Towards Human-Centric Mental Health Chatbot Design: Leveraging on DASS-21

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ABSTRACT

Keywords:

Depression, anxiety and stress scale 21 (DASS-21); Mental health assistant chatbot; Mental health prevention; Mental health support through technology

The existing landscape of mental health apps exhibits several limitations, particularly concerning their effectiveness in mental health prevention and their ability to provide adequate assistance for mental health practitioners. In this study, a human-centric design chatbot is proposed leveraging on the Depression Anxiety and Stress Scale 21 (DASS-21) for addressing these challenges. Based on the interviews carried out with five mental health professionals, a chatbot prototype was developed by integrating the DASS-21 assessment tool together with other features aimed at enhancing mental health prevention. The chatbot was then subjected to comprehensive testing involving users and two mental health practitioners. The usability testing with mental health practitioners revealed promising results, indicating that the chatbot effectively supports mental health prevention. Additionally, the feedback from mental health practitioners highlighted the usefulness of the chatbot as a tool in their practice. The usability testing involved 15 university students, with 40.0% female and 60.0% male participants. The majority of respondents were in the age range of 24-26 years old (53.3%), followed by 21-23 years old (40.0%), and a small percentage (6.7%) were 18-20 years old. In terms of their university year, 86.7% were Year 4 students, and 13.3% were Year 3 students. While most university students expressed agreement with the features in the mobile app, some (13.33%) rated certain aspects as "Average." These included the availability of sufficient information on specific pages and the user interface design, indicating that the chatbot may still be lacking in knowledge, data, and comprehensive functionalities. These findings demonstrate the potential of our human-centric design approach and the integration of DASS-21 within a chatbot framework to enhance mental health prevention. By addressing the limitations of existing mental health apps and garnering positive feedback from users and practitioners, our study contributes to the ongoing efforts in improving mental health support through technology.

1. Introduction

The main objective of this paper is to design and develop a Mental Health Assistant Chatbot to prevent more serious mental health issues among university students. The proposed mobile app

acts as a screening tool for evaluating the mental health situations of university students through psychometric tests based on the Depression Anxiety and Stress Scale 21 (DASS-21) as elaborated by Soo [1]. After taking the psychometric evaluation test, the chatbot will recommend several mental health professionals to ease the route for university students seeking suitable medical advice and provide advice on coping strategies based on different severity. According to Soo [1], technology should not be regarded as a counselling or professional mental health service especially for mental health issues that is in too-critical state. Chatbots cannot perform similarly to a human to detect how is the current change in the sentiments of the patients during a chat conversation. Hence, the role of the chatbot is to create awareness among university students on their mental health issues and possible preventive steps before their mental health exaggerates further. Evaluation on the performance and effectiveness of the Mental Health Assistant Chatbot were conducted according to the feedback of the users and mental health practitioners such as counsellors.

Rickwood *et al.,* [2] stated that even though the number of mental health problems and disorders are increasing among adolescence and early adulthood, young people tend to not seek professional help. Furthermore, they become accustomed to social distancing since face-to-face social interaction has been gradually reduced since the COVID-19 pandemic [3,4]. This leads to them continuously keeping their mental problems in mind with less heart-to-heart consultation with families, friends, and colleagues. In addition, young adults such as university students have trouble seeking help by approaching family, friends, and mental health professionals, owing to feelings of shyness, low self-esteem, and a lack of contact information for mental health professionals [5]. Although on an increase, internet-based information and digital interventions are being used to engage young people in the help-seeking process [6], however, how to design technology for mental health prevention remains an open question as highlighted by Zaiyadi *et al.,* [7]. This paper proposed using a chatbot for mental health prevention targeting at young adults' names Mental Health Assistant Chatbot.

1.1 Related Work

This section reviews a commonly used psychology evaluation or psychometric test by mental health practitioners: Depression Anxiety and Stress Scale 21 (DASS-21) introduced by Lovibond & Lovibond [8]. Several existing mental health chatbots with similar goals but varying objectives had been examined, and three comparable applications are reviewed here.

1.1.1 Depression anxiety and stress scale 21 (DASS-21)

Depression Anxiety and Stress Scale 21 (DASS-21) was chosen as the psychology evaluation or psychometric test. It is the most extensively used self-report scale for measuring the three negative emotional states of depression (D), anxiety (A), and stress (S) as mentioned by Antony *et al.,* [9]. The three DASS-21 scales should fulfil the demands of both researchers and clinicians who want to measure the current condition or change in status over time, such as during therapy since the scales have been shown to have good internal consistency and to provide meaningful discriminations. This scale is appropriate for both clinical and non-clinical contexts. DASS-21 is made up of 21 groupings of statements. The scores are summed up for each scale (D, A and S) and multiplied by two (x2) since the DASS-21 is the short form of DASS-42 as the longer version has 42 items.

1.1.2 Existing mental health chatbots

Three popular health chatbots in the market are reviewed in this section. According to Prochaska *et al.,* [10], Woebot, established in 2017 by Stanford psychiatrists and AI experts, is the world's first mental health chatbot. It has undergone clinical research trials and is utilized by hundreds of thousands of individuals in over 130 countries. It employs AI-powered conversation therapy and Cognitive Behavioural Therapy concepts to assist users in managing mood disorders, stress, and anxiety, particularly targeting young adults in college and graduates [11].

Moodkit, developed by clinical psychologists Drew Erhardt and Edrick Dorian, is a unique mental health chatbot aimed at adults and older individuals [12]. Moodkit offers practical techniques derived from Cognitive Behavioural Therapy (CBT) to be applied in users' daily lives [13]. Moodkit encompasses four key features: Moodkit activities, a thought checker, a mood tracker, and a Moodkit journal [14].

Fisher [15] emphasized that Dr. Jose Hamilton founded Youper in 2016, and it was relaunched in July 2017 as a comprehensive mental health platform. The user base primarily consists of young people, with a higher proportion of women due to their greater interest in self-care [16]. Youper provides teletherapy and behavioural coaching using cognitive behavioural therapy (CBT) techniques [11]. It provides AI bot-guided exercises and journals on various themes such as self-care, sadness, anxiety, and productivity. Additionally, Bell [12] stated that it includes breathwork, body scan meditations, and soundtracks for sleep and focus assistance.

The advantages and disadvantages of these mental health chatbots: Woebot, Moodkit, and Youper are summarized and compared in Table 1. Each of the chatbots are designed for certain purpose and shown to be effective. Never the less, these chatbots can further be improved with integration of early mental health detection. Our proposed chatbot: Mental Health Assistant Chatbot integrated DASS-21 as a supporting tool to the existing ones. All the proposed features of the Mental Health Assistant Chatbot are presented in Table 1.

Table 1 shows the proposed system, Mental Health Assistant Chatbot, is designed to incorporates all features except for Cognitive Behavioural Therapy. Behavioural therapy relies on users' motivation and time engagement, and short-term engagement like a chatbot will be less effective [16]. The proposed system will provide details of medical consultation and therapy so that users can get connected to appropriate medical helplines. Additionally, the system will include resources about mental health issues. According to Phan [17], the existing chatbots have weaknesses, such as limited response options, restricted medical helplines, and a less user-friendly interface. The proposed system should be globally accessible and provide a better user experience by allowing users to return to previous questions during psychometric evaluations. Additionally, providing medical advice hotlines near the user's location is recommended to make seeking mental health advice more accessible and user-friendly.

Table 1
Summary of comparing similar existing mental health chatbots and proposed system

Features	Woebot	Moodkit	Youper	Proposed Mental Health Assistant Chatbot
Platform	Android App and Facebook Messenger	Apple App	Android and Apple App	Android App
Cost	Paid after two-week trial	Paid without trial	Paid after one-week trial	Free
24 hours available	Yes	Yes	Yes	Yes
Globally accessible	Yes	Yes	No	Yes
Use Cognitive Behavioural Therapy (CBT)	Yes	Yes	Yes	No
Evaluate mental health conditions	Yes	Yes	Yes	Yes
Provide emotional support	Yes	Yes	Yes	Yes
Provide resources about mental health issues such as causes and warning signs	No	No	No	Yes
Provide mental health self-care practices	Yes	Yes	Yes	Yes
Provide medical helplines	Yes	No	Yes	Yes
Connect with mental health professionals	No	No	Yes	Yes
Provide better user experience	No	No	No	Yes
Target Users	Adults who suffer from depression and anxiety	Adults and elders who have depressive symptoms and anger	Adults and elders who have depressive symptoms and anger	University students who encounter slight or moderate depression, anxiety and stress
Mental Health Prevention: DASS-21	No	No	No	Yes

2. Methodology

The methodology employs for this paper integrates the principles of human-centred design into a chatbot [19]. The four principles of human-centred design [20]:

    i.   Understand and address the core problems
    ii.   Be people centred
    iii.   Use an activity centred systems approach
    iv.   Use rapid iterations of prototyping and testing

The Mental Health Assistant Chatbot was developed using the Scrum methodology [21] in alignment to with the four principles of human centred design. Scrum involves breaking down the

project into smaller tasks. Each task has a deadline and is completed within sprints lasting 1 to 4 weeks. For every sprint cycle, the principles are referred to.

First and foremost, the process begins with a thorough understanding of the core problems by engaging in interviews with mental health professionals and conducting research on the challenges faced by university students seeking mental health support. This initial phase ensures that the project is squarely focused on addressing the most critical issues.

Throughout the development journey, a people-centred approach is maintained. User requirements are gathered not only through professional input but also by directly involving university students in the process. This approach ensures that the chatbot's design and functionality are centred around the needs and preferences of the end users, making it more effective and relevant.

The development process follows an activity-centred systems approach, with distinct phases such as planning, implementation, testing, and review. Each phase is systematically executed to create a user-friendly chatbot system that effectively addresses the concerns of both mental health professionals and students. This structured approach ensures that the project remains focused and organized.

Rapid iterations of prototyping and testing are a recurring theme throughout the development process. A prototype of the chatbot is created based on priority user requirements, and frequent feedback loops are established through weekly scrum meetings. Additionally, the sprint retrospective stage enables the project team to examine feedback and suggestions from various stakeholders, including the Scrum master, mental health professionals, and university students. These iterative cycles ensure that the chatbot continually evolves and improves in response to user input, aligning perfectly with the iterative nature of human-centred design.

Thus, the development of the Mental Health Assistant Chatbot showcases a strong commitment to human-centred design principles. It was chosen for its flexibility, allowing for iterative development of high-quality products while optimizing resources according to Wrike [20] shown in Figure 1 below.
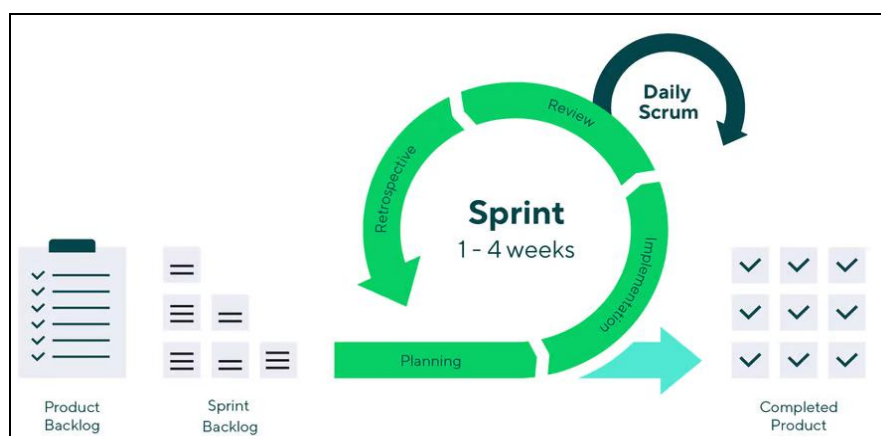

Fig. 1. A graphical illustration of the scrum methodology

2.1 Mental Health Assistance Chatbot

Through integration of DASS-21, the Mental Health Assistance Chatbot dashboard page and psychometric evaluation page are shown in Figure 2. Once the user logs in to the system, the dashboard page provides an overview and description of the system, featuring four key features: "START EVALUATION", "VIEW PAST RESULT", "GET HELP" and "ABOUT MENTAL ILLNESS" when

using the application. After utilizing the system, the user can log out of the system by clicking the "SIGN OUT" button. Starting from the dashboard page, the specific user's email is displayed in the bottom bar for every page of the system. To initiate the psychometric evaluation, the user selects the "START EVALUATION" button on the dashboard page, leading them to the psychometric evaluation page. On this page, the chatbot engages the user in a conversation, posing questions for evaluation purposes. The user responds by choosing the most applicable option from the provided choices.

(a) Dashboard page   (b) Psychometric evaluation page
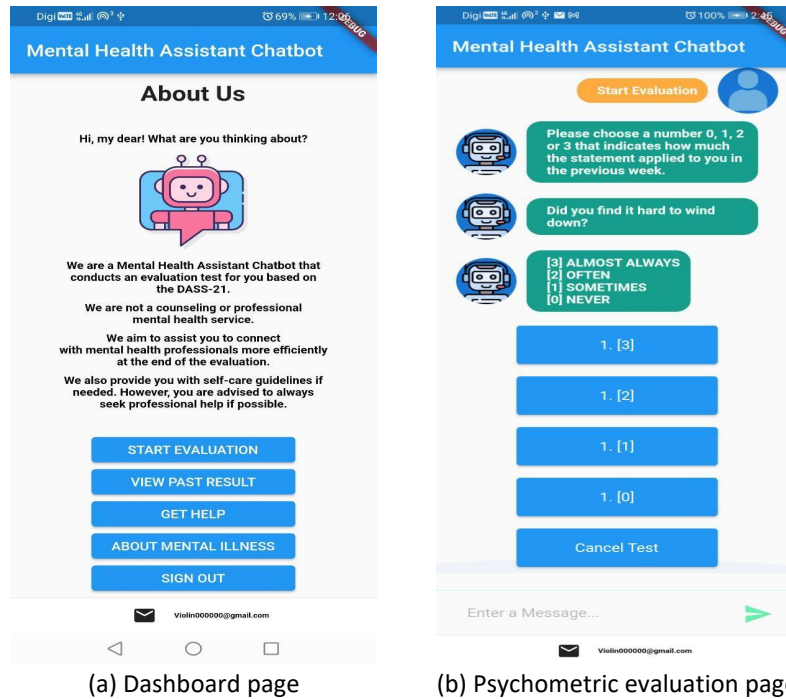
Fig. 2. User Interface (UI) of Mental Health Assistant Chatbot: (a) Dashboard page; (b) Psychometric evaluation page

Figure 3 shows the chatbot's evaluation result page and the page that displays the DASS-21 scoring guide. Once the user responds to all the psychometric evaluation questions, the chatbot will provide a summary message of the test results, displaying the scores for depression (D), anxiety (A), and stress (S). The user can then click the "DASS-21 Scoring Guide" button to check their severity levels for each emotional state. Furthermore, the user has the option to choose from "Retest", "Get Help", "About Mental Illness" or "Back to Menu" as the next step in the chatbot interaction.

(a) Evaluation result page   (b) DASS-21 scoring guide
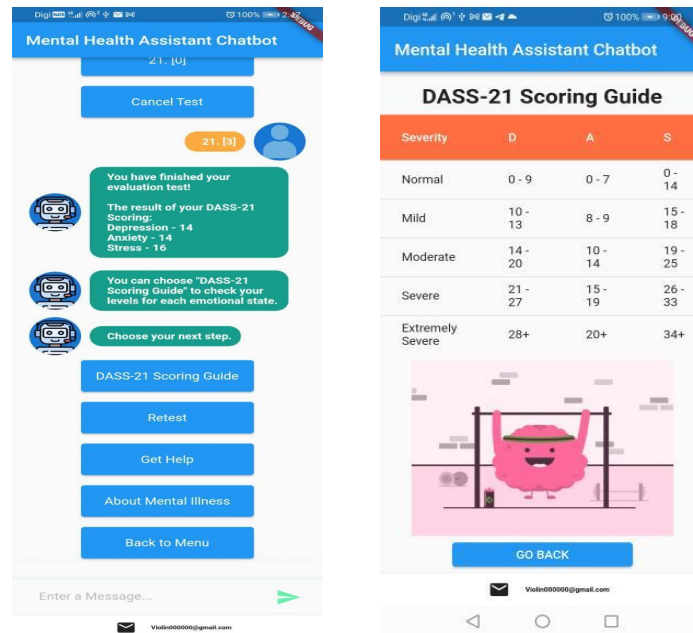
Fig. 3. User Interface (UI) of the psychometric evaluation part: (a) Evaluation result page; (b) DASS-21 scoring guide

Figure 4 displays the user's psychometric evaluation result history and "About Mental Illness" page. The result history page allows users to view past results for a better understanding of their mental health conditions. A random quote of the day is also shown at the bottom of the page to provide daily motivation. The user can access the scoring guidelines by clicking the "VIEW DASS-21 SCORING GUIDE" button or return to the dashboard page using the "GO BACK" button. When the "ABOUT MENTAL ILLNESS" option is selected on the dashboard page, the user is led to the "About Mental Illness" page. Since it is available on the dashboard page or at the end of the evaluation page, the user will have easier access to the "About Mental Illness" action.
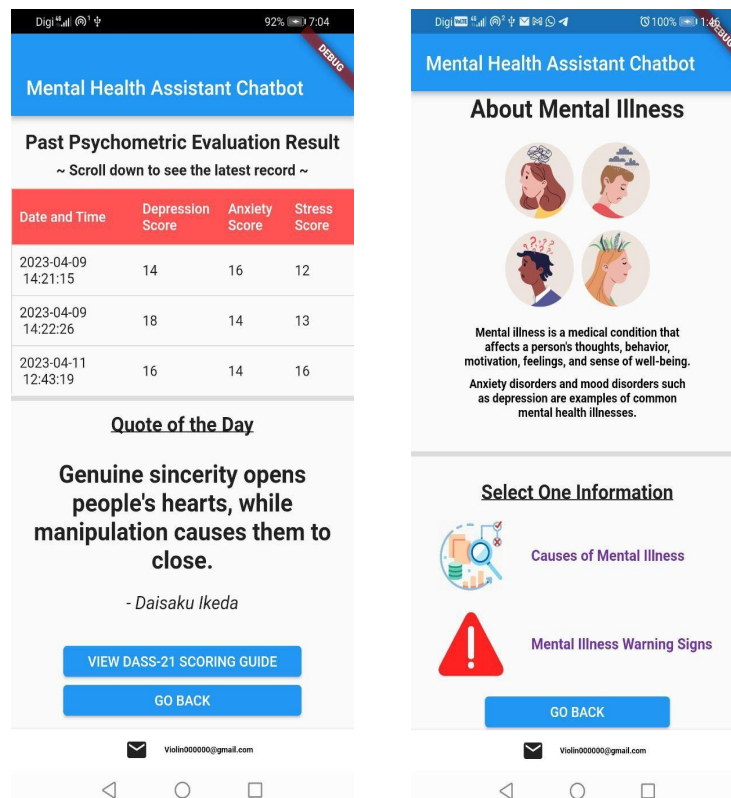
(a) Evaluation result history   (b) About mental illness page

Fig. 4. User Interface (UI) of Mental Health Assistant Chatbot:
(a) Evaluation result history; (b) About mental illness page

On the "About Mental Illness" page, the chatbot system will provide a brief description of mental illness. At the bottom of the page, the user can choose to enter the "Causes of Mental Illness" and "Mental Illness Warning Signs" as displayed in Figure 5. The "Causes of Mental Illness" page is shown if the user picks the "Causes of Mental Illness" action. The website will go into detail about five major factors, including "Academics", "Relationships", "Financial Issues", "Body Health Conditions", and "Life Experiences". The "Mental Illness Warning Signs" page is displayed if the user picks the "Mental Illness Warning Signs" action. The page will give twelve warning symptoms of mental illness, each with a brief explanation.
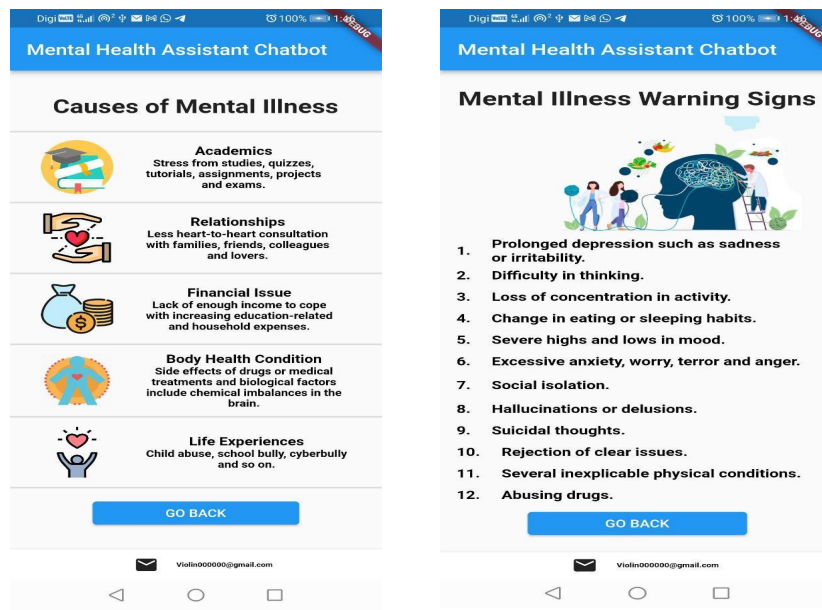
(a) Causes of mental illness page   (b) Mental illness warning signs page

Fig. 5. User Interface (UI) of the about mental illness part: (a) Causes
of mental illness page; (b) Mental illness warning signs page

Mental Health Assistant Chabot also comes with other feature such as "GET HELP" option on the dashboard page (Figure 6). Based on the severity level of the emotional states revealed through the psychometric evaluation, the chatbot system provides advice and instructions on the cautious performance of various activities on the "Get Help" page. At the bottom of the page, the user can choose between the "Self-Care Guidelines" or "Medical Helplines" options. The "Self-Care Guidelines" screen is shown in Figure 6 if the user selects the "SELF-CARE GUIDELINES" action. The page will include seven self-care rules as well as brief examples of activities. The user has the option of doing actions such as "PLAY GAME" and "MOOD TRACKER" on the "Self-Care Guidelines" page.
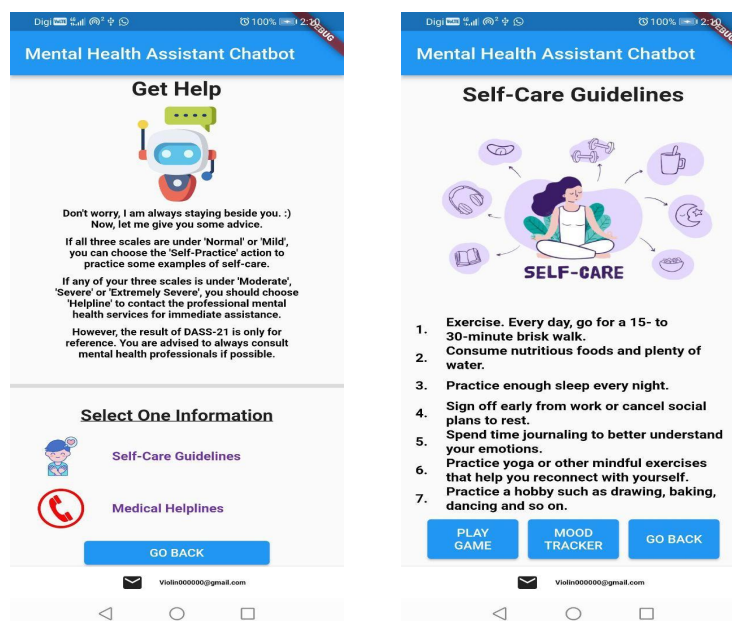

(a) Get help page   (b) Self-care guidelines

Fig. 6. User Interface (UI) of Mental Health Assistant
Chatbot: (a) Get help page; (b) Self-care guidelines

The "PLAY GAME" action will take the user to the free online games website's external link, whereas the "MOOD TRACKER" action will transfer the user to the Mood Tracker main page to track the user's moods, as shown in Figure 7.

(a) Play game page   (b) Mood tracker main page
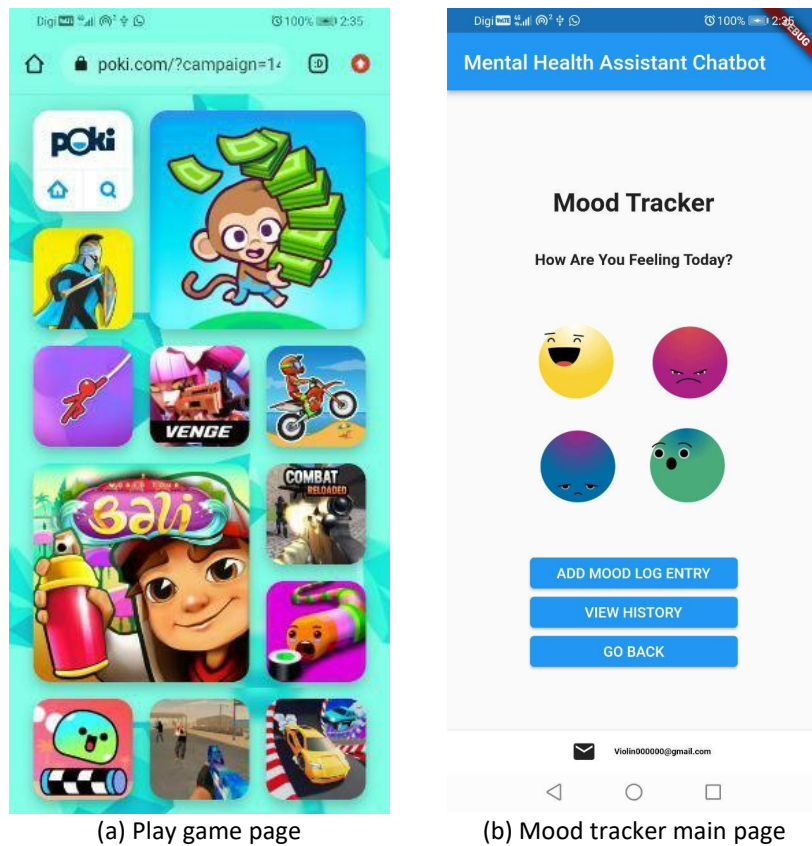
Fig. 7. User Interface (UI) of the get help part: (a) Play game page; (b) Mood tracker main page

The user has also been given the option to "ADD MOOD LOG ENTRY" and "VIEW HISTORY" on the mood tracker main page in Figure 8. The figure depicts the mood tracker screen on which the user chooses to make a new entry to the mood logs. When the user successfully adds a new entry, the date will be the current time. The user can select one of the mood alternatives such as "Worst", "Bad", "Okay", "Good" or "Best" while also writing down any comments about the current mood. If the user changes their mind, they should click the "ADD" button after filling out all of the mood entry parameters, or they should click the "CANCEL" button. The user can also choose the "VIEW HISTORY" option to view the history of the user's mood logs (Figure 8). All mood logs will be saved on the mood tracker history page for the user's future benefit in understanding mood swings.
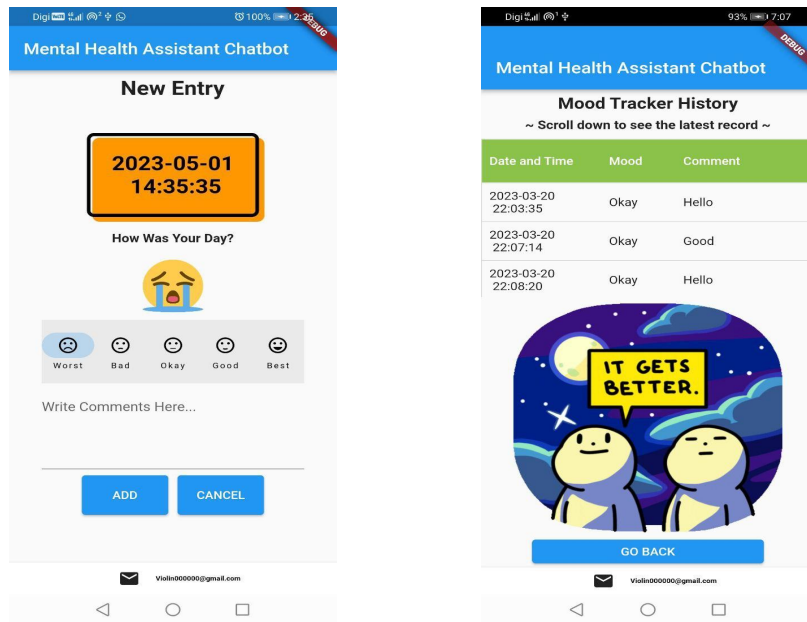
(a) Mood tracker add entry   (b) Mood tracker history

Fig. 8. User Interface (UI) of the mood tracker part: (a) Mood tracker add entry; (b) Mood tracker history

Figure 9 represents the "Medical Helplines" page that will be displayed if the user chooses the "MEDICAL HELPLINES" action. Based on the user's location, the page will track the user's location and display the three closest medical helplines. The chatbot utilizes Dialogflow's NLP capabilities to interpret the user's severity ratings for depression, anxiety, and stress in the DASS-21 evaluation. It stores and retrieves evaluation results using SQLite as a local database within Android Studio. By combining Dialogflow and SQLite, the chatbot guides users through the evaluation process, calculates scores, and maintains assessment history for personalized recommendations. Consulting a professional for a comprehensive interpretation of DASS-21 results is advised. To display nearby mental health helpline locations on a Flutter Map, the app retrieves the user's location using Geolocator and fetches helpline data from an API. The data is visualized on the map using Flutter Map, with custom markers and interactive features.
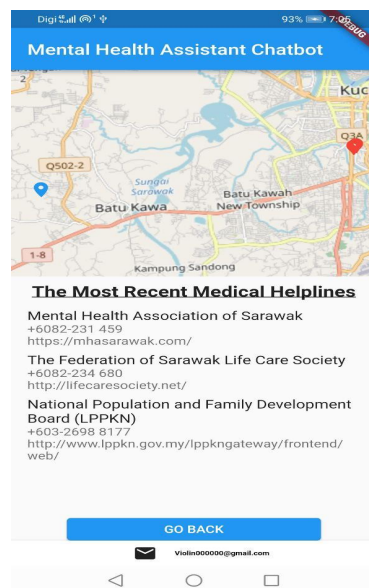
Fig. 9. Mental helplines page

3. Results and Discussion

The human centred design requires involvement of the users hence the feedback from both mental health practitioners and users were gathered throughout the design and development of the Mental Health Assistant Chatbot. On top of ensuring that the chatbot function well, the feedback from the mental practitioners include expressing the willingness to utilise the chatbot for their own patients.

Based on the testing with 15 university students, with their background overview and majority of them male (Figure 10) and 24 – 26 years (Figure 11), they agreed that the design of the chatbot is suitable and appropriate as shown in Figure 12. There has been evidence that chatbots can indeed help those with mental issues [22].
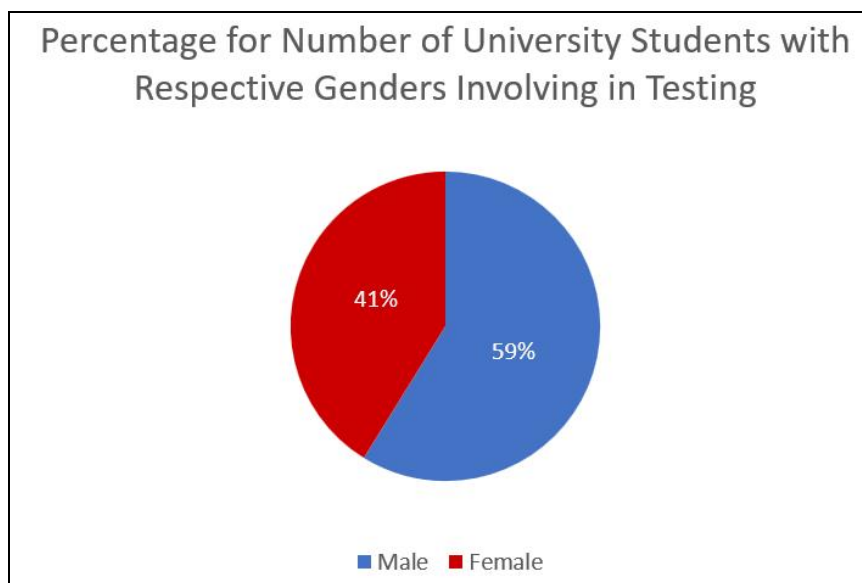
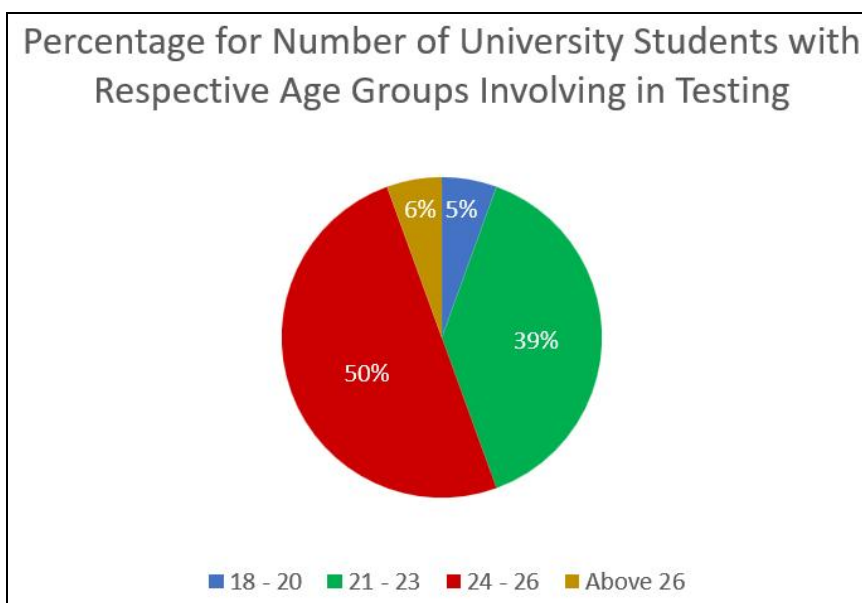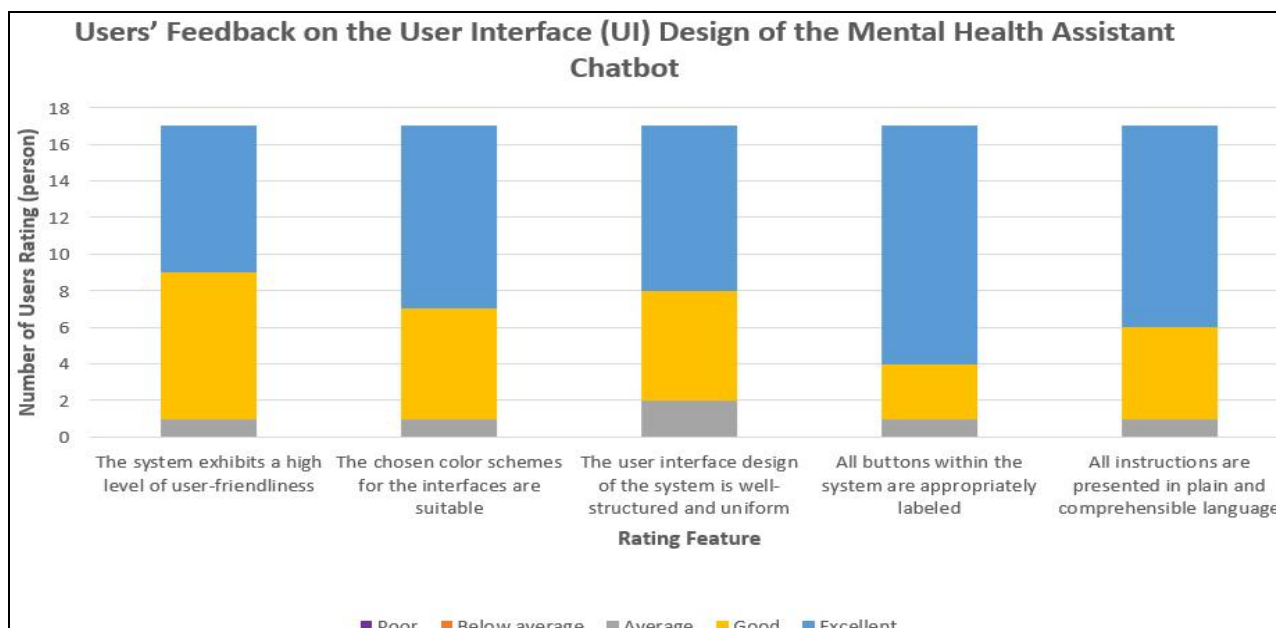**Fig. 10.** Overview of the university students' gender in testing

Fig. 11. Overview of the university students' age groups in testing

Fig. 12. Overview of the users' feedback on the user interface (UI) design of the Mental Health Assistant Chatbot

To sum up, the focus of this study on university students is driven by their unique challenges and high prevalence of mental health issues, which are more pronounced compared to children and adults. University students often face significant academic stress, financial difficulties, and work pressures from part-time jobs, making them particularly vulnerable to mental health problems based on Ariffin *et al.,* [23]. Studies show that these demographic reports higher incidences of anxiety, depression, and stress. In contrast, children require developmentally appropriate interventions involving parents or guardians, while adults face complex mental health issues needing nuanced, personalized care that a chatbot cannot adequately provide as mentioned by Azuddin *et al.,* [24]. Therefore, this study targets university students to offer tailored support addressing their specific mental health needs.

4. Conclusions

The integration of human centred design principles has assisted in the design and development of the Mental Health Assistant Chatbot. The chatbot acts as a screening tool to address mental health concerns among university students that represent a distinct community as highlighted by Muniandy *et al.,* [25]. By utilizing psychometric tests based on the DASS-21, the chatbot evaluates the mental health status of students. Following the assessment, the chatbot provides recommendations of mental health professionals and offers coping strategies based on the severity of the situation. Us propose chatbot acts to preventive measure to mental health.

To improve the Mental Health Assistant Chatbot system, several areas of future work have been identified. These include expanding the coverage of mental health topics to encompass a wider range of issues, integrating reliable external resources to ensure up-to-date and evidence-based information, implementing a user-friendly mood tracker log deletion feature, incorporating directions to medical helplines for immediate assistance, providing options for password reset and editing personal information, adding multilingual support for inclusivity, strengthening privacy and data security measures, and maintaining regular updates and maintenance of the chatbot's knowledge base. By addressing these aspects, the Mental Health Assistant Chatbot can become a

more comprehensive, accessible, and secure system to support the mental health needs of university students.

Acknowledgement

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