

Report on the “ReGroup” mobile application

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1 Our Goal

The primary goal of our mobile application is to empower teachers to monitor their students using Bluetooth technology. By prioritizing student safety and data privacy, our application will deliver the following functionalities:

- A *user-friendly* registration process requiring only a username for quick access.
- *Real-time* notifications are sent to the teacher's device whenever a student strays beyond a predefined distance from the teacher or the group.
- Implementing a *secure* and *private* system for storing and handling student location data, eliminating the need for GPS technology.

2 Competitors Analysis

After analyzing two similar services, Life360 and Find My Kids, we have gained valuable insights into their features and functionalities. Enhancing our understanding of these competitors allows us to refine our mobile application's goals and better align them with user expectations.

2.1 Life360

Life360 is a comprehensive location-sharing and communication platform for families and friends. It utilizes GPS technology to track designated group members' real-time location and share it with others. In addition, the app offers driving safety alerts, crash detection, emergency response, location history, and a communication platform for better coordination. While it provides valuable features for family safety and connectivity, privacy concerns, battery drain, and limited functionality¹ are some drawbacks to consider.

2.2 Find My Kids

On the other hand, Find My Kids specifically targets parents seeking to ensure their children's safety. It offers real-time location tracking, geofencing² to set up safe zones and panic alerts in emergencies. The app aims to give parents peace of mind and assist in keeping their children safe. However, privacy concerns, false alarms, battery drain, limited functionality, and potential costs are factors to consider.

¹Advanced features are only available for subscribed users.

²Geofencing is a technology that creates virtual boundaries in the real world, and GPS, Wi-Fi, or RFID triggers actions or notifications when a device enters or exits these boundaries.

3 Interviews

We considered some scenarios good for our tracking system and figured out that monitoring students' positions in school trips perfectly suited us. The primary need of our application is to ensure students' safety by providing support to teachers. It means alerting teachers if a child walks away from them.

3.1 Teachers

During our interview sessions with teachers, we aimed to gain insights into their requirements concerning school trips. Based on the feedback received, the following key aspects emerged:

- In most cases, classes consist of approximately 20-25 students, and usually, 2 teachers are assigned to each class. As a result, each teacher is responsible for monitoring approximately 15 students simultaneously.
- Although missing students were infrequent, teachers expressed deep concern and fear when such incidents occurred.
- The consensus among all interviewed teachers was that an application capable of alerting them in case of a missing student would be highly beneficial.

User 1

1. On average, how many school trips do you participate in a year?

As a teacher in a lower secondary school, I typically participate in around three to four school trips per year.

2. Have you made any this year? If yes, how did the last trip go?

Yes. The last school trip we had went smoothly, and the collaboration between the teachers helped maintain a safe and organized experience.

3. How many teachers supervise the same group during a school trip?

During our school trips, we usually have a team of two teachers supervising the same group. This allows us to ensure proper supervision and manage the students effectively.

4. What is the average number of pupils supervised on a school trip?

On average, we supervise a group of approximately twenty to twenty-five pupils during a school trip. This number allows us to maintain a manageable group size while ensuring adequate supervision and attention to each student.

5. Have you ever felt that a group member was missing?

Fortunately, I haven't experienced a situation where I felt a group member was missing during a school trip. However, we always maintain a headcount and implement buddy systems to ensure the safety and presence of all students throughout the journey.

6. Would you consider a practical application that warns you in real time if a member of the group leaves?

Absolutely, I would consider using a practical application that provides real-time alerts if a group member leaves the designated area during a school trip. Such an application would significantly enhance our ability to monitor student safety and respond promptly to potential issues or concerns.

User 2

1. On average, how many school trips do you participate in a year?

I usually participate in around four school trips per year.

2. Have you made any this year? If yes, how did the last trip go?

Yes, I have been able to participate in a few trips this year. One recent trip was successful, with seamless student and teacher coordination. In addition, it created a positive and enjoyable environment for everyone involved.

3. How many teachers supervise the same group during a school trip?

Typically, two teachers supervise the group during a school trip.

4. What is the average number of pupils supervised on a school trip?

Our school's average number of pupils supervised on a school trip is around fifteen.

5. Have you ever felt that a group member was missing?

Yes, there was one instance during a school trip where I felt that a group member was missing, and it caused a significant amount of concern and anxiety among the teachers. Fortunately, we quickly located the student and ensured their safety.

6. Would you consider a practical application that warns you in real time if a member of the group leaves?

While the concept of a practical application that warns in real-time sounds useful, I have concerns about the potential privacy implications and the reliance on technology for supervision during school trips. Therefore, I would need more information and assurances about data security and privacy before deciding.

User 3

1. On average, how many school trips do you participate in a year?

Five.

2. Have you made any this year? If yes, how did the last trip go?

This year, we have been fortunate to organize several local trips for our students. The last trip was well-organized, and the students gained valuable experiences.

3. How many teachers supervise the same group during a school trip?

We typically have two teachers supervising the group during a school trip.

4. What is the average number of pupils supervised on a school trip?

From twenty to twenty-five.

5. Have you ever felt that a group member was missing?

I have never experienced a situation where a group member went missing during a school trip. Our meticulous planning and attentive supervision have contributed to ensuring the safety and presence of all students throughout the trip.

6. Would you consider a practical application that warns you in real time if a member of the group leaves?

Yes, I think a practical application that alerts in real-time could be a valuable tool for ensuring student safety during school trips. It would provide teachers and parents additional security and peace of mind.

User 4

1. **On average, how many school trips do you participate in a year?**

Two, one at the beginning of the year and one at the end.

2. **Have you made any this year? If yes, how did the last trip go?** This year, I did not have the opportunity to participate in any school trips. Due to personal reasons and professional commitments, I had to prioritize other responsibilities.

Yes, I made three school trips this year. During the last trip, we visited the Borghese Gallery and Museum, where the students admired Bernini's paintings, and then we took walks inside the Villa Borghese gardens.

3. **How many teachers supervise the same group during a school trip?**

Usually, we are two.

4. **What is the average number of pupils supervised on a school trip?**

About twenty.

5. **Have you ever felt that a group member was missing?**

Well, fear is always there. Then you turn around, count them and calm down.

6. **Would you consider a practical application that warns you in real time if a member of the group leaves?**

Yes, I would consider using a practical application that provides real-time alerts if a member of the group leaves. It would greatly enhance our ability to ensure the safety and well-being of our students during school trips.

User 5

1. **On average, how many school trips do you participate in a year?**

Three.

2. **Have you made any this year? If yes, how did the last trip go?**

I had two school trips this year. The last trip was an incredible experience as we visited the "Roman Forum" and "Borghese Gallery and Museum". The students were engaged and enthusiastic throughout the trip, immersing themselves in the locations' rich history and cultural heritage.

3. **How many teachers supervise the same group during a school trip?**

Usually, we are two.

4. **What is the average number of pupils supervised on a school trip?**

The average is around twenty per class.

5. **Have you ever felt that a group member was missing?**

Yes, I have. I often count the class members to check if any is missing! Luckily it has never happened yet.

6. **Would you consider a practical application that warns you in real time if a member of the group leaves?**

Yes, I would, I love technology, and if it can help me, I am pleased to use this application.

User 6

- 1. On average, how many school trips do you participate in a year?**

I typically take part in two school trips every year.

- 2. Have you made any this year? If yes, how did the last trip go?**

This year, I had just one school trip.

- 3. How many teachers supervise the same group during a school trip?**

It was just me.

- 4. What is the average number of pupils supervised on a school trip?**

In the last one, the students were just nine students; however, usually is a class of fifteen per school trip.

- 5. Have you ever felt that a group member was missing?**

Yes, I always have this feeling. I am just one person, and it is not easy to control every student!

- 6. Would you consider a practical application that warns you in real time if a member of the group leaves?**

Of course, I would. It would make things very easier, and I would feel more comfortable.

3.2 Parents

Most parents are apprehensive when their children have a school trip. Indeed even children without a mobile phone are provided one by their parents for this particular activity. We noticed that this concern grows up as the age of children decreases, assuming that an older student is more responsible. Almost every parent would feel safer if there was a mobile application warning the teachers in case of children missing. Moreover, most parents are OK with sharing their children's credentials even though they prefer not to include pictures.

User 1

1. How many children do you have? What are their ages?

I have two children. One is eleven, and the other is thirteen.

2. Do your children own mobile phones?

Yes, they both have.

3. Are you concerned about your children getting lost on a school trip?

Yes, I'm worried they can get lost during a school trip.

4. Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?

Yes, I would install this application and feel safer for my children.

5. Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?

There is no problem sharing their name, surname, or photo with their classmates or teachers.

User 2

1. How many children do you have? What are their ages?

Two boys. One is eight years old, and the other is twelve.

2. Do your children own mobile phones?

Yes, but only the twelve-year-old one.

3. Are you concerned about your children getting lost on a school trip?

Yes, I am. I want to be assured that my children are safe and do not get lost during a school outgoing.

4. Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?

I would be open to considering a mobile app that alerts the teacher if my children get lost on a school trip. Safety is a top priority for me.

5. Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?

Regarding storing and sharing sensitive information, such as my children's names and profile pictures, I would need more information about the app's security measures and privacy policies before deciding.

User 3

1. **How many children do you have? What are their ages?**

Yes, I have a child, and he is nine years old.

2. **Do your children own mobile phones?**

She does not have a personal phone, but I give her one only for emergencies, such as during a school trip.

3. **Are you concerned about your children getting lost on a school trip?**

Yes, I am always worried about her getting lost.

4. **Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?**

Yes, I would.

5. **Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?**

I agree with sharing her name and surname but not with sharing her photo.

User 4

1. **How many children do you have? What are their ages?**

Yes, I have a child, and he is eleven years old.

2. **Do your children own mobile phones?**

Yes, he has a mobile phone.

3. **Are you concerned about your children getting lost on a school trip?**

I am not this much worried about him getting lost. I trust the teachers.

4. **Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?**

If this application would help teachers, I have no problem installing it.

5. **Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?**

It is fine to share his name and surname or the photo with his classmates and teachers.

User 5

1. **How many children do you have? What are their ages?**

I have three children aged 9, 13 and 17.

2. **Do your children own mobile phones?**

Yes, they do. All of them.

3. **Are you concerned about your children getting lost on a school trip?**

The 13-year-old doesn't bother me. I think he's mature enough, while my 9-year-old does.

4. **Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?**

Indeed, I would feel more secure.

5. **Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?**

Yes, I would, but the sensitive data must not be exploited commercially.

User 6

1. **How many children do you have? What are their ages?**

Yes, I have a child, and she is nine years old.

2. **Do your children own mobile phones?**

Yes, she has a mobile phone.

3. **Are you concerned about your children getting lost on a school trip?**

Yes, I am worried that she can get lost in crowded places.

4. **Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?**

Sure, I would be thrilled.

5. **Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?**

I would allow sharing only her name and surname but not a picture of her.

User 7

1. **How many children do you have? What are their ages?**

Yes, I have a child, and he is twelve.

2. **Do your children own mobile phones?**

Yes, he has a mobile phone.

3. **Are you concerned about your children getting lost on a school trip?**

I am not worried because I fully trust his teachers.

4. **Are you willing to consider a mobile app that alerts the teacher if your children get lost on a school trip?**

I have no problem downloading an application if it can help teachers with their work.

5. **Would you allow this application to store and share sensitive information, such as your children's names and profile pictures?**

I would allow it, but it must be limited to his classmates and teachers.

4 Prototyping

4.1 Scenarios

- **Create a profile picture:** Suppose you are in a museum with other participants. The visit will start in a few minutes, and your teacher will create a new group. You must be ready to join the group by setting up your profile picture.
- **Create a group:** Suppose you want to create a group. You want to hide the profile picture of the group's members.
- **Join a group:** Suppose your teacher created a group. She provided the information to join the group. You want to join the group in the shortest possible time.

4.2 Used Approach

Testing involved groups of 3-4 university students, with an evolutionary prototyping approach employed for each task. With each iteration, modifications were suggested to enhance the prototype and address issues observed in the previous version. The evaluation method employed was Think Aloud.

4.3 Iterations and Changes

For details regarding the positive and negative aspects encountered in different versions and the corresponding solutions to previous issues, please consult the document **prototyping.pdf**.

5 Development

The end goal of the project was to develop a mobile application. We decided to implement it using the Flutter framework developed by Google. Although the framework permits cross-platform development, we decided to concentrate only on Android devices. The application allows the user to create and share a group with other users by monitoring each member's location.

Onboarding

To guide users through the ReGroup features and to create a positive first impression, an onboarding screen consisting of three slides is shown to the new users. At the end of the onboarding process, the user is encouraged to create an account by entering only the username. We aim to streamline the registration procedure by eliminating the need for users to enter an email address or password. It is important to note that the uniqueness of a member within a specific group is ensured through the relationship between the group and device identifiers. Finally, the application initiates by displaying a list of permissions (camera, notifications, Bluetooth) that it needs to function correctly. Upon the user selecting "Allow Permissions", an approval request is triggered for notifications and Bluetooth permissions. If Bluetooth is turned off, an additional pop-up prompts the user to enable it. With the permissions granted, users are now directed to the home screen, where they can either create a new group or join an existing one.

Roles

The mobile application features an organized approach to role assignment, allowing users to assume specific roles based on their actions within a group.

- **Owner:** Users automatically become the owner when they create a group. As the owner, they have complete control and authority over the group. This includes promoting or demoting participants to the moderator role, removing members from the group, and deleting the entire group if necessary. The owner plays a pivotal role in group management and decision-making.
- **Moderator:** The group owner can elevate participants to the moderator role. Moderators have certain privileges within the group, allowing them to assist in maintaining order and enforcing group guidelines. A unique feature of the moderator role is temporarily stepping away from the group without generating notifications, offering flexibility while ensuring their presence and engagement.
- **Participant:** The participant role is assigned to every user upon joining a group. To ensure the safety and cohesion of the group, participants can only leave if their location is not marked as lost. This restriction guarantees that members remain actively engaged and connected, fostering a sense of security and accountability within the group.

Create Group

After the user clicks on the create group, he becomes the group owner, and he decides if the profile picture of each member will be displayed or not. Then the group gets an ID that can be shared with other users to make them join the group through a QR code.

Join Group

Users can manually enter the group identifier or conveniently scan the QR code to join a group. However, if a user has previously denied camera permissions, a popup will appear when attempting to scan the QR code, prompting them to grant the necessary permissions. Once a user joins a group, every five seconds, the application initiates an automatic Bluetooth scan lasting around 20 to 30 seconds to detect nearby group members. If Bluetooth is disabled, a popup will be displayed, requesting the user to enable it. Upon completion of the neighbour scan, the list of detected neighbours is securely stored in the remote database.

Cloud Functions

- *RecursiveDelete*: This function serves as a comprehensive deletion mechanism within the application. When invoked, it systematically removes an entire group, including all associated user accounts and their respective personal data. This includes sensitive information such as private photos and the list of neighbours, ensuring a thorough cleanup process.
- *CheckNeighbours*: This function lies at the heart of the application's core operations. Its primary objective is to continuously evaluate the neighbour lists associated with each group member, ensuring the overall well-being and security of the group. In addition, if a participant becomes lost, this function takes immediate action by notifying all group members and fostering a collaborative response to locate and support the missing individual.

6 Testing

The mobile application underwent iterative user testing throughout the development process to ensure a seamless user experience. This iterative approach aimed to identify and address any potential issues with interaction flow and to anticipate a wide range of user requests, thereby enhancing the overall usability and functionality of the application. A range of testing scenarios was devised to evaluate the application's suitability for teachers and students. Unfortunately, not being able to directly install the application on the teachers' and students' phones, the development team had to create and simulate testing scenarios as close as possible to an actual use case, i.e. participating in a school trip. These scenarios encompassed critical actions, including registration, group creation and joining, Bluetooth scanning, notifications, role management, and group deletion. In addition, the application's performance was rigorously assessed by simulating these scenarios during testing, ensuring it effectively addressed teachers' unique requirements and objectives. Finally, ensuring data integrity and privacy was a key focus during the development phase. While the number of parents with data-related concerns was small, the development team diligently verified the proper handling and deletion of data about group members. This encompassed sensitive information such as current location and images, which were securely managed and deleted when a group was disbanded.

7 Conclusions

In conclusion, developing this application offers significant benefits to the education sector. This innovative solution addresses the challenge of monitoring students' whereabouts and ensures their safety. By leveraging Bluetooth technology, the application establishes a reliable connection between teachers and students, allowing immediate notifications when a student walks away from the designated range. Furthermore, the Android application's user-friendly interface and intuitive functionality make it accessible to teachers with varying levels of technological expertise. Finally, its simplicity and convenience contribute to its wide adoption within educational institutions, enabling more teachers to leverage this valuable tool.