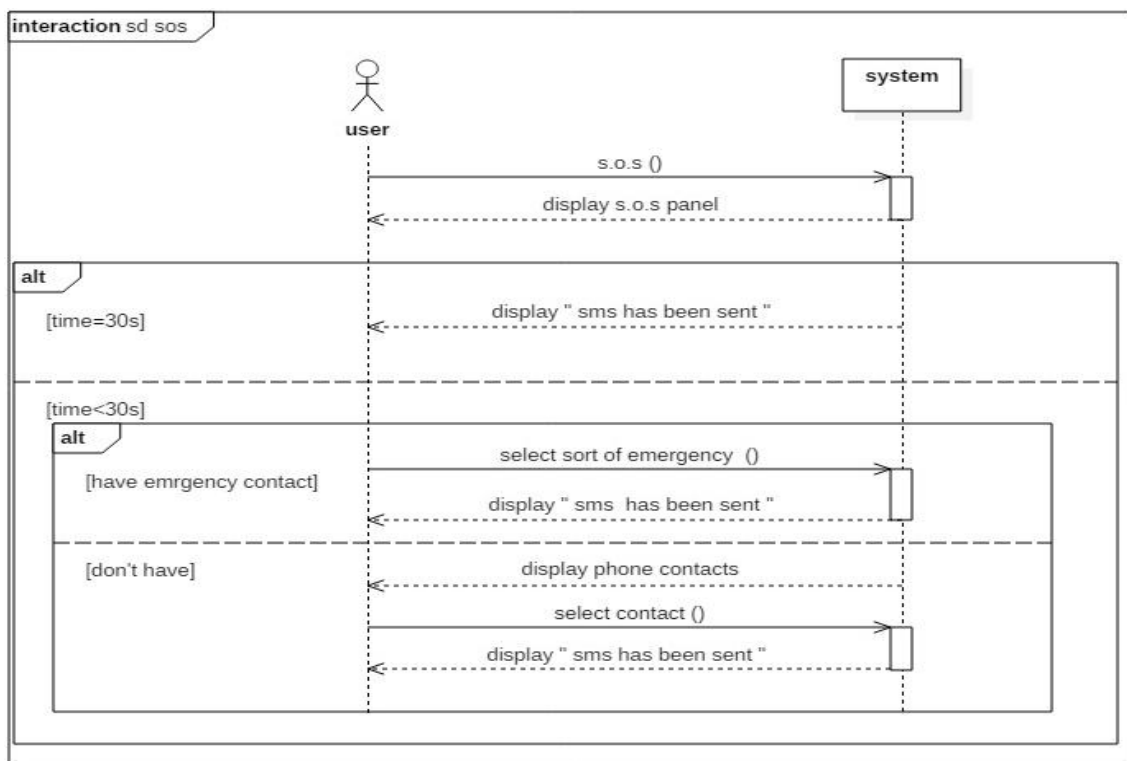


DIAGRAM 39 SEQUENCE DIAGRAM <<S.O.S >>.

III.4.2. SERVER SIDE

III.4.2.1. USE CASE CATALOG

N	Use case	
1	Manage accounts	Validate account Delete account View accounts
2	Manage services	Validate service Delete service View services
3	Manage events	Validate event Delete event View events

TABLE 27: LIST OF USE CASES << SERVER >>.

III.4.2.2. USE CASE DIAGRAM

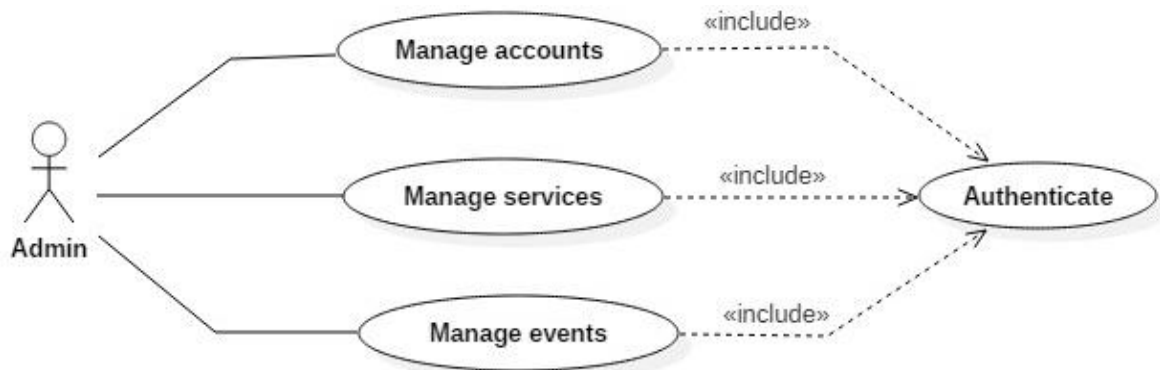


DIAGRAM 40: USE CASE DIAGRAM << SERVER >>.

III.4.2.3. DESCRIPTION OF USE CASES

III.4.2.3.a. MANAGE ACCOUNTS

Use case	Manage accounts
Actors	Admin
Goal	Allow the admin to validate delete or view accounts
Pre conditions	The admin has to be authenticated
Nominal Scenario	The Admin selects one of the actions: View accounts (see case description) Validate account (see case description) Delete account (see case description)

TABLE 28 DESCRIPTION OF USE CASE << MANAGE ACCOUNTS >>.

III.4.2.3.b. VIEW ACCOUNTS

Use case	view account
Actors	Admin
Goal	Allow the admin to view accounts
Pre conditions	The admin has to be authenticated
Nominal Scenario	The admin chooses view accounts The system displays a list of accounts

TABLE 29 DESCRIPTION OF USE CASE << VIEW ACCOUNTS >>.

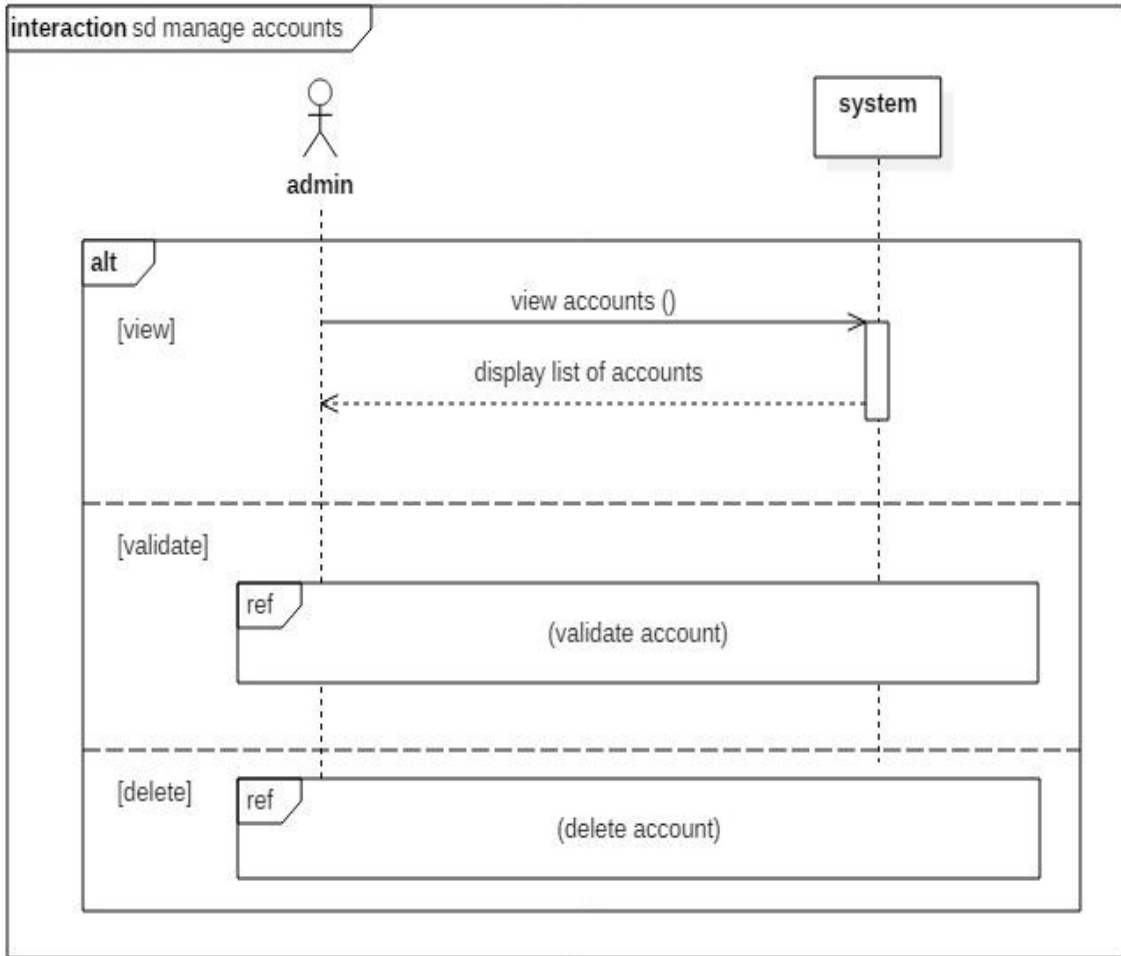


DIAGRAM 41: SEQUENCE DIAGRAM << MANAGE ACCOUNTS>>.

III.4.2.3.c. VALIDATE ACCOUNT

Use case	Validate account
Actors	Admin
Goal	Allow the admin to validate account
Pre conditions	The admin has to be authenticated
Post conditions	Accounts validated
Nominal Scenario	<p>The admin chooses validate account</p> <p>The system displays the accounts that have not been validated yet</p> <p>The admin consults the account and confirms to validate it</p> <p>The system displays “account has been validated”</p>

TABLE 30: DESCRIPTION OF USE CASE << VALIDATE ACCOUNT>>.

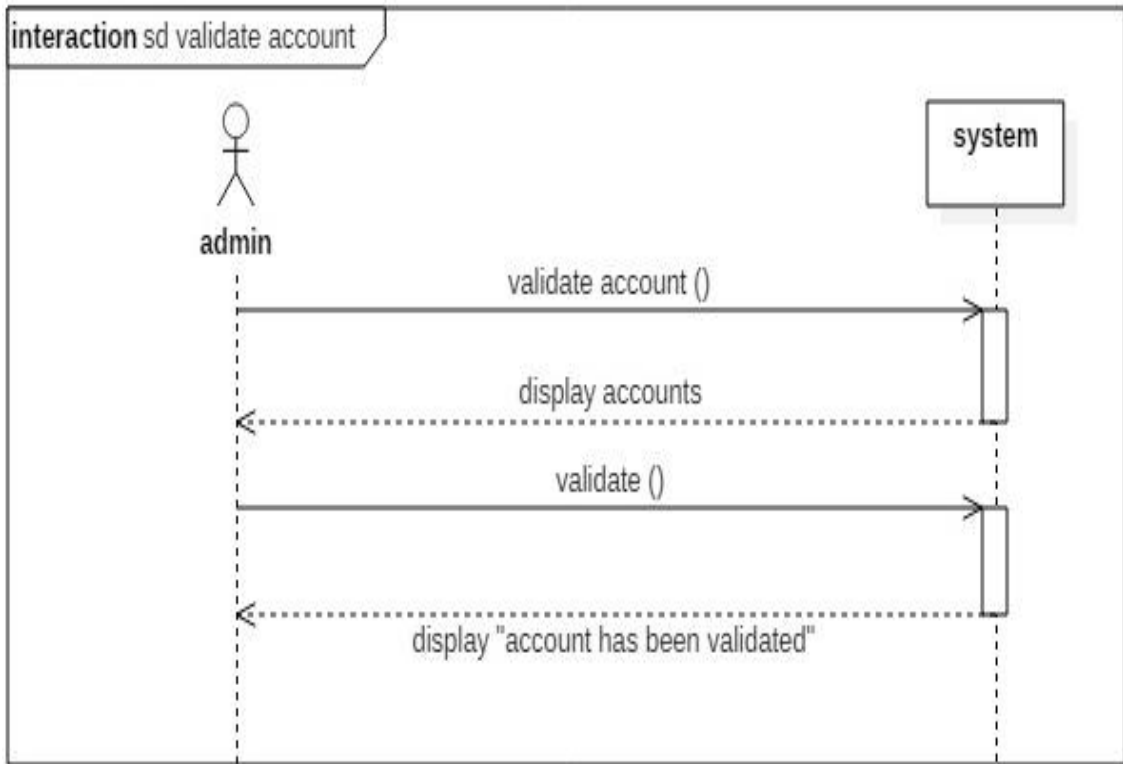


DIAGRAM 42: SEQUENCE DIAGRAM << VALIDATE ACCOUNT >>.

III.4.2.3.d. DELETE ACCOUNT

Use case	Delete account
Actors	Admin
Goal	Allow the admin to delete accounts
Pre conditions	The admin has to be authenticated
Post conditions	Accounts deleted
Nominal Scenario	The admin chooses delete account The system displays a list of accounts The admin chooses account to delete The system display a confirmation panel The admin confirms the deletion The system displays “account has been deleted”
Alternative scenario	The admin can cancel the operation of ‘delete account’ in the confirmation panel The system displays "delete account has been canceled"

TABLE 31 DESCRIPTION OF USE CASE << DELETE ACCOUNT >>.

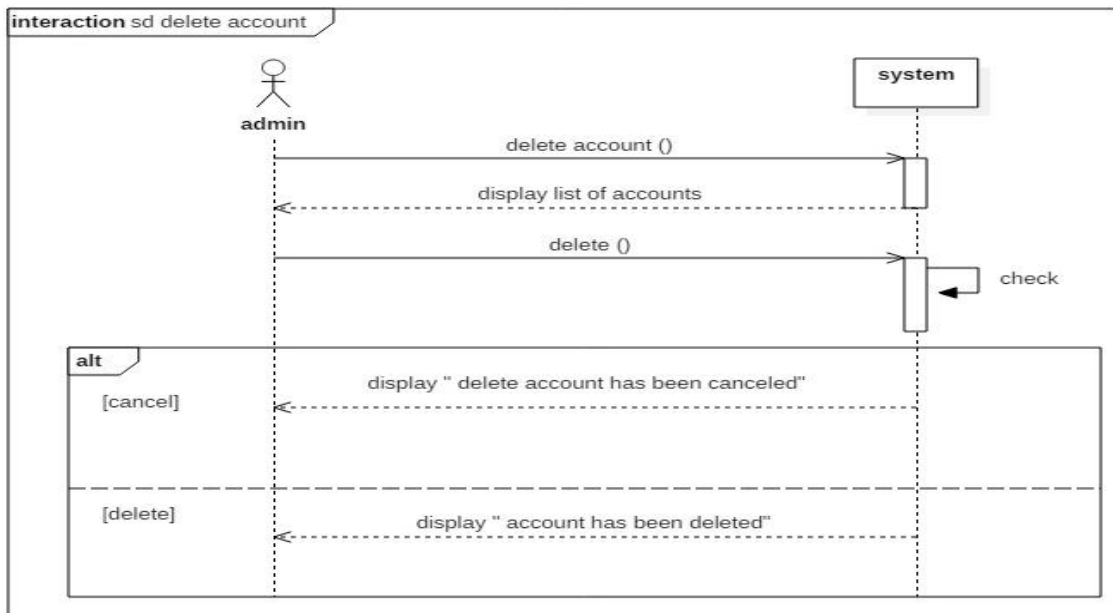


DIAGRAM 43 SEQUENCE DIAGRAM << DELETE ACCOUNT >>.

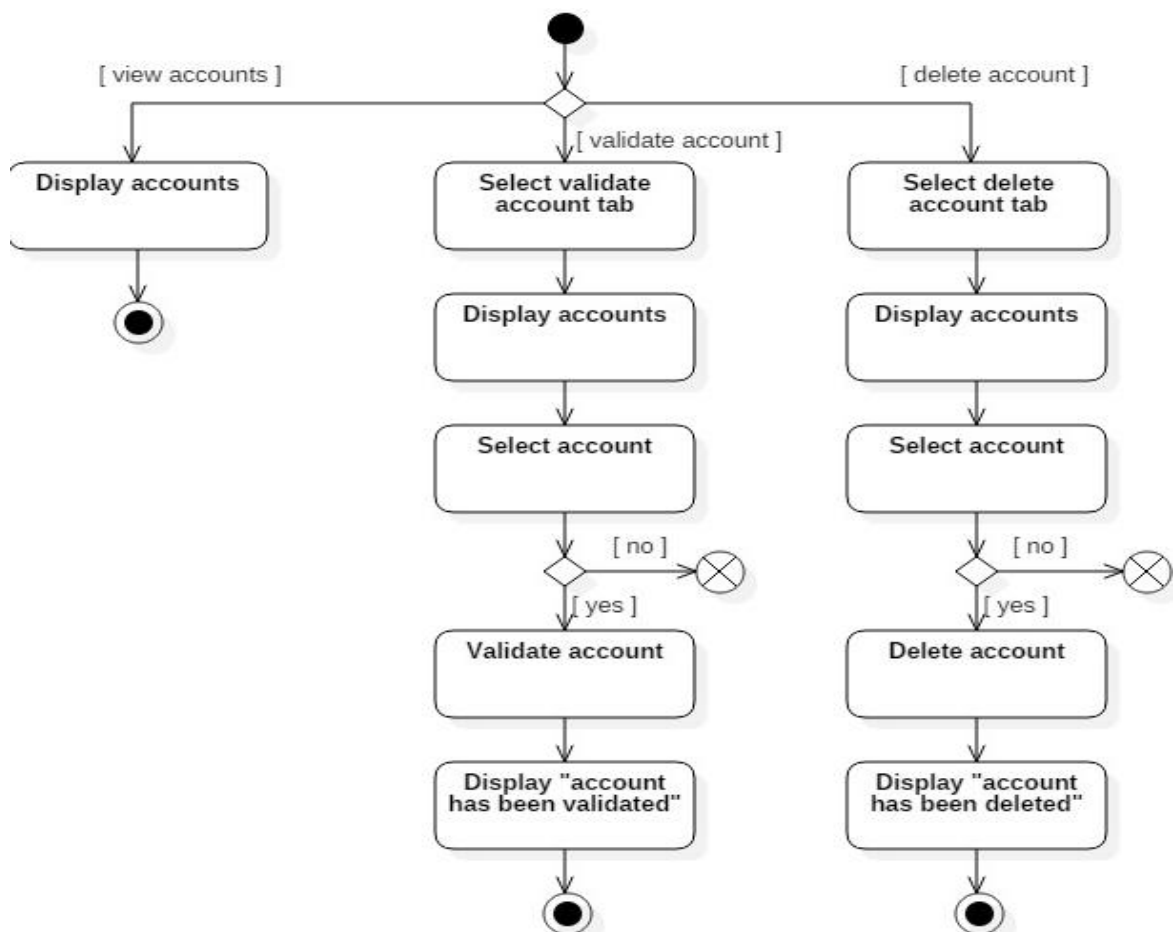


DIAGRAM 44 ACTIVITY DIAGRAM << MANAGE ACCOUNT >>.

III.4.2.3.e. MANAGE SERVICE

Use case	Manage services
Actors	Admin
Goal	Allow the admin to validate delete or view services
Pre conditions	The admin has to be authenticated
Nominal Scenario	The Admin selects one of the actions: View services (see case description) Validate services (see case description) Delete services (see case description)

TABLE 32 DESCRIPTION OF USE CASE << MANAGE SERVICES >>.

III.4.2.3.f. VIEW SERVICES

Use case	view services
Actors	Admin
Goal	Allow the admin to view services
Pre conditions	The admin has to be authenticated
Nominal Scenario	The admin chooses viewservices The system displays a list of services

TABLE 33: DESCRIPTION OF USE CASE << VIEW SERVICES >>.

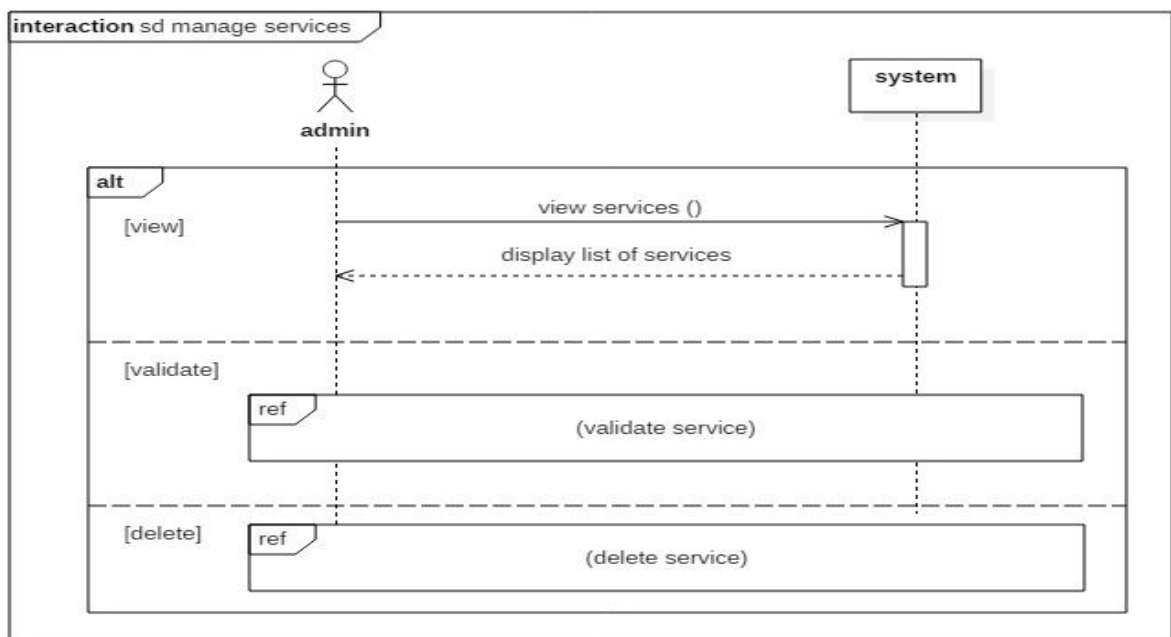


DIAGRAM 45: SEQUENCE DIAGRAM << MANAGE SERVICES >>.

III.4.2.3.g. VALIDATE SERVICE

Use case	Validate service
Actors	Admin
Goal	Allow the admin to validate services
Pre conditions	The admin has to be authenticated
Post conditions	services validated
Nominal Scenario	The admin chooses validate service The system displays the list of services The admin consults the service and confirms to validate it The system displays “service has been validated”

TABLE 34: DESCRIPTION OF USE CASE << VALIDATE SERVICE >> .

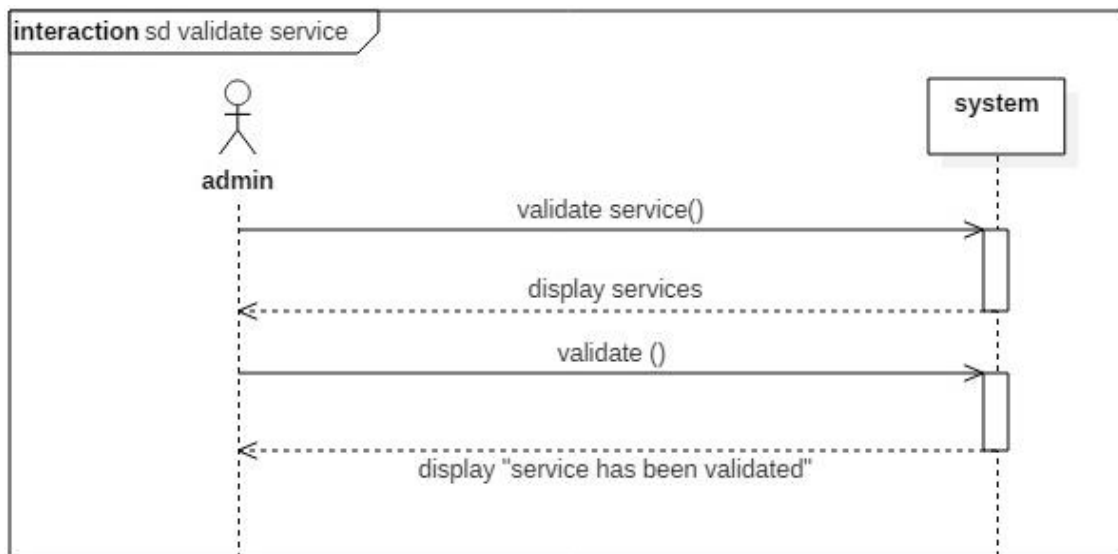


DIAGRAM 46: SEQUENCEDIAGRAM<<VALIDATE SERVICE >> .

III.4.2.3.h. DELETE SERVICE

Use case	Delete service
Actors	Admin
Goal	Allow the admin to delete service
Pre conditions	The admin has to be authenticated
Post conditions	services deleted
Nominal Scenario	The admin chooses delete service The system displays a list of services The admin chooses service to delete The system displays a confirmation panel The admin confirms the deletion The system displays “service has been deleted”
Alternative scenario	The admin can cancel the operation of ‘delete services’ in the confirmation panel The system displays "delete service has been canceled"

TABLE 35: DESCRIPTION OF USE CASE << DELETE SERVICE >>.

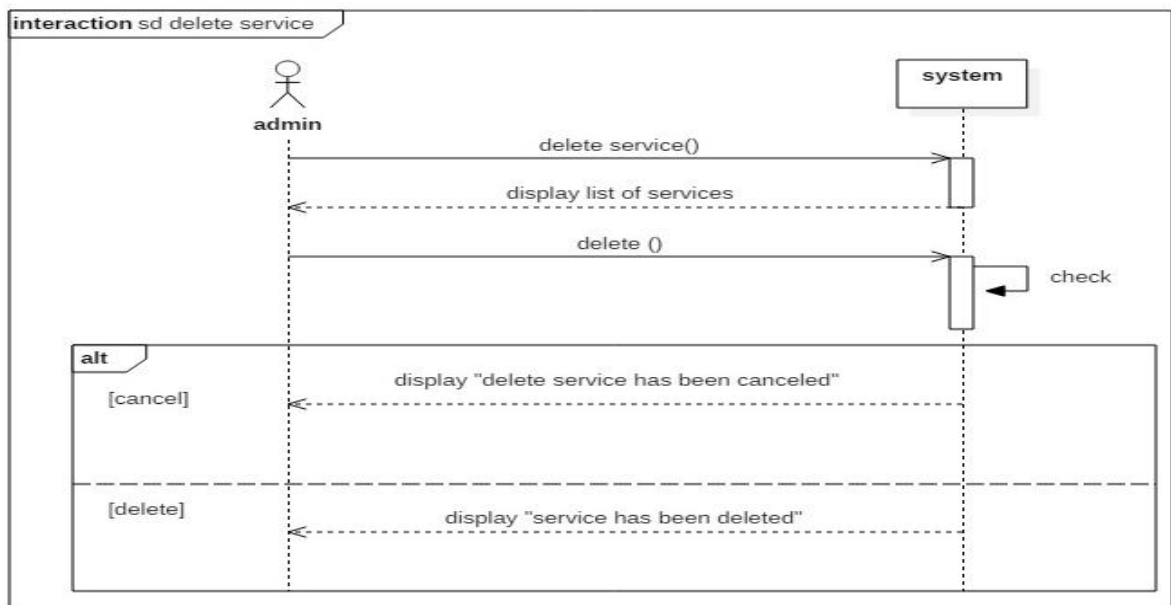


DIAGRAM 47 SEQUENCE DIAGRAM << DELETE SERVICE >>.

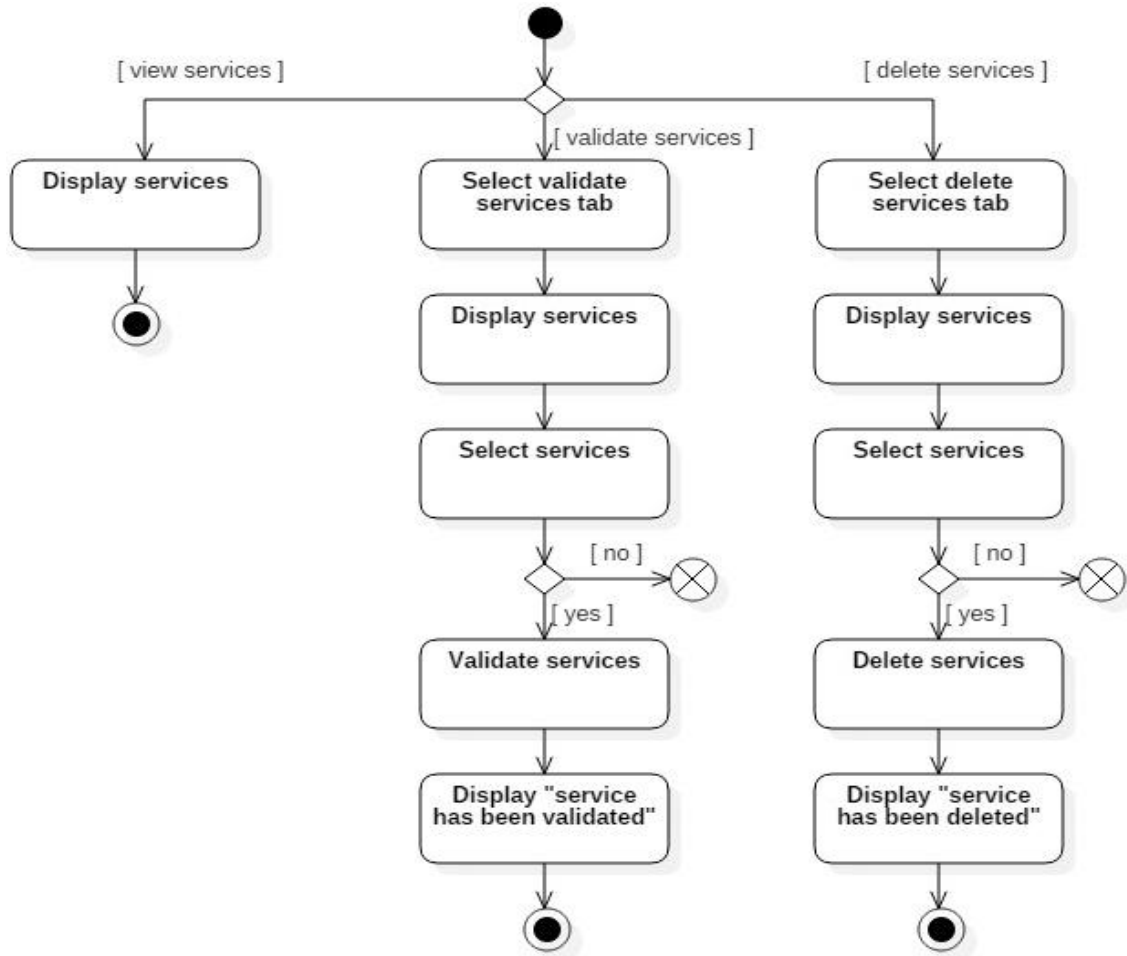


DIAGRAM 48: ACTIVITY DIAGRAM << MANAGE SERVICES >>.

III.4.2.3.i. MANAGE EVENTS

Use case	Manage events
Actors	Admin
Goal	Allow the admin to validate delete or view events
Pre conditions	The admin has to be authenticated
Nominal Scenario	The Admin selects one of the actions: View events (see case description) Validate event (see case description) Delete event (see case description)

TABLE 36: DESCRIPTION OF USE CASE << MANAGE EVENTS >>.

III.4.2.3.j. VIEW EVENTS

Use case	view events
Actors	Admin
Goal	Allow the admin to view events
Pre conditions	The admin has to be authenticated
Nominal Scenario	The admin chooses viewevents The system displays a list of events

TABLE 37: DESCRIPTION OF USE CASE << VIEW EVENTS >>.

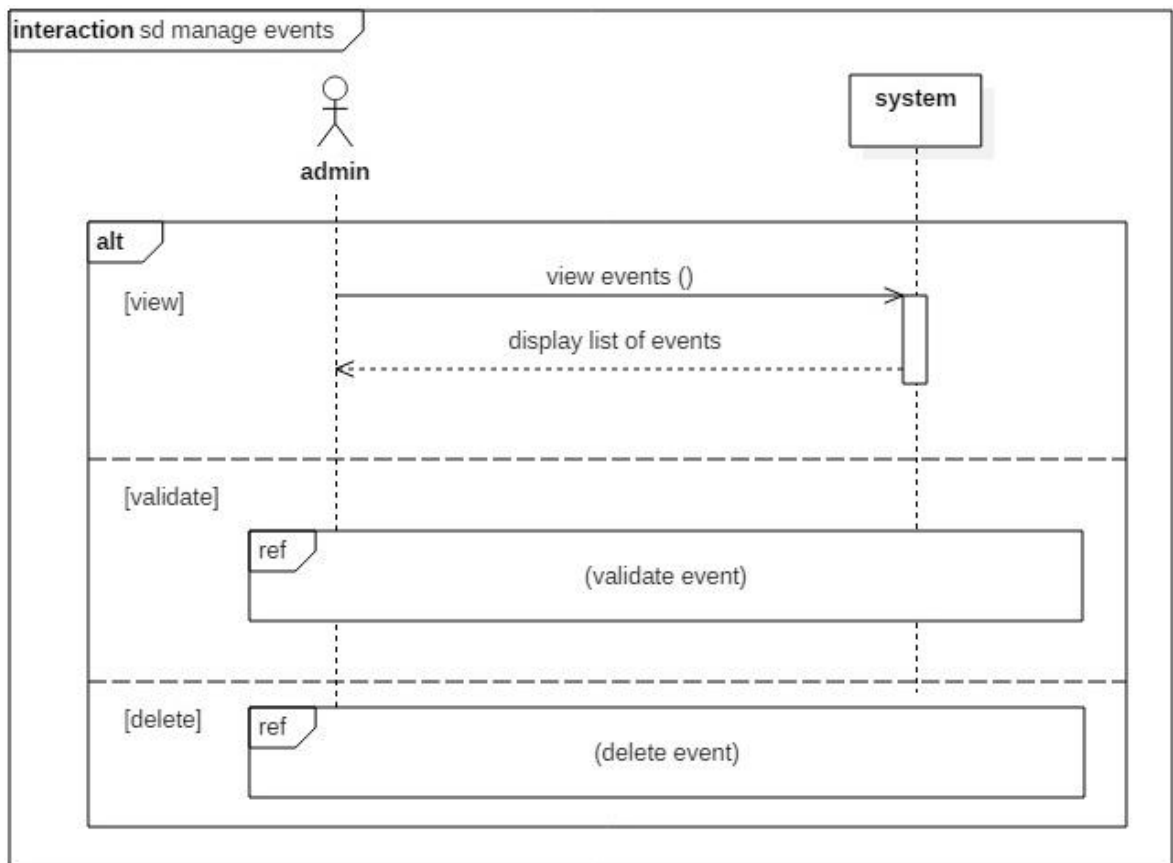


DIAGRAM 49: SEQUENCE DIAGRAM << MANAGE EVENTS >>.

III.4.2.3.k. VALIDATE EVENT

Use case	Validate event
Actors	Admin
Goal	Allow the admin to validate event
Pre conditions	The admin has to be authenticated
Post conditions	events validated
Nominal Scenario	<p>The admin chooses validate event</p> <p>The system displays the events that have not been validated yet</p> <p>The admin consults the event and confirms to validate it</p> <p>The system displays “event has been validated”</p>

TABLE 38: DESCRIPTION OF USE CASE << VALIDATE EVENT >>.

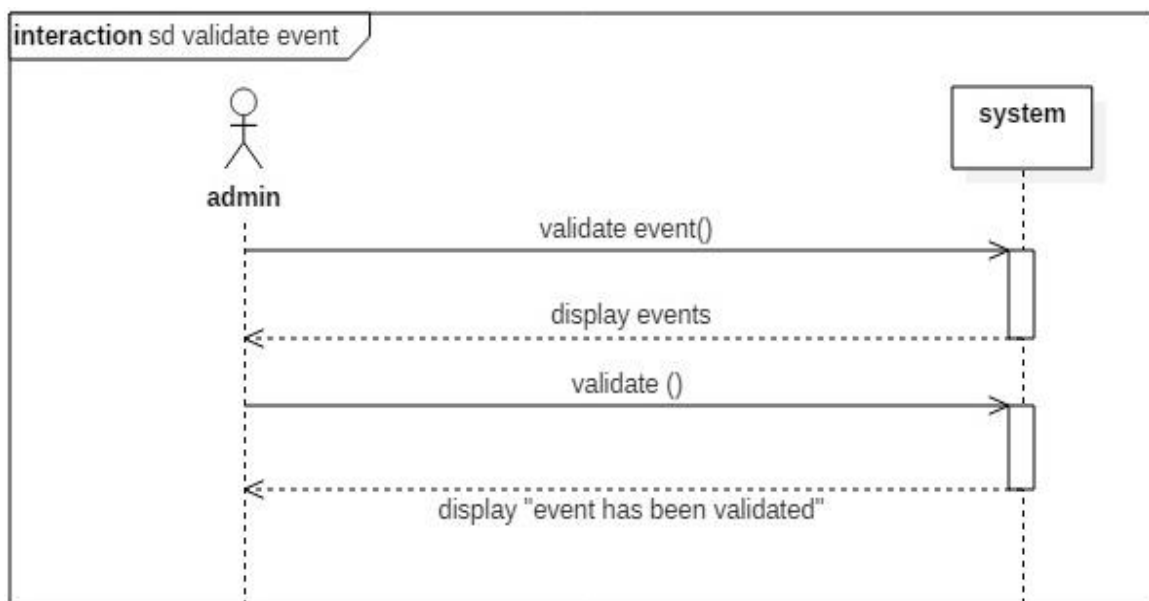


DIAGRAM 50: SEQUENCE DIAGRAM << VALIDATE EVENT >>.

III.4.2.3.1. DELETE EVENT

Use case	Delete event
Actors	Admin
Goal	Allow the admin to delete event
Pre conditions	The admin has to be authenticated
Post conditions	events deleted
Nominal Scenario	The admin chooses delete event The system displays a list of events The admin chooses event to delete The system display a confirmation panel The admin confirms the deletion The system displays “event has been deleted”
Alternative scenario	The admin can cancel the operation of ‘delete events’ in the confirmation panel The system displays "delete event has been canceled"

TABLE 39: DESCRIPTION OF USE CASE << DELETE EVENT >>.

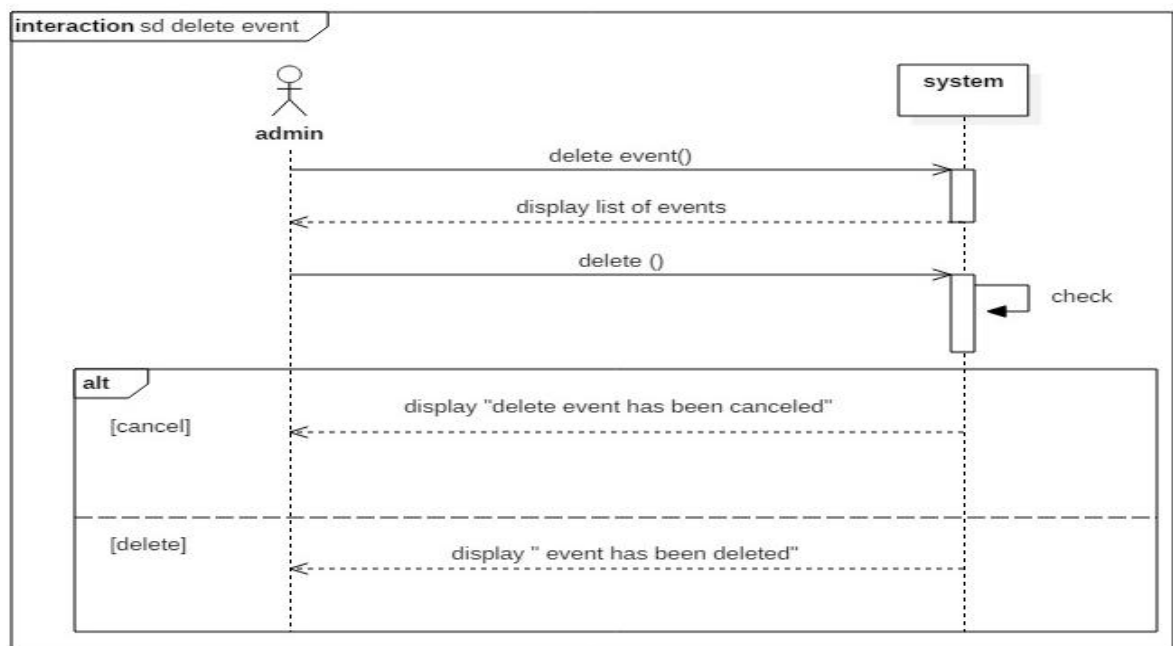


DIAGRAM 51 SEQUENCE DIAGRAM << DELETE EVENT >>.

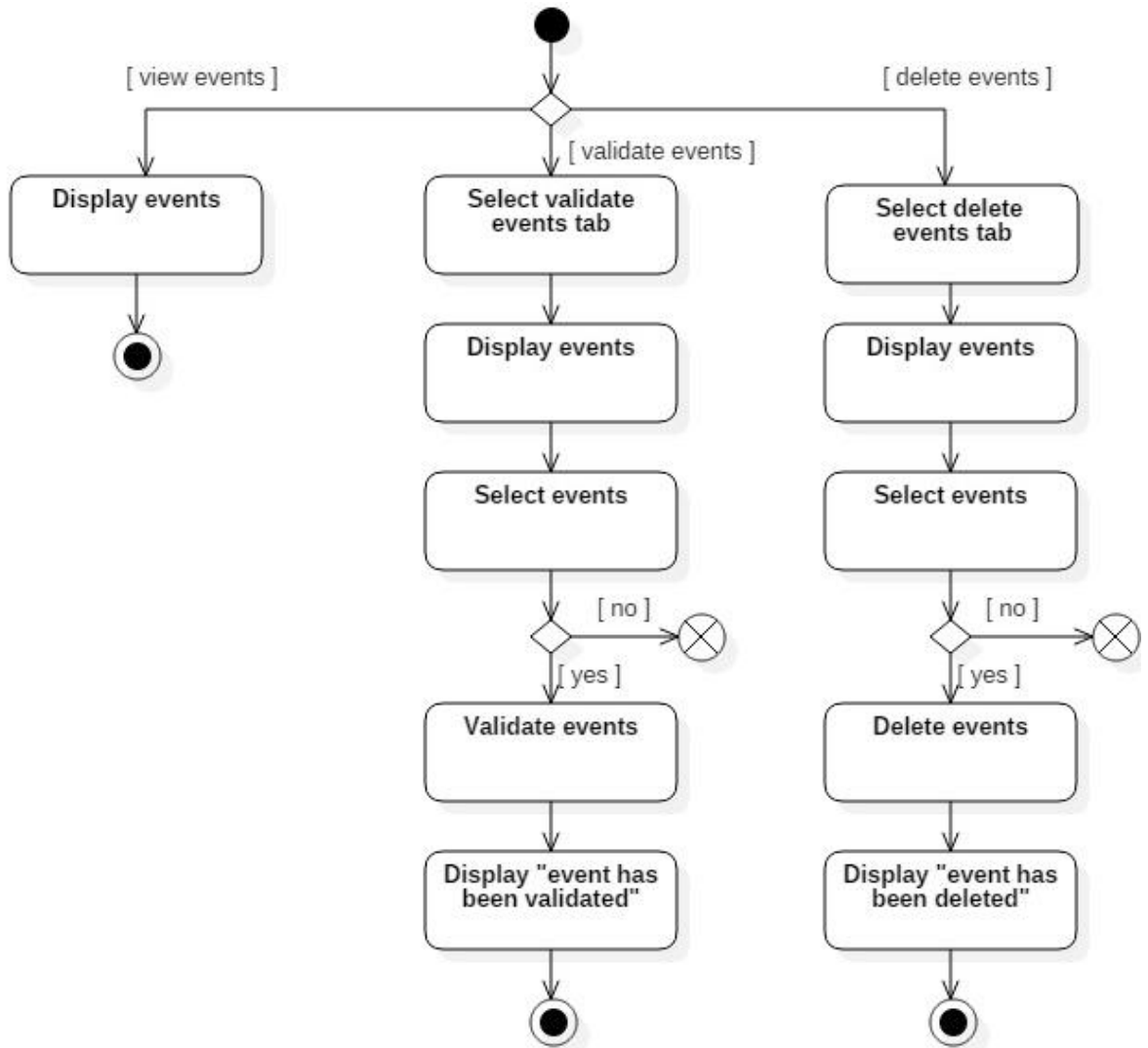


DIAGRAM 52: ACTIVITY DIAGRAM << MANAGE EVENTS >>.

III.5. CLASS DIAGRAM

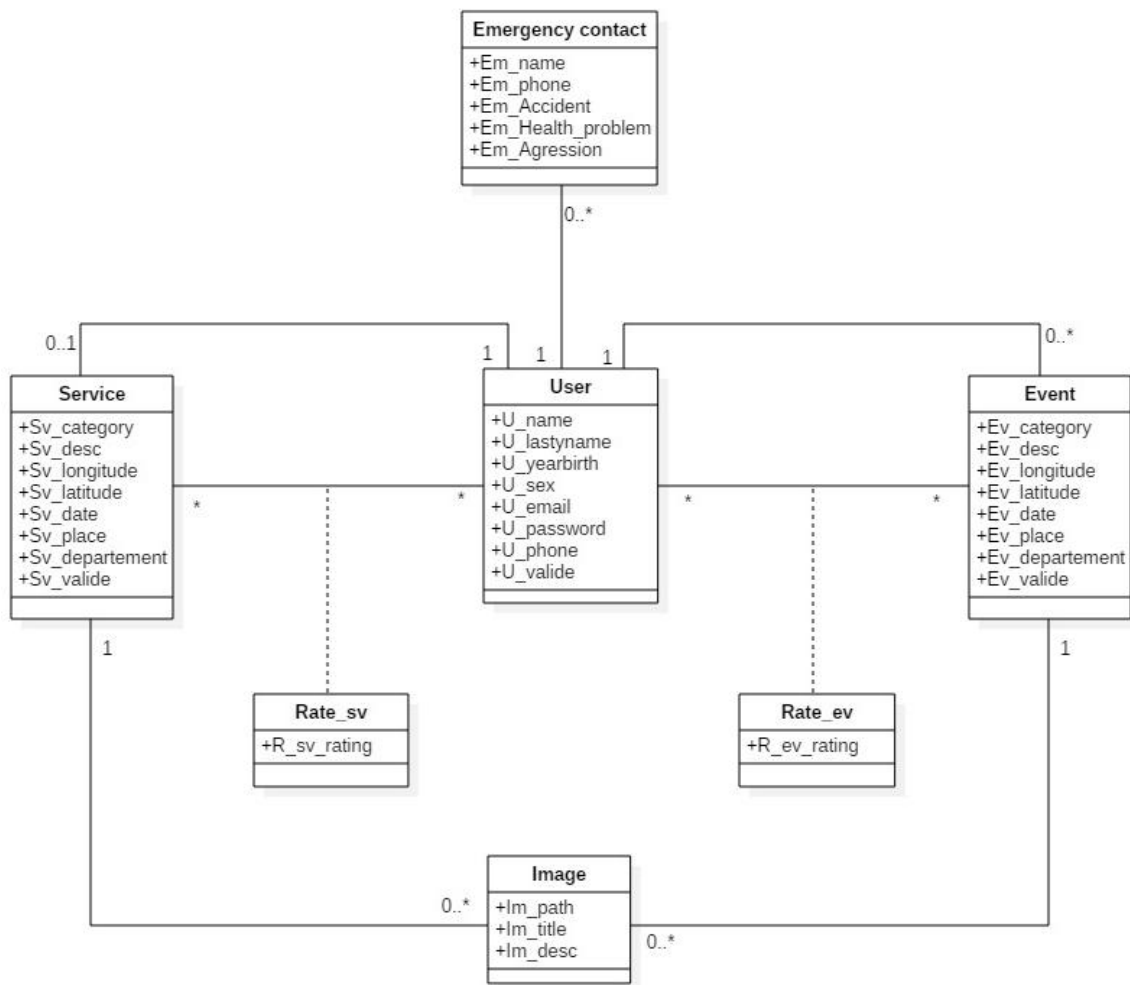


DIAGRAM 53 CLASS DIAGRAM

III.6. DATA DICTIONARY

Classes	Attributes	Types
User	U_name U_lastname U_yearbirth U_sex U_email U_password U_phone U_valide	String(30) String(30) Integer String(2) String(30) String(30) Integer Integer
Service	Sv_category Sv_desc Sv_longitude Sv_latitude Sv_date Sv_nbrrate Sv_average Sv_place Sv_departement Sv_valide	String(30) Text Float Float Date Int Float String(30) String(30) Int
Event	Ev_category Ev_desc Ev_longitude Ev_latitude Ev_date Ev_nbrrate Ev_average Ev_place Ev_departement Ev_valide	String(30) Text Float Float Date Int Float String(30) String(30) Int

Rate_sv	R_sv_rating	Int
Rate_ev	R_ev_rating	Int
Emergency_conatct	Em_name	String(30)
	Em_phone	Int
	Em_accident	Int
	Em_health_problem	Int
	Em_agression	Int
Image	Im_path	String(50)
	Im_title	String(30)
	Im_desc	Text

TABLE 40 DATA DICTIONARY

III.7. RELATIONAL MODEL

III.7.1. CONVERSION RULES

The realization of the relational model can be done from the conceptual description. This model transition must respect a set of rules; we have used these rules:

- **Rule1:** Any class becomes a relation, the attributes of the class become attributes of the relation. If the class has an identifier it becomes the primary key of the relation, otherwise an arbitrary primary key must be added.
- **Rule2:** To represent a 1 to 1 (1..1) association between two relationships, the primary key of one of the relationships must be a foreign key in the other relationship.
- **Rule3:** to represent an association 1 to several (1 .. *), one proceeds as an association 1 to 1, except that it is the relation of the several side which receives as foreign key the primary key of the relation of the side 1.
- **Rule4:** To represent a multiple association to several (* .. *), we must introduce a new relation whose attributes are the primary keys of relations in association, and whose primary key is the concatenation of these two

attributes. If the association has attributes, they become attributes of the matching relationship.

- **Rule5:** Inheritance cases, transforming each subclass into a relation, the primary key of the super class becomes the primary key of each subclass.
- **Rule6:** composition case, the primary key of the compound class becomes foreign key of the component class.
- **Rule7:** cases of aggregation, the same principle as Rule 3.

Note that in the image class we have 2 association (1 .. *), so from the rules we have to put 2 foreign keys in the relation image, one of this foreign keys must be null but the other not. This is known as exclusive arc. A better way is to split the relation image to 2 separate relations: Image_sv which contains service key and Image_ev which contains event key as foreign keys.

III.7.2. MODEL

The resulting relational model is as follow:

For the notation, we chose to bold the primary keys and put # at the beginning of each foreign key.

User (**U_id**, U_name, U_lastname, U_yearbirth, U_sex, U_email, U_password, U_phone, U_validate);

Emergency_contact (**Em_id**, #U_id, Em_name, Em_phone, Em_accident, Em_health_problem, Em_agression);

Service (**Sv_id**, #U_id, Sv_category, Sv_desc, Sv_longitude, Sv_latitude, Sv_date, Sv_nbrrate, Sv_average Sv_place, Sv_departement, Sv_validate);

Rate_sv (**U_id**, **Sv_id**, R_sv_rating,);

Event(**Ev_id**, #U_id, Ev_category, Ev_desc, Ev_longitude, Ev_latitude, Ev_date, Ev_nbrrate, Ev_average Ev_place, Ev_departement, Ev_validate);

Rate_ev (**U_id**, **Ev_id**, R_ev_rating);

Image_sv (**Im_sv_id**, # Sv_id, Im_sv_path, Im_sv_title, Im_sv_desc);

Image_ev (**Im_ev_id**, # Ev_id, Im_ev_path, Im_ev_title, Im_ev_desc);

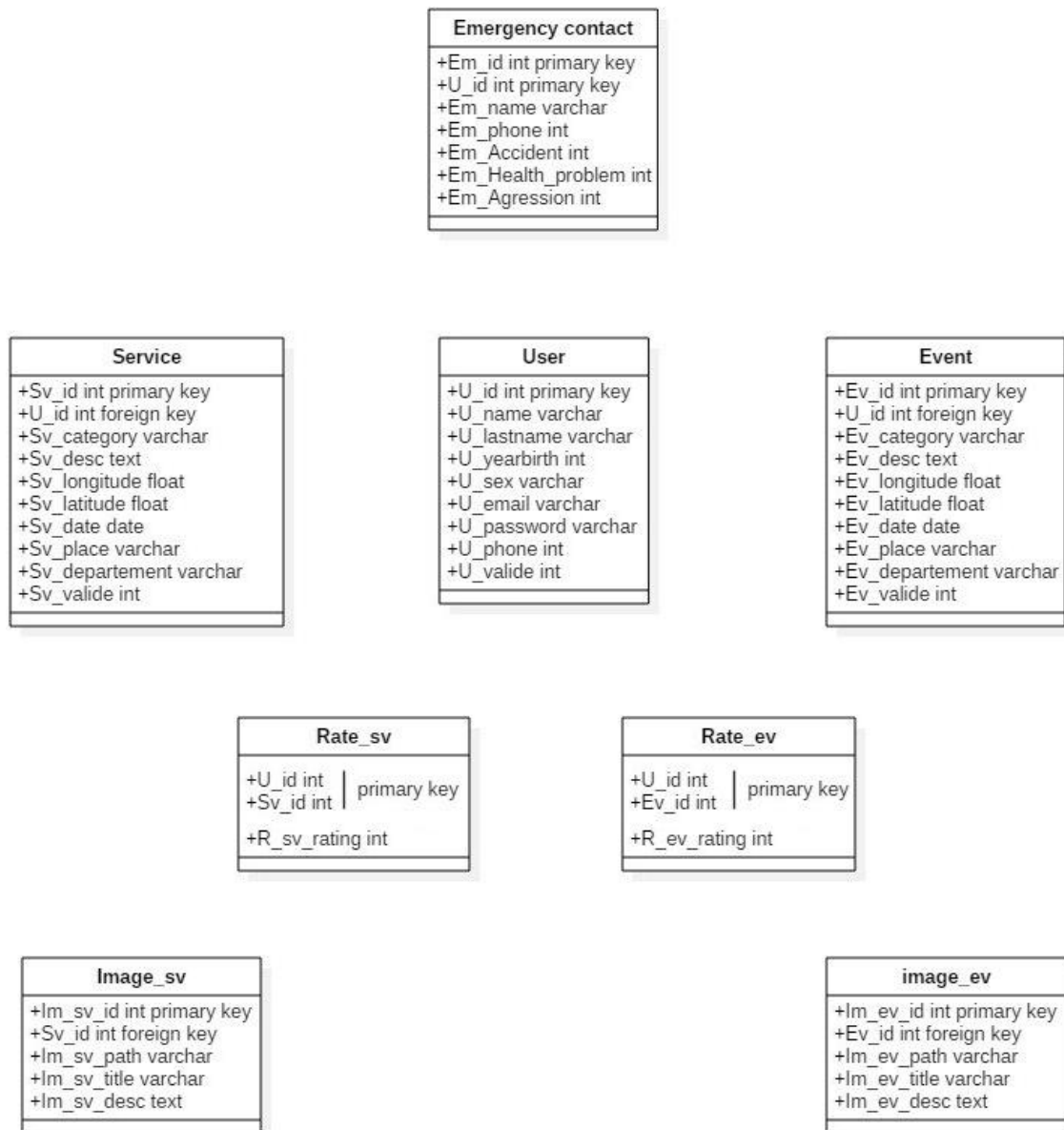


DIAGRAM 54 RELATIONAL MODEL

III.8. CONCLUSION

In this chapter, we have completed the design of our system and we are now ready to start the implementation phase. All questions about how to make the system to be developed were elucidated. The product obtained is a graphic model (set of diagrams) ready to be coded. In the next chapter we will show how we have translated this conceptual model to setup our application.

Chapter IV

SYSTEM IMPLEMENTATION

The implementation phase is based primarily on the results of the conception phase. The requirements defined in the previous phase will be realized in this phase using the appropriate technologies and tools, which will be presented in this chapter, while illustrating examples of how our application works.

IV.1. TOOLS

IV.1.1. ANDROID STUDIO (22)

Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps, such as:

- A flexible Gradle-based build system
- A fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Instant Run to push changes to your running app without building a new APK

- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- Lint tools to catch performance, usability, version compatibility, and other problems
- C++ and NDK support
- Built-in support for Google Cloud Platform, making it easy to integrate Google Cloud Messaging and App Engine



FIGURE 24: ANDROID STUDIO LOGO

IV.1.2. WAMP SERVER

WampServer is a Windows web development kit which contains a web server, a database engine and a PHP interpreter. It allows for the creation of web applications with Apache2, PHP and MySQL databases. It also provide a set of interfaces that help the user manage his website and databases.



FIGURE 25: WAMP SERVER LOGO

IV.1.3. STARUML (23)

StarUML is an open source project to develop fast, flexible, extensible, featureful, and freely-available UML/MDA platform running on Win32 platform. The goal of the StarUML project is to build software modeling tool and also platform that is a compelling replacement of commercial UML tools such as Rational Rose, Together and so on.

We used StarUML for the realization of the various diagrams in the design phase.



FIGURE 26: STARUML LOGO

IV.2. PROGRAMMING LANGUAGES

IV.2.1. JAVA (24)

The Java programming language is a high-level language that can be characterized by the following:

- Simple
- Object oriented
- Distributed
- Multithreaded
- Dynamic
- Architecture neutral
- Portable
- High performance
- Robust
- Secure

The guarantee of portability makes Java a successful language in client-server architectures by facilitating migration between servers, which is very difficult for large systems. It is the language most adopted by developers thanks to its reliability and high performance.

IV.2.2. THE SERVER-SIDE LANGUAGE: PHP

PHP Stands for "PHP Hypertext Preprocessor". It is an HTML-embedded Web scripting language. This means PHP code can be inserted into the HTML of a Web page. When a PHP page is accessed, the PHP code is read or "parsed" by the server the page resides on. The output from the PHP functions on the page is typically returned as HTML code, which can be read by the browser. Because the PHP code is transformed into HTML before the page is loaded, users cannot view the PHP code on a page. This make PHP pages secure enough to access databases and other secure information.

IV.2.3. WEB DEVELOPMENT LANGUAGES

- **HTML:** Stands for "Hypertext Markup Language." HTML is the language used to create webpages. "Hypertext" refers to the hyperlinks that an HTML page may contain. "Markup language" refers to the way tags are used to define the page layout and elements within the page. [25]
- **CSS:** Stands for Cascading Style Sheets. It describes how HTML elements are to be displayed on screen, paper, or in other media. CSS saves a lot of work. It can control the layout of multiple web pages all at once [26].
- **JavaScript:** JavaScript is a programming language commonly used in web development. It was originally developed by Netscape as a means to add dynamic and interactive elements to websites. [27]

IV.2.4. ADDITIONAL RESOURCES

IV.2.4.1. VOLLEY LIBRARY

Volley is an HTTP library that makes networking for Android apps easier and most importantly, faster [28]. It offers the following benefits:

- Automatic scheduling of network requests.
- Multiple concurrent network connections.
- Transparent disk and memory response caching with standard HTTP cache coherence.
- Support for request prioritization.

- Cancellation request API. You can cancel a single request, or you can set blocks or scopes of requests to cancel.
- Ease of customization, for example, for retry and backoff.
- Strong ordering that makes it easy to correctly populate your UI with data fetched asynchronously from the network.
- Debugging and tracing tools.

We used this library to send and receive data between our mobile app and the PHP server.

IV.2.4.2. GOOGLE API CLIENT

Google APIs give us programmatic access to Google Maps, Google Drive, YouTube, and many other Google products. To make coding against these APIs easier, Google provides client libraries that can reduce the amount of code we need to write and make our code more robust. The libraries can also make it simpler to set up authorization and authentication. [29]

IV.3. SYSTEM ARCHITECTURE

Our system consists of three major parts:

- A mobile application where users can register, log in and make use of the application's various functionalities. This application itself consists of multiple layers, the most important of which are:
 - The XML based layer, which represents the application's interface and resources (strings, images, etc.)
 - The Java based layer, or the code behind part. This is where actions are programmed
- A web application, for the admin to control the data in the database
- A database which is accessed by both the mobile app on the client side through the Volley library, and by the web app on the on the server side through PHP scripts

The following schema describes this architecture:

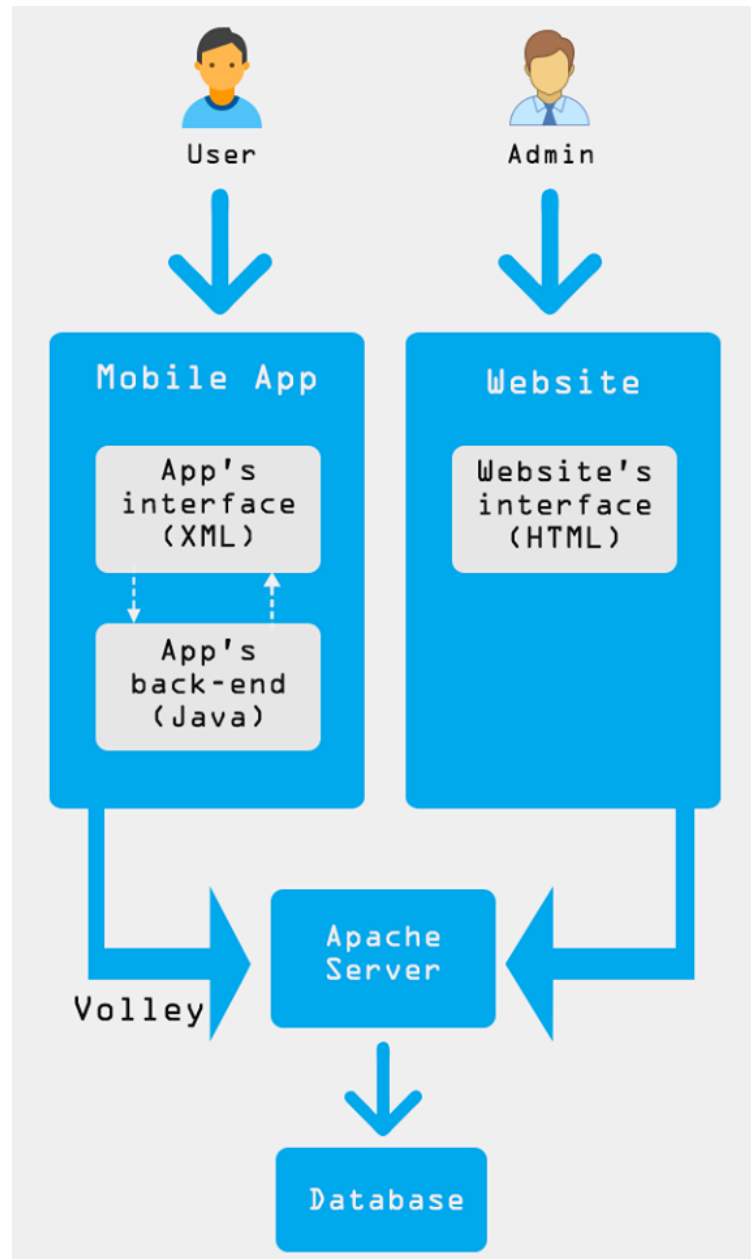


FIGURE 27: SYSTEM ARCHITECTURE

IV.4. APPLICATION PRESENTATION

IV.4.1. NAVIGATING THE MAP

The user starts the app. When the login page appears, they fill the email and password fields and login or they just log in as guests:

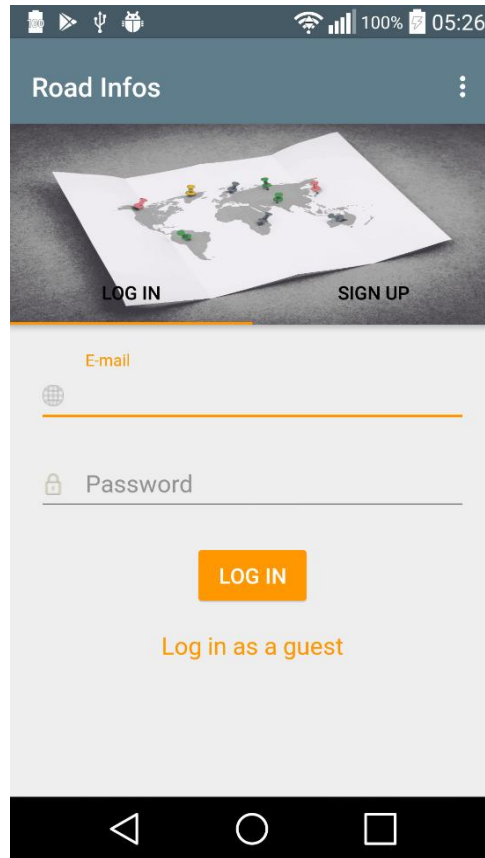


FIGURE 28: LOGIN SCREEN

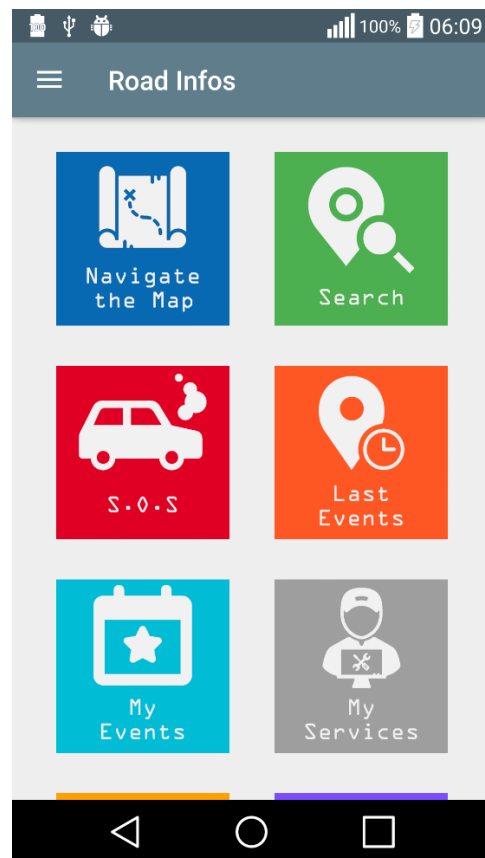


FIGURE 29: WELCOME SCREEN

- The Welcome screen appears. The user clicks on “Navigate the map”
- A map appears. The user browses the map and picks an event or a service.
- The details of the event are displayed

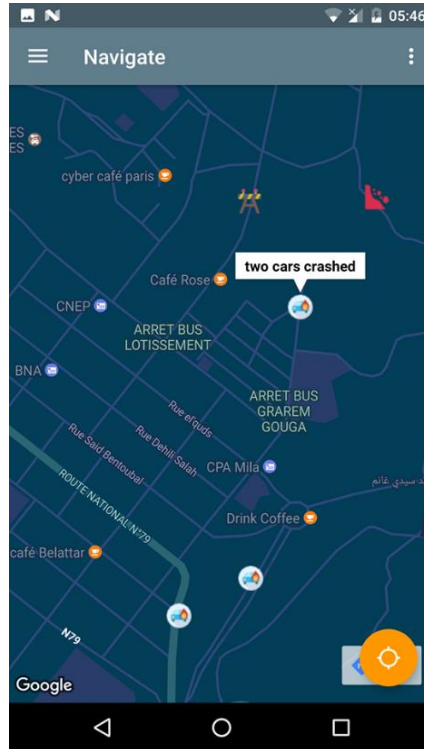


FIGURE 30: THE NAVIGATION MAP

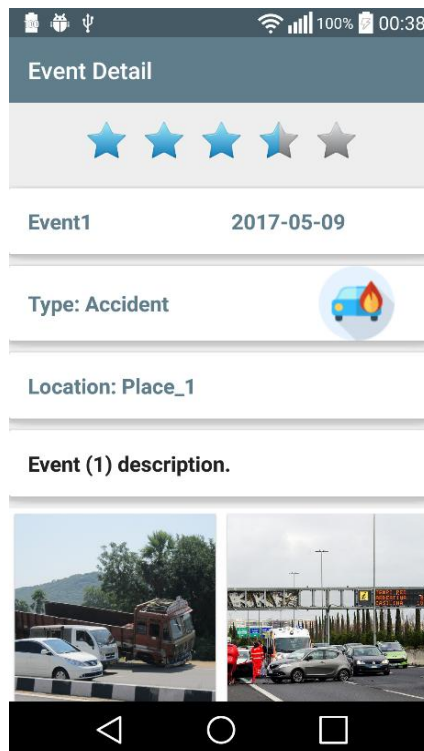


FIGURE 31: THE EVENT'S DETAIL VIEW

IV.4.2. ADDING AN EVENT

- The user logs in.
- “Navigate the map”
- Perform a long click at the location they want to add the event in.
- After that, the user fills the event’s details and submits

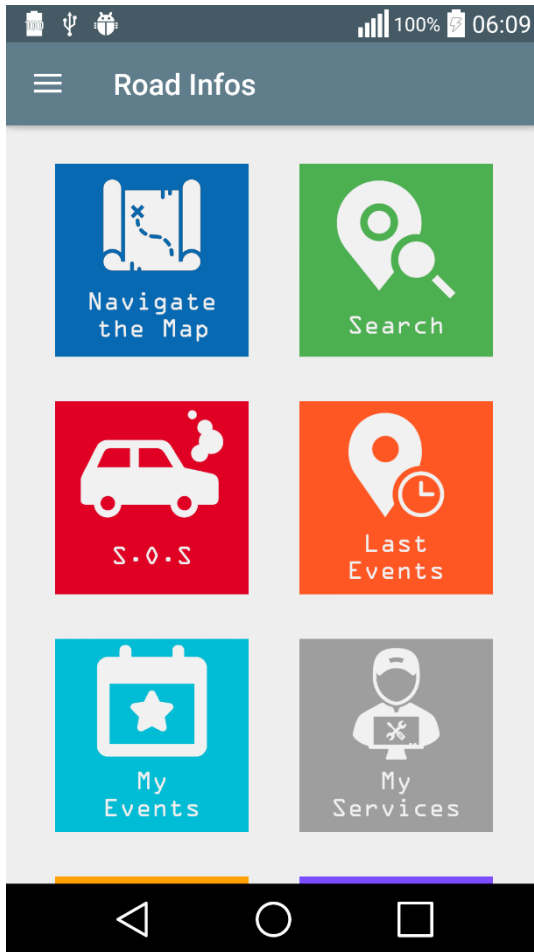


FIGURE 32: WELCOME SCREEN

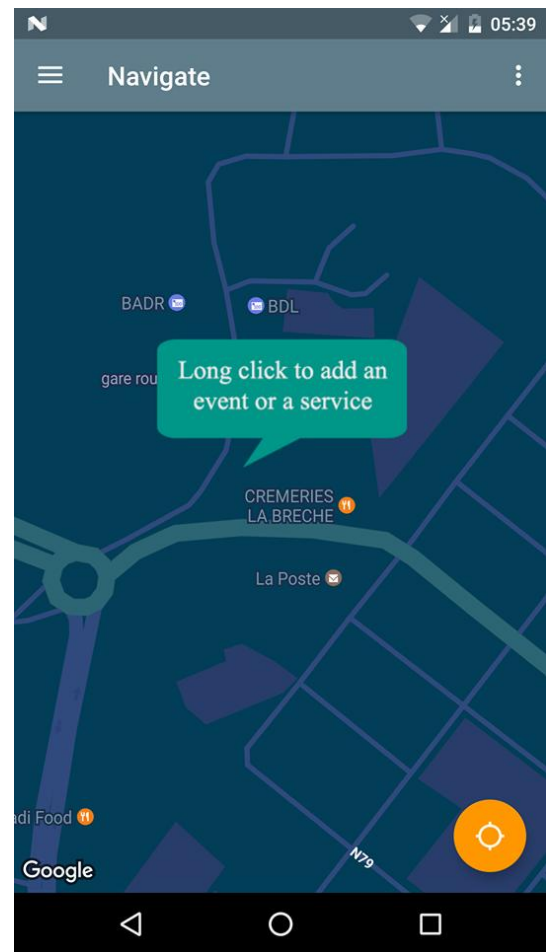


FIGURE 33: ADDING AN EVENT ON THE MAP

Otherwise the user may add a new event as follow:

- The user logs in.
- The press « my events »
- This displays a map. The user then performs a long click at the location they want to add the event in.
- After that, the user fills the event’s details and submits

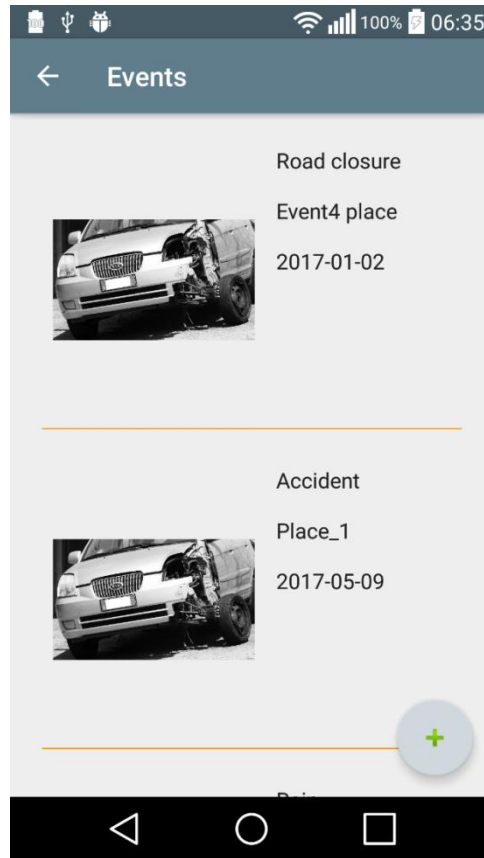


FIGURE 34: LIST OF THE USER'S EVENTS

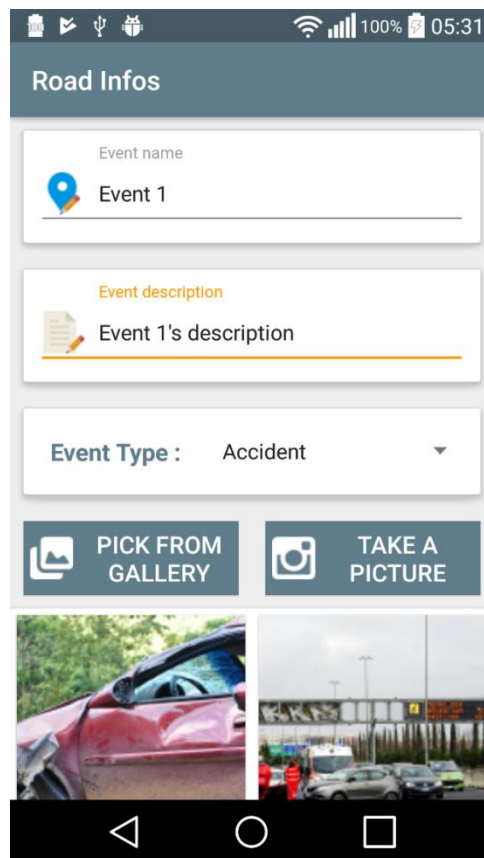


FIGURE 35: FILLING IN THE EVENT'S DETAILS

IV.4.3. SENDING AN S.O.S

- The user logs in. They click on the red S.O.S button
- They pick one of the 3 available types of emergencies: a car accident, a medical emergency and an assault
- Each one of the emergency cases is linked to an emergency contact, so as soon as the user picks an emergency case and clicks ok, an S.O.S message (which can be optionally extended) is sent to the appropriate contact
- In case the user doesn't have any emergency-contacts registered already, they can pick a one from their list of contacts to send the S.O.S to

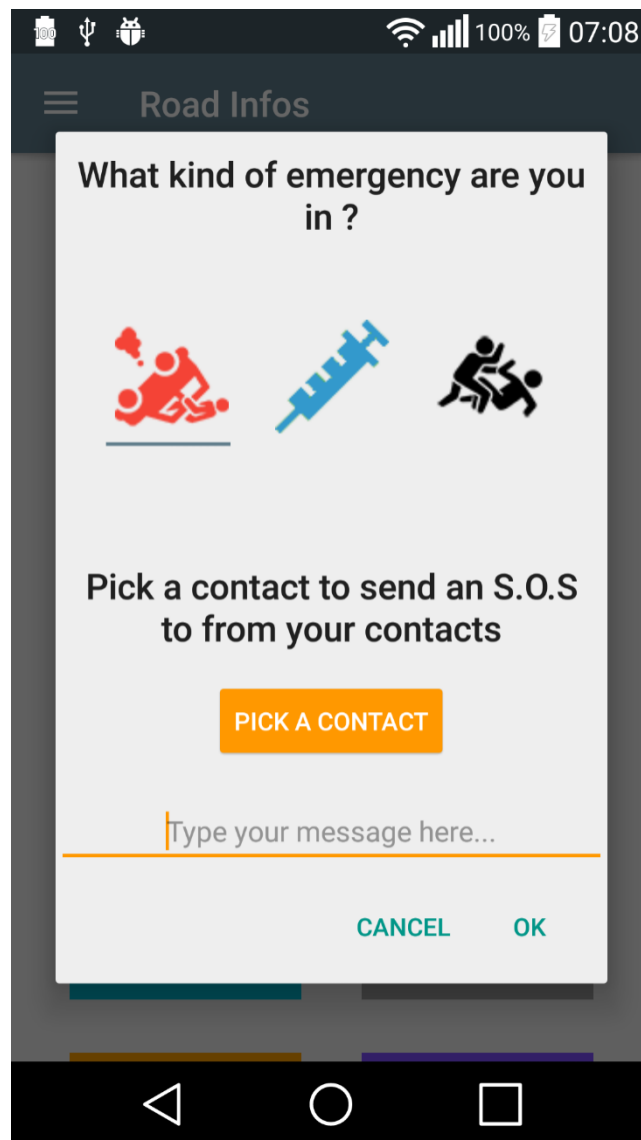


FIGURE 36: EMERGENCY CONTACT DIALOG

IV.4.4. SIGN UP

- In the login screen the user chooses the Sign up tab
- The user fill the fields with his profile information
- The user can add emergency contacts in this phase
- He then taps Sign up button.
- The login screen appears again

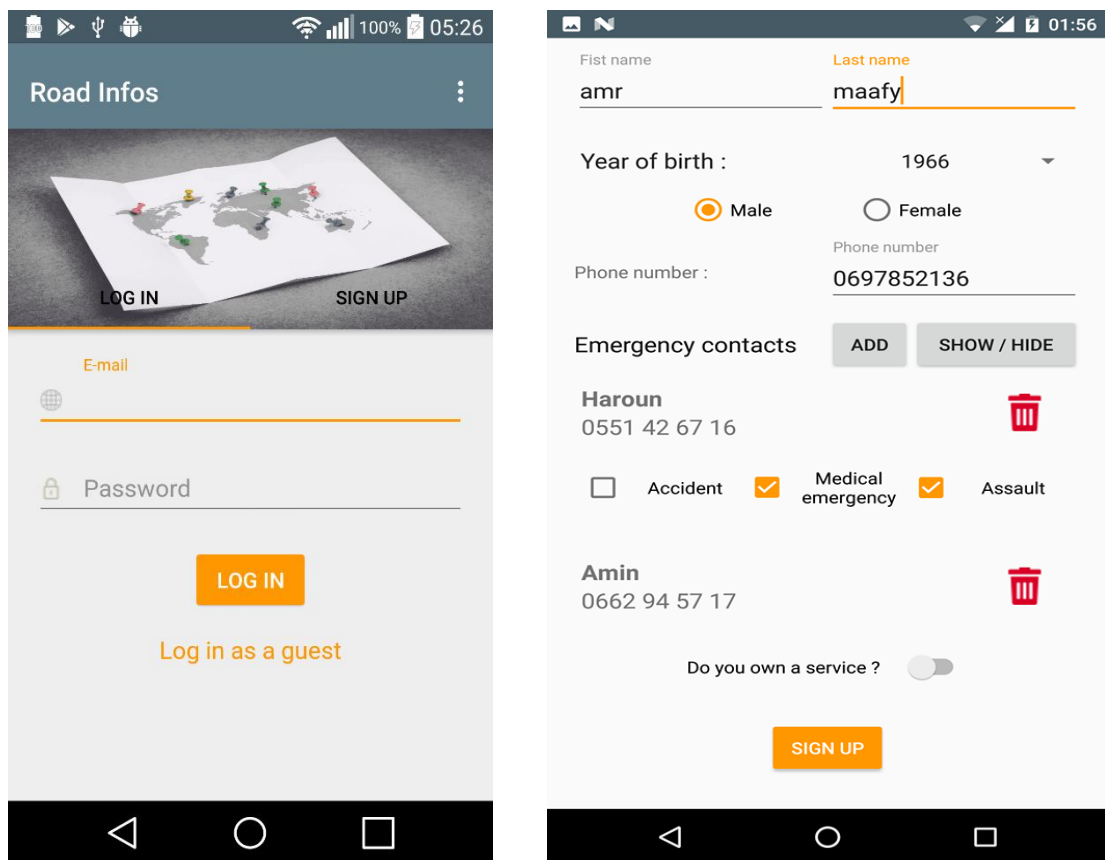
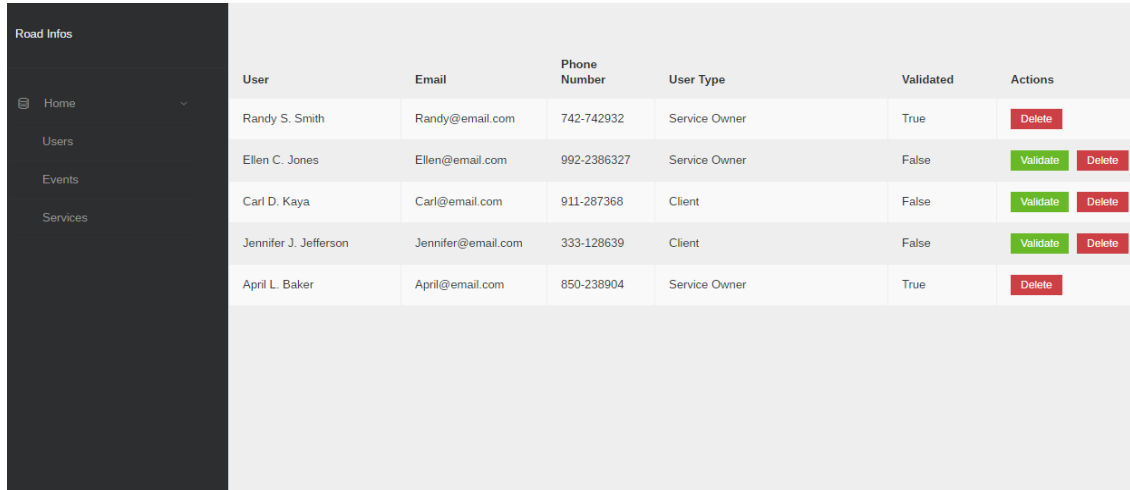


FIGURE 37: SIGN UP SCENARIO

IV.4.5. ADMIN INTERFACE

- The admin logs into his account on the web app. They can browse the lists of users, events and services.

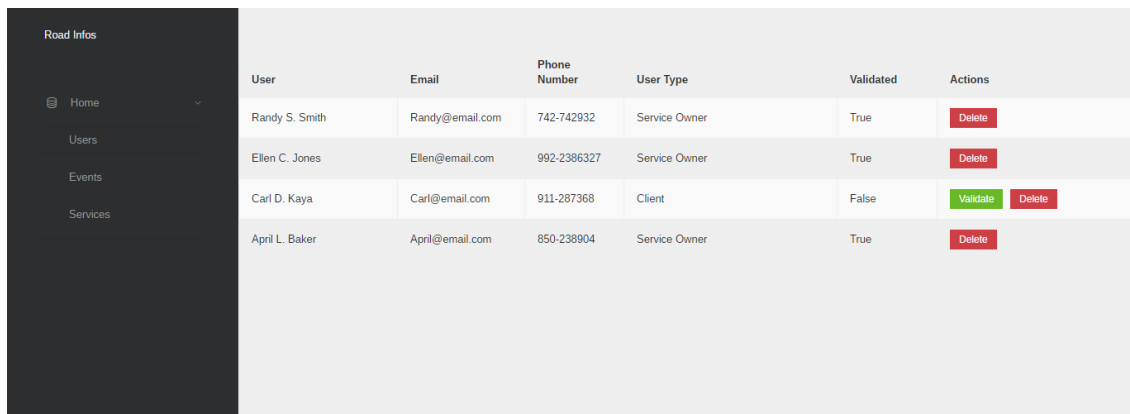


The screenshot shows a web application interface with a dark sidebar on the left containing navigation links: Home, Users, Events, and Services. The main content area displays a table of users with the following columns: User, Email, Phone Number, User Type, Validated, and Actions. The table contains five rows of user data.

User	Email	Phone Number	User Type	Validated	Actions
Randy S. Smith	Randy@email.com	742-742932	Service Owner	True	Delete
Ellen C. Jones	Ellen@email.com	992-2386327	Service Owner	False	Validate Delete
Carl D. Kaya	Carl@email.com	911-287368	Client	False	Validate Delete
Jennifer J. Jefferson	Jennifer@email.com	333-128639	Client	False	Validate Delete
April L. Baker	April@email.com	850-238904	Service Owner	True	Delete

FIGURE 38: THE WEBSITE'S INTERFACE

- The admin validates the user “Ellen C. Jones”
- The admin deletes the user “Jennifer J. Jefferson’s account”



The screenshot shows the same web application interface as Figure 38, but after the admin's actions. The table now shows that Ellen C. Jones is now validated (True) and Jennifer J. Jefferson's account has been deleted, leaving only four rows of data.

User	Email	Phone Number	User Type	Validated	Actions
Randy S. Smith	Randy@email.com	742-742932	Service Owner	True	Delete
Ellen C. Jones	Ellen@email.com	992-2386327	Service Owner	True	Delete
Carl D. Kaya	Carl@email.com	911-287368	Client	False	Validate Delete
April L. Baker	April@email.com	850-238904	Service Owner	True	Delete

FIGURE 39: THE WEBSITE'S INTERFACE AFTER THE ADMIN'S ACTIONS

IV.5. CONCLUSION

In this last chapter, we presented the implementation of our system, the tools we used and how we integrated the best practices to produce a reusable and maintainable code. This was also an opportunity to show some parts of the system developed with the help of some screenshots.

CONCLUSION

The objective of this project was the development of a roads and traffic information system. We developed our solution with client/server architecture. On the client side our mobile application allows the user to add and explore events on a map. The same app also allows the user to register as a service owner. A service owner can make public their real-life service on the map so that other users can find it and Benefit from it.

The design of such a solution required the follow-up of a methodology. The latter was based on a suitable development process, in addition to the use of a specific modeling language. The methodology we followed was inspired from 2TUP.

On the implementation level, the application was built using the Android Studio development environment, and using Java, the Object-Oriented programming language, as well as some internal and external libraries of that language or the Android SDK.

Although we have achieved a part of the objectives set at the beginning of this project, the final product requires more time and work. It also may be enhanced and our current main suggestions for possible improvements include:

- The functionality to get directions to specified locations, and show all possible routes (mainly the shortest one)
- Adding voice commands to facilitate the application's use especially while driving
- A chat functionality to help users communicate the state of the road

Finally, this project was a great opportunity to test and deepen our theoretical and practical knowledge acquired during our entire cycle of academic education.

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