

Project Interviews

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2023/2024

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1 Interviews

1.1 Questions

These interviews were conducted to assess the viability of the project idea and serve as the initial stage of the need-finding process. The questions asked to the participants during the interview are:

1. Have you experienced situations in which you or someone you know was in danger? (e.g., my father fell down and was not able to use the phone) If yes, what was the situation? Were you able to contact someone for help? Was it difficult, or were you able to alert someone easily?
2. Would you install the application to alert contacts in an easy and fast way? Do you find this idea useful?
3. Do you prefer to inform contacts through a phone call, SMS, or a notification? (Or other options)
4. Would you install such an application to be informed about other contacts' emergencies? Why?

1.2 Answers

The following rows contain the main content of each interview, highlighting the most significant contributions given by each participant:

1. She said that once her grandmother had a medical emergency at home, and she wasn't able to reach anyone for help because her phone was out of reach. However, the grandmother is not able to use the smartphone.
2. He shared a story about a camping trip where one of his friends got injured, and his phone fell several meters away from him. He started screaming to ask for help, luckily, the other friends heard him. He said that he would install that application only during particular periods of the year, such as when he goes on holidays during summer. He prefers phone calls whenever possible.
3. He mentioned a situation where a colleague experienced a severe allergic reaction while he was alone at home. He was able to use the phone, but he struggled to talk during the phone call with the ambulance operators. He said that probably a method to alert family members in some ways with predefined messages was probably the best thing in that situation because

he had to alert them several hours later when the crisis was gone. He told us that these situations are not so common, so probably he wouldn't install such an application as he prefers to be contacted via WhatsApp or SMS through that system.

4. She told us about one situation in which she felt followed by someone. Because she was very nervous, she had some difficulties quickly dialing her mother's phone number on the phone. She stated that she would install the application to feel safer when she comes back home during late hours of the day.
5. He doesn't know anyone who experienced emergencies. He said that this is a situation he has never thought about, but the application could be useful for his grandma who lives alone and uses a smartphone. The interviewee prefers to be informed via notifications.
6. She said her mother fell to the ground in the evening, couldn't get up, and couldn't call anyone. She would install an application that could help herself and others in difficult situations. She would like to be notified both by a call and by an SMS.
7. She says she was alone in the middle of the night in Rome and felt like someone was chasing her. So, she was on the phone the whole time with her friend. She would like an application that can promptly assist her in case of difficulty with a call. Additionally, she would install the application to help other people in emergency situations.
8. He has never experienced firsthand situations where he was in trouble or where someone he knows alerted him in emergencies, but he would still find an application for such purposes useful and would install it. He would like to be notified, and to notify others, using all available methods.
9. He experienced a situation where his father had a heart attack and fortunately managed to contact the ambulance but couldn't reach his son, who only found out about the news after some time. So, he would appreciate having the possibility of being contacted immediately. He would thus install the application both in case he himself is in danger and in case it's one of his parents. He would like to be informed with a call and a notification of the location.
10. She has never experienced situations of danger herself nor secondhand where it was necessary to contact someone, but she would appreciate an application that can alert others in a simplified way, and to be alerted, in cases of danger and emergency. She would find it useful to be notified in all available ways, through calls, SMS, and notifications. She would install the application both for herself and for friends or relatives.
11. The interviewee had a nasty situation once while riding his bike. He slipped while making a turn, and his smartphone flew out of his pocket. Both his legs were stuck underneath the

bike, and he was unable to move. It wasn't until a good samaritan came by that he received medical attention. He mentioned that had it been an isolated road with bad weather, he could have easily died that day. He thinks calls are the most effective way to get someone's attention, though a very loud notification from the app could also work. He expressed interest in using the app because his parents are getting older, and he would love to keep an eye on them to be notified immediately in case of an emergency.

12. This person recounted an incident where she was trying to get her grandfather to bed when he suddenly lost consciousness and fell on his back. She immediately called the emergency number and got him escorted to the hospital. She noted that her grandfather does not even have a clamshell phone and is not keen on integrating technology into his daily life. Thus, she does not think this idea could benefit her family.
13. She has had a few close calls while rock climbing. One time, she fell and got stuck in a narrow crevice. A fellow climber nearby was able to pull her out safely. This experience made her realize the importance of a reliable emergency response system. She believes this idea could benefit people with disabilities or mobility issues by providing an easy way to alert contacts in case of an emergency. She thinks SMS messages would be the most effective notification method to ensure the person receiving the message is aware of the situation. She would definitely install an app like this to keep an eye on loved ones who live far away, understanding the importance of seniors having autonomy while still having a safety net.
14. He shared that his mum once fell down the stairs, which was quite worrying for him and his brother. They managed to patch her up, and she walked away with a minor scratch. While he finds the idea useful, he does not trust technology enough. He worries about the phone's battery running out, lack of signal, or a bug preventing a notification from appearing. He prefers good old-fashioned phone calls and does not believe apps can truly benefit daily life.
15. The interviewee has never had a personal experience with danger but has worked in emergency services for years. He has seen the impact of timely interventions on people's lives, with one incident involving a distress call from a lost hiker. He managed to locate and guide the hiker back to safety, which highlighted the importance of having the right tools and systems in place. He believes efficient communication is crucial and views the app as a game-changer for staying connected and getting help quickly. He thinks a combination of notifications and phone calls would be most effective for alerting contacts in an emergency. He would install the app to receive notifications about other contacts' emergencies, believing in the importance of being connected and informed to help each other, whether by providing support or offering a listening ear.
16. He recalled a time when his neighbor suffered a stroke while gardening in the backyard. The

neighbor's wife was inside the house and unaware of the situation for several minutes. He believes an app that could send alerts through loud notifications would be extremely useful. He prefers SMS and notifications over calls, as they are less intrusive but still effective. He would install the app to ensure his family is informed in case of emergencies.

17. She shared an incident where she was in a car accident and her phone was damaged, making it impossible to call for help. A passerby assisted her, but the experience made her realize the importance of an emergency alert system. She would definitely install the app, especially for her children who are often away at college. She prefers notifications and SMS for their reliability and simplicity.
18. He described a situation where his diabetic friend experienced a severe hypoglycemic episode and couldn't reach his phone to call for help. Another friend luckily noticed in time and assisted him. He thinks the app would be beneficial, particularly for people with medical conditions. He prefers notifications as the primary method of alert. He would install the app to monitor his friend's condition and ensure timely assistance.
19. She mentioned an instance where her elderly father wandered off and got lost while she was at work. It took hours to find him, causing significant distress. She believes an app with GPS tracking and emergency alerts could prevent such situations. She prefers phone calls for immediate attention. She would install the app to keep track of her father's whereabouts and ensure his safety.
20. He recounted a time when he was hiking alone and twisted his ankle, making it difficult to move. His phone signal was weak, and it took a long time to contact anyone for help. He believes an emergency alert app that works in low-signal areas would be invaluable. He prefers SMS for its reliability in such situations. He would install the app for personal safety during solo outdoor activities.

1.3 Interviews Analysis

The interviews conducted provided valuable insights into the potential viability and usefulness of an emergency alert application. Participants shared a diverse range of experiences and opinions, highlighting both the demand for such a solution and the considerations necessary for its successful implementation. There was a significant interest in the application among the participants, especially those who had encountered emergencies or had elderly family members living alone.

These interviews underline a common theme: emergencies can occur unexpectedly, this highlights a clear need for an application that can facilitate quick and easy communication during such critical moments.

Preferences for notification methods varied among participants. Some preferred phone calls for their immediacy and effectiveness in grabbing attention during emergencies. Others favored SMS or app notifications, considering them more reliable and less intrusive.

2 Questionnaire

For performing a more extended need-finding phase, we create a Google form with some questions to retrieve more information about our idea. The form is available at the following link: <https://forms.gle/1AnJ6wdFpiuWXPuFA>.

2.1 Results

We achieved a total of 80 answers and these are the results. As shown in Figure 1, more than 70% of the participants were having an age between 18 and 30 years old.

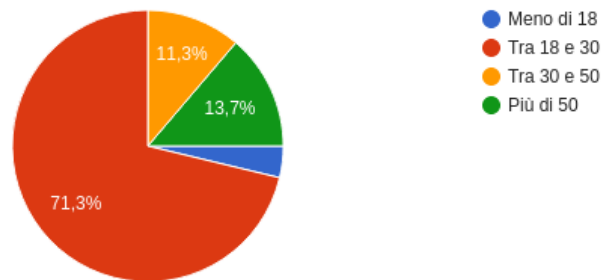


Figure 1: Graph showing the participants' age.

From the second question, we can see how many participants have ever been in an emergency situation. 41.3% have never experienced a critical situation, while 59.7% have at least one experience. As we can see from Figure 2, only 16.3% of the users were not able to alert someone during these situations. However, by taking a look at the next question, where the users described their experiences, we can see how most of these situations could generate so much panic that the user is not able to make quick decisions and thus even alerting someone using the phone can be difficult.

The next two questions are very similar to the previous two. Nevertheless, in this case, the users were asked to answer if one of their acquaintances has ever experienced one of these situations. Unlike the previous question, in this case 63.7% of the participants answered "No" (Figure 3). If we look at the open answers, we can see how the experiences are mostly similar to those described for personal experiences.

The motivation most people give for using the app is that it makes the user save precious time. The arguments being that if someone is injured, panic might prevent the user from making a swift

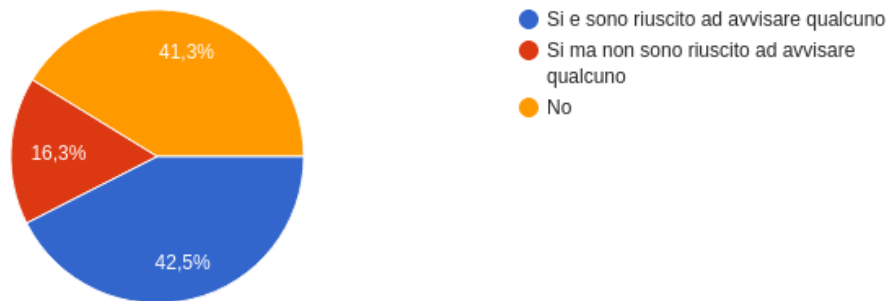


Figure 2: Graph showing if the participants have ever experienced an emergency situation, and if they were able to alert someone.



Figure 3: Graph showing if the participants know someone who has ever experienced an emergency situation, and if they were able to alert someone.

call to the emergency services. Even worse, if someone is unable to use their cellphone due to severe injuries or fainting, users suggest the app could help save their lives. Other people argue that by intergrating the app with official first response services might result in a quicker response time (Figure 4).

A striking majority (66.3%) of people would very surely install the applicaton (4) followed by 21.3% on option (3), 10.0% on (2), which are not very convinced by the idea, and lastly 2.5% say they would not install the app. Overall the response is positive and very encouraging. (Figure 5).

More than half the people (52.5%) would like to be informed by a notification with relevant infos, followed by 30.0% which would prefer to start an automatic call to the person in potential danger, and lastly, with 16.3% would prefer an SMS (Figure 6).

As for the mean through which people prefer to inform their contacts, the majority (37.5%) leans towards a notification with important informations. Followed by an automatic call to a pre-determined contact (35.0%) and lastly SMS to pre-determined contact (Figure 7).

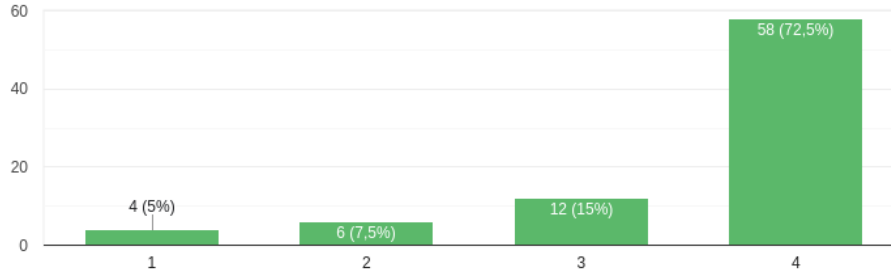


Figure 4: Graph showing how the user will likely install the application for alerting their contacts.

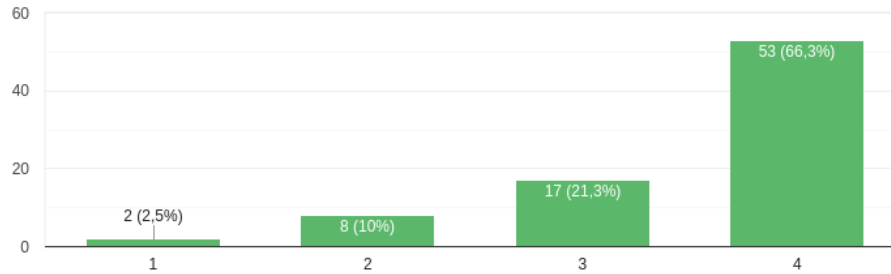


Figure 5: Graph showing how the user will likely install the application for receiving alerts from their contacts.

3 Needs, Context and Interaction Analysis

3.1 User's Needs & Competitors

After the interviews and the questionnaire, we dedicated a good amount of time to analyze the results, trying to underline the user needs we found through the need-finding step. On Google Play and Apple Store, we didn't find any application with the same intent as the one we tried to propose. There are some applications dedicated to emergencies, but their main scope is to alert ambulances, hospitals, or the police. Our main idea is to create an application to alert someone from our contact list and eventually ambulances. Users don't necessarily need to alert hospitals for their emergencies, so we have to give them the possibility to contact someone and, if needed, the public services. The main goals of our application are:

- Keep the interface simple to facilitate usage during emergencies.
- Keep the user informed about all the running services, also giving the possibility to turn them off if not needed.

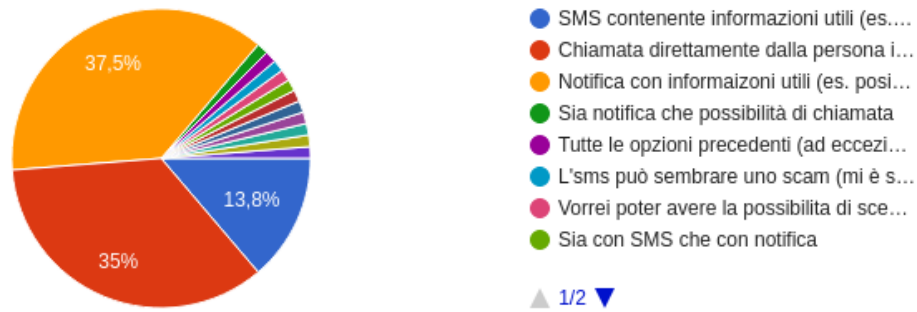


Figure 6: Graph showing how users want to be alerted.

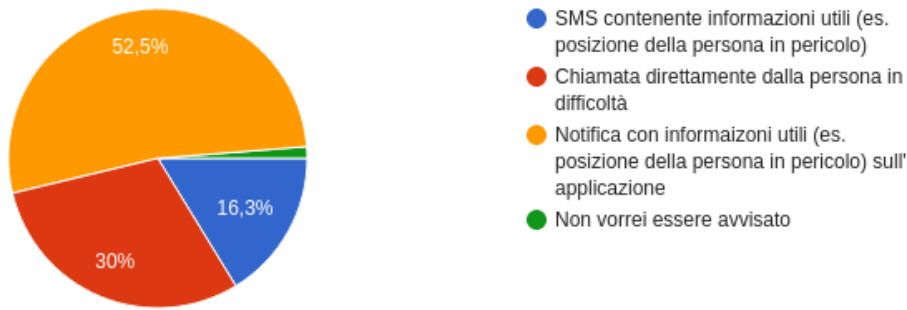


Figure 7: Graph showing how users want to alert their contacts.

- Try to keep only essential background services to avoid energy waste, thus saving phone battery life.
- Provide a fast and easy way to use the functionalities even in eye-free situations.
- Try to detect specific contexts and use this information as input.

3.2 Contexts

After the need-finding step, we devoted part of the time to context analysis. There are mainly two contexts in which the application is designed to be used:

- **Emergency Context**
- **Non-emergency Context**

Emergencies, as seen from the need-finding step, can include a vast number of situations, from a simple fall to serious accidents. However, there are mainly three sub-contexts we identified that can be considered as common emergencies:

- Fall down
- Fight situation
- General emergency

Once we chose the contexts, we also had to understand how these contexts could be deduced. A fall can be easily detected through accelerometer monitoring. A fight is more difficult as it needs a machine-learning algorithm trained on sound waves; once deployed, the sounds are available through the microphone listening. Lastly, a general emergency is something not specific where the user can still use the phone but has to alert someone explicitly. The sensors needed are described in Section 3.3 as they are strictly related to the interactions designed to manage this context.

3.3 Interactions

The interactions are intrinsically derived from the context analysis made previously, as they are designed to be used in specific situations. While for the fall down and fight contexts, the interaction can be considered implicit as the input is deduced from the context deduction itself, for the general emergency the user has to explicitly perform an action to interact with the system. We designed a tangible interaction, in which the phone is used as an object to perform the action. We are provided back with a non-tangible output that can vary depending on the status in which the action is performed. When the application is in the background, we simply inform the user about the detection using a push-notification, while if the application is in the foreground, then it means that the action was not performed unintentionally, hence we activate the emergency mode. For more details, see Section 5.1.2.

4 Marvel Prototype

As a first prototype, we decided to create a Marvel prototype, which can be tried at the following link: <https://marvelapp.com/prototype/fa2f7b8>. We conducted 12 tests with different users, trying to cover the widest age range possible.

4.1 Tasks

During the tests, we asked each user to perform the following tasks:

1. Try to activate the emergency mode.
2. Find settings and add a new contact.
3. Modify the contact priority.
4. Add a new notification method.
5. Remove a detection.

4.2 Tests

The following rows contain the main content of each test:

1. The user is a 52-year-old woman. The first task was completed easily. For the second one, she encountered a bug during the contacts selection. However, once the bug was fixed, she completed all the remaining tasks without problems.
2. The user is a 22-year-old man. He faced a bug in selecting the notification methods that checks the whole list instead of the single one selected by the user. After fixing the bug, he completed the remaining tasks easily.
3. The first user is a 55-year-old woman. The first task was completed without hesitation. The second task required more time to be executed as the user tried to uncheck one of the checked contacts. However, due to a prototype limitation, this was not possible as we didn't create enough screens to cover all possible combinations. All the other tasks were performed easily.
4. The user is a 17-year-old boy. All tasks were executed without problems.
5. The user is a 22-year-old woman. We repeated the test two times due to a bug that caused a wrong screen to appear when tapping on the contacts after a particular sequence of actions. Once fixed, the tasks were performed correctly.
6. The user is a 57-year-old man. All tasks were executed with no problems.
7. The user is a 29-year-old man. He completed all tasks without too many problems. The only task where he experienced slight uncertainty was the one regarding the change in the contact priority, which is task number 3.
8. The user is a 59-year-old woman. She completed all tasks correctly. Although she initially hesitated, she became more confident as she continued using it.

9. The user is a 23-year-old man. He completed all tasks correctly and precisely without hesitation, demonstrating that he knew what to do immediately after the request.
10. The user is a 45-year-old woman. She completed all tasks without any issues and found the interface intuitive and easy to navigate.
11. The user is a 34-year-old man. All tasks were completed successfully, and he mentioned that the process was straightforward and user-friendly.
12. The user is a 28-year-old woman. She completed all tasks efficiently and commented positively on the smooth workflow of the application.
13. The user is a 40-year-old man. He encountered no problems and completed all tasks successfully, praising the application's responsiveness.

5 Android Studio Application

To develop our application, we used Android Studio with Java as the main programming language. This IDE provides many benefits, such as straightforward integration with Google APIs and tools (like the one we used and will describe in the next part) and simple yet powerful XML styling for the application's pages. However, the application is trivially not available for iOS devices.

5.1 Implementation

5.1.1 Activities

As the first step, we developed the main interfaces (called activities in Android Studio) trying to remain consistent with those presented in the Marvel prototype. The main activities are:

- **Home:** When we developed the home, we aimed to keep it simple to facilitate the user. We have mainly two contexts in which the user can use that interface: emergency situations or standard contexts. When we are in an emergency, we struggle to perform even those actions considered "automatic," such as unlocking the phone or using it as habitual. Therefore, we collapsed all the needed elements into buttons:
 1. Emergency button: A red button that implicitly focuses our attention, so even if we are panicking, we can immediately identify what we need in that moment (the button itself to activate the emergency mode).

2. **Settings button:** A typical gear in the top-right corner. In this case, it is not necessary to capture our attention as it should be used in non-emergency contexts, when the user can calmly analyze the interface.
- **Emergency Activity:** This activity is designed to be minimal to satisfy the emergency requirements exposed before. The user can confirm the emergency by pressing the confirm button or cancel the action. The system will also confirm the emergency after a 10-second timer expires after the activity launch. The user is informed using a reversed progress bar under the confirm button (**context mental model**).
 - **Settings Activity:** This screen is organized into 3 options:
 1. **Contacts:** By clicking on it, the user can select one or more contacts from the phone contact list. These contacts will then be informed through the notification methods about emergencies.
 2. **Notification Methods:** The user can use three checkboxes to choose which of the proposed methods he intends to use in case of an emergency. The options are: **Call, SMS, and Application notification**.
 3. **Detections:** This section is dedicated to activating or deactivating the detection services offered by the application (explained in detail in Section 5.1.2).
 - **Signup Activity:** This activity is automatically shown when the user opens the application for the first time. It is necessary to register the user on our server. We save both the phone number and the FCM token (see Section 5.1.3). The user can still modify its phone number by simply pressing on the reset button available in the settings activity.
 - **Map Activity:** This activity cannot be accessed directly, we access to it once that we receive an emergency notification. By clicking on it, the map will show the last 5 known position of the user who activated the emergency mode. By selecting one of these markers, we will be redirected to google maps application with the destination set as the marker we selected.

5.1.2 Services

Once the main activities were developed, such as the main screen, the emergency mode, and all the settings screens, we implemented the so-called services. In Android Studio, a service is a forever-running task in background mode. We have five services:

- **Firebase service:** This service is an always-running background service which listens for incoming messages from Google firebase API (see Section 5.1.3).

- **Position logging service:** This service is used to log the user's position every 2 minutes. These positions are then stored in a .txt file so they can be accessed in other parts of the code, remaining persistent even if the app is closed.
- **Shake detection service:** By using the accelerometer, we managed to develop the shake detection part of the project. The accelerometer values are monitored and change in a few milliseconds, then an action is triggered. In particular, when the phone is being shaken, we have two possible actions based on the system status:
 - When the application is in the background, we send a notification to the user informing him about the detection.
 - When the application is in the foreground, we activate the emergency mode.
- **Fall detection service:** Through the accelerometer, we monitor the y-axis velocity detecting an eventual fall down. Like for the previous service, the actions are those described based on the application being in the background or foreground.
- **Bonus, Fight detection service:** This service is not explicitly implemented as we had no time to develop a machine-learning algorithm able to process sound. However, we developed all the necessary code for its integration.

The user is informed about which service is running in the background through a persistent notification.

5.1.3 Google Firebase

We had to implement a system that was able to notify the selected users to inform them about emergencies. The way we did that is through Google Firebase. Firebase offers features such as real-time database, authentication, hosting, cloud messaging, analytics, and more, all integrated into a single platform. In this application we used Google cloud messaging to provide a notification system for the users. The main logic is the following:

1. When the user opens the application a new FCM token (unique for each user) is generated and sent to the server (see Section 5.1.4) that stores the token associating it to the user's phone number.
2. When an emergency must be broadcasted among the selected user, the application sends an emergency message to the server containing the phone number of the user who has the emergency and all the phone numbers to be informed. The server retrieve the FCM tokens and sends the request to the google firebase API that will send the notification to numbers associated with that FCM token.

3. Each application has the Firebase service always running in background that waits for incoming notifications. Once received, the application shows the notification with the number of the person who is in difficulty.

5.1.4 Server

The server is a simply python server deployed using Flask. The main duties of the server are:

- **Save the new user into a database** associating their phone number with the fcm token.
- **Send the emergency request to firebase API.**

5.2 Tests

We conducted a total of 20 tests; the first 5 were made on a preliminary version of the application, while the last 15 were on the final version. The first version of the application was designed to be identical to the Marvel prototype, so it was also missing important features such as the notification system implemented through Firebase and the map activity. The first 5 tests were fundamental to ensure that the application design was easy to use and consistent with what was observed with the Marvel tests.

5.2.1 Taks

In the first 5 tests we used the same tasks used during the Marvel prototype testing phase. While for the remaining 15, we asked to the participants the to perform the following actions:

1. Open the application for the first time and signup.
2. Find the contact section and add some contacts to the list.
3. Find the detection section and disable at least one detection.
4. Find the notification method section and personalize the notification methods.
5. Activate the emergency mode. Then close the application and try to activate the emergency mode.
6. Acting as someone who is alerted by the app, try to understand where is the person.
7. Try to reset the settings.

5.2.2 Results

These are the results of all the 15 tests on the full-developed application:

1. He was able to perform the first 4 tasks without hesitation. Regarding the first part of the fifth task, the user correctly shook the phone to trigger the emergency mode, however when he was asked to close the application and activate again the emergency mode, he opened the app and then he shook the phone instead of doing it with the application running in background. For the localization task he clicked on the notification but he faced some problems to understand how to reach the location. Lastly he was able to reset the settings very fastly.
2. She performed all the tasks without problems. She suggested to add something that makes more clear that the markers on the map can be clicked to open the map application directly with the coordinates.
3. He performed the first task without problems. During the second task he pressed the emergency button for error and he also confirmed the emergency. Since no contacts were present in the list, the application crashed. After this problem, all the tasks were completed without problems.
4. She performed all the tasks correctly, however after the tests while she was giving some opinions about the system, she was moving the hands and the phone detected a fall. Therefore, we adjusted the accelerometer threshold to avoid false detections as much as possible.