



Faculty of Computer Science and Information Technology

Suicide Prevention Chatbot

Chong Hui Fern

Bachelor of Computer Science with Honors (Computational Science)

2020

SUICIDE PREVENTION CHATBOT

CHONG HUI FERN

This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science with Honours

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK

2020

CHATBOT PENCEGAHAN BUNUH DIRI

CHONG HUI FERN

Projek ini merupakan salah satu keperluan untuk
Ijazah Sarjana Muda Sains Komputer dengan Kepujian

Fakulti Sains Komputer dan Teknologi Maklumat
UNIVERSITI MALAYSIA SARAWAK

2020

UNIVERSITI MALAYSIA SARAWAK

THESIS STATUS ENDORSEMENT FORM

TITLE SUICIDE PREVENTION CHATBOT

ACADEMIC SESSION: 2019/ 2020

(CAPITAL LETTERS)

hereby agree that this Thesis* shall be kept at the Centre for Academic Information Services, Universiti Malaysia Sarawak, subject to the following terms and conditions:

1. The Thesis is solely owned by Universiti Malaysia Sarawak
2. The Centre for Academic Information Services is given full rights to produce copies for educational purposes only
3. The Centre for Academic Information Services is given full rights to do digitization in order to develop local content database
4. The Centre for Academic Information Services is given full rights to produce copies of this Thesis as part of its exchange item program between Higher Learning Institutions [or for the purpose of interlibrary loan between HLI]
5. ** Please tick (✓)

- CONFIDENTIAL (Contains classified information bounded by the OFFICIAL SECRETS ACT 1972)
- RESTRICTED (Contains restricted information as dictated by the body or organization where the research was conducted)
- UNRESTRICTED



(AUTHOR'S SIGNATURE)

Validated by



(SUPERVISOR'S SIGNATURE)

Permanent Address

Lot 3624, Lorong 22,
Taman Desa Wira, Jalan Batu Kawa,
93250 Kuching, Sarawak.

Date: 12/ 08/ 2020

Date: 12/ 08/ 2020

Note * Thesis refers to PhD, Master, and Bachelor Degree

** For Confidential or Restricted materials, please attach relevant documents from relevant organizations / authorities

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude and appreciation to my Final Year Project's supervisor, Dr. Bong Chih How for his patient guidance and suggestion throughout this project. Dr. Bong has offered me with a lot of constructive comments for this project.

Next, I would like to thank my family who always support and motivate me throughout the project. They have given me unlimited support by providing suggestions and feedbacks to enrich this project.

Lastly, I would like to thank my friends and course mates for helping me with their knowledge and experience that they had in my final year project. Their effort and time spend are highly appreciated.

ABSTRACT

Suicide is known as the most serious public health issues. There are many risk factors such as depression, bipolar disorder, personality disorder and so on. Comparing those risk factors, depression is the second leading cause of global death in the age range 15-29 years. Even though the effective treatments are available, yet it is still lack of resources, lack of trained counsellors and failed to provide services to the depressive group 24 hours. This causes the depressive group unable to seek help on time and the suicidal thought grow up in their mind. Therefore, a Messenger bot, namely Suicide Prevention Chatbot, is developed to provide help to depressive people with suicidal thought and people around them by providing useful resources. User can access this chatbot anytime as it is operated 24 hours. Chatbot might not be able to answer some of the questions from user but it will collect the unanswered questions and update the reply by human admin accordingly. Suicide Prevention Chatbot allows the user to measure their depression level by asking the questions based on Beck's Depression Inventory II and collecting the answer from user. This chatbot also allows the user to enquire suicide-related questions.

ABSTRAK

Pembunuhan diri boleh dianggap sebagai isu kesihatan yang paling serius. Terdapat banyak factor risiko seperti kemelesetan, gangguan bipolar, gangguan personality dan sebagainya. Kemelesetan dikenali sebagai penyebab kedua terbesar kematian global dalam julat umur 15-29 tahun. Walaupun rawatan yang berkesan boleh didapati, namun rawatan tersebut masih kekurangan sumber, kekurangan kaunselor terlatih dan gagal menyediakan perkhidmatan kepada kumpulan yang mempunyai kemelesetan 24 jam. Inilah menyebabkan kumpulan tersebut tidak dapat mendapatkan bantuan terus dan juga perasaan bunuh diri membesar dalam fikiran mereka. Oleh itu, Messenger bot yang bernama Chatbot Pencegahan Bunuh Diri diwujudkan untuk memberi bantuan kepada golongan yang mempunyai perasaan bunuh diri dan orang di sekeliling mereka dengan menyediakan sumber yang berguna. Pengguna boleh mengakses chatbot ini bila-bila masa kerana chatbot ini beroperasi 24 jam. Chatbot mungkin tidak dapat menjawab beberapa soalan daripada pengguna tetapi soalan tersebut akan dikumpulkan dan dijawab oleh admin manusia sewajarnya. Chatbot Pencegahan Bunuh Diri membolehkan pengguna untuk mengukur tahap kemelesetan dengan bertanya soalan berdasarkan Beck's Depression Inventory II dan mengumpul jawapan daripada pengguna. Chatbot ini juga membolehkan pengguna untuk bertanya soalan yang berkaitan dengan pembunuhan diri.

TABLE OF CONTENT

CHAPTER 1: INTRODUCTION	1
1.1 Introduction.....	1
1.2 Problem Statement.....	2
1.3 Scope.....	2
1.4 Objective.....	3
1.5 Methodology.....	3
1.5.1 Requirements Planning.....	4
1.5.2 User design.....	4
1.5.3 Construction.....	4
1.5.4 Cutover.....	4
1.6 Significance of Project.....	5
1.7 Project Schedule.....	5
1.8 Expected Outcome.....	5
1.9 Project Outline.....	6
CHAPTER 2: LITERATURE REVIEWS	8
2.1 Introduction.....	8
2.2 Review on Similar Existing Solutions in Helping Suicide.....	8
2.2.1 Befrienders.....	8
2.2.2 Lifeline.....	11
2.2.3 Live for Tomorrow.....	16
2.2.4 Summary of Existing Solutions.....	18
2.3 Comparison between Existing Solutions and Proposed Solution.....	21
2.4 Proposed System.....	22
2.5 Selected Instrument.....	22
2.6 Review of Tools and Technologies.....	23
2.6.1 Dialogflow.....	23
2.6.2 JSON Language.....	24
2.6.3 Facebook for Developers.....	24

2.6.4 Firebase	25
2.7 Summary	25
CHAPTER 3: REQUIREMENT ANALYSIS AND DESIGN	26
3.1 Introduction.....	26
3.2 Summary of Methodology	27
3.3 User Requirements and System Requirements	29
3.4 Software Requirement.....	30
3.5 Requirement Analysis	31
3.5.1 Use Case Diagram.....	31
3.5.2 Use Case Description	32
3.5.3 Sequence Diagram	39
3.5.4 Activity Diagram.....	41
3.6 System Design	44
3.6.1 Conversational Flow Diagram.....	44
3.6.2 System Architecture	45
3.6.2 View Layer	46
3.7 Conclusion	49
CHAPTER 4: IMPLEMENTATION AND TESTING	50
4.1 Introduction.....	50
4.2 Installation and Configuration of System Component.....	50
4.2.1 Visual Studio Code	50
4.2.2 Firebase	51
4.2.3 Postman.....	52
4.2.4 Proposed Messenger Bot for Suicide Prevention Service	53
4.2.5 Start Conversation.....	53
4.2.6 Discover Intensity of Depression	54
4.2.7 View Test Result.....	57
4.2.8 Type in a query	58

4.2.9 Cancel Conversation	61
4.3 Testing	61
4.3.1 Functional Testing.....	62
4.3.2 Usability Testing	68
4.4 Summary.....	69
CHAPTER 5: CONCLUSION AND FUTURE WORK	70
5.1 Introduction.....	70
5.2 Objective Achievement.....	70
5.3 Project Limitation	71
5.4 Future Work.....	71
5.5 Conclusion	71
REFERENCES	72
APPENDICES.....	74

LIST OF FIGURES

Figure 1.1: Graphical illustration of Rapid Application Development (RAD)	3
Figure 2.1: Befrienders Malaysia Network (“Contact”, n.d.)	9
Figure 2.2: Autoreply Message of Befrienders Kuching Sarawak	10
Figure 2.3: Mobile view of Lifeline Twitter Chatbot	12
Figure 2.4: Preventing Suicide topic in Lifeline Twitter Bot	12
Figure 2.5: Self-Harm topic in Lifeline Twitter Bot.....	15
Figure 2.6: Response of Lifeline Twitter Bot when failed to understand user message	15
Figure 2.7: Helpline provided by Lifeline Twitter Bot.....	15
Figure 2.8: Greeting message of EmpathyBot	16
Figure 2.9: Response of EmpathyBot when failed to understand user message	17
Figure 2.10: Helpline provided by EmpathyBot.....	17
Figure 2.11: Dialogflow Dashboard	23
Figure 3.1: Use Case Diagram	31
Figure 3.2: Sequence Diagram.....	39
Figure 3.3: Activity Diagram of Start Conversation.....	41
Figure 3.4: Activity Diagram of Type in a Query	41
Figure 3.5: Activity Diagram of Discover Intensity of Depression.....	42
Figure 3.6: Activity Diagram of View Depression Score and Level.....	42
Figure 3.7: Activity Diagram of Cancel Conversation	43
Figure 3.8: Activity Diagram of Pass Message	43
Figure 3.9: Activity Diagram of Forward Response.....	43
Figure 3.10: Conversational Flow Diagram.....	44
Figure 3.11: Retrieval-based Model	45
Figure 3.11: Get Started of Suicide Prevention Chatbot.....	46
Figure 3.12: Persistent Menu of Suicide Prevention Chatbot.....	46
Figure 3.13: Downloadable File of Suicide Prevention Chatbot	47
Figure 3.14: Confirmation Message from Suicide Prevention Chatbot.....	47
Figure 3.15: Sample Depression Test of Suicide Prevention Chatbot.....	48
Figure 3.16: Test Result of Suicide Prevention Chatbot.....	48
Figure 4.1: Interface of Visual Studio Code	51
Figure 4.2: Interface of Firebase	51
Figure 4.3 Postman Interface	52

Figure 4.4: Persistent Menu	53
Figure 4.5: Self-introduction of Suicide Prevention Chatbot	53
Figure 4.6: Start Depression Test.....	54
Figure 4.7: Handling Unrelated Answer	54
Figure 4.8: Depression Test Flowchart.....	55
Figure 4.9: Depression Test Result.....	57
Figure 4.10: Detailed Test Result	57
Figure 4.11: Instructions Given to Severe Depression User	57
Figure 4.12: Handling Message Out of Chatbot Knowledge.....	58
Figure 4.13: Suicide-related Topic	58
Figure 4.14: Get Help	59
Figure 4.15: Suicide Facts.....	59
Figure 4.16: Causes and Warning Signs	60
Figure 4.17: Downloadable File	60
Figure 4.18: Malaysia Helpline.....	61
Figure 4.19: International Helpline in File	61
Figure 4.20: Cancel Conversation.....	61

LIST OF TABLES

Table 2.1: Summary of Existing Solutions	18
Table 2.2: Comparison between Proposed Solution and Existing Solutions	21
Table 3.1: Requirement Planning Phase of RAD.....	27
Table 3.2: User Design Phase of RAD.....	27
Table 3.3: Construction Phase of RAD	28
Table 3.4: Cutover Phase of RAD.....	28
Table 3.5: Comparison of user requirements and system requirements	29
Table 3.6: Software Requirement.....	30
Table 3.7: Use Case Description for Start Conversation.....	32
Table 3.8: Use Case Description for Type in a Query	33
Table 3.9: Use Case Description for Discover Intensity of Depression.....	34
Table 3.10: Use Case Description for View Depression Score and Level.....	35
Table 3.11: Use Case Description for Cancel Conversation.....	36
Table 3.12: Use Case Description for Pass Message	37
Table 3.13: Use Case Description for Forward Response.....	38
Table 4.1: Functional Testing Result of Start Conversation	62
Table 4.2: Functional Testing Result of Discover Intensity of Depression	63
Table 4.3: Functional Testing Result of View Result	64
Table 4.4: Functional Testing of Enquire Question	66
Table 4.5: Functional Testing of Cancel Conversation.....	67
Table 5.1: Objectives Achievement	70

CHAPTER 1: INTRODUCTION

1.1 Introduction

Suicide often happens when people have exceeded their limit to cope with problems, this leads to a helpless and hopeless feeling to their future. Suicidal thought becomes common in today's world as a lot of people experience them when they are having depression or feeling stress. According to the estimation of World Health Organization (WHO), around 800,000 people died due to suicide in each year, which is one person dying of suicide within 40 seconds. Death of a person due to suicide will cause more than 20 persons to attempt suicide (2019).

To reduce the elevated global suicide rate, suicide prevention hotline and chatting platform are available online to offer help to whoever realizes he or she is having suicidal symptoms such as getting the means to take his or her life, withdrawing from social media and wanting to be left alone, being preoccupied with death or violence, and feeling hopeless about a situation. This avoids face to face service which might cause the person feels uncomfortable. However, trained counsellors of those platforms are not always available 24 hours a day.

To solve the problems stated, a Messenger chatbot namely Suicide Prevention Chatbot is proposed to help whoever in need or with suicidal thought to replace the trained counsellors. Suicide Prevention Chatbot is a conversational agent that mimics human-like discussion and help people with suicidal thought to begin a conversation about suicide. Facebook Messenger is selected as the chatbot deployment platform because it has a low barrier to entry. As of July 2019, Facebook Messenger is the fourth most-used social network sites in the world, with 1300 million active users (J. Clement, 2019).

1.2 Problem Statement

The suicide rate is escalated at an alarming rate throughout the world. One of the risk factors is depression that can weaken a person's mind which dead seems better and easier to solve their problems than staying alive. Depression is also the second leading cause of global death for the age group between 15-29 years (Hoyte, 2017). The depressive group may resist seeking help from people around them due to fear of discrimination and rejection, offended by pity and stigma. This group of people are having difficulty in finding a suitable platform to soothe their feelings and seek for assistant. Currently, there are suicide prevention hotline and live chat available online, but those services are not available 24 hours a day due to the shortage of trained counsellors. Other than that, some of the services cannot be access globally. This causes the people with suicidal thoughts unable to get responses instantly while they are seeking help or emotional support.

1.3 Scope

Suicide Prevention Chatbot is a virtual conversational agent focused on providing psychometric tests that can measure the depression tendency of a person. User will be aware of their depression tendency after taking the test and thus preventive action can be taken earlier before their depression is worsen. The chatbot provides also suicide preventive information that can assist user to overcome depression or self-harm action. The targeted users of this application are whoever with suicidal thought or whoever seeking suicide-related information. This application can be accessed through Facebook Messenger.

1.4 Objective

This project aims to design and develop a conversational bot that provides emotional support to the user. The objectives in developing the Suicide Prevention Chatbot include:

1. To investigate the way for chatbot to understand and respond to the receiving messages using Natural Language.
2. To provide emotional support and suicide prevention advice in the conversation based on the response provided by the user.

1.5 Methodology

Rapid Application Development (RAD) will be used throughout the development of Suicide Prevention Chatbot. The four phases of RAD are requirement gathering, user design, construction and cutover. User design phase and construction phase will be repeated until the final product fit all the requirements. The graphical illustration of RAD phases is shown below.

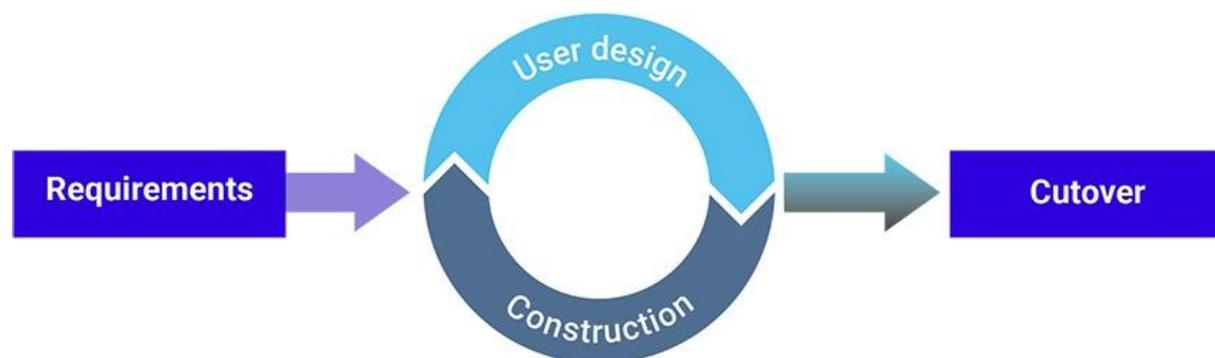


Figure 1.1: Graphical illustration of Rapid Application Development (RAD)

1.5.1 Requirements Planning

In this phase, goals and expectations for this project are determined. Requirements are gathered through researching the current problem of existing online suicide prevention services (live chat and helpline) and discussing the application functionality with supervisor. The collected requirements of Suicide Prevention Chatbot will be documented.

1.5.2 User design

The actual development process takes place in this phase. Conversational scripts that represent actual user conversations are built after fully understanding the gathered requirements. The knowledge of suicide prevention is then implemented to the chatbot so that it can handle the conversational statement. The conversational scripts will be modified according to user feedback after testing.

1.5.3 Construction

Suicide Prevention Chatbot will be tested in the emulator and actual messaging platform by different user. Feedbacks and comments from the users will be collected to improve the functionality of the chatbot. User can still suggest alterations and new ideas to solve the problems arise in this phase. User design phase and construction phase will be repeated to enhance the chatbot until there is nothing much to be improved, which means the product meets all the requirement.

1.5.4 Cutover

This is the implementation phase of the project. The final product of Suicide Prevention Chatbot will be launched after passing user design phase and construction phase. Testing and maintenance will be carried out in this phase.

1.6 Significance of Project

The significances of this project are shown below:

1. To create a virtual suicide prevention conversational agent that can replace the use of trained counsellors to communicate with users at anywhere and anytime.
2. To provide emotional support and suicide prevention information immediately after understanding users' messages.
3. To allow the free access of the application in Facebook Messenger to whoever in need if they have a Facebook account.

1.7 Project Schedule

The project schedule is the entire project progression guideline. The duration to complete Suicide Prevention Chatbot is two semesters, approximately nine months starting from September 2019 to May 2020.

Please refer to Gantt Chart shown at Appendix A.

1.8 Expected Outcome

The expected outcome of this project will be Suicide Prevention Chatbot, a Messenger chatbot with the ability to offer immediate help and emotional support to users by providing suicide prevention information at anywhere and anytime.

1.9 Project Outline

This project is categorized into 5 chapters as listed below:

Chapter 1: Introduction

Chapter 1 describes an overview and introduction of Suicide Prevention Chatbot. Other things such as problem statement, scope, objective, methodology and expected outcome are defined in this chapter.

Chapter 2: Literature Review

Chapter 2 includes the background study of artificial intelligence in helping suicide. Comparison is made between the existing systems and Suicide Prevention Chatbot in the aspect of its strength and weakness in different perspective. After reviewing and comparing the systems, one appropriate solution will be introduced at the end of this chapter.

Chapter 3: Requirement Analysis and Design

This chapter gives a summary of the selected methodology. The system will be developed using the methodology mentioned in Chapter 1. System requirements will be identified and fully taking into consideration during the development process.

Chapter 4: Implementation and Testing

This chapter is mainly focused on the implementation. Feedbacks and comments are collected from the user to enhance the system. The system will be tested on its functionality

to ensure the objectives mentioned in Chapter 1 are accomplished. After the system implementation and testing are done, the system is ready to be launched live.

Chapter 5: Conclusion and Future Work

For the last chapter, all the findings and achievement made will be summarized and concluded after the system has been successfully developed. Limitation of the system will be defined and analysed while the recommendation for future improvements will be discussed and documented.

CHAPTER 2: LITERATURE REVIEWS

2.1 Introduction

In this chapter, an overview of objectives written in Chapter 1 will be first discussed as it is important to know the main aim of Suicide Prevention Chatbot before the project is initiated. After that, review on existing solutions in helping suicide will be made. The reviewed results will be used as the reference during the development of this project.

2.2 Review on Similar Existing Solutions in Helping Suicide

The selected existing solutions to be reviewed and analysed are services from Befrienders, Lifeline and Live For Tomorrow. Those organizations are playing role in helping people with suicidal thought, either through the helpline, email, live chat or chatbot (#BeALifeline Chatbot by Lifeline and EmpathyBot by Live For Tomorrow).

2.2.1 Befrienders

Befrienders is a not-for-profit organization established in 1974 by Chad Varah. It is then launched as an independent charity in 2012 (Base Creative UK Ltd, n.d.). Currently, they are having 349 emotional support centres available in 32 countries. They provide free and confidential emotional support for the suicidal and depressed.

For Befrienders Malaysia, they aim to help whoever contact them to develop better emotional self-awareness that leads to improved emotional health and well-being. According to their official website, a few services are provided to those who are in crisis or distress such as helpline, email, face-to-face counselling (only for some branches) and outreach.

2.2.1.1 Helpline

From the official website of Befrienders Kuching, there are 9 helplines available in 9 towns of Malaysia, as shown in *Figure 2.1*. Other than the helpline of BefriendersKL is operated 24 hours, the other helplines are available only for a specific time.



Figure 2.1: Befrienders Malaysia Network (“Contact”, n.d.)

2.2.1.2 Face to face Counselling

Face-to-face counselling is available only in some branches of Befrienders Malaysia. If help seekers want to meet the trained counsellors face to face, they are required to book an appointment through the hotline.

2.2.1.3 Outreach

Befrienders intends to reach out to the groups at high risk of suicide by providing on-site emotional support, talks, workshop sessions and seminars on suicide prevention and mental health awareness.

2.2.1.4 Email

If the help seeker does not want to have face to face service, they can choose to email Befrienders. This service might take longer time to get response.

2.2.1.5 Direct Message

There is no live chat service available. Even though there are Facebook and Twitter page, but Direct Message is only for asking general information and not for emotional support. Facebook page of BefriendersKL has no message sending feature but provided only the helpline, while the Facebook page of Befrienders Kuching Sarawak has this feature but only for enquiries. *Figure 2.2* shows the autoreply of Befrienders Kuching Sarawak in Facebook Messenger, which listed their available services and pointed the users to contact BefriendersKL helpline if the help seeker needs immediate emotional support.

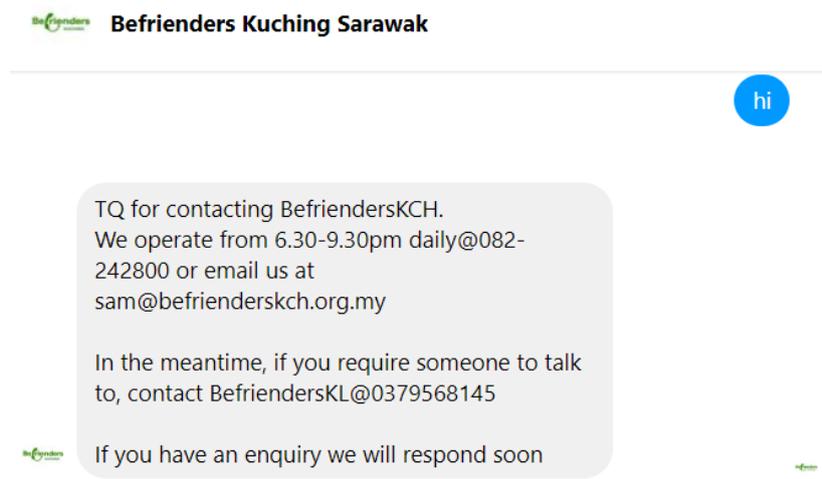


Figure 2.2: Autoreply Message of Befrienders Kuching Sarawak

2.2.2 Lifeline

Lifeline was founded in 1963 by Dr Rev. Sir Alan Walker in Sydney, New South Wales (“Lifeline’s living history”, n.d.). According to Lifeline official website, Lifeline is a non-profit organization that provides 24 Hours Telephone Crisis Line, Online Crisis Support Chat and suicide prevention services to the people staying in Australia that are experiencing personal crisis.

2.2.2.1 Helpline

24 Hours Telephone Crisis Line is available 24 hours for people living in Australia. Crisis supporters will listen to the situation and provide immediate support to help seeker. They might be experiencing high demand for the helpline service if the call does not answer straight away.

2.2.2.2 Live Chat

This is a confidential one-to-one service with a Lifeline Online Crisis Supporter. Help seeker needs to answer a pre-survey questions before accessing this service. Lifeline’s Crisis Support Chat is only available at a specific time (Sydney Time 7.00pm until midnight) daily and is provided only for those who are living in Australia. Other than the stated time, help seeker can contact their helpline which is available 24 hours.

2.2.2.3 #BeALifeline Twitter Direct Message Chatbot

Lifeline has launched #BeALifeline Twitter Direct Message (DM) Chatbot on 12th October 2018 (Brancatisano, 2018). This chatbot helps family and friends access support for people around them who are struggling with suicidal thought and self-harm action. It acts as a