Kiara: an open source SIP system to support Deaf telephony

Long Yi and William D. Tucker
Department of Computer Science, University of the Western Cape, Bellville, South Africa
Telephone: +(27) 21 959-2461, Fax: +(27) 21 959-3006, Email: {**2475600**, btucker}@uwc.ac.za

Abstract—This paper describes Kiara, an open source SIP-based communication system that provides the building blocks to enable Deaf relay services. We have implemented a prototype that provides real-time text, voice and video to a variety of end user devices over a variety of networks. The work-in-progress concerns the addition of relay services for the Deaf.

SATNAC Classification: Innovation and Regulatory – Telecommunications Developments and Inventions

Index Terms—Deaf telephony, Instant Messaging, SIP, VoIP

I. Introduction

HEARING people use a variety of communication systems: voice telephony, video conferencing, SMS, email, Instant Messaging, etc. Choosing an appropriate system to communicate depends on the context, as well as on the abilities and preferences of the users. Sometimes SMS will be sufficient, whereas in other cases, voice telephony is needed to talk directly. Similar context choices are available for Deaf, hard of hearing and speech-impaired people, but their choices are limited [1].

Users that cannot hear or use voice tend to use text telephony, whether text is appropriate or not. Many text technologies have been developed and either directly or indirectly cater for the communication needs of Deaf people [2]. Deaf users, however, prefer to use sign language. As bandwidth becomes increasingly available at a lower cost, bandwidth affordability will be a less significant factor preventing the use of video. Video enables Deaf people to communicate with each other in sign language, and with hearing people via some form of relay. A video relay service (VSR) translates a language like South Africa Sign Language (SASL) into text or voice with an interpreter. Such systems are common in the developed world [3], but not in South Africa. This paper describes relay software called Kiara that was designed for the Deaf Community of Cape Town (DCCT). Kiara supports any combination of text, voice and video, including video relay, and is completely built with free and open source software.

II. Design and Implementation

A. Relay Scenarios

For *voice relay*, a hearing person calls the household of a Deaf person and a hearing person. A voice conversation is initiated between the hearing participants. During the conversation, the hearing person asks to talk with the Deaf person, while keeping the voice connection open so that voice-to-voice communications can continue if required. A Relay Service is invited into the conversation. The Relay Service translates the hearing person's words into text. Text from the hearing person's voice appears on the display of the Deaf person's screen. The Deaf person types a response. The Relay Service receives the text and reads it to the hearing person. The hearing person asks to talk with the hearing person in the Deaf person's household. The Relay Service withdraws from the call.

For *video relay*, a Deaf person enables a sign language call by setting up a User Agent to send video streams. For outgoing communications, the sign language in the video stream is translated into a text message or voice stream for the other conversation participant. A similar translation occurs in the opposite direction.

B. Objectives

There are third-party relay services that facilitate communications for Deaf, hard of hearing and speech-impaired people. Currently such relay services are mostly operator-assisted (manual). One goal of this project is to enable automatic re-direction and relay between text, voice and video without operator assistance. However, sign language translation still requires a human interpreter.

C. Architecture Overview

Fig. 1 shows the proposed architecture of the relay system. All of the components except for the Relay Session Manager have been coded. All of the major components are briefly described on the following page.

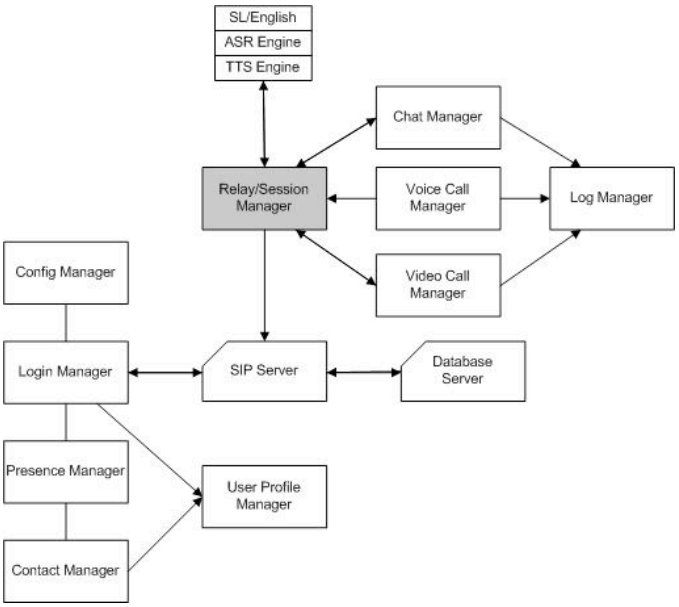

Fig. 1 Architecture Overview

- *Config Manager* stores configuration options such as software executable name, SIP default port, audio/video codec, audio/video device information, enable auto start, etc.
- *Login Manager* handles user login and logout.
- *Presence Manager* handles presence information. There are four options: online, offline, away and busy.
- *Contact Manager* manages a contact list for a Kiara user. A user can add, remove and modify a contact profile.
- *User Profile Manager* stores a Kiara user profile including name, birth date, phone number, SIP address, etc. It also enables the user to change the information.
- *Chat Manager* handles Instant Messaging using Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE).
- *Voice/Video Call Manager* handles calls using SIP and RTP/RTCP to transmit the voice/video stream.
- *Log Manager* records call activities.
- *Relay Manager* is the most important part in Kiara for Deaf telephony. This is the work-in-progress. Kiara needs a human interpreter help translate text, voice and video, but the relay mechanics are meant to happen automatically.

1) Session Initiation Protocol

The Session Initiation Protocol (SIP) is a standard for establishing sessions over Internet Protocol (IP) [4]. SIP's capacity to simplify creation, management and termination of sessions is ideally suited to build communication systems for the Deaf. SIP meets requirements for accessing a wide array of devices (telephone, mobile phone, PC) over a variety of networks (IP, WiFi, PSTN, 3G). This widespread availability enables any SIP-compatible device (soft phone, telephone, SIP-enabled cell phone, PBX, VoIP server) to work with our software.

2) User Interface

Deaf users at DCCT have a lot of experience with Instant Messaging, email and video chat. They are familiar with Skype and Google Talk, so we used those tools as a reference to build the user interface reference to Kiara.

D. Implementation Details

1) Server Side

Table 1 lists the services on the server side. Kiara integrates several fully open source software packages.

Table 1 Open source services used by Kiara

OpenSER	SIP registrar, proxy
Asterisk	Transfer calls from PSTN to IP network
MySQL	Restore user information

2) Client Side

Table 2 lists the open source libraries that a Kiara client is built on. For more information on Kiara, including documentation and source code, please refer to http://softbridge.uwc.ac.za/.

Table 2 Open source libraries utilized by Kiara.

oSIP	oSIP is an implementation of SIP
ortp	oRTP is an implementation of RTP
Qt	Qt is a cross-platform application framework for desktop and embedded development.
ffmpeg	Ffmpeg includes libavcodec, the leading audio/video codec library.
PortAudio	PortAudio is a cross-platform audio I/O library.
TinyXML	TinyXML is a simple, small, C++ XML parser.

III. CONCLUSION

In conclusion, Kiara is a SIP-based communication tool that currently supports synchronous communication of text, voice and video. All Kiara components, at both client and server side, are implemented in free and open source software. The goal is to use this functionality as a basis to design and build text and video relay services for the Deaf.

IV. FUTURE WORK

Kiara still needs several extensions to support both text and video relay for the Deaf. First, Kiara should implement automatic translation between text and voice using open source Text-to-Speech (TTS) and Automatic Speech Recognition (ASR) technologies. We may also use a human interpreter for speech-to-text instead of ASR. A human SASL interpreter is definitely needed to translate between text and sign language. Lastly, Kiara should support asynchronous messaging for text (like SMS), voice and video.

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