PUSH TO TALK APPLICATION OVER WI-FI DIRECT FOR DRIVERS

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CSE497 / CSE498 Engineering Project report submitted to Faculty of Engineering
in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

Supervised by:
Assoc. Prof. Müjdat SOYTÜRK

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ABSTRACT

Most people may face some problems such that traffic jam, broken road etc. and they may want to warn about this problem to other people or they may want to ask information of the road, traffic, air condition to other people via their mobile phones, while they are driving. However, sometimes, there may not exist cellular network due to the location of the mobile user and coverage of the cellular network and they cannot exchange information with other drivers. In our project, we provided communication between mobile users by using Wi-Fi Direct technology when there is no cellular network.

ACKNOWLEDGEMENTS

We would like to thank Assoc. Prof. Müjdat SOYTÜRK for their guidance and support throughout the course of this project. In addition, I would also like to thank my friends, colleagues, the department faculty and staff. I want to also offer my appreciation to those who were willing to participate in my researches and studies, without whom, this thesis would not have been possible.

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1. INTRODUCTION

1.1 Problem Description and Motivation

Most of the people check the traffic conditions on their routine routes before getting on the road. If they are lucky, then there will not a traffic jam on their route but what if traffic condition goes bad, then these people will need to learn the reason and how much time will take this problem, to decide to change or not to change their routes. However, people usually cannot have these kinds of information instantly. In this project, our goal is to provide that real-time information to needy person from someone who is already in traffic jam inside a specific range without any cost by using Wi-Fi Direct technology. So, people can talk each other without taking any risk by only speaking rather than looking at the screen, which is the action that you have to do in most of the navigation apps to get information about the traffic while driving. Also, our project can help drivers who are in trouble on the road to get assist from someone nearby. So, our biggest motivation is the demand for the instant information about the traffic, which is needed by drivers. And there are some sub benefits of our project, which supports our motivation, such as being free for communication, usability for not only being informed about traffic but also calling help when needed.

1.2 Aims of the Project

- The main goal is to make safe and clear communications between drivers in a specific range by using Wi-Fi Direct, VoIP via Android smart phones.
- To create free and accessible communication between drivers in specific distance without paying to any GSM company.
- To supply information about traffic, location, road, accident to drivers.
- To provide help between drivers. While drivers are driving their vehicles, sometimes they may have some troubles and they need some help. By using our application, they can call help.
- To make a social environment. Sometimes, drivers may not want to trip alone and seek a friend to accompany with them. By using via this application, drivers can find people to come along with them.

2. DEFINITION OF THE PROJECT

2.1 Scope of the Project

Our project had several phases. At first, we connected two peers via Wi-Fi Direct and we managed the connection between them. In this step, we had a knowledge about usage and management of Wi-Fi Direct technology. When we completed the first step successfully, we improved our application for multiple peer environment. In the second step, we implemented VoIP features such as error correction, noise reduction on signals etc. Finally, we worked for adding some extra features to our project, such as end to end encryption, extended range via relay nodes etc. In these steps, the main technology that we used is Wi-Fi Direct and even if it was a good technology, its short range is a disadvantage and one of our constraints. In addition, making a Voice over IP (VoIP) call without internet connection was a constraint, too because to make a traditional VoIP call, an intermediate server is needed, and we assume that our application will not use internet connection.

2.2 Success Factors and Benefits

If we could succeed the statements below, then we could say that we reach our goal on this project.

- Connecting peers each other in a specified range and make all peers visible to each other if they are in the range.
- Providing a stable connection between peers if they are in the specified range.
- Preventing the congestion by using a good algorithm.
- Creating an optimised connection strategy to decrease power consumption.
- First, we tested all these statements in a down scaled environment and if our project could pass the test, we tested it in real environment.

When all these statements were succeeded then the benefits of this project are;

- Providing a free communication to get and share real time information about traffic and roads between drivers.
- Being a platform to call and get help on the road from nearby drivers.
- Additionally, being a social platform to make friends or to plan an activity.

2.3 Professional Considerations

Our project includes following considerations:

Methodological Considerations/Engineering Standards: Agility project management was used. The project was developed in Git environment. VoIP, Wi-Fi Direct technologies were going to be used. API level of Android should be 9 or more to able to use VoIP.

Societal/ethical considerations: The main goal of our project was to help people in traffic. Sometimes, mobile phones may be out of services, they could not call help when they need in traffic. Due to using Wi-Fi direct technology, people did not need to connect a GSM company. Hence, people could benefit free communication. In VoicR application, when the driver passed front of a store, an advert of this store is published. Sometimes, people may not want to listen adverts. For this reason, unlike the VoicR application, we did not make adverts publish not to disturb them and unlike some applications, we were not going to share our user's information.

Legal considerations: For this project, there was no required specific permission we had to take. We followed IEEE standards.

2.4 Literature Survey

Android: Android is a mobile operating system which is developed by Google. The first release was in September 23rd, 2008 and it was developed for mainly mobile devices but now many kinds of smart devices operates with Android. [1]

Android Studio: It is the official Integrated Development Environment (IDE) which is used to develop applications for Android operating system. It uses IntelliJ IDEA environment. [2]

Wi-Fi Direct: Wi-Fi Direct, in other words Wi-Fi Peer-to-Peer, is a Wi-Fi standard which allows devices to easily connect and communicate with each other with no need an access point or a wireless router. [3]

Voice over IP: Voice over Internet Protocol (VoIP) provides voice communications and multimedia sessions between devices over Internet Protocol (IP) networks, which means that it uses packet switching rather than circuit switching. [4]

SQLite: SQLite is a widely used relational database management system which has been written in C/C++ programming languages. Unlike many other database management systems, SQLite is not a client–server database management system. It is an embedded database which means that there is no server process. [5]

3. SYSTEM DESIGN AND SOFTWARE ARCHITECTURE

3.1 Project Requirements

3.1.1 Functional Requirements

- Clients should be able to see other users that are in client's range.
- Users should be able to send request to connect any broadcaster user
- Users should be able to add any unwanted user to blocked users list.
- Users should be able to add any user to their favourite list.
- Time for push-to-talk should be limited for each user not to block other users.
- Users should be able to communicate with minimum delay time.

3.1.2 Non-functional Requirements

- Users should have a device which operates with Android 4.0 (Ice Cream Sandwich) or a higher version of Android operating system.
- The device should support Wi-Fi Direct technology.
- Wi-Fi Direct connection of the device should be enabled.

3.2 System Design

3.2.1 UML Use case Diagram(s) for the main use cases

In this part, we are going to explain how Push to Talk over Wi-Fi Direct application runs briefly with UML Use Case diagram. As we explain the implementation; firstly, clients have to enable Wi-Fi Direct feature from settings of their smart devices to able to use our application then they can register with their name. After clients register, they can prefer either to check or update their profile in home page of the application or to see available users who are in a specific range of Wi-Fi Direct to chat. They can also reach available clients from home page. If they want to chat with someone in available clients, they have to choose from clients list where shows available users to send request for communication. If user whose response to the request is okay, client who send request can send his/her voice message. The use case diagram (see Figure 1.) on the below shows that this application is implemented. (Actor: A client or user)

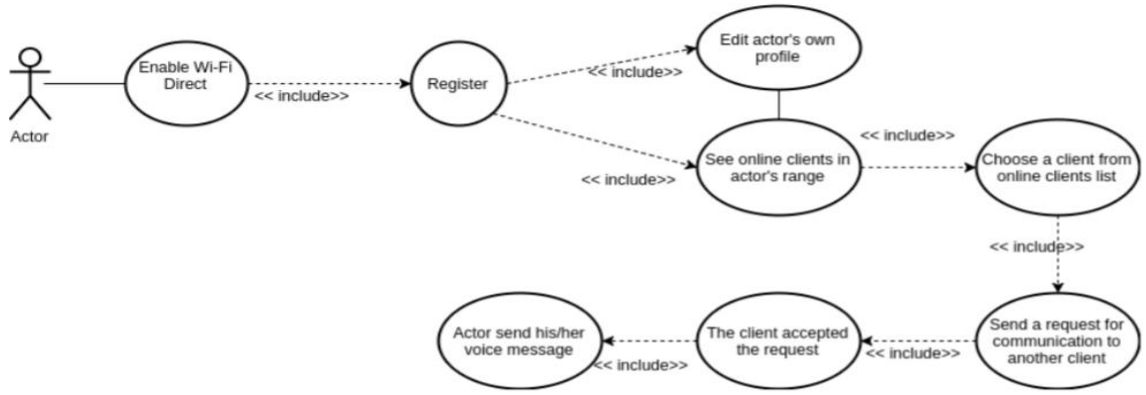

Figure 1 UML Use Case Diagram

3.2.2 UML Class and/or Database ER diagram(s)

Push to Talk over Wi-Fi Direct application has three classes which are Wi-Fi Direct Class which handles Wi-Fi Direct connections, FileTransfer that processes voice message like sending or receiving, Client which stores data (name, interest). The following UML class diagram (see Figure 2) shows classes of this application.

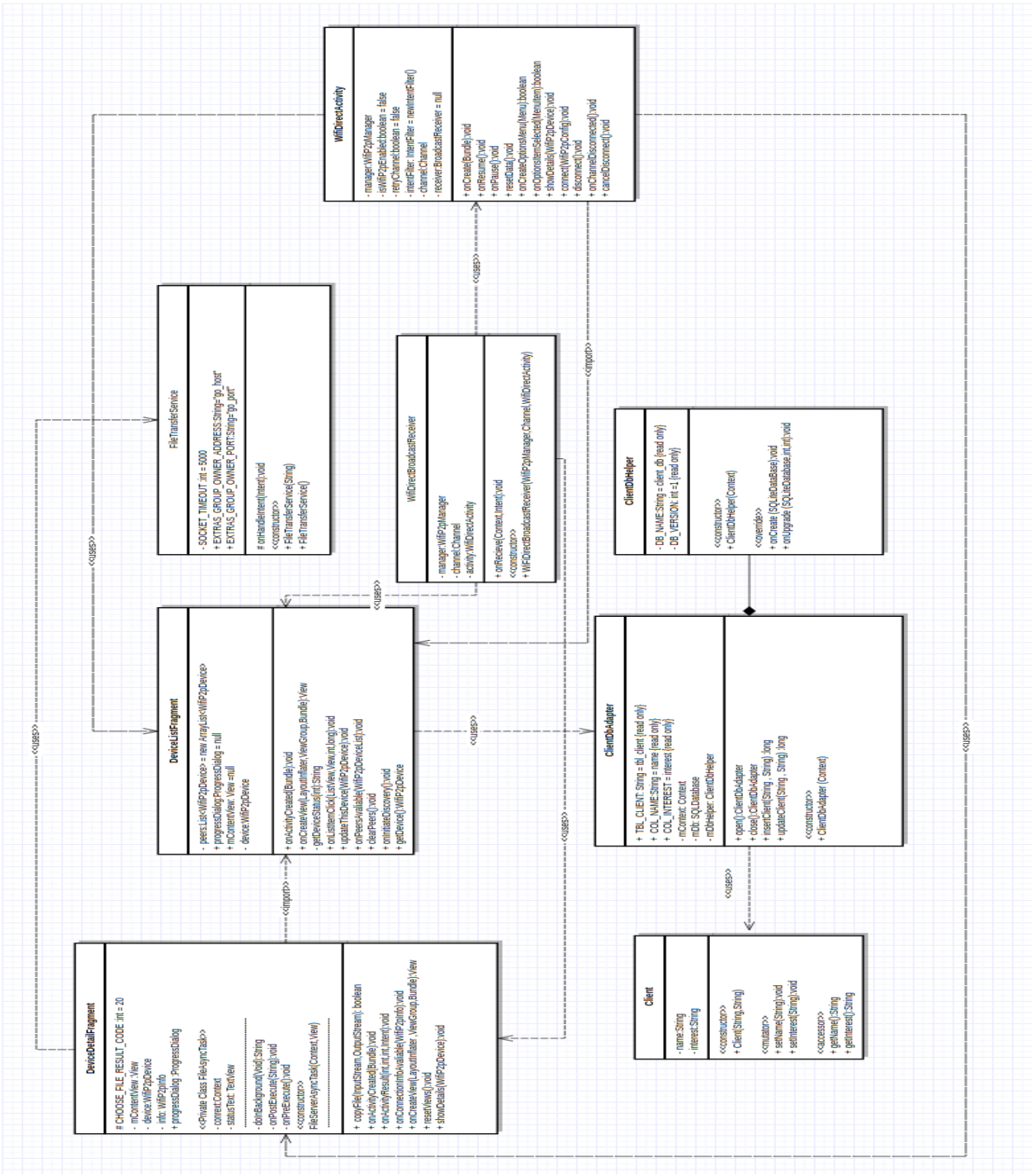

Figure 2 UML Class Diagram of the Application

3.2.3 User Interface

In this section, we are going to talk about user interface of Push to Talk over Wi-Fi Direct. We build and design our project in Android Studio. On below you can see preliminary version of application.

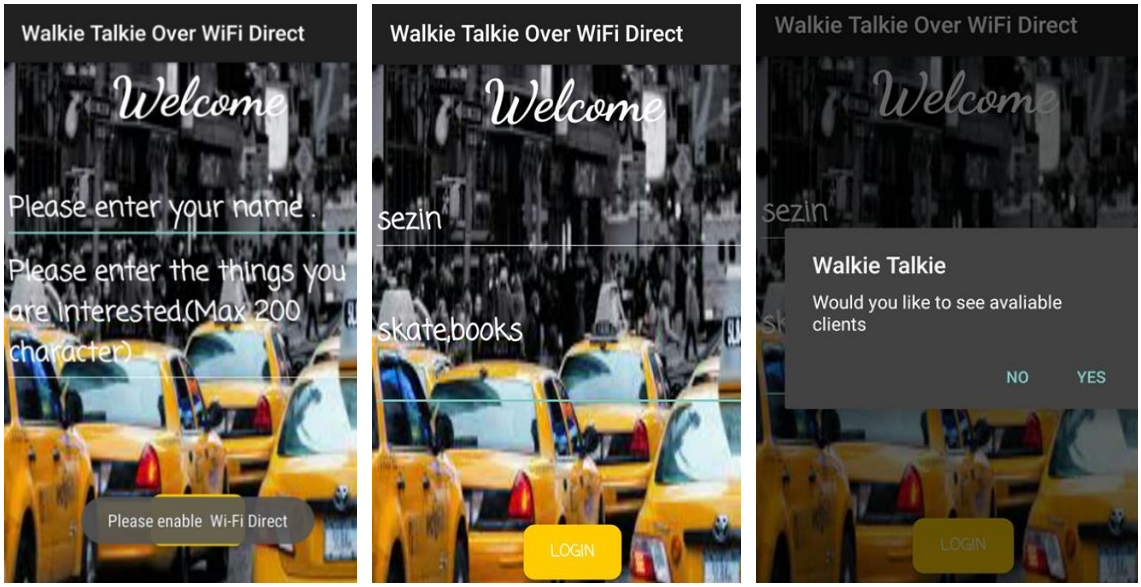

Figure 3 Initial Screens of the Application

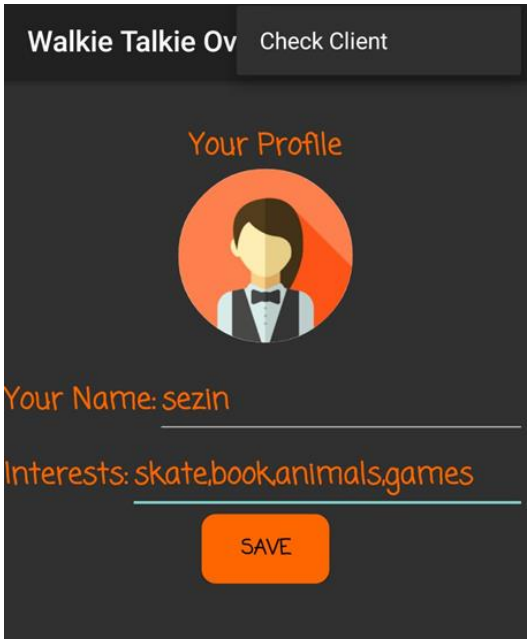

Figure 4 User Profile Screen

Figure 5 List of Available Users

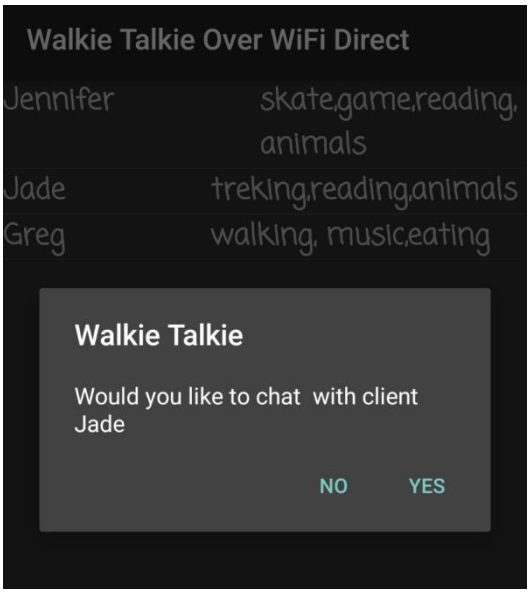

Figure 6 Send request to the other user

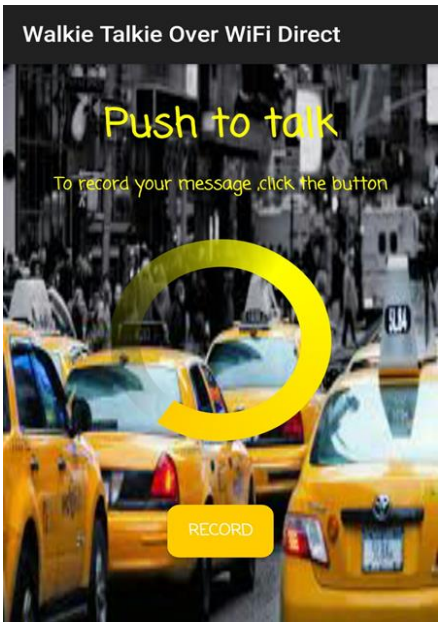

Figure 7 Record Voice Message

3.2.4 Test Plan

In this part, we are going to explain our test plan fort his application. In our project, we processed the audio package and sent them over Wi-Fi Direct, according to this brief description, we defined test plans as follows:

- We checked that application could receive Wi-Fi Direct signal or not.
- After step 1 was succeeded, we tried to see available devices in a specific range of Wi-Fi Direct.
- If all these two steps were done, we sent a request to one of the available devices. If this request could be responded successfully, we were done with step 3.
- We checked the data that entered in login screen was displayed correctly at home screen and another client's available devices list.
- We sent a file over Wi-Fi Direct to other device and checked that this file was sent correctly and could be opened or not from other device in a small Wi-Fi Direct area. If we did this step, then we increased distance between two devices and again tried same processes.
- After completed previous stage, we did same process as step 5 however for this time, we sent a sound file to the other device.
- If we did the previous process successfully, we tried recording our voice message. The client clicked record button in record message window then he/she spoke (she/he could speak max 30 seconds), after he/she completed with recoding her/his message, then this client sent this voice message. The other client received voice message and listened to it.
- If all processes were completed successfully, then we completed our testing process.

3.3 Software Architecture

Control flow of this project is shown on Figure 8.

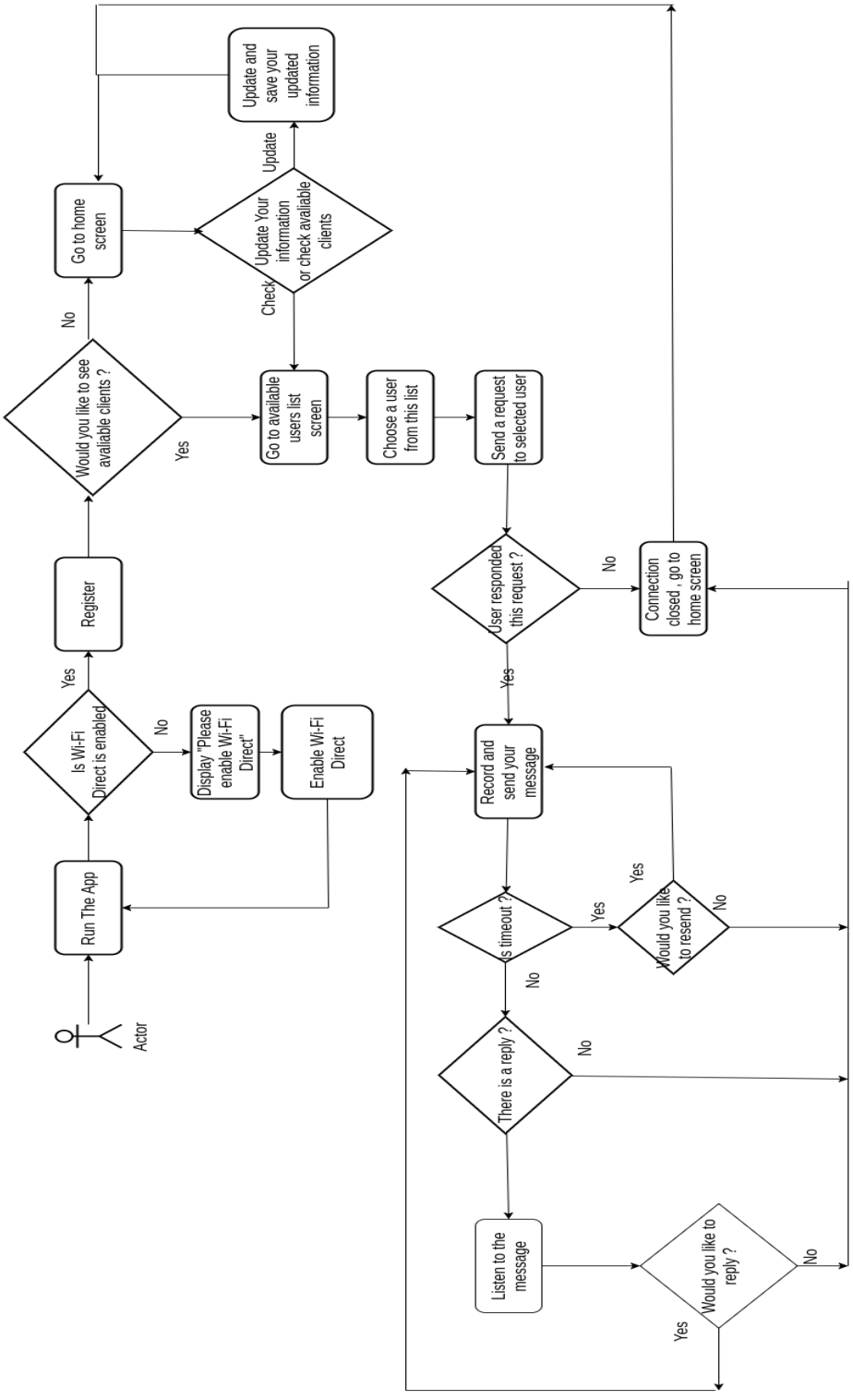

Figure 8 Control Flow of Push-to-Talk via Wi-Fi Direct Application

4. TECHNICAL APPROACH AND IMPLEMENTATION DETAILS

4.1 Used Software Technologies and Hardware Components

Main technologies:

- Wi-Fi Direct
- VoIP

Software technologies:

- Android Studio
- Android

Hardware Components

- Android smartphone (Two devices)

4.2 Implementation Details

We developed our application on Android Studio IDE. We used XML for the design phase and JAVA programming language for the implementation.

The most important part of the implementation was the network programming part, and, on this part, we used native libraries of the Android. To manage the Wi-Fi Direct connection and communication we used libraries under the android.net.wifi.p2p package.

After Wi-Fi Direct implementation was done, we focused on recording, sending and playing audio. In this step, we used native Android libraries again. For recording audio, we used the android.media.MediaRecorder library and for playing audio, we used the android.media.MediaPlayer library. To handle all the input/output operations for recording and playing audio, we used libraries under the java.io package.

While we were working on recording and playing audio, simultaneously we were working on the transferring audio file between two devices. In this part, we used socket programming techniques. In this part, we mainly used java.net.ServerSocket and java.net.Socket libraries.

5. SOFTWARE TESTING

We could not test all the cases for our application, we were able to test only the main features which are scanning Wi-Fi Direct devices around, Wi-Fi Direct connection, recording audio, sending recorded audio and playing audio on the receiver device.

We did not use any test tools for the tests. All the feature tests were done by running application on two devices manually.

6. CONCLUSION AND FUTURE WORK

In this project, we aimed to supply communication between mobile users without any cellular network. To do our goal, we preferred to use Wi-Fi Direct technology rather than Bluetooth due to having large range and being able to transfer data fast. We achieved recording and sending an audio file to another user via Wi-Fi Direct and other user could receive and listened to coming audio file.

As we talk about future works for our project; first work is secure communication. In our project, we did not encrypt audio file packages during streaming, thus an attacker can easily sniff outgoing and incoming packages. To prevent sniffing, we are planning to encrypt packages with some encryption algorithms, such as sha-2 or sha-3.

Second future work for our project is group chat. Our application is peer to peer, it means only two users can speak at the same time. Wi-Fi Direct supports multiple file sending, thus we can make group chat.

Last future work for our project is to extend range. Wi-Fi Direct has large range (100-150 meter), however still it is not so efficient. By using a user as a access point, we are planning to extend range of our application.

In conclusion, we learnt Wi-Fi Direct technology, implementation of VoIP and we had knowledge about how to make efficient communication without any cellular network.

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