Voice Call Communication Over Wi-Fi

Name: Omkar V. Manjare , Sagar S. Bamnikar , Prathamesh N. Deshmane ,Om U. Dongre ,

Guide: Dr. Preeti S. Patil

Abstract—

Today, we are standing on the edge of wireless connectivity where everyone prefers to be online without a bundle of wires. Colleges, B-Schools, corporate offices, coffee shops provide Wi-Fi facility for sake of internet connectivity.

The purpose of this project, Voice Call Over Wi-Fi, is to make use of available resources in order to provide a facility of making free voice calls, without using service provider. Pre-established Wireless Fidelity (i.e. Wi-Fi) service is more often used as medium to access internet. This project enhances the use of WLAN, offered by Wi-Fi as a medium for voice transmission. Wi-Fi enabled smart phones can be connected to the router and can communicate with each other. This system can prove as the best alternative for existing intercom system. Use of existing resources put no burden on institute as infrastructure cost.

Keywords: VoIP, Wi-Fi, router, android, caller & receiver module.

INTRODUCTION

Communication is the essential part of our day to day life. Technology has improved a lot and hence everyone seeks for convenient and efficient way of communication. In organizations like colleges, corporate offices, communication channels among all employees plays a vital role. Considering all these facts, it is necessary to develop such a system which is easy to deploy, easy to run, and easy to access it. Many organizations are providing Wi-Fi facility in order to provide internet connectivity. One can connect a mobile device like laptop, tablet or cell phone to the Wi-Fi router and gets internet connectivity.

Wi-Fi is predicted to grow 109 percent between 2011-2016 in automotive applications such as infotainment systems, navigation, and traffic monitoring, 39 percent in health, fitness and medical applications, 25 percent in smart meters and automation products.[1].

Even hundreds of millions of mobile devices are using Android platform in more than 190 countries around the world. Every day more than 1 million new Android devices are activated worldwide. 1.5 billion Android apps are being downloaded in a month and figure still continues to rise. [2]

Considering these facts about growth in both, Wi-Fi as well as Android, we create an android application that's runs using Wi-Fi networks.

Currently, we are using Intercom System more often. In the traditional intercom system, we come across following limitations. :

1. Phone is fixed on the table so mobility of user is very limited.
2. Adding a new connection in this system requires additional wiring and trained person to establish this connection. This is an extraneous system to maintain.

We are providing solution for the above mentioned limitations. They are:

1. We are making use of existing Wi-Fi network which is utilized for enhancing additional facility. This facility is provided on cell phones so that mobility of user is maintained.
2. Adding a new connection in the system is just an adding a new entry in IP table by network administrator.
3. We look forward to make use of WLAN as communication medium and want to provide a free voice call facility in Wi-Fi covered area.

RELATED WORK

Following are some of the technologies that provides voice communication over network. Their features along with their limitations are mentioned here.

1. Title: Voice Over Internet Protocol (VoIP)
   - It provides facility for connecting two remote clients via voice over the internet. IP phone application can provide the necessary interfaces between telephony signals and IP networks.

- Although IP phone communication over the data networks such as LAN exists but these IP phones are of fixed type. Thus they result in violation of users' mobility.
- Even VoIP phones need internet service provider, resulting increase in running cost.

2. Title: Voice Transmission over LAN Using Bluetooth
- Two cell phones, connected via Bluetooth, can exchange media files. Constraint over this is geographical area covered by Bluetooth is limited.
- Even today, Bluetooth enabled laptops and desktops are in the market, using which we can obtain the wireless communication.
- Area covered by Bluetooth's range is very small, resulting in limitations over users' mobility.
- In ad-hoc network, power consumption is major issue. [3]

3. Title: Voice Calls Over Wi-Fi
- This paper explains use of Wi-Fi enabled phones as IP phones and their communication within local wireless LAN. Authors state that each mobile device connects to WLAN router and updates its routing table. Calls can be placed by a user by sending packets to the router which then tries to reach to the destination.
- According to the authors of this paper, security is major issue to tackle in this environment. For this sake, packets in headers can be encrypted by one encryption and payload can be encrypted by other.[4]

4. Messenger (Company Van Loo Software Version 2.1.1.1)
- There are several video calling applications over LAN, like mentioned above.
- We can make video calls using this software. Conference calls are also possible.
- This small size software recognizes nodes connected in LAN automatically. Manually adding a node is also possible. [5]

5. Calls over Bluetooth of Laptop in Windows 7
- A call initiated from cell phone, connected to laptop via Bluetooth, is charged by the service provider of cell phone.

- Also, caller has to talk through the microphone of the laptop only. He can neither talk nor listen voice on his cell phone. All communication takes place through the laptop. This violates user mobility though he is connected over Bluetooth. (This result is practically obtained with cell phone connected to laptop over Bluetooth)

PROPOSED WORK

Proposed System:

To establish voice call communication over WLAN by using Wi-Fi facility of the cell phone.

In this project we are focusing on following features:
1. Establishing voice call over Wi-Fi.
2. Voice message storage at the server for unreachable receiver.

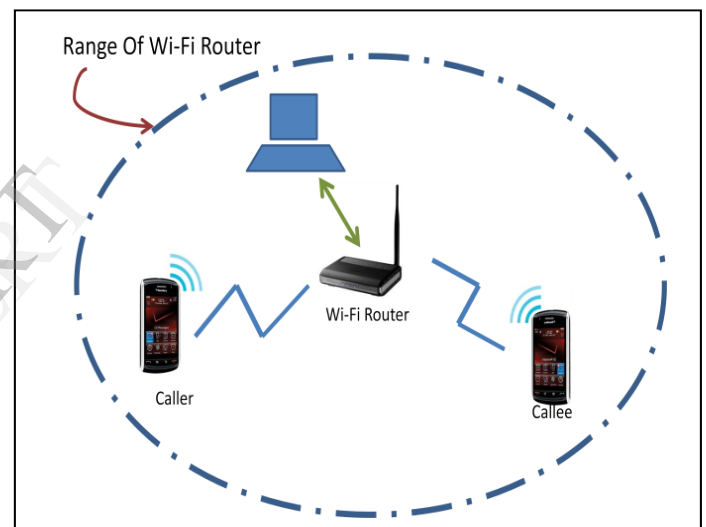The proposed system has architectural diagram as follows:

Fig. 1Area covered by Wi-Fi router

Fig. 1 shows caller, callee (i.e. receiver), Wi-Fi router and server. The Wi-Fi coverage area boundary is shown as well. Voice is exchanged between caller and callee through Wi-Fi router.

Fig.2: Simultaneous Voice communication

Wi-Fi router acts as access point which detects nodes, currently active in the network. As per caller's choice, cell phone sends request to connect with callee and in turn , router forwards the voice connection request which is tagged with the sender and receiver name (i.e. address).

Simultaneous communication between two pairs of users is shown in fig. 2. Number of calls supported simultaneously depends on router's capacity. In fig. 4 caller A has placed a call for receiver B. Voice is exchanged between A and B via router.

Modules of System:
The proposed system consist of three modules namely,
1. Caller Module
2. Router Module
3. Receiver Module

1. Caller Module:
- Wi-Fi enabled cell phone with Android operating system opens an application and it receives the list of users. Reachable users are shown by green bubble. Other names are shown by red bubble which indicates unreachable users.
- User selects the name of callee. He is provided with facility to identify the callee as per the selection of department, designation. Once he is connected to the callee, he can start voice communication.

2. Router Module:
- Sending the list of reachable user is the first task when any user opens an application. Here server and router together take decision of users' reachability. Server pings a list of users categorized under above parameters.
- Accepting the request from caller and placing a call is another responsibility of this module. On demand of user, server has to refresh the list of available users.

3. Receiver Module
- This module allows receiver to receive call.
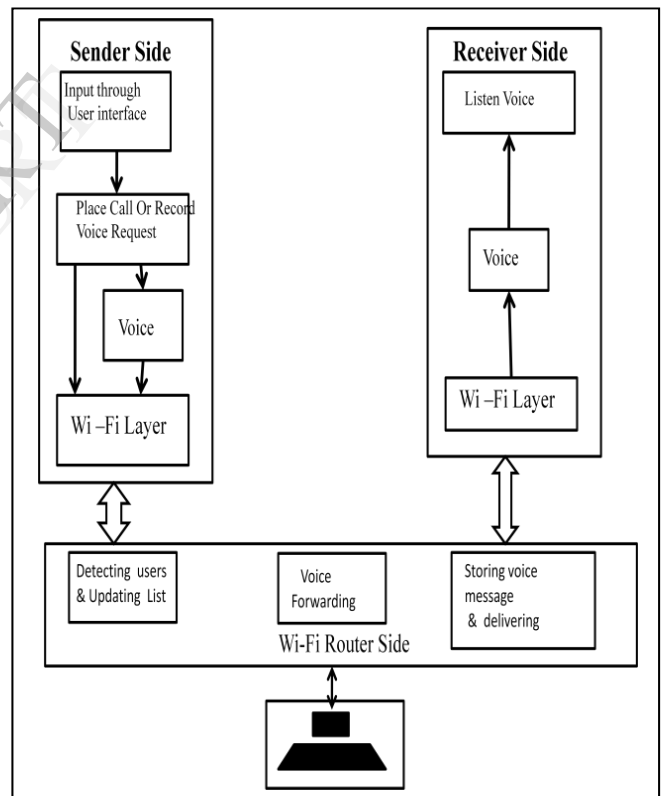- Retrieving the voice file when router intimates about voice file.

System Design:

Fig. 3 :System Design

1. Sender Side:

Caller's Mobile consists of following functional units:

User interface:

- This unit acts as an interface between the application and the user. It enables the user to view contacts according to their availability, selecting one from them and placing either call or voice message.

Initiating Call/Voice record:

- When a receiver name is selected then user will select option for calling or voice message recording, depending on user's choice. Then appropriate function is invoked and voice is forwarded to intended receiver via central router.
- This unit is responsible for capturing the audio data and forwarding it to Wi-Fi layer.

Wi-Fi layer:

- Recorded voice message is sent through Wi-Fi of cell phone.
- Whenever the voice message is to be sent, it must go through the Wi-Fi layer as it is the only intermediate layer through which communication takes place.

2. Receiver Side:

Receiver Mobile consists of following functional units:

User interface:

- Incoming call is displayed to receiver as a notification. Alert type such as ringing or vibration of this notification depends on current profile of user.
- In actual both GUIs are part of sender as well as receiver because role played by sender and receiver are switched for every voice packet transmission.

Wi-Fi Layer:

- All communication takes place through the Wi-Fi layer which makes communication between caller & receiver. Receiving as well as forwarding packets is the job of this layer.

3. Wi-Fi Router side:

Central Wi-Fi router consist of following functional units.

Detecting users & Updating List:

- On demand of caller, the central server has to ping the group list and sends the statistics to the caller.

Voice Forwarding:

- Accepting voice packets and forwarding them to intended receiver is the main task of this router. Router acts as network channel provider.

Storing and delivering message:

- If user wants to store message then he sends voice message to router. Router then saves it with receivers' name. When receiver asks for message, it is delivered to him.

Android application development

A user, in this proposed system, uses android application as a front-end. Android provides many ready to use libraries for application development. Use of these libraries put less burden on android app developer. Major libraries we have used for application development are listed below.

1. android.app.Activity
2. android.util.Log
3. android.widget
4. android.media

These are some values in Hz, considered for implementation and testing of a application.

Sample rates used are: 7000, 7500, 8000, 8500, 9000, 10000, 11025, 22050, 44100 in Hz.

Audio encoding formats used are: ENCODING PCM_8BIT and ENCODING PCM_16BIT.

Channel Configuration used are:

1. AudioFormat.CHANNEL_IN_MONO
2. AudioFormat.CHANNEL_IN_STEREO.

OBSERVATIONS & RESULTS

Following results are obtained when a call is established between two cell phones through Wi-Fi router.

SR.No	Sample rates used in Hz	Nature of voice
1.	7000	A lady/ childish voice
2.	7500, 8000	Natural voice as it is of a person
3.	8500, 9000, onward	Voice elongates and delay increases

Table I : Results of voice quality obtained during application execution

SR.No	Distance from router in meter	Delay observed (in milli seconds)
1.	2	72.9, 81.2, 103, 7.71, 45.3, 7.29, 94.9
2.	4	62.4, 78.9, 101, 124, 45.3, 67.4, 90.1, 113
3.	6	120, 40.8, 62.4, 87.4, 109, 31.2, 51
4.	8	37.8, 59.3, 81.7, 47.4, 23.6, 44.1, 68.9
5.	10	115, 26.6, 44.1, 68.5, 91.8, 114, 144, 58.7
6.	20	1010, 284, 50.6, 76.2, 95.2, 124, 141, 64.6
7.	30	114, 9.03, 56.5, 183, 101, 119, 43.7, 69.1

Table II: Delay observed in ping results:

APPLICATIONS

1. Many institutions and organizations make use of traditional intercom system for internal communication. These intercom systems require resources like telephones, excessive cabling, central connection board etc., which makes organization to invest considerable money. Even maintaining and running these intercom systems is an addition to the cost. This application will effectively reduce cost of maintaining resources as it is an add-on to existing system.

2. Places like malls, airports, college campuses, hospitals have Wi-Fi as a medium to use internet only. Such existing network can be used for voice communication for which users need not have to pay for setting up an environment.

3. Voice call done by this application does not depend on service provider. Thus all problems that occur due to coverage of service provider can be eliminated.

4. Providing free voice communication over Wi-Fi network is main agenda of this application. Thus any sector which pays to service provider for calling purpose, can use this application. The infrastructure requirement is to mount Wi-Fi fouter and android cell phones only.

CONCLUSION

Proposed system makes use of Wi-Fi router as a medium to have voice communication. It provides communication without any service provider i.e. free of cost to user , which eliminates various issues like range coverage, cost of calls etc. Even this application provides flexibility to user by allowing him to retrieve his message afterwards when he was unable to receive call. As Wi-Fi is established for internet access and we are extending its use, the system is cost efficient. Finally, this application is of immense useful where communication is an essential and takes place very frequently.

FUTURE SCOPE

- This application can be further extended to perform call handoff between multiple Wi-Fi routers so that user is allowed with greater mobility.

- Even this application can be used to broadcast voice message to multiple users at a time.

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