

A Video Conferencing System based on WebRTC for seniors

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Abstract—With the technology growing, traditional communication way is insufficient to meet everyone needs. Video chatting is gradually become more and more popular. There are many mature and free video chatting tools to use on the internet. However, for senior citizens, learning news is much more difficult, none of them are design for senior citizens, so that it is too hard for elder to use it, it is result in the elder have no wish to learn new things. Therefore, in this thesis, we focus on the needs of elder adults; this study use HTML5 and WebRTC to propose a video chatting system designed for senior citizens, the elder can video chatting without complex operation. In addition, we also combine it into the television, the elder can use remoter controller to watch television and chat to people at the same time. After chatting, the system will upload the chatting video to server and elder can share it to friends. In the experiment, the result shows that the senior citizens is interesting in this system, also, the elder thinks that the system is very useful, feel comfortable to use it. They can learn this system quickly.

Keywords—WebRTC; Video Chatting; HTML 5

I. INTRODUCTION

Now a day, if we want to talk to our friend, we just pick up the telephone and call a number. With the quick growth of internet, telephone is not the only one way to talk. There is lots of software on the internet such as Skype and Google hangouts that provide a free voice call service to user, allow to chatting with friends. People get used to chatting to friends by software. But now, traditional voice call seems dissatisfied with people, video call is the most popular way now, have a webcam or a smartphone can share a video call with anyone quickly.

To learn how to use video chatting on the computer or smartphone is easier for the new generation. However, it is painful for the senior citizens to learn new modern technology. We used to feel that the senior is not able to learn new things. But according to the research [1], the senior adults are willing to learning new technologies; unfortunately, they need more time to learn it, familiar it and a friendly environment to help them close to new technology. In addition, the aging population is worse and with the advent of the technology, learning new technology is an inevitable trend, the question is how to help senior person to learn. Although there are lots of

software provides free service such as video chatting, text chatting and voice chatting, however, it is too hard for the senior to use it. Little attention has been focus on provide any senior-friendly user interface. Easy to use is one of the key points when we are trying to help elders use new technology. For that reason, design and develop a system that provides video chatting for the elder to use is what the senior citizen needs.

In elders' life, television plays an important role. The elder person spends a lot of time on watching television. Some researcher tries to integrate the concept "lifelong learning" with television. "Lifelong learning" means as long as you live, keep learning how to live. By integrate the two things, the elders' shows better learning performance and feels comfortable to learn it, so that we can know the television will helps elder learning performance.

All mention above is the reason that we wants to design a video chatting system for elder to use. We can develop a video chatting interface and integrated it on the television, hopes the elder using the system to share his/her life to all their friends.

To make sure that everyone can talks to the elder in every place, a browser-based video chatting system without plugin is one of the major goal. WebRTC is one of our choices. By using WebRTC and HTML5, people does not need to download and install additional apps or plugins, they can simply use the browser to chat. Only need to click the URL, open the browser and talks.

Another goal is design a senior-friendly interface for elder to let them feel no difficult when using the system. As of right now, video chatting need to use computer or smartphone, but many of senior citizens does not own a computer or are not able to use computer without assistance, using compute us a big trouble. To assist the senior, we want integrated the system into television and hope the system is simply enough that the elder only click the television remote controller and then the communication will start, without using mouse or keyboard. In this way, the senior citizens can chat with friends while watching television.

WebRTC is a free, open project that enables web browsers with Real-Time Communications (RTC) capabilities via simple

JavaScript APIs. It can start a real-time communication via browser without any other plugins, and it is available in Chrome, Opera and Firefox. Users only need to install the browser and can start a chat without install additional plugin. Website with WebRTC can talk to each other with different OS version or different browser. The overall architecture is shown as Fig. 1 Web App developer will be interested in the Web API layer, there are many APIs in this layer that developer can use it to for developing web based videochat-like application. In order to acquire and exchange the media stream between browser, WebRTC using the following two APIs:

MediaStream is an API used to get audio and/or video media stream from local device, e.g. Webcam as an input. The MediaStream object collects the input stream and RTCPeerConnection reads the data from the output of MediaStream [2][3]. RTCPeerConnection is an API provides the connection establishment between two users. To establish a peer-to-peer connection, the STUN [4] protocol and TURN [5] are used by the ICE [6] framework to cope with NAT traversal and other network vagaries. The STUN and TURN are provided by Google [7]. The connection will be established after ICE find a way to directly connected to peers [8][9][10].

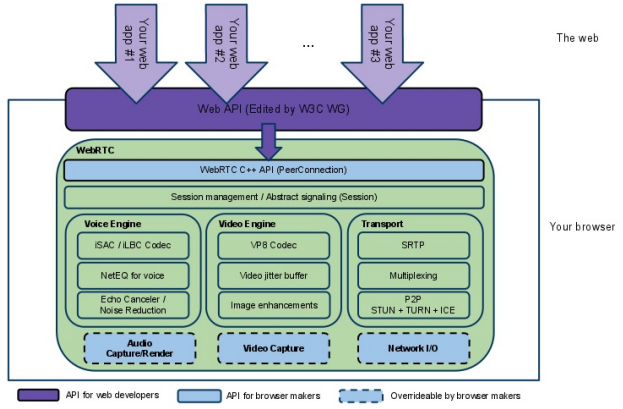


Fig. 1. General overview of WebRTC [11]

II. SYSTEM DESIGNED

A. System Overview

The objective of the paper is proposing a web chatting system that is specially designed for senior citizens. Fig. 2 shows the overview of the web chatting system. In the figure, the elder sends a message to carer through the server, and then the carer reply a message to the elder, finally the two peers communicates to each other.

The system workflow is shown in Fig. 3. First, system checks whether if the user is first time login to system, if yes, user is asked to enter account and password to login the system. After user login to the system, system sends the chatting request to all the friend of user via Email and wait for friend's response. After receives first response from friend, system used the WebRTC API to set video and audio connections between user and friends and recording the video and audio media at the same time. After the chatting, system

uploads the audio and video file to server and server transcode the two files to one .mkv file and keep in video server. After that, friend can watch the recording video file on the website.

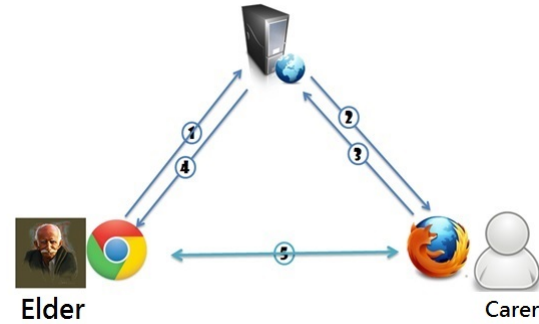


Fig. 2. The overview of the web chatting System

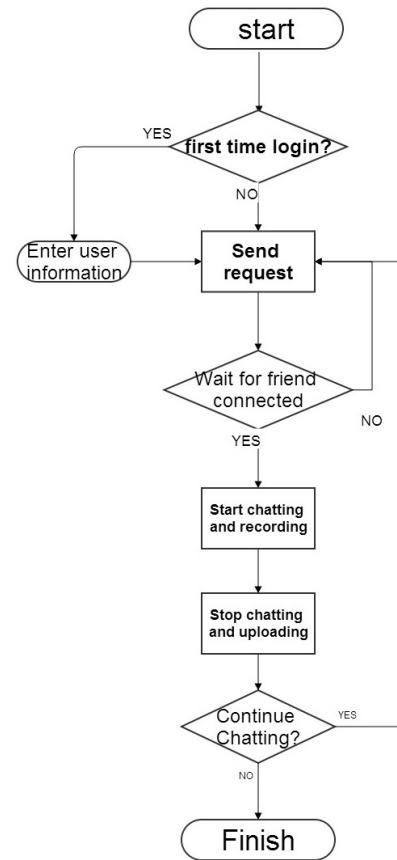


Fig. 3. The system workflow for elder

The main theme of this system is to develop a system for the elder. A system designed for the senior citizens should be allowed them feels the system is very easy to learn. In order to make it simple, the elder man does not need to do anything except for talking to friend in this system. All the steps are completed by the system in the background or triggered by the friend.

B. User Interfaces

In this system, we design two different interfaces for user. One is video chatting interface designed for the elder and the other one is the user management interface designed for carer. We will introduce these interfaces briefly and the detail will be described in the following section. TABLE I shows the main features of video chatting interface for elder.

1) *Auto Login*: If the user is the first time login to the web chatting system, user need to enter account and password to enter the system, the information of user will be stored as COOKIE because COOKIE is stored in the computer, and system can use COOKIE to maintain the login status of user so that user doesn't need to enter account and password again next time using system.

2) *Video conferencing*: This system provides user a browser-based video chatting interface, the two peers can see and talk to each other after the connection established. In addition, this system allows make call to participants on any device and anywhere.

3) *Auto friend/relative calling*: This feature is to help user invite friend to the chatting room. After user login to the system or participants leaves the communication, the system sends the chatting room URL to user's friend by Email, invite them to join the communication.

4) *Video recording and playback*: This system provides recording function that helps user records the communication process and uploading the record video after the communication is over. The upload video will be share to friends and friend can find the video in the user management system.

TABLE I. FEATURE OF VIDEO CHATTING INTERFACE FOR ELDER

Features	Description
Auto login	If user have been login to the system, it will auto login next time
Video conferencing	Providing a chatting interface between two peers, allows them to make calls to anyone uses any devices anywhere
Auto friend/relative calling	The system will helps user to send an invite message to friends.
Video recording and playback	The system will record the chatting video while chatting and uploads that record to the server

C. Video conferencing

WebRTC (Web Real-Time Communication) is a project that enables user communication to each other via browser. The following is a description of set up two connections between two users.

As shown in Fig. 4, it shows the exchange flow of real-time media stream between browsers. At first, browser will get user's video stream and audio stream via GetUserMedia [12] API from input devices, and then the video stream and audio stream will be encoded into many packets. The packets are transmitted across the network after the network is setting. At the media endpoint, browser decoded the packets, formed into a media stream and attach stream to output devices

A video stream is transported from local peer to the remote peer on a RTP link and a RTCP link. The remote peer also transported the video stream on the same way. It means that a user needs to maintain four links to establish a two-way video chatting.

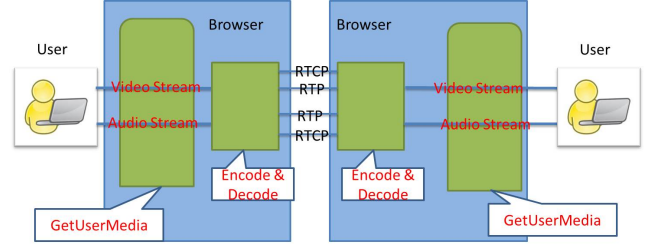


Fig. 4. The exchange of real-time media flow

D. Auto friend/relative calling

Video chatting is a two-way communication between two users. That is, invite a friend to chatting room is an important thing to this system. Here, we provide a friend notifications feature to help user notify his friend when they are ready to chat. After user login to system, system will help user to invite friend to the chatting room. When friend connected in, they can communicate to each other.

Fig. 5 displays the diagram of send an invite message to friends. System will send an invite request to friend's mail box according to the user's friend list and friends can enter the chatting room by click the URL on the mail.

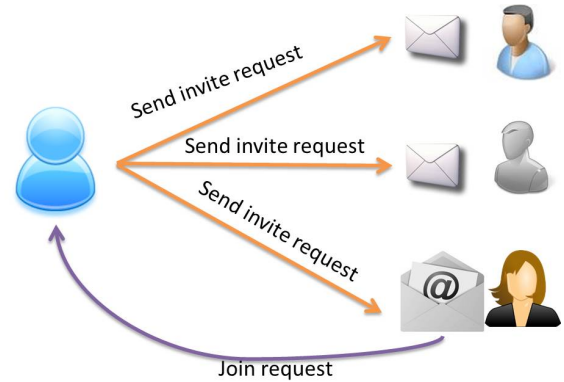


Fig. 5. Send an invite message to friends

Owing to this is a one-to-one video chatting, after friend connected, the system sends a "The room is full" message to other friends. Fig. 6 shows diagram of notify the room is full.

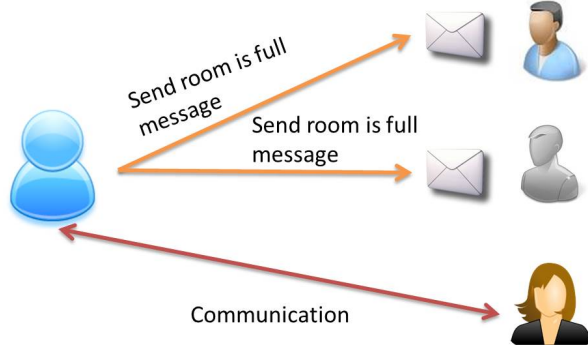


Fig. 6. Notify friends that the room is full

E. Video recording and playback

Video recording is a way that translating the live stream to a format files which can be store in device. By recording the media, users who miss the communication or forgot something important in the communication can watch the replay after the communication at any time and carer can know what happen to the elder when accident happened.

In recording aspect, because getting media stream from webcam is not easy, but the media stream is present as a media element on the webpage. Instead of getting stream from webcam, it is easily record the media stream at the media element. A StereoRecorder [13] is an open source web video and audio recorder. Here, we use the StereoRecorder for recording media from local peer. The recorder start recording when the remote peer join the communication and stop recording when remote peer leaves the communication. The recorder will generate a video file and audio file.

In uploading aspect, after recorder generate video and audio file, system use POST method to upload video and audio to server. Servers will transcode the two files into an .mkv file by using FFmpeg [14], and move it to the file server. Fig. 7 shows the architecture of recording and uploading video.

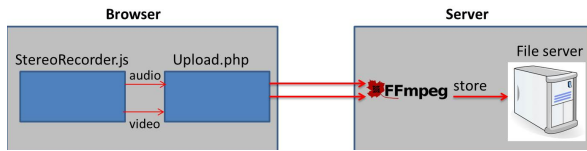


Fig. 7. The architecture of recording and uploading video

III. EXPERIENCE RESULT

The main idea of this paper is to provide a system designed for senior citizens, in order to verify the system whether suitable for seniors; we use questionnaires to verify it.

We use SUS [15] to verify the system. The SUS was released into the world in 1986 by John Brooke. SUS is a famous valuable tool for measuring the usability like hardware and websites. The purpose of SUS is to help us to find the usability of this system, to see if it meets the user needs. The SUS consists 10 items and each item's score contribution will range from 0 to 4. The respondent should check all the items

on the questionnaire. If the respondent cannot response it or think too much time, the item should mark the third position. The total score is 100, for items 1,3,5,7 and 9; the contribution is the position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the position. Then multiply the sum of the score by 2.5 to get the final value of SUS.

To verify this system, we invite 14 participants to use this system and hopes them can give advices to this system. Their age ranges from 50 to 68. The basic information of participants shows in TABLE II and TABLE III. The participants include 9 males and 5 females. Most of the participants are not familiar with computer; some of them even have no smart phone and computer. Most of the using computer time for them is working, seldom using computer at home. There are 9 participants use the internet service more than 10 years, 1 participant use the internet service more than 4 years but less than 7 years, 2 participants use the internet service more than 1 year but less than 4 year and the other 2 participants use the internet service less than 1 years. There are 6 participants use the internet service less than 1 hour on average each day, 8 participants use the internet service more than 1 hour but less than 4 hour each day. All of them are familiar with television, 14 participants use the television for more than 10 years. There is 2 participants use the television less than 1 hour each day and the other 12 participants use the television more than 1 hour but less than 4 hours. 3 participants have been used kind of video chatting system before and another 11 participants have no experience on video chatting system.

TABLE II. PERSON INFORMATION OF PARTICIPANTS I

Participants	Gender		Use internet experience(Year)				Using internet per day(Hour)		
	Male	Female	>10	4~7	1~4	<1	4~7	1~4	<1
14	9	5	9	1	2	2	0	8	6

TABLE III. PERSON INFORMATION OF PARTICIPANTS II

Watching television experience(Year)	Watching television per day(Hour)		Video chatting experience	
>10	<1	1~4	YES	NO
14	2	12	3	11

To make sure the elder can use this system, it needs make this experiment in person. We invite two participants at a time, one is senior person and the other one is the person who wants talk to the senior.

The experiment has three stages: introduction, demonstration and questionnaire. Each stage spends about 15 minutes, totally 45 minutes. The experiment device includes two laptops, two webcam and a television, the experiment environment is shown in Fig. 8. First, one laptop output its screenshot to television, simulate as a set-top-box on the television and place a webcam on the top of television. The television is for the elder. Another laptop is for the people who want to talks to the elder. The elder is sitting in front of the television and friend sitting in the other side. All the devices will be setting up before the experiment getting start.

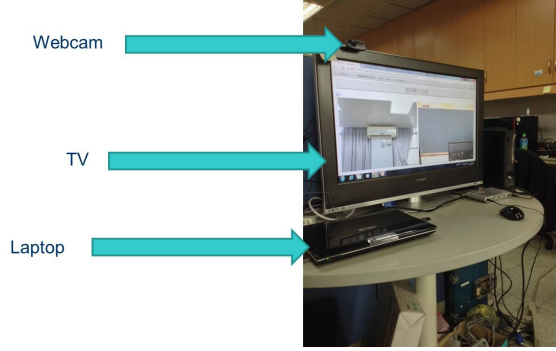


Fig. 8. Experiment environment

The first stage is “introduction”, the purpose is to introduce this system to participants, teach participants how to use it until they sufficiently know how to operate it. The second stage is “demonstration”, after introduce the system, this stage is let the participants to operate the system, video chatting to each other. By watching and listening to the participants trying our website, it gives more information whether the system is friendly or can find some problems. The third stage is “questionnaire”, after demonstration, the SUS questionnaire gives to participants, we explain every question on the questionnaire and exchange options when they filling it. The questionnaire allows us to know the usability about the system, and we wants the participants could give helpful advices and options to make the system better. After fill out the questionnaire, we will discuss the system with the participants to know their feeling to the system.

TABLE IV presents the statistics of the of the system questionnaire. There are 14 valid questionnaires. The mean SUS score is 74.64, the maximum score of questionnaire is 92.5 and the minimum score of questionnaire is 50 and the SD (standard deviation) is 10.17.

To compare and better understand when using SUS, according to Aaron Bangor [16], the research claims that the SUS score of an acceptable system needs above 70, better system needs score high 70 to upper 80. A commercial system SUS must above 90. The research also shows a comparison of adjective rating scale and acceptability ranges, in this comparison, the score more than 70 but less than 85 is between “GOOD” and “EXCELLENT”. According to the acceptability provided ranges by Aaron Bangor, the result is “acceptable” but not guarantees high acceptability.

The SUS questionnaire responses are shown in TABLE V. Mean in the table indicate the position of participants’ choice, SD is the standard deviation of participants’ choice. According to the results in TABLE V, we can find that there are many things we can discuss. The question “I thought the system was easy to use.” gets the highest score of the questionnaire and the lowest SD, the results reveal that participants thinks they can handle the system. And score of the question “I think that I would like to use this system frequently”, “I felt very confident using the system” and “I would imagine that most people would learn to use the system very quickly” is all above 4, it shows participants is interest in the system, feel the system is

easy to use and wants to use the system if we provide it to them.

But in the question “I think that I would need the support of a technical person to be able to use the system”, the SD is 0.88 which is the highest, high SD means participants have different options on this question. While some participants think the system is easy to use and easy to learn, some participants still feel insecurity when use it, the fact is that they still thinks need a technical person to help them if the system faces problems, they does not know how to deal with computer.

In addition, we also asking two additional questions to participants for system functionality which SUS have not mentioned, the questions are “I think this system is designed for elder” and “I think this system integrate into television is suitable”. These questions have five check boxes, from “Strongly agree” to “Strongly disagree”. In order to get more detail comments, we asking three short answer to make sure the option of participants.

TABLE IV. Statistics OF VIDEO CHATTING SYSTEM QUESTIONNAIRE

	N	Mean	Min	MAX	SD
Statistics	14	74.64	50	92.5	10.17

TABLE V. SUS Questionnaire RESULT

System Usability Scale	Mean	SD
1. I think that I would like to use this system frequently.	4.00	0.76
2. I found the system unnecessarily complex.	1.93	0.59
3. I thought the system was easy to use.	4.29	0.45
4. I think that I would need the support of a technical person to be able to use this system.	2.29	0.88
5. I found the various functions in this system were well integrated.	3.71	0.88
6. I thought there was too much inconsistency in this system.	2.21	0.67
7. I would imagine that most people would learn to use the system very quickly.	3.93	0.59
8. I found the system very cumbersome to use.	2.00	0.53
9. I felt very confident using the system.	4.36	0.61
10. I needed to learn a lot of things before I could get going with this system.	2.00	0.65
SUS Score: 74.64		

TABLE VI. RESULTS OF THIS SYSTEM IS DESIGNED FOR ELDER

I think this system is designed for elder	
Comment	Number
Strongly Agree	3
Agree	9
No comment	2
Disagree	0
Strongly disagree	0

TABLE VII. RESULTS OF I THINK THIS SYSTEM INTEGRATE INTO TELEVISION IS SUITABLE

I think this system integrate into television is suitable	
Comment	Number
Strongly Agree	3
Agree	10
No comment	0
Disagree	1
Strongly disagree	0

In TABLE VI, it shows the result of question "I think this system is designed for elder". There are 3 strongly agree, 9 agree and 2 no comment, the results show that most participants agree the system is specially designed for the elder. 12 participants agree the design of video chatting system. The other 2 people think they need more time to get used to the system, so they have no comment.

The result of the question "I think this system integrate into television is suitable" shown in TABLE VII There are 3 participants strongly agree the integration and 10 participants agree the integration and the other 1 participant disagree the integration. Almost all the participants agree the integration but one. The reason of the one participants is that he thinks while idea of integrate the system into television is suitable, but our system is not integrate very well, the system should be better

IV. CONCLUSIONS

With the advance of technology, a voice call seems not satisfy to people. Now, people prefer video call rather than voice call. Through plenty of free software that provides video and audio service, there is no software provides a friendly user interface for the elder person. To helps the elder to learn and use the video call, we propose an easy-use video call system especially designed for the elder and combine it on the television. After user login the system, it will invite elder's friend to chatting and waiting for friend connected. User can watch television and waiting at the same time until a friend connected. During the whole chatting process, user only uses the remote controller to switch the source of television. In this way, elder will be feel comfortable use it. In addition, the chatting system is based on browser and does not need to download and install any plugin or Apps. Therefore, people can care about their elder anytime and anywhere as long as they have a smart phone, laptop or tablet.

Furthermore, the system can be used as an elder care system. In traditional, a social worker needs to visit solitary elder every day, but it is inefficient. With this system, social worker can know the situation of elder as soon as possible, reduce the frequency to see elder in person. We provide recording video function in our system; carer can record the whole meeting procedure.

In the analytics of SUS, our result indicated that most users considered the system was easy to use and they have confident to use it, the SUS score is 75 reflects user derived a high opinion to this system. According to the short answer, we also find participants give favorable consideration to this system.

The most contribution of this video chatting system to users is that this system provides an senior-friendly interface for the

elder to use; the elder can learn and use the system quickly, once the elder learns how to use the system, carer can use the system to master the situation of elder. This is the difference between this system and other communication software.

In conclusion, we propose a system that designed for the elder person. According to the experiment result, these finding confirms most of participants think this system helps elder to learn how to use video chatting, and the elder can learn this system quickly.

ACKNOWLEDGMENT

This paper was supported by the Ministry of Science and Technology of the Republic of China under Contract No. 102-2511-S-009 -006 -MY3.

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