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HelpApp – A WiFi direct based disaster management application

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ABSTRACT

Communication during a disaster is very crucial and a very challenging domain due to the fact that the traditional communication infrastructure are very prone to go offline which prevents the people stuck in the disaster to communicate with each other and report their status to the rescue authorities which in turn causes delays to rescue operations. To enable communication between devices during a disaster and for effective and productive rescue operations, we propose an Android Application (named HelpApp) to overcome the inoperative traditional communication network where we use WiFi Direct. Android OS is used because it has 70% of the total smartphone users in the world 95.2% of the market share in India. While the primary connection is WiFi Direct, we make use of WiFi Legacy to give it Adhoc-like behaviour where the network can be largely scaled up. A prototype of this application has been successfully built and tested in a controlled environment to show the capabilities. This application is published under a FOSS license and source code is available on GitHub[7].

Keywords— *Communication, disaster, android, WiFi Direct and WiFi Legacy*

1. INTRODUCTION

Traditional network infrastructure is very susceptible to damage and becomes inoperable when disaster strikes. This means that the network goes down bringing down connectivity. Stable connectivity of communication plays a vital role during disasters and especially during rescue operations. With HelpApp, we want to (1) help retain communication during a disaster, (2) maintain a single channel of communication during a disaster and (3) improve upon existing WiFi Direct-based chat applications. Android natively does not support Wi-Fi Direct Ad-hoc mode so we implement an Ad-hoc-like network using Wi-Fi Legacy [Reference Paper]. We use Wi-Fi Direct to create a group containing a few devices then use WiFi legacy to interconnect 2 groups so communication can happen between them. Another feature of this app is the simplicity of the interface it provides. The application must be simple to use with a very simple interface so as to not confuse users. HelpApp will have a public ledger feature built-in which records a few details like landmark, required necessities, and GPS location and this information is synced between all the devices in the network. And when a rescue team connects to the network, they can get all the information about everyone stuck including the exact GPS location with accuracy shown. HelpApp also provides Group Messaging where all the devices on the network can communicate with each other using the interface provided. This group is for all the members in the network and can be used to post about aid being offered nearby or something similar. According to the best of our knowledge, no other WiFi Direct-based group chat application exists as Open Source. HelpApp also provides a Direct Messaging feature where people can directly chat with specific users. Because this project is FOSS, anyone can contribute to the code on GitHub.

2. EXISTING SYSTEM

2.1 WiFi Hotspot

There exist multiple applications published in the Google Play Store, all with multiple active users, which use the traditional WiFi hotspot to create an AP (Access Point) where client devices can join an AP and communicate with the other devices that are also connected to the AP.

2.2 FireChat

FireChat was an application available on Android and iOS which worked using Bluetooth and WiFi. It did not rely on an internet connection to function and used wireless mesh networks with the help of WiFi and Bluetooth to connect devices. This app is popular for being used during the Hong Kong protests of 2014. The last update to this app was in 2018.

3. IMPLEMENTATION

We have created an application with 4 modules which all help with communication during disaster.

3.1 Connection Module

Connection module is a single button click. This module will enable the user to either create or join a network. To begin the connection processes, the user will input a username. The application will scan the network for existing groups. If a group exists, the device will join it as a group member. If a group does not exist the application will create a group and the device will become the group owner and wait for devices to connect to it. The device list is shared with all the group members.

3.2 Group Chat Module

This module provides an interface to send messages to all the members in the group. All the messages by the group members are sent to the group owner (GO) first. The group owner is responsible for forwarding the messages to all the devices that are part of the group. Along with GO, a bridge GM also forwards the broadcast messages it receives to the other group it is connected to. The group owner acts as a mediator between all the group members.

3.3 Direct Chat Module

This module provides an interface to send messages from one group member to another group member. When a device is connected to the network, a list of all the available members is displayed. The user can select any specific user to chat with. On typing and message and clicking send, the group member sends the message to the group owner with the details of the receiver. Group owner uses a routing table to find the receiver details and delivers the message to the right group member.

3.4 Ledger Module

This module provides an interface to send and view help requests. The group members are presented with needs to select from, that are water, food, first aid, sanitation. The device GPS location is automatically detected and stored. Group members can also enter the landmark in case the GPS location is not accurate. The data is stored in the local database. The data is synced on all the devices on the network. All the group members can view all the requested help.

4. ARCHITECTURE

4.1 Data Flow Diagram

There are three instances where data transfer is happening which are registration, messaging and ledger data transfer.

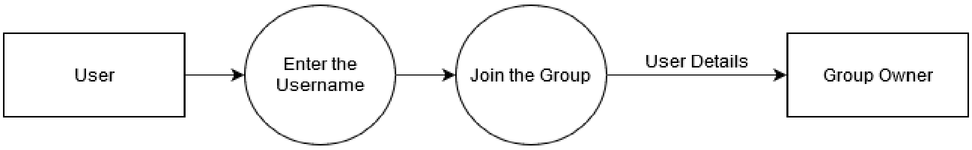

Fig. 1: Data transfer while registration

Initially data transfer takes place when a new member joins the group or the registration phase. In this, the user enters the user name and joins an existing group, the username and its address is transferred to the group owner. Group owner stores this information for messaging purposes.

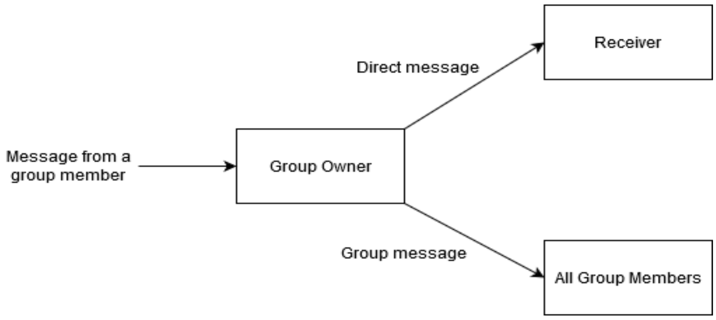

Fig. 2: Data transfer while messaging

When a device sends a message to another device, then the data transfer between devices takes place. Using WiFi Direct, devices can only talk to each other through the group owner because of WiFi Direct limitations. If a direct message is sent by a group member, the group owner reads the address of the recipient and forwards the message to that address. If a group message arrives it is broadcasted to all the group members.

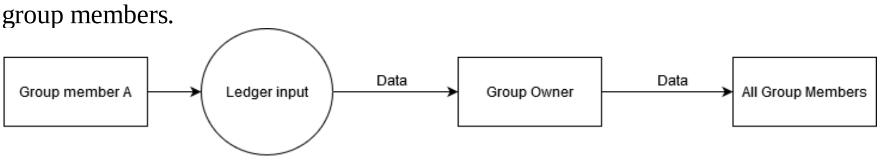

Fig. 3: Ledger data transfer

Our proposed system has one module where help requests can be sent which contains important user data. All the different types of data, that includes GPS location, landmark and needs, are packed together and sent to the group owner who forwards it to all the group members. As the ledger data is very important it is stored in the local database of each device and shared between devices every time a connection is established.

4.2 Sequence Diagram

In our proposed system we have four modules and sequence diagram of each module is presented below.

4.2.1 Connection Module: Figure 4 shows the sequence diagram of the connection module. First the user grants the Wi-Fi and GPS permission to the application. After that, user is introduced with a login screen to enter a username and connect to a network. The device then checks if a group already exists. If a group exists, the device will join that group. If no group exists, the device will create a group and wait for other devices to connect to it.

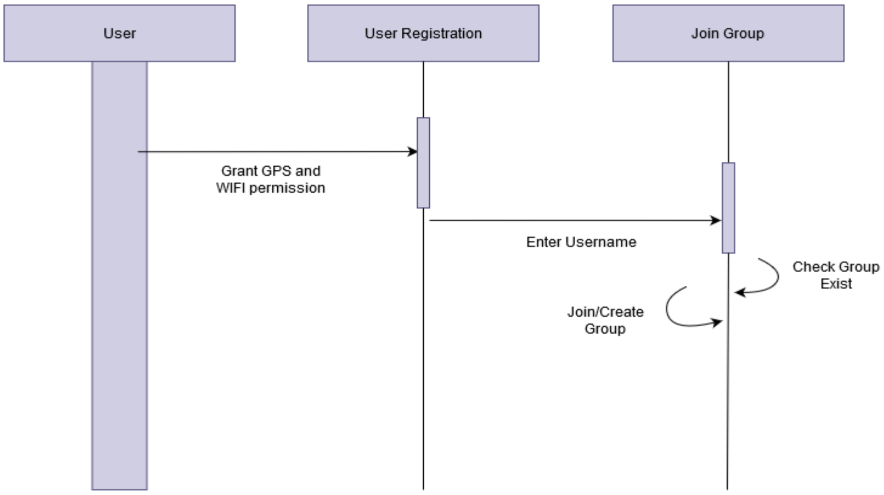

Fig. 4: Connection module sequence diagram

4.2.2 Group Chat Module: Sequence of group chat is given in figure 5 where first a group member sends the message to the group owner and the group owner forwards it to every group member after which it is displayed on all the devices.

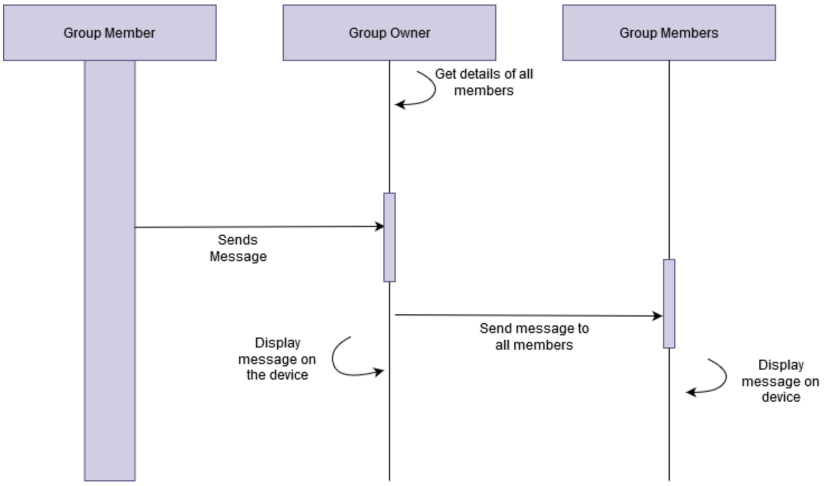

Fig. 5: Group chat sequence diagram

4.2.3 Direct Chat Module: Sequence diagram of the direct chat module is shown in figure 6. A Group Member sends the message to the Group Owner and that forwards it to every Group Member. After which it is displayed on each of the device.

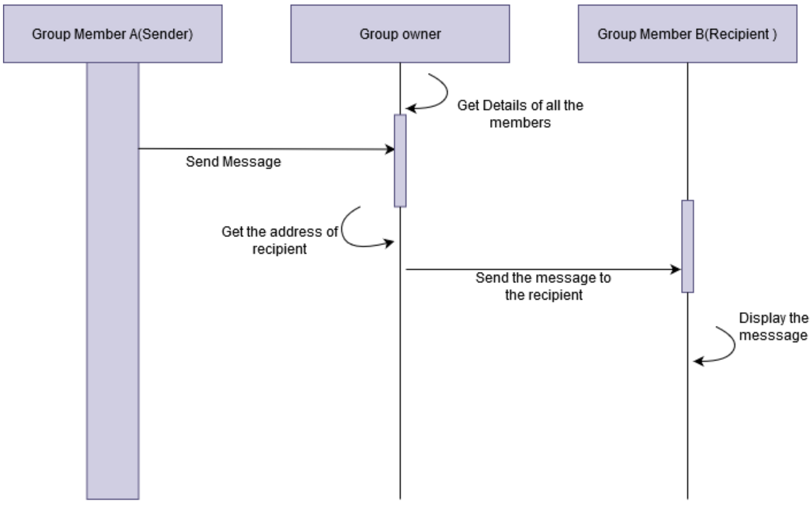

Fig. 6: Direct chat module sequence diagram

4.2.4 Ledger Module: Ledger module's sequence diagram is shown in figure 7. The Group Member first selects the needs in the form of a check box and can enter a landmark with which GPS location is automatically packed. This data is stored in the database. The data is then sent to the Group Owner that forwards the packed data to all the devices and all devices stores this information in the database.

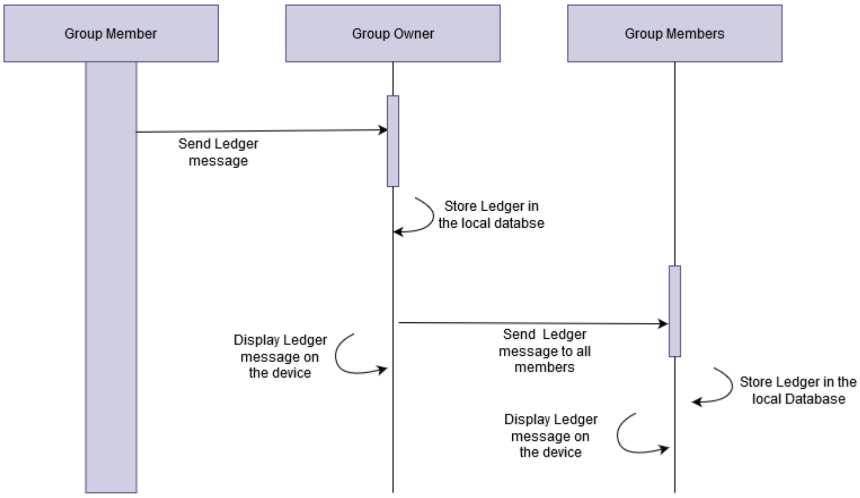

Fig. 7: Ledger module sequence diagram

5. CONCLUSION

We propose a system to provide an application that allows people stuck in disasters, where normal infrastructure networks may not be present or cannot be used, to communicate and request help. The application also provides a platform for users to share their GPS location even during unavailability of a traditional network. Using this application, government agencies/ disaster relief task forces can provide swift and accurate help to the people who are stuck using the ledger feature. This paper is a proof of concept that scalable networks are possible and these networks will greatly aid disaster relief. There are still a few limitations in the Android WiFi Direct APIs with regards to WiFi Direct ad-hoc mode and permissions which might be a reason why there are no such commercial products already available.

6. REFERENCES

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