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Real-Time WebRTC-Based Application for Psychological Support During COVID-19

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ABSTRACT

Crisis or outbreak may cause any individual to be mentally and emotionally affected. The Coronavirus Disease 2019 (henceforth Covid-19) pandemic had cause a deep and universal impact on global mental health as many struggles to survive within restricted and uncommon lifestyle. During the Covid-19 pandemic, any individual may experience stress, anxiety, sadness and loneliness. Therefore, some of affected individuals might need a platform to enable them to express their thoughts and feelings anonymously without exposing their identities. This paper proposed a real-time WebRTC-based communication platform to facilitate the needs of mental support by affected individual during the pandemic and Movement Control Order (henceforth MCO). The proposed model uses the concept of random call and anonymity during the two-way communication via Voice over IP (VoIP). The application implements WebRTC to support the real-time communication. The signalling server is used to initiate the connection between the client and STUN/TURN server to run the network addresses translation. Furthermore, to ensure anonymity in the communication channel, a randomization algorithm has is implemented.

Key words : COVID-19, Real-time communication, VoIP, WebRTC.

1. INTRODUCTION

Real-time communications (RTC) is any telecommunications mode in which all users can exchange data with negligible latency or instantaneously. The word “real-time” in this context is synonymous with “live” [1]. RTC generally refers to peer-to-peer communications, not broadcast or multicast [2]. Examples of real-time communications are Voice over IP (VoIP), Internet Relay Chat (IRC), Instant Messaging (IM), Mobile and cellular telephone. Examples of applications that use RTC are WhatsApp, Skype, Telegram, Viber and many more.

In 2011, google has introduced an open source project known as WebRTC. WebRTC allows real-time communications through a JavaScript API [3]. Web browsers users will be experienced peer-to-peer based synchronous capacities through WebRTC. WebRTC provides the browser and mobile applications with audio/video calling, chat and peer-to-peer file sharing without the needs of having third-party software or plugins [4].

Mental health is like physical health, where everyone has it and need proper cares. Good mental health means, capable of thinking, feeling and reacting in a good way. however, if an individual going through a period of mental health disorder, they may face difficulty in handling their minds, feelings and reactions towards surrounding. This may feel as bad or even worse than a physical disease [5].

Coronavirus (COVID-19) has been considered as a life-threatening pandemic disease due to fast spreading infection around the world and hard to control. Therefore, it has become global attention and considered as one of life-threatening pandemic diseases [6],[7]. In Malaysia, the 2020 Movement Control Order (*Perintah Kawalan Pergerakan Malaysia 2020*), commonly referred as the MCO is implemented as a preventive measure by the federal government of Malaysia in response to the COVID-19 pandemic in the country starting 18 March 2020.

During the Covid-19 outbreak, many parties are affected either by group or individuals. Dealing with a problem during the Covid-19 outbreak [7][8], lead some individuals to feel tense, nervous and worried which are also major causes of suicide cases and mental illness, commonly depression. People who are feeling suicidal are overwhelmed by painful emotions and see death as the only way out, losing sight of the

fact that suicide is a permanent "solution" to a temporary state [9].

In this paper, the Real-Time WebRTC-based model is implemented to provide a new alternative to support mental health during the COVID 19 outbreaks.

2. REVIEW OF LITERATURE

This section reviews related literatures to mental health disorder including the causes, signs and symptoms and interventions. In addition, there are two (2) mental health supports system reviewed.

2.1 Mental Health during COVID-19

World Health Organization [10] describes mental health as an integral and essential component of an individual health. Good mental health means and individual aware of his or her own capabilities. Everyone should have skills to manage the stress level in daily life, work productively and involve in any activities with the community. on the other hand, poor mental health refers to the disabilities in control own emotions, depression, suffer from anxiety and post-traumatic stress disorder (PTSD). The causes, signs and intervention of mental health during COVID-19 [10]-[13] are discussed as the following.

A. Causes

Digital or Online Media. The COVID-19 outbreak [8], [14] may cause a person to experience panic and anxiety due to the absence of information or facts about the crisis. They must face the fake news being spread online through social media or any digital platform. These make individuals to have fear and keep thinking about the impact of the crisis.

Restriction of Movement. When the government enforces Restriction Movement Order and Conditional Movement Control Order [15], [16], people must stay at home. Depending on how individual response to the changes of this new norm the psychological impact on individual may varies. Those that having a day routine such as perform outdoor activities have experienced the difficulties that led to helplessness, loneliness, and depression.

New Norms. Because of the crisis, people have to adapt themselves to the new norms such as working from home (WFH), learning online (ODL), home-schooling of children etc.

B. Signs and Symptoms

Normalities. Those who suffer from mental health will have a drastic change in sleeping pattern and their appetite. The individual will also have an extreme mood changes.

Behaviour. In addition, the individual will look tired and feel easily fatigued. They will lose interest on the things they love to do as well as try to isolate themselves from family. In the worst cases, they have the desire to increase alcohol or tobacco intake.

C. Interventions

Family Support. During the Movement Control Order (MCO), to maintain good mental health, it is an essential to stay connected with family members either via email, any social media platform such as WhatsApp, Instagram, video conference and phone call.

Leisure and Routines. People have been encouraged to create a new hobby or new routine in their life during the MCO. This is important to avoid individual from looking or surfing the Internet to fulfil their time which indirectly would save them listening to rumours. The presence of mobile technology makes it possible to people in regulating basic life functionalities [17].

Spiritual and Holistic. During the crisis, as Muslims, they are recommended to perform solat Jemaah (congregational prayers) with family members. By doing this, they can mitigate their fear and loneliness.

Organizations. As part of its public health responses, WHO has worked closely with partners including Mental Health Innovation Network (MHIN) and Malaysian Medical Relief Society (MERCY) Malaysia to develop a set of new materials on the mental health and psychosocial support aspects of COVID-19. Ministry of Health Malaysia also has formed a response team named Crisis Preparedness and Response (CPRC). In addition, there are several non-profit organizations (NGO) involved together by offering their services to support people that need help.

2.2 Mental Health Support

Instead of self-care approaches, there are several support systems available online worldwide that provide services to facilitate and help those with mental health illness [12]. This paper provides overview of three (3) well-known support systems that collaborate closely with World Health Organization (WHO) during the crisis namely Crisis Preparedness and Response Centre (Ministry of Health, 2020), Mental Health and Psychosocial Support (MPHSS) namely Mental Health Innovation Network [18] and Malaysian Medical Relief Society [19] Malaysia.

Mental Health and Psychosocial Support (MHPSS), refer to

any kind of external and local support, which provides services to help, educate, protect and even promoting psychosocial well-being including preventing and treat mental illness. These include the involvements in education, health and community based- services.

The services are delivered to the needy based on the model in Figure 1. The model details the role in each level of the needs. By looking at the bottom-up approach, the delivery of MHPSS services begins with basic service that is required by all levels of victims involved in COVID-19 outbreak, then the rebuilding of community and family support, followed by focused and specialized services to a smaller subgroup within the affected community in this crisis.

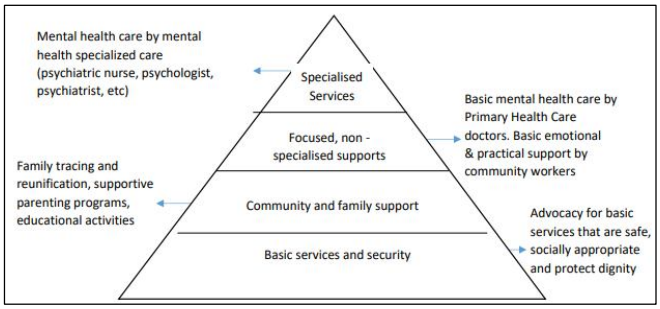

Figure 1: Intervention Pyramid for Mental Health and Psychosocial Support in Emergencies by Inter-Agency Standing Committee [10]

For the COVID-9 outbreak, MHPSS also outlines the step-by-step procedure that has to be taken carefully for mental health and psychosocial support services for Persons Under Investigation (PUI), Health Care Workers (HCW) / response workers and reporting mental health and psychosocial support activities.

Persons Under Investigation (PUI). Firstly, the PUI will be assessed using Depression Anxiety Stress Scales (DASS). If the result is negative, PUI will be monitored and supported through online psychoeducation activities by providing them with information on tips of handling stress in crisis. This approach can be seen in digital platform such as digital content on the television hosted by most of channels worldwide. However, if the result is positive, PUI will be further treated using MHPSS schemes such as individual session or group session by MHPSS team or Psychology officers. If the PUI is getting better, he will be monitored regularly through online psychoeducation activities. However, if there are no changes shown by the PUI after sessions conducted, PUI will be referred to Family Medicine Specialist and Psychiatrist.

Health Care Workers (HCW) / Response Workers. Based on the MHPSS scheme, the steps taken to help HCW are similar to PUI except for the negative result, the HCW will be treated using Psychoeducation and information on stress management in crisis, art therapy and relaxation.

Reporting Mental Health and Psychosocial Support Activities. For future references, MHPSS also outlined the reporting process of mental health cases and psychosocial support to CPRC. Right after the MHPSS activities are implemented, MPHSS staff will write a report and send the report to be verified by state non-communicable diseases (NCD) officer. Finally, after the verification by NCD, the report will be sent to National CPRC.

A. Crisis Preparedness and Response Centre (CPRC)

Crisis Preparedness and Response Centre (CPRC) plays an important role in helping the government to educate citizens and giving valid information regarding the statistics and useful information related to health. Due to the wide availability and reach of mobile applications or platforms [20], CPRC has created a Telegram channel; *CPRC Kementerian Kesihatan Malaysia* for executing their purposes. Until this article is written, the channel has about 840,600 subscribers in total.

CPRC will update the statistics of cases every day. Besides, CPRC team also updates citizens with the latest news from Ministry of Health, Ministry of Defense and other related departments or ministries. The most important content of the channel is the posters of guidelines of the crisis handling procedure such as the standard operation procedure (SOP) and health and psychosocial education.

B. Mental Health Innovation Network (MHIN)

Mental Health Innovation Network (2020) is a community of mental health innovators comprises of scholars, experts, policy-makers, service user advocates, and donors from around the world. MHIN becomes a platform for the community to share innovative resources and promote the importance of mental health in order to improve the lives of people with mental, neurological and substance use disorders.

MHIN's core team is based at the Centre for Global Mental Health at the London School of Hygiene & Tropical Medicine and WHO's Department for Mental Health and Substance Abuse. The collaboration is focusing to highlight the incredible efforts of individuals and organisations providing mental health and psychosocial support during the COVID-19 pandemic.

MHIN provides a resourceful page that contains useful information, blogs and webinars provide practical solutions to the challenging issues we are all grappling with.

C. MERCY Malaysia

MERCY Malaysia (2020) is known as an international non-profit organisation focusing on providing medical relief,

sustainable health-related development and risk reduction activities for vulnerable communities, in both crisis and non-crisis situation.

On March 24, the Health Ministry's CPRC and MERCY Malaysia launched a support hotline for those who had affected by the pandemic. Since the launched, one third of the calls received is related with psychological problems. This number is expected to increase as the virus continues to spread and Malaysians are placed under increasingly strict MCO.

2.3 WebRTC in Communication

WebRTC is a unrestricted, open project that provides mobile applications and browser with Real-Time Communications (RTC) capabilities via simple APIs. WebRTC is a collection of standards, protocols, and JavaScript APIs that enables audio, video, and data sharing between browsers in a peer to peer (P2P) fashion [21]. The main objective of WebRTC is to enable rich, high-quality RTC applications to be developed for the browser, mobile platforms, and IoT devices, in order to allow them to communicate via a common set of protocols. The WebRTC initiative is a project supported by Google, Mozilla, and Opera, amongst others.

WebRTC APIs are built around three core concepts: 1) Mediastream: an abstract representation of audio/video data streams that serves as a handle to control activities such as displaying, recording, or sending information to a remote peer; 2) RTCPeerConnection: a WebRTC protocol stack interface that is responsible for transmitting data streaming between browser peers by providing an abstraction for the multimedia bidirectional communication channel; 3) DataChannel: a component that provides a particular transport service that allows peer-to-peer data exchange between web browsers [22].

Figure 2 shows the System Architecture of WebRTC. For the peers to be introduced together, a signalling server written by node.js is required. The STUN server is used to find an optimal path to relay the media. The reason why WebRTC was chosen for this project because there are many new features that are more advanced than other technologies including VoIP [23]. These features are shown in Table 1.

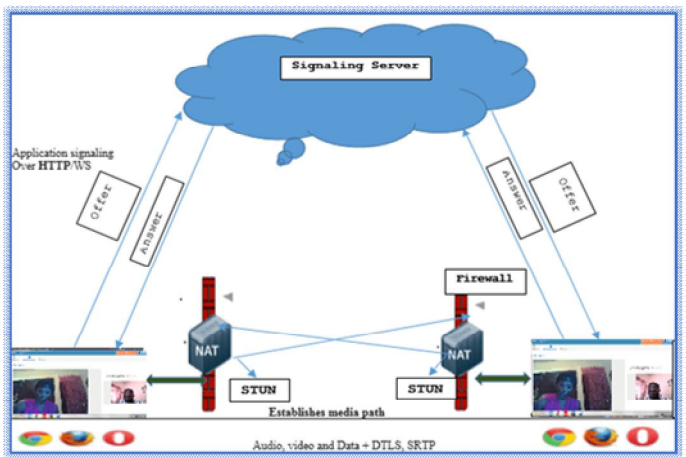

Figure 2: P2P System Architecture of WebRTC [24]

Table 1: Features of WebRTC [23]

Feature	Standard	Importance
High audio and video quality	Opus audio codec, VP8 video codec, and others	During congestion, it will adapt with possible new codec
Peer connection	ICE for hole punching.	peer-to-peer direct media is better than server-relayed media in terms of reliability and quality.
Support for multiple media types and multiple source of media	Standard signalling and APIs to negotiate format and size of each media source individually	Efficient use of bandwidth and resources due to the ability to support multiple type sources and type of media.
Self-adaptive to network conditions	Multiplexed RTCP and SAVPF	Feedback on network conditions is essential for the high definition, high bandwidth WebRTC sessions.
Multiple media streams and media types sent over a single transport	SRTP and SDP extensions	Sending all media over a single transport is more reliable and efficient.
Secure voice and video	SRTP encryption and authentication	Encryption and authentication mean others cannot interfere with voice and video
Platform independence	Standard APIs from W3C and standard protocol from IETF	WebRTC code can run across different OS, browsers, and devices.

3. Real-Time WebRTC-Based Model

This project proposed the use of WebRTC to enable the peer connection with the implementation of Voice over IP (VoIP). This application supports a random voice call and maintaining the concept of anonymity within the communication channel.

3.1 Proposed System Architecture

The proposed model implements three servers which are the application server, signalling server and STUN/TURN server. The application server hosts the application's functions with the database and authentication whereas signalling server is used to initiate the connection between the clients. The mechanism of passing message between clients and server is not implemented by the WebRTC APIs, therefore we use the signalling server. The external network address will be handled by the STUN server. Meanwhile, the process of relay traffic during the failure connection of direct peer-to-peer is done by the TURN server.The client can either be laptop or mobile phone which will be used as peer communication medium.

Figure 3 shows the proposed model. The clients will be connected via the signalling server first. STUN/TURN Server will only be used when it involves two different network addresses, then the application server's data will be sent to the clients, therefore, the peer connection will be initiated through the roles of WebRTC. After being connected to each other, both clients will be able to communicate via VoIP. A randomizer algorithm is implemented on the application server in order to randomize the call. The randomization concept will be explained in 3.2.

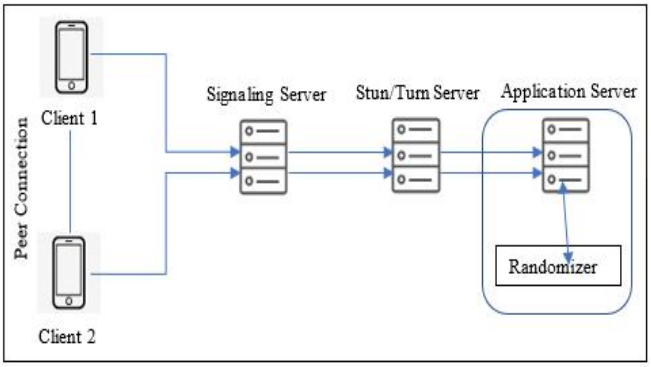

Figure 3: System Architecture for Real-Time WebRTC-Based Communication Application

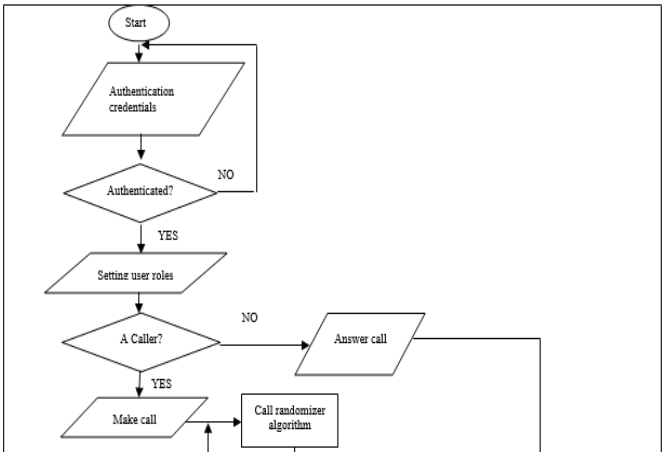

Figure 4: System Flowchart

Figure 4 simplifies the flow of the system. The user of the application enters the authentication credentials which are the username and password. The system will verify the credentials to allow only authenticated user. The user may set up his/her role either as caller, callee or can be both. As a caller, the user then may use the application to start a conversation anonymously by making a call. The application then will start to call the server to run the randomizer algorithm in order to randomize the call. If the callee is available, the server will start to initiate the call. Once the conversation is done, the application will automatically create the profiling of the caller and the callee. Both users need to answer a question which is to profile each other. Each user may view profiling details which include rating given and comments

3.2 Random Call Process

Figure 6 shows the random algorithm process. The random algorithm for the call process is divided into three steps; user checking, specification checking and rating checking.

a. User Check: Check the number of users available. If no user is available, alert pop-up will be displayed. If a number of users are available, then it will proceed to the next check which is specification check.
b. Specification Check: If there is no user with specification, it will proceed with the randomizer function. If there is more than one, then it will take the highest rating user for the next check.
c. Rating Check: If there is more than one user with the same rating, then randomizer function will be called. Otherwise, it will check the only one user whether it is free to call or not. It will be called if it is free, if not, the randomizer function will be called.

The randomizer function is used to randomize the callee based on the number of users available. The minimum value for randomizer is zero, while the maximum will be the number of users. After the random algorithm is used, the user will be called if he is free, otherwise it will be randomized again. Figure 5 shows the randomizer process.

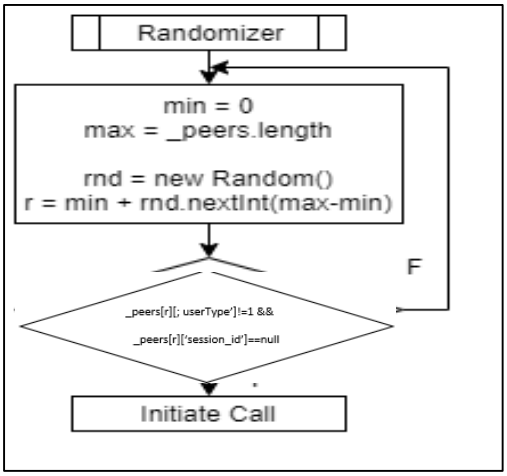

Figure 5: Randomizer process

4. IMPLEMENTATION

Figure 3 shows a simplified view of the architecture for our proposed platform. This platform use a WebRTC to enable the user to communicate in real-time and on the other hand stay anonymous. The user may communicate and share their thoughts during the COVID-19 pandemic without the needs of face to face meeting.

We can use this architecture as a psychological support, as shown in Figure 7, where the users can be the patient/public in one endpoint of the WebRTC session, and the remote psychological support, such as a doctor/therapist/psychologist or even a public, in the other endpoint. Finally, we create an anonymous environment to ensure the first end point user can keep sharing their problems freely. This could help those that are having depression or anxiety during COVID-19/Movement Control Order (MCO) to release the emotional burden without exposing themselves.

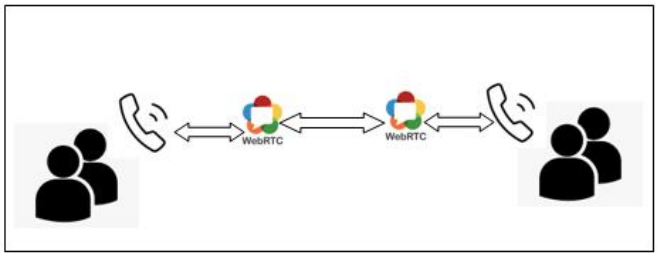

Figure 7: Adapted architecture for psychological support scenarios

Using the current state of the architecture, an implementation of the remote consultation is possible, where an expert is communicating with a patient using WebRTC. Finally, the patient has the access to the listener profiles and rating.

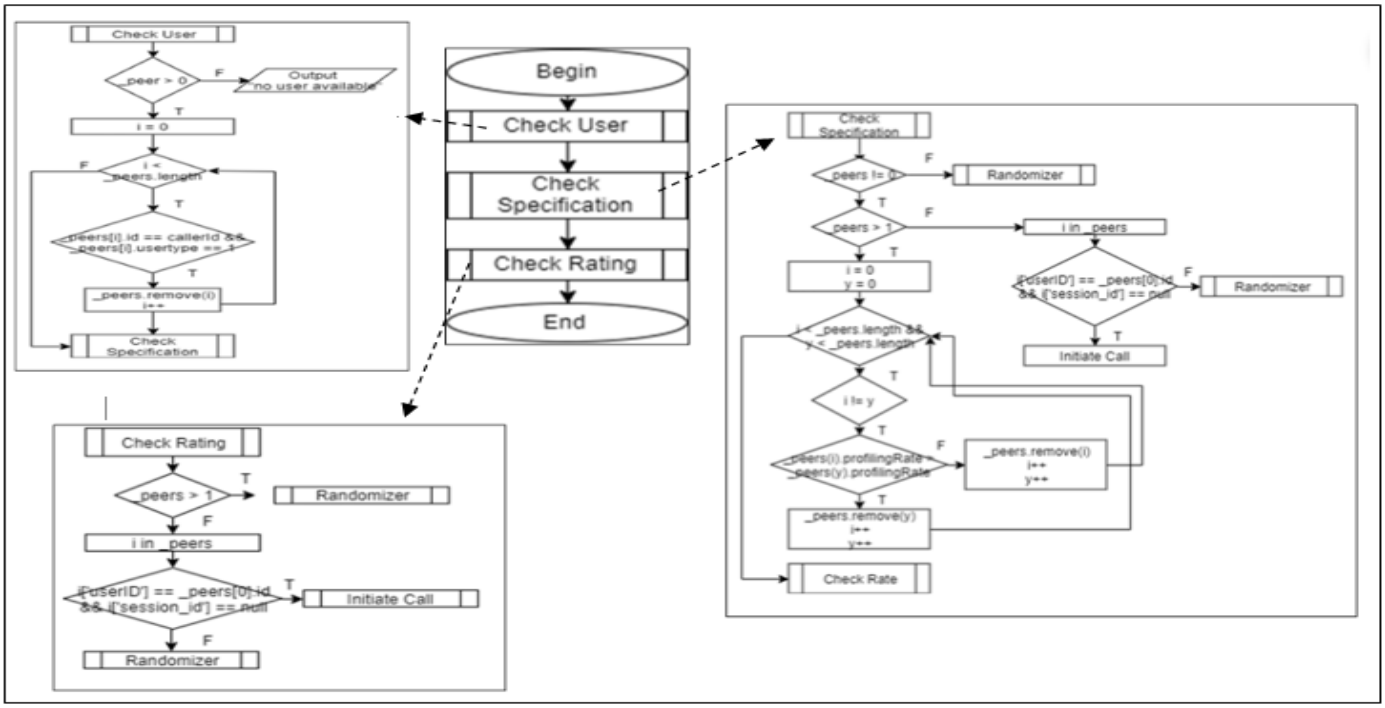

Figure 6: Random Algorithm

5. RESULT AND DISCUSSION

This project has proposed an architecture of WebRTC as a new platform for psychological support among mental illness patient. Therefore, we have conducted the User Acceptance Test on the targeted respondent. The testing focus on the performance of the application, user-friendliness and user objectives.

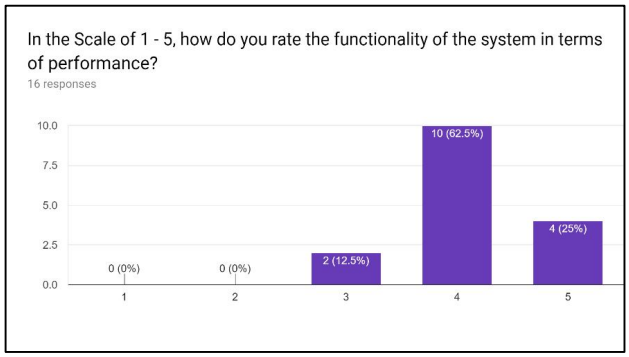

Figure 8: Result from responder regarding the functionality of the system (performance)

Figure 8 shows a result for the functionality of the system in terms of performance. 25% agrees that it provide an excellent performance whereas 62.5% agrees that it is good and 12.5% are on neutral. Overall, this platform provides a good performance due to the focus VoIP function only rather than any other unnecessary functions.

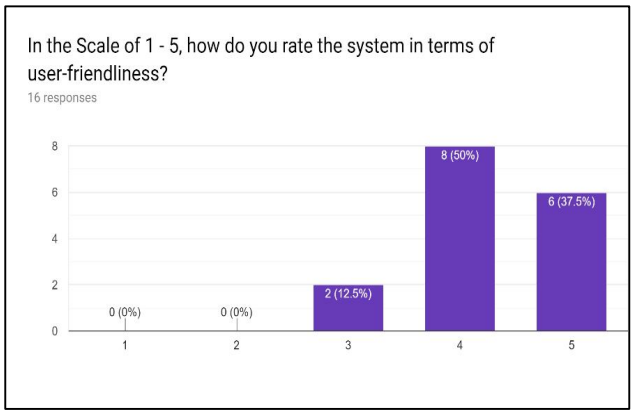

Figure 9: Result from responder in terms of user-friendliness

From Figure 9, 50% of the respondent agrees that it is good in term of user-friendliness, 37.5% respondents thinks that it is excellent and 12.5% of respondents are on neutral. This is due to the use of icons and button are comprehensible, easy to understand, and learnable application. Therefore, it makes this application user-friendly for the first-time user.

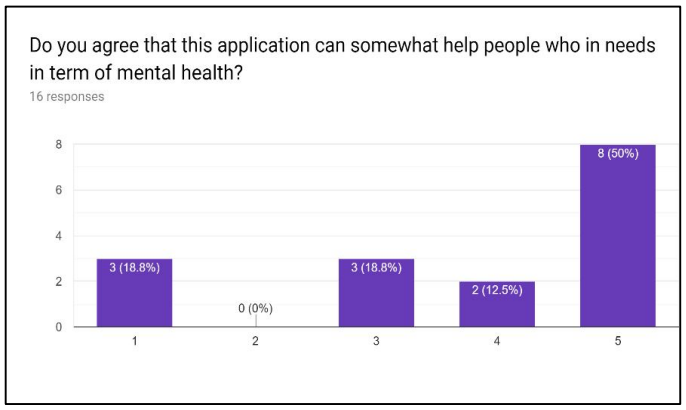

Figure 10: Result of user objective achievement

Figure 10 shows that 62.5% of the respondent agrees that they achieved their objective through this application and 18.8% of respondents are on neutral. However, 18.8% of the respondent disagree that this application enables to help them in achieving their objectives on helping them with mental support.

Results shows that, most of the respondent agrees that this is a good implementation of platform for mental illness suffered like a 'suicide hotline' where they can call when they need helps. However, 3 respondents disagree as they thought that it is susceptible to scammer or someone who want to take advantages to these people. However, this problem can be prevented through the profiling system that has been implement in this application.

6. CONCLUSION

During the pandemic, many suffer from the psychological problem as the effect of the COVID-19. People having difficulties in expressing their thoughts and feelings face to face because some may thoughts that they are overreacting toward the current pandemic situations. This may lead to more serious problem such as suicide thought. The need of support group increasing as the global pandemic remains. Therefore the objectives of this project is to proposed a new platform for psychological support during the COVID-19 using WebRTC by considering the needs of privacy, which has been successfully delivered.

We have proposed a model to facilitate the psychological support during the COVID-19 outbreak. The proposed model could help the people with mental illnesses expressing their thoughts freely without meeting face to face either to anonymous people or even to an expert by running the application and making a call. The server will find random people, both caller's and recipient's identity and information will be kept confidential to protect their privacy. This project

would be the best solution because it is free for users to use, convenient because it can be used anywhere, and it provides a platform for these people to express their feelings freely without the fear of getting judged or their circle getting affected.

The next step of our work is to run the prototype of this proposed model. We need first to evaluate the features of this prototype based on the main module which are; peer connection, call, call log, randomization algorithm and profiling. The second aspect is in term of the network performance. There will be two parts of network test which is to confirm the flow and the connection of the server-client and peer-to-peer between server and client, and client to client. Second, we will evaluate the network performance in terms of bandwidth, jitter and packet loss between server and clients.

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