جامعة البترا

AI-Driven Robotic System for Mental Health Diagnosis & Personality Type Analysis

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Abstract

This project is Artificial Intelligence (AI)-Driven Robotic System for Mental Health Diagnosis and Personality Type Analysis; the main purpose of the project is to develop an AI-driven robotic system to assess mental health and understand personality type for the students in a safe and easy way. The mental health issue among students is still rising, so many students avoid them to seeking help from traditional support centers, because they may have barriers, such as stigma and social anxiety. This project addresses these challenges by using Pepper, a humanoid robot, integrated with ChatGPT and Retrieval-Augmented Generation (RAG) technologies to provide private, interactive, and voice-based assessments. The system will allow Pepper to detect students, then Pepper will start guiding them with simple and clear audio instructions and allow voice or text-it evaluates student inputs to assess both mental health and personality traits using an integrated assessment approach. Pepper will provide instant feedback and referral suggestions if needed. By offering a private and stigma-free environment, this solution encourages more students to engage in self-assessment and become more aware of their emotional well-being and personal development.

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List of Acronyms

AI Artificial Intelligence

VR Virtual Reality

AIST Advanced Industrial Science and Technology

PPG Photoplethysmography

EEG Electroencephalogram

RAG Retrieval-Augmented Generation

DSM Diagnostic and Statistical Manual of Mental Disorders

NLP Natural Language Processing

SARs Socially Assistive Robots

CBT Cognitive-Behavioral Therapy

PTSD Post-Traumatic Stress Disorder

HCI Human-Computer Interaction

PSCO Psycho-Social Counselling Office

Q and A Questions and Answers

Pepper-CPGE Care Prevention Gymnastics Exercises for Pepper

WBS Work Breakdown Structure

MBTI Myers-Briggs Type Indicator

API Application Programming Interface

Chapter 1

Project Initiating

1.1 Introduction

Mental health disorders among university students have become a major concern in recent years. Studies show that a large percentage of students are affected by common mental health issues such as depression, anxiety, and stress, often without seeking help. For instance, a global survey involving over 14,000 students across 19 universities found that 35% met the diagnostic criteria for at least one common mental health disorder (Auerbach et al. 2016). Similarly, the Healthy Minds Study reported that during the 2020–2021 academic year, more than 60% of college students met the criteria for at least one mental health problem (Lipson et al. 2019). Many students avoid traditional counseling services due to social stigma, personal fears, or limited availability of support (Osborn et al. 2022). This rising demand for mental health assistance, especially in academic environments, highlights the need for innovative solutions.

With the advancement of technology and AI, new tools have emerged that offer private, accessible, and interactive support. These tools can help students manage their mental health more confidently and safely. Among the most promising technologies is the integration of AI with robotics, allowing real-time interaction, emotional recognition, and support delivery. Social robots, designed to interact with people in human-centric terms, have shown potential in providing mental health support by adhering to behavioral norms and expectations, such as emotional expressiveness and verbal communication (Breazeal et al. 2016).

Pepper is one of the most well-known social robots created for human interaction. Developed by SoftBank Robotics, Pepper is a humanoid robot capable of recognizing emotions through voice, facial expressions, and gestures. It was designed to engage people in natural conversations, provide assistance, and interact socially in environments like schools, hospitals, and homes (Pandey & Alami 2018). Pepper's sensors allow it to detect and analyze human emotions, making it a suitable candidate for mental health applications (Osborn et al. 2022).

In this project, we propose an AI-Driven Robotic System for Mental Health Diagnosis and Personality Type Analysis, specifically designed for students at the University of Petra. This system uses the humanoid robot Pepper, enhanced with ChatGPT and RAG, to conduct private and personalized mental health assessments. Pepper guides students through a voice-based or text-based conversation, asks adaptive questions, and analyzes responses to identify mental health symptoms and personality traits. At the end of the session, students receive a detailed feedback report on Pepper's screen, showing their mental health status, personality type, confidence level of the assessment, and, if necessary, a referral suggestion to a specialist.

By providing a confidential and user-friendly experience, this system encourages more students to explore their emotional well-being and understand themselves better. It reduces the barriers of traditional support systems and promotes early detection, aiming to improve student mental health and support personal development.

1.1.1 Problem Definition

Mental health and personality types are closely connected and play a crucial role in shaping the quality of students' lives, achievements, academic success, and overall well-being. As the numbers of mental health issues being reported is rising continuously, various academic institutions and educational organizations are becoming increasingly aware of the growing importance of providing mental health support for their students and addressing their personalities related challenges. However, there is currently a lack of extensive guidance and support centers at universities, even if such centers exist, students still face multiple barriers, including perceived public stigma, self-stigma, social anxiety, preventing them from reaching support, in terms of help-seeking intentions and actual help-seeking behavior. Additionally, tools may not be available for identifying students' mental health concerns in such centers.

Students often encounter multiple barriers that prevent them from reaching out for help. These include perceived public stigma, internalized self-stigma, and social anxiety, which can significantly reduce their willingness to seek support. In addition, existing university services are often limited in their ability to detect early signs of mental distress or to understand how these issues are influenced by students' individual personality traits. This leads to a gap in recognizing and responding to students' psychological and personality-related needs in a meaningful way.

- **Diagnostic and Statistical Manual of Mental Disorders (DSM)-5 and Myers-Briggs Type Indicator (MBTI)**

  The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), published by the American Psychiatric Association, is a standardized classification system widely used by clinicians and researchers to diagnose and understand mental health conditions. It provides structured criteria that help identify specific psychological disorders based on observed symptoms and behaviors (Carter 2014).

  In contrast, the MBTI is a personality framework based on psychological preferences in how people perceive the world and make decisions. It categorizes individuals into 16 personality types using four key dichotomies: Introversion–Extraversion, Sensing–Intuition, Thinking–Feeling, and Judging–Perceiving. While not diagnostic, MBTI can offer valuable insight into how students process emotions, interact socially, and respond to stress and academic pressure (Myers 1985).

By combining the structured mental health criteria from DSM-5 with personality traits identified through MBTI, and analyzing students' natural language using Natural Language Processing (NLP), it becomes possible to create an anonymous, AI-powered system that detects signs of mental distress and aligns them with personality profiles.

The **goal** of this project is to support students facing mental health challenges by promoting anonymous AI-based interaction, improving the accuracy of early detection through DSM-5 and NLP integration, and increasing awareness of personal mental health and personality traits to help students grow both academically and emotionally.

1.2 Objectives

This is the main objectives of the project:

- Objective 1: Assist students with mental health issues and disorders by promoting the awareness and usage of anonymous AI interactions.
- Objective 2: Provide institutional mental health analytics by collecting anonymized data to identify mental health issues in the campus.
- Objective 3: Enhance students' awareness of their mental health and personality traits for better academic and personal development.

1.3 Current System

The current system accessible to students seeking mental health support is Psycho-Social Counselling Office (PSCO) of UOP . This office offers mental health support and counseling services exclusively for University of Petra students to improve their personalities and control their emotions, providing expert assistance during designated times. But one of its most prominent drawbacks is that sessions are relatively short, with modest outcomes. Which may lead to limited therapeutic value observed from the intervention. In addition, only in-person sessions are available, as online or phone consultations are not included, focusing primarily on academic-related issues and topics, such as poor desire to study, depression, mental support, lack of self-confidence, and anxiety of the exam, and the expertise is narrowed to general areas of knowledge (University of Petra 2023).

1.4 Existing Systems

This section is talking about existing systems that are currently in use to solve similar problems or serve similar purposes, such as:

1.4.1 Qhali

As shown in Figure 1.1, a humanoid robot for assisting in mental health treatment which is like the Pepper robot, that is designed for mental health treatment and patient monitoring by providing emotional support, tracking metal health symptoms, and assisting healthcare professionals with real-time data (Pérez-Zuñiga et al. 2024). Figure 1.1 represents the Qhali Robot system :

Figure 1.1: Qhali Robot system (Source: de (2023))

1.4.2 Paro Therapeutic Robot

Paro is therapeutic robot using AI and biometric sensing technology, provided by National Institute of Advanced Industrial Science and Technology (AIST), Japan, to deliver emotional support through lifelike interactions which enhance engagement with users, helping with stress, depression, and anxiety disorders. While it is not used for diagnostic purposes primarily, it offers companionship experience especially for people with social isolated issues, reducing anxiety and stress, indirectly supporting mental health management. Nevertheless, it does not present personality types analyzing as well as being a comfort tool rather than providing in-depth mental health or personality assessments (Anon. n.d.*b*).
Figure 1.2 represents the official logo of Paro Therapeutic Robot:

paro
therapeutic robot

Figure 1.2: Official Logo of Paro Therapeutic Robot (Source: Sense Medical Limited (2024))

1.4.3 MindEase

This system can be a website or an application that has personal mental health coach by using AI-Driven mood tracking. The MindEase system contains features such as daily positivity reminder and personalized stress relief techniques. This system include a panic button that connects the students to have an emergency mental health help (Mindease.io n.d.).

Figure 1.3 represents the official logo of MindEase system:

Figure 1.3: Official Logo of MindEase (Source: Mindease.io (n.d.))

1.4.4 Mind Ally

This system provides discussion and educational content for helping the student who has mental health problems. Mind allies provide a group where the students can join discussions with mentors and provide educational content about the mental health topics and coping strategies (Mindally.org n.d.).

Figure 1.4 represents the official logo of Mind Ally system:

Figure 1.4: Official Logo of Mind Ally (Source: Mindally.org (n.d.))

1.4.5 Woebot

An ai chatbot that was listed in Newsweek's Inaugural list of the World's Best Digital Health Companies, with a mission make emotional and mental support easily assessable using various AI wellness tools. Woebot provides solution for the long waiting period to consult a mental health professional, enabling 24/7 access to mental health support with personalized coping strategies, in addition to having indirect analytical capabilities for personal traits. While Woebot effectiveness in tooling up mental support, it is not designed for official psychological diagnoses and complex mental health conditions detection is not guaranteed (Anon. n.d.*c*).

Figure 1.5 represents the official logo of Woebot System:

Figure 1.5: Official Logo of Woebot (Source: Anon. (n.d.*c*))

1.4.6 Cogito

Cogito is an AI-powered tool that assesses mental health, emotional wellness, and personality traits by analyzing speech patterns, behavioral changes in addition to voice tone. It is produced by Cogito Corporation with real-time feedback and personality insights based on user question answers and changes on emotional state over time. Despite all integrated advantages, it may not capture nonverbal cues such as facial expression, limiting the accuracy of mental and personality assessment (Anon. n.d.*a*).

Figure 1.6 represents the official logo of Cogito System:

Figure 1.6: Official Logo of Cogito (Source: Anon. (n.d.*a*))

Areas where significant differences between these existing systems have been found including availability, cost and stakeholders. A comparison between existing systems is shown in Table 1.1 :

Product Name	**Customized/Public**	**Cost**	**Stakeholder**
Qhali	Customized for health-care and patient monitoring	institutional funding	University students, patients, AI researches
Paro Therapeutic Robot	Customized	Paid (one-time purchase)	Elderly patients, care-givers, healthcare facilities
MindEase	Public	Subscription or institution funded	Students, mental health professionals, emergency support services
Mind Allies	Public	Free or low cost	Students, Mentors and educators
Woebot	Public (App-based)	Free	Individuals seeking mental health support
Cogito	Customized	Paid	Call centers, health-care providers, enterprise users

Table 1.1: Comparison between existing systems

1.5 Project Scope

The purpose of this project is to develop a mental health assistant using Pepper Robot that communicates with the university population, offering an intelligent robotic assistant capable of assessing their emotional well-being and offering personalized insights and guidance. At the core, this system is integrating RAG, ChatGPT, by using Pepper for mental health assessment and identifying personality traits to provide a personalized insight indicating the mental health state with personality traits. Furthermore, we will be combining Pepper's capabilities with RAG and ChatGPT, where Pepper will act as an interface with students by detecting their emotions and responses in real-time, presenting a screening therapist who provide emotional support and demonstrates empathetic understanding of the individual . RAG will then retrieve mental health resource data, personality types, and traits, which will enhance ChatGPT generated responses to deliver a detailed feedback report displayed on Pepper's screen. This report will serve as a first-level screening for the user associating accuracy percentage. Based on the result, the system will supply self help recommendation, and if necessary, suggest a referral to a mental health professional.

1.6 Constraints and Scope Excluded

This section outlines the constraints of the project and what is excluded from its scope. It discusses limitations related to time, finances, and technical challenges.

1.6.1 Time Constraints

The time constraint may prevent us from developing an application to provide results or direct help to the users. The primary focus of the project will be on the Pepper robot's capabilities and its interactions with users.

1.6.2 Financial Constraints

The financial constraint will be based on the cost of providing Electroencephalogram (EEG) sensors, which measure student brain activity for use in the project. In addition, the Photoplethysmography (PPG) sensors, which are used in smart watches and fitness trackers to measure heart rate and blood pressure, may be too costly to provide to every participant.

1.6.3 Technical Constraints

There are two significant technical constraints include being able to develop an appropriate Application Programming Interface (API) to connect the RAG system to the Pepper robot, and being able to properly secure access, storage, and transmission of user data.

1.6.4 Scope Excluded

It is beyond the scope of this project to implement the following activities:

- **Generating traceable, downloadable, or shareable PDF reports.**
- **Mobile data storage or access**: This project will not offer further tracking for the user state, that there is no app integration or cloud storage for report, as the interaction will be limited to Pepper Robot without being able to access mobile application for wider range of services.
- **Arabic Language Support** : The System will not provide Arabic Language and it will be restricted on English Language.

1.7 Stakeholder List

Table 1.2 shows the main stakeholders of the project.

Stakeholder	Interest	Importance
Developers	Build and develop the project.	High
Students	Seeking confidential mental health support and personality analysis.	High
University Counselors & Psychologists	Using AI-driven insights to provide better mental health support.	Mid
Professors & Academic Advisors	Understanding students' personality traits for academic and personal development.	Low
University Administration	Improving student mental health services and implementing AI-driven solutions.	Low
AI & Robotics Experts	Provide technical expertise and guidance.	High
Team Supervisor	Keep track of team's progress.	High

Table 1.2: Stakeholder List

1.8 Literature Review

In this section, related work to our project will be discussed, identifying related concepts and drawbacks of these systems along with our contribution presented in this project:

1.8.1 Introduction

The demand for mental health care is on the rise and the psychiatric illnesses have escalated substantially notably subsequent to COVID era (Costa et al. 2022). With the current shortage of human therapists, supplies, and capital, in addition to the growing number of potential patients, there is a thriving search for innovative solutions to meet these demands. One potential solution is technology itself. Concurrently, a novel phenomenon known as artificial intelligence, or AI, has surfaced, which includes algorithms that mimic human cognitive processes like learning, reasoning, and problem-solving (Yin et al. 2021).Correspondingly, humanoid robots figures prominently in the field of medical and therapeutic interventions (Boubaker 2020). Recently, Socially Assistive Robots (SARs) have been used in this context more frequent (Naslund et al. 2022). This results many people that are looking into this new area of technology to help not only people but also mental health professionals by developing creative tools to alleviate their increasingly stressful jobs.

SARs are robots designed to help people by interacting with them (Feil-Seifer & Mataric 2005). The Pepper Robot, developed by SoftBank Robotics in particular, present unique advantages in this domain due to its ability to engage users through speech, gestures, and emotional recognition (Pandey & Alami 2018).The integration of AI into SARs has created full of promise opportunities for therapeutic interventions and mental health diagnostics (Rafique & Rizwan 2020). Then as well, incorporating both mental health assessment and personality type analysis, offers the potential to develop a comprehensive and highly accurate tool for evaluating and addressing a wide range of mental health conditions. SAR use in other health care contexts has been reviewed, but there aren't many reviews that are specifically about mental health care (Abdi et al. 2018). Moreover, recent reviews of SARs have either restricted their attention to a specific diagnosis, a particular kind of robot, or a population of a particular age. This review aims to evaluate the effectiveness, outcomes, barriers, and facilitators of mental health interventions supported by AI and SARs, helping to identify current gaps and opportunities for future development.

1.8.2 AI Chatbots in Mental Health

There are several studies which explored AI role in diagnosing mental health disorders and improving the support and accessibility to mental health services:

- **ChatGPT**
  As ChatGPT provide wide variety of mental healthcare services, including accessibility and scalability of support, providing instant and continuous assistance, and serving as a non-judgmental space for users. It offers solutions, coping strategies, as well as helping in identifiying necessity referral. However, the main weaknesses for ChatGPT in the context of mental healthcare is diagnostic inaccuracy, limited understanding of complex human emotions, and critical ethical concerns regarding data privacy and bias. It needs to be thoroughly validated and carefully regulated before being used responsibly.

- **Woebot**
  Woebot is an AI-driven mental health chatbot that delivers Cognitive-Behavioral Therapy (CBT) techniques through conversational interactions, simulating empathetic conversations to guide users and foster a sense of connection. Research indicates its effectiveness in reducing symptoms of depression and anxiety, with users forming bonds comparable to traditional therapy. However, limitations include its inability to handle crisis situations such as suicidal scenarios and the need for more long-term studies (Fitzpatrick et al. 2017*b*). Insights from Woebot's design, particularly its use of CBT and conversational engagement, are relevant for developing interactive features in AI-driven robotic systems for mental health diagnosis and personality analysis, highlighting the potential of AI chatbots to complement professional mental health services (Anon. n.d.*c*).

These studies show the effectiveness of AI chatbots in mental health diagnosis and a solution for universities.

1.8.3 AI-Driven Robots in Mental Health Assessment

RAG in AI Systems

RAG is a modern AI technique that improves the accuracy of generated responses. It combines a retriever module, which searches for reliable information, with a generator that uses the retrieved data to construct a relevant answer. Unlike traditional AI models that rely only on pre-trained knowledge, RAG systems can dynamically fetch and use real-world content while responding. This makes the output more informative, up-to-date, and personalized (Rangan & Yin 2024).
In the proposed system, Pepper is enhanced with RAG capabilities to deliver deeper and more personalized interactions. For instance, when engaging with students who express stress, the robot does not rely solely on scripted replies (Rangan & Yin 2024). Instead, relevant mental health content is retrieved in real time and used to generate supportive responses tailored to the user's needs. The combination of robotics and RAG remains uncommon in mental health applications, positioning this approach as a more intelligent and responsive solution (Rothman 2024).

Talking Therapies and Talking Technologies

- **Conversational Robots in Mental Health Care**
  The integration of conversational robots into mental health care is gaining traction, offering support, companionship, and feedback to users. These robots are designed to alleviate stress, combat loneliness, and assist individuals during challenging times. However, the incorporation of advanced AI tools like RAG in such systems remains limited.

- **Pepper Robot in Healthcare Settings**
  A notable example in this domain is Pepper, a social humanoid robot developed by SoftBank Robotics (SoftBank Robotics 2024). Pepper is equipped with capabilities to recognize emotions, engage in verbal communication, and interpret facial expressions. It has been utilized in various settings, including educational institutions, healthcare facilities, and research projects, to facilitate discussions around emotions and stress (Pandey & Alami 2018). While Pepper excels in initiating conversations and providing a sense of companionship, its interactions are often based on predefined scripts or basic responses. Some initiatives have integrated AI to enhance its conversational depth, but these are still in nascent stages.

  In Japan, an innovative application called Care Prevention Gymnastics Exercises for Pepper (Pepper-CPGE) was introduced to support elderly patients and those with schizophrenia. This 40-minute program combines physical exercises with cognitive stimulation, tailored to the functional levels of the elderly. Implemented at Mifune Hospital, the program observed increased communication between patients and caregivers, heightened patient engagement, and overall enjoyment during sessions. Such interventions highlight the potential of humanoid robots in enhancing rehabilitation and recreational activities for patients requiring long-term care (Ujike et al. 2019).

  Unlike systems that operate solely as chatbots or physical companions, the approach described here combines a humanoid robot with dynamic, knowledge-aware AI. Real-time retrieval enables more contextually accurate and meaningful responses, leading to deeper, more effective dialogue. A summary of the interaction, including an assessment of mental health indicators and personality traits, is presented to the user at the end of the session.

- **Paro: A Non-Interactive Comfort Robot** Another therapeutic robot, Paro, resembles a baby seal and is designed to provide comfort through tactile and auditory interactions. Primarily used with elderly individuals or those with cognitive impairments, Paro responds to touch and voice, offering a calming presence akin to that of a therapy animal. However, Paro lacks conversational abilities and analytical functions, limiting its role to passive interaction (Anon. n.d.*b*).

1.8.4 Mental Health Integration with Personality Type Analysis using AI

Recent research highlights the importance of integrating personality type analysis into AI-driven mental health support systems, particularly within university student populations. De Melo et al. (2024) found that users' affective states and personality traits significantly influence their perception of AI agents designed for mental health assistance. In academic settings, where students often face heightened stress and psychological challenges, tailoring AI interactions to individual personality profiles can enhance engagement, trust, and the perceived efficacy of support. This integration not only personalizes mental health interventions but also improves user satisfaction and outcomes, making it a promising direction for university-based AI mental health solutions.

1.8.5 Design Principles for Pepper-Based System

User Engagement and Empathy

To foster meaningful interaction in mental health contexts, Pepper must exhibit social behaviors that align with users' emotional states. (Looije et al. 2024) emphasize that robots capable of initiating affect-sensitive dialogue and displaying prosocial behaviors are more likely to be perceived as trustworthy and engaging.

Adaptive Learning and Personalization

Effective mental health support requires systems that adapt over time to user preferences, mood patterns, and personality traits. Incorporating adaptive feedback loops enables Pepper to refine its responses, thereby enhancing the relevance and personalization of its diagnostic and conversational outputs (Looije et al. 2024).

Ethical and Practical Considerations

Designing Pepper for mental health roles necessitates careful attention to user privacy, data protection, and informed consent. According to Looije et al. (2024), such systems must also be practical for sustained deployment, ensuring robustness, ease of use, and accessibility in diverse care environments.

1.8.6 Gaps

The common limitations between most related work were:

- **Limited Accessibility in University Campus:** Not all students are able to access AI mental health services and university centers only rely on traditional consultation which also might not always be available.
- **Lack of Integration Between AI and Robotics:** Currently, only chatbots or robotic systems are used as mental health tools but little too few projects that tried to use both and link them to each other.
- **Lack of Human Empathy and Nuance:** AI mental health tools lack human nuance, risking impersonal support. Hybrid (AI and human) care is ideal.
- **Insufficient Personalization Based on Personality Types:** Current AI mental health tools do not adequately tailor their interactions based on users' personality traits, reducing the effectiveness of support, especially in high-stress academic environments.
- **Underutilization of Advanced AI Tools like RAG:** RAG remains rarely implemented in robotic systems like Pepper, limiting real-time, context-rich dialogue and adaptive learning capabilities.

1.8.7 Summary

This literature review explores the growing demand for mental health support, particularly in the post-COVID era, and evaluates the role of technology—specifically AI and robotics—in addressing this challenge. SARs, such as the Pepper robot, are emerging tools that can interact socially with users to support therapeutic processes. The integration of AI into these robots, especially for mental health diagnostics and interventions, is gaining traction but remains underexplored.

Key AI tools like ChatGPT and Woebot have demonstrated potential in delivering accessible and scalable mental health support. However, limitations such as diagnostic accuracy, emotional understanding, and ethical concerns persist. Robots like Pepper and Paro have been used in healthcare, with some success in enhancing patient engagement and well-being, but they often rely on basic or scripted responses.

A significant gap identified is the lack of integration between AI chatbots and robotics, particularly for personalized mental health assessment. Current systems typically focus either on chatbots or robotic platforms, not both. Moreover, advanced AI tools like RAG remain underutilized in robotic systems, limiting their conversational depth and adaptability.

The review also highlights the importance of incorporating personality type analysis in AI-driven mental health tools to improve personalization and user engagement, especially in high-stress environments like universities. To address these gaps, the proposed project integrates Pepper with RAG and personality assessment, aiming to deliver personalized, adaptive, and insightful mental health interactions.

Chapter 2

Project Requirements

This section will be talking about the project's requirements and the methods used to identify said requirements, by using a questionnaire and conducting one-to-one interview with a mental health professionals to understand what requirements stakeholders would like to see in our system. Also, it will include a list of functional and non-functional requirements based on the results of the elicitation techniques used.

2.1 Gathering Techniques

Two requirements gathering techniques were used for this project as elaborated in this section:

2.1.1 Questionnaire

We conducted a questionnaire to gather information for a AI-driven robotic system that we are developing for University of Petra. The questionnaire was distributed electronically to 30 participants, and we designed the questions to gain insights on students preferences and needs with regards to AI-driven robotic system (Link to the questionnaire). Our questionnaire aimed to understand usage and convenience factors of AI-driven robotic system in universities, and we analyzed the results to identify the most common preferences and needs of university population, based on the results of the questionnaire, the following statistics were obtained:

- 26.7% of respondents, rated their comfort level at 4 and 5 (on a scale of 1 to 5, with 5 being most comfortable) when discussing mental health anonymously with an AI-powered robot like Pepper. Conversely, 13.3% rated their comfort at 1.
- 40% rated their comfort level at 3 when providing personal information (e.g., name, DOB, disability status) to an AI system. 30% were least comfortable, rating their comfort at 1.
- 70% of respondents, would like to receive personal feedback from the system based on their messages. Only 13.3% would not, and 16.7% selected "Maybe".
- The most preferred interaction method is "Both" (voice and touchscreen input), selected by 60% of respondents. Voice input was preferred by 13.3%, and touchscreen input by 26.7%.

- When asked about what features would make the system easier to use students would like to see:
  - Simple language was the most desired feature, selected by 80% of respondents.
  - Visual aids (icons, images) were chosen by 73.3%.
  - Audio instructions were selected by 50%.
  - Navigation through the system was chosen by 3.3%.
- 50% of respondents believe that if the robot adapts its questions based on earlier answers (dynamic flow), it would improve their experience (rated 5 on a scale of 1-5). Only 3.3% rated it as 1 or 2.
- 40% of respondents rated the importance asking for consent before starting the assessment 4, and 46.7% rating it 5 (on a scale of 1-5).
- 56.7% of respondents would be willing to skip or decline specific questions during the assessment. 30% would not, and 13.3% selected ”Maybe”.
- 43.3% of respondents rated the importance of a robot using friendly gestures (e.g., waving, smiling) when interacting with them as a 4. Another 20% rated it as a 5, and 20% rated it as a 3.
- 40% of respondents prefer a session length that ”depends on the purpose”. 33.3% prefer a ”quick (under 10 minutes)” session, and 26.7% prefer a ”detailed (10-20 minutes)” session.
- 53.3% of respondents believe that cultural relevance would increase their comfort level using the system. 20% said it would not, and 26.7% selected ”Maybe”.
- The majority (70%) of respondents would want the system to link with a mental health professional if it detects high-risk responses, but only ”with my consent”. 26.7% selected ”Yes, always”.
- When asked about expected actions after receiving results:
  - Self-help recommendations were expected by 76.7% of respondents.
  - Referral to a mental health professional was expected by 63.3%.
  - More information about personality traits was expected by 63.3%.
  - Only 13.3% expected ”No action needed”.
- Some respondents suggested adding features like ”Listing the accuracy percentage,” ”Make it empathize with the user,” and ”Accuracy”.

Details of the questionnaire analysis are in Appendix (A).

2.1.2 One-to-one interview

After the interviews that happened between the psychiatrist and the therapist, they made it clear for us to focus on understanding how to assess students more effectively during the interaction between them and Pepper. The therapist and psychiatrist focused on how important it is to gather information about the sleep quality which can be a strong indicator of underlying mental health issues. They also discussed how important it is to explore childhood which also can reveal patterns and traumas that influence the student current behavior. Another keypoint, is to detect signs of addiction or substance use without making the student aware of this happening or judged, allowing for more accurate reports to be generated. Finally, both agreed that closely observing speech patterns, body language and the interaction during the session is highly important for accuracy of the report. Details of the interviewee and collected information are in Appendix (B).

2.2 Requirements

2.2.1 Functional Requirements

FR.1 The system shall allow Pepper to detect the students.

FR.2 The system shall support voice-based interaction as the primary method, with optional text-based input.

FR.3 The system shall include audio instructions to assist users during the interaction process.

FR.4 The system shall allow users to skip or decline specific questions during the assessment.

FR.5 The system shall conduct mental health and personality assessments through interactive sessions with Pepper.

FR.6 The system shall analyze user input to determine mental health state and personality traits.

FR.7 The system shall support dynamic question flow, adapting questions based on prior responses.

FR.8 The system shall integrate ChatGPT to generate natural, personalized responses.

FR.9 The system shall integrate RAG to retrieve relevant mental health and personality information to enhance responses.

FR.10 The system shall generate and display a detailed feedback report on Pepper's screen.

FR.11 The feedback report shall include Mental health status, Personality traits and type, Accuracy percentage and Referral suggestion (if needed).

FR.12 The system shall express empathy and emotional sensitivity during user interactions.

2.2.2 Non-Functional Requirements

NFR.1 The system shall be easy to use for students with minimal technical knowledge.

NFR.2 The system shall protect user anonymity and privacy, especially when handling mental health-related conversations and personal data.

NFR.3 The system shall maintain a high accuracy rate in analyzing mental health state and personality traits.

NFR.4 The system shall use a clear and readable layout on Pepper's screen to present feedback results.

NFR.5 The system shall allow session flexibility, supporting both short (10-minute) and long (detailed) assessments.

2.3 Use Cases

The proposed system consists of a human-aid robotic system using Pepper Robot that offers mental health assessment and support integrated with personality type and traits. The system performs the following use cases.

- **Initiate Conversation and Detect Users**
  Scenario: As users approach, the robot Pepper detects their presence and greets them. It begins a brief conversation, analyzing the user's tone and responses to assess emotional well-being. If signs of distress are detected, the robot offers support or alerts a counselor. Table 2.1 presents the use case for Initiate Conversation and Detect Users function:

Component	Description
Use Case Name	Initiate Conversation and Detect Students
Preconditions	– Robot is powered on, connected to the detection and NLP system, and idle
Actors	User
Flow of Events	1. Robot detects user using sensors. 2. Robot greets the user. 3. Engages in short conversation. 4. Analyzes emotional cues (sentiment, tone, keywords). 5. If distress detected, suggests support or alerts staff.
Post Conditions	The user is either identified for further support or marked as emotionally stable
Exceptions	E1: User ignores the robot → Robot returns to idle mode E2: No emotional cues detected → Robot offers general well-being advice
Alternatives	A1: Robot waits briefly, then returns to idle mode.

Table 2.1: Use case initiate conversation and detect students

- **Voice-Based Interaction**

  Scenario: A user stands in front of Pepper and says, "Hello." Pepper immediately responds using voice and starts the session. The user continues interacting verbally, while a text input option is also available on the screen for accessibility. Table 2.2 presents the use case for Voice-Based Interaction function:

Component	**Description**
Use Case Name	Voice-Based Interaction
Preconditions	– Microphone and speaker are active – Noise level is low to moderate
Actors	User
Flow of Events	1. Pepper greets the user via audio. 2. User responds through voice. 3. Pepper confirms recognition. 4. Interaction proceeds through voice commands.
Post Conditions	User is engaged in a voice-based session.
Exceptions	E1: Voice not detected → prompt for retry or switch to text.
Alternatives	A1: User opts to input via touchscreen/text.

Table 2.2: Use case Voice-Based Interaction

- **Provide Audio Instructions**

  Scenario: When the system is powered on and detects a user, Pepper starts a new session, then Pepper plays audio instructions to guide the user. If the audio system fails, or the speaker is disconnected the system shows error message ”Audio not available. Please follow on-screen instructions”, then the user is prepared to interact with Pepper. The user can choose to display text-based instruction. Table 2.3 presents the use case for the Provide Audio Instructions function:

Component	**Description**
Use Case Name	Provide Audio Instructions
Preconditions	– System is powered on and user is present
Actors	User
Flow of Events	1. Pepper detects user presence and initializes session. 2. Pepper activates audio system and performs sound check. 3. Pepper plays welcome audio instruction to guide user. 4. Pepper provides step-by-step audio navigation guidance. 5. User receives audio confirmation of each interaction. 6. Pepper completes audio instruction sequence successfully.
Post Conditions	Users are prepared to interact with Pepper
Exceptions	E1:The audio system fails, or speaker is disconnected → System shows error message: ”Audio not available. Please follow on-screen instructions.”
Alternatives	A1: Display text-based instructions.

Table 2.3: Use case provide audio instructions

- **Skip or Decline Questions**

  Scenario: A user using the mental health support chatbot is prompted with a question about past traumatic experiences. Feeling uncomfortable, the user chooses to skip the question and continues with the rest of the session without interruption. The system respects the decision without pressuring the user and adjusts the flow of conversation accordingly. Table 2.4 presents the use case for the Skip or Decline Questions function:

Component	**Description**
Use Case Name	Skip or Decline Questions
Preconditions	– The user is interacting with the mental health support system and is presented with a question
Actors	User
Flow of Events	1. The system asks a question. 2. The user feels uncomfortable and chooses "Skip" or "Decline". 3. The system acknowledges the choice. 4. The conversation continues with the next relevant question.
Post Conditions	The system registers the question as skipped, adapts the conversation flow, and ensures the session continues smoothly
Exceptions	E1: User accidentally clicks "Skip" → the system allows them to return to the previous question if desired
Alternatives	A1: User skips multiple questions – the system offers a summary or asks if they want to reschedule

Table 2.4: Use case user skip or decline questions

- **Conduct Mental Health and Personality Assessment**

  Scenario: In case the user agrees to start the session, the session starts, then Pepper conducts interactive questions and answers to assess the user. If the session interrupts (e.g., Pepper restarts) the system will display the message "Session interrupted. Please restart the assessment.", then the session data collected. Table 2.5 presents the use case for Conduct Mental Health and Personality Assessment function:

Component	**Description**
Use Case Name	Skip or Decline Questions
Preconditions	– User agrees to start session
Actors	User
Flow of Events	1. User starts session and provides initial consent. 2. Pepper initiates assessment protocol and loads question database. 3. Pepper conducts interactive Questions and Answers (Q and A) to assess user. 4. System processes user responses using NLP algorithms. 5. Pepper applies DSM-5 criteria for mental health evaluation. 6. System compiles assessment results and generates analysis report.
Post Conditions	Session data collected for analysis
Exceptions	E1: The session is interrupted (e.g., Pepper restarts) → System displays: "Session interrupted. Please restart the assessment."
Alternatives	A1: User reschedules assessment.

Table 2.5: Use case conduct mental health and personality assessment

- **Analyze User Input**

  Scenario: When the system collects the user inputs, AI System analyzes responses to determine mental state and personality traits, System fails to analyze because unclear input, the system will display message: "Unable to process response. Please try again.". Then the system will generate Insights generated from user inputs. Table 2.6 presents the use case for Analyze User Input function:

Component	**Description**
Use Case Name	Analyze User Input
Preconditions	– Assessment session has completed and system has collected user input.
Actors	System Backend
Flow of Events	1. The system retrieves collected user responses from database. 2. System applies NLP algorithms to process natural language responses. 3. The system analyzes responses to determine mental state and personality traits. 4. System validates analysis results against DSM-5 criteria. 5. System generates comprehensive insights and diagnostic scores.
Post Conditions	Insights generated from user input and diagnosed traits and scores are available.
Exceptions	E1: System fails to analyze due to corrupted or unclear input → prompt additional input
Alternatives	A1: Notify user and suggest repeating the assessment.

Table 2.6: Use case Analyze User Input

- **Adapt Question Flow**

  Scenario: During the assessment session running, user answer the questions, the system selects the next question based on previous questions, if there is a logical error in the answer the system will fail to adapt and the system will display message: ”Switching to default question set.”. Then the system will perform a customized and responsive interaction with the user. If the user wants quick session, the user will be able to choose pre-structured questions flow. Table 2.7 presents the use case for Analyze User Input function:

Component	**Description**
Use Case Name	Adapt Question Flow
Preconditions	– User has initiated assessment session and answered at least one question.
Actors	User
Flow of Events	1. User answers a question and submits response. 2. System analyzes the answer for content and logic validation. 3. System selects next question based on previous answer patterns. 4. System evaluates user response time and engagement level. 5. System customizes question difficulty and format accordingly. 6. System presents the adapted next question to user. 7. System logs adaptation decisions for continuous improvement.
Post Conditions	Customized, responsive interaction
Exceptions	E1: System fails to adapt due to logic error $\rightarrow$ Message: ”Switching to default question set.”
Alternatives	A1: Pre-Structured questions flow mode

Table 2.7: Use case Adapt Question Flow

- **Generate Natural Responses via ChatGPT**

  Scenario: OpenAI status is online, the user submit inputs to the system, ChatGPT generate natural replies, if ChatGPT is times out the system will display message: ”Sorry, I'm having trouble generating a response right now”, then Pepper delivers the replies. Personal conversation will be maintained. Table 2.8 presents the use case for Generate Natural Responses via ChatGPT function:

Component	**Description**
Use Case Name	Generate Natural Responses via ChatGPT
Preconditions	– ChatGPT API is integrated and network connectivity is established
Actors	User, System Backend
Flow of Events	1. User gives input and submits to system. 2. System validates input format and sends request to ChatGPT API. 3. ChatGPT processes request and generates natural replies. 4. System receives and validates ChatGPT response quality. 5. Pepper delivers the natural replies to user.
Post Conditions	Personalized conversation is maintained
Exceptions	E1: ChatGPT is unreachable or times out → System shows: ”Sorry, I'm having trouble generating a response right now.”
Alternatives	A1: Retry with simplified prompt.

Table 2.8: Use case Generate Natural Responses via ChatGPT

- **Retrieve Information via RAG**

  Scenario: RAG module is active, the system sends prompts to RAG, then retrieves relevant documents. The system enhances ChatGPT's response using retrieved content. If no documents are found or connection is lost, the system shows: "Relevant information not found. Continuing with general advice." The system then generates a high-quality, context-based response. The user can also select ChatGPT-only response without RAG enhancement. Table 2.9 presents the use case for Retrieve Information via RAG function:

Component	**Description**
Use Case Name	Retrieve Information via RAG
Preconditions	– RAG module is enabled, and connection to the knowledge base is established.
Actors	User, System Backend
Flow of Events	1. User submits a prompt. 2. System sends the prompt to the RAG module. 3. System validates the connection to the knowledge base using RAG. 4. System retrieves relevant documents RAG. 5. System verifies that documents were retrieved. 6. System integrates retrieved documents into ChatGPT's response for improved relevance. 7. System generates a high-quality, context-based response. 8. System delivers the response to the user.
Post Conditions	High-quality, context-based response generated
Exceptions	E1: No documents retrieved, or connection lost → System shows: "Relevant information not found. Continuing with general advice."
Alternatives	A1: Use ChatGPT-only response without RAG enhancement

Table 2.9: Use case Retrieve Information via RAG

- **Generate and Display Feedback Report**

  Scenario: When the assessment session is complete, the system will retrieve the assessment data, compile the results, and generate a personalized feedback report. The system will then prompt the user to confirm readiness to view the report. If the user agrees, the system will display the report on Pepper's screen. If a display error occurs, the system will show the message: "Unable to show report. Please check screen." Then the user will be able to review the results. Table 2.10 presents the use case for Generate and Display Feedback Report function:

Component	**Description**
Use Case Name	Generate and Display Feedback Report
Preconditions	– Assessment session and analysis is complete
Actors	User, System
Flow of Events	1. The system retrieves completed assessment data. 2. The system compiles assessment results. 3. The system generates personalized feedback report. 4. The system prompts user: "Ready to view your feedback?" 5. User selects Yes/No. 6. If Yes, the system displays report on Pepper's screen.
Post Conditions	User views feedback report
Exceptions	E1: Display screen error or no output shown → System says: "Unable to show report. Please check screen".
Alternatives	A1: Offer to send report via email.

Table 2.10: Use case Generate and Display Feedback Report

- **Include Mental Health & Personality Details in Report**

  Scenario: When the system analyzed user input, the system will create a report includes mental health status, personality traits and type, accuracy percentage and referral suggestions, some data could not be calculated, so the system will display a message: "Some report sections are incomplete", then the receives a complete summary. Table 2.11 presents the use case for Generate and Display Feedback Report function:

Component	**Description**
Use Case Name	Include Mental Health & Personality Details in Report
Preconditions	– System has analyzed user input
Actors	User, System
Flow of Events	1. Report includes mental health status. 2. Lists personality traits and type. 3. Shows accuracy/confidence score. 4. Suggests referrals if needed.
Post Conditions	User receives a complete summary
Exceptions	E1: Missing content → retry report compilation.
Alternatives	A1: Notify user about incomplete results.

Table 2.11: Use case Include Mental Health & Personality Details in Report

- **Express Sympathy During Interaction**

  Scenario: While the user engaged in active session with Pepper, user starts a conversation or assessment with Pepper, then user express a negative or emotional statement, the system detects emotional cues I the user's input, If the system fails to detect emotional content, the response may not fully reflect sympathy. ChatGPT generates a sympathetic and sensitive response, then Pepper delivers the response using a gentle tone and empathetic expression. Table 2.12 presents the use case for Express Sympathy During Interaction function:

Component	**Description**
Use Case Name	Express Sympathy During Interaction
Preconditions	– User is engaged in an active session with Pepper.
Actors	User
Flow of Events	1. User starts a conversation or assessment with Pepper. 2. User expresses a negative or emotional statement. 3. The system detects emotional cues in the user's input. 4. ChatGPT generates a sympathetic and sensitive response. 5. Pepper delivers the response using a gentle tone and empathetic expression. 6. Lists personality traits and type. 7. Shows accuracy/confidence score. 8. Suggests referrals if needed.
Post Conditions	User feels emotionally supported by the system
Exceptions	E1: If the system fails to detect emotional content → the response may not fully reflect sympathy.
Alternatives	A1: The system defaults to a neutral, supportive tone. A2: The robot pauses regular interaction.

Table 2.12: Use case Express Sympathy During Interaction

Chapter 3

Project Plan

3.1 Process Model

For this project, the Waterfall process model was chosen to provide a clear and structured planning approach. The Waterfall model follows a sequential design process, where each phase must be completed before proceeding to the next. A detailed WBS was created to organize the project into distinct phases: requirements gathering, system design, implementation, testing, deployment, and maintenance. Each phase was carefully planned and broken down into specific tasks and deliverables, ensuring that every stage was completed and verified before moving forward. This structured planning approach enabled effective task management, resource allocation, and progress tracking throughout the project lifecycle.

The Waterfall model offers several benefits for project planning and execution:

- Well-defined phases provide a clear roadmap and make it easier to manage and monitor progress.
- Comprehensive documentation ensures that all requirements and decisions are clearly recorded and traceable.
- Predictable timelines result from detailed upfront planning and sequential task execution.
- Quality assurance is strengthened by verifying each phase before moving to the next, reducing the risk of errors.

Overall, the Waterfall model supports disciplined and organized project execution, making it well-suited for projects that require clarity, stability, and a structured development path.

3.2 Scope Initiation (WBS)

In this chapter, the WBS provided will show the task names, details, estimated time and dependencies, resource plans and cost estimation for each resource, and human resources with roles. This chapter also includes system requirements and how much they cost, as well as a list of potential risks that could occur during the project's lifetime.

Figure 3.1 and figure 3.2 illustrates the WBS in this project:

ID	Tas Mo	Task Name	Duration	Start	Finish	Pr	Resource Names
1		**AI Robotic system for mental health Project**	**190 days**	**Mon 4/28/25**	**Mon 1/19/26**		
2		**Project Inititation**	**45 days**	**Mon 4/28/25**	**Fri 6/27/25**		
3		Creat project proposal	4 days	Mon 4/28/25	Thu 5/1/25		Faris,Joud,Muhammed,
4		Problem definnition	3 days	Fri 5/2/25	Tue 5/6/25	3	Faris
5		Current & existing system	2 days	Wed 5/7/25	Thu 5/8/25	4	Joud,Sara
6		Define the project scope and the excluded scope & Define The Objectives	4 days	Fri 5/9/25	Wed 5/14/25	5	Joud,Muhammed
7		Define project constrains	9 days	Thu 5/15/25	Tue 5/27/25	6	Muhammed,Sara
8		make stackeholders	4 days	Wed 5/28/25	Mon 6/2/25	7	Faris
9		create Literature	7 days	Tue 6/3/25	Wed 6/11/25	8	Faris,Joud,Muhammed,
10		Develop project plan	12 days	Thu 6/12/25	Fri 6/27/25	9	Faris,Joud,Muhammed,
11		Project Initiation	0 days	Fri 6/27/25	Fri 6/27/25	10	Faris
12		**Requirements Gathering**	**14 days**	**Mon 6/30/25**	**Fri 7/18/25**		
13		conduct Survey and interview	4 days	Mon 6/30/25	Thu 7/3/25	11	Joud
14		Define Functional requierments & Nonfunctional	4 days	Fri 7/4/25	Wed 7/9/25	13	Faris
15		validate and approve requirements	7 days	Wed 7/9/25	Thu 7/17/25	14	Faris
16		Requirements gatherign submission	0 days	Fri 7/18/25	Fri 7/18/25	15	Joud
17		**System desigen**	**28 days**	**Wed 10/1/25**	**Sat 11/8/25**		
18		Create template use case for functional	7 days	Wed 10/1/25	Thu 10/9/25	16	Faris
19		Architecture des	7 days	Fri 10/10/25	Mon 10/20/2	18	Faris,Muhammed
20		Data flow desigr	7 days	Tue 10/21/25	Wed 10/29/2	19	Muhammed
21		User Interface design	7 days	Thu 10/30/25	Fri 11/7/25	20	Muhammed
22		Design complete	0 days	Sat 11/8/25	Sat 11/8/25	21	
23		**Implementaion**	**39 days**	**Mon 11/10/2**	**Fri 1/2/26**		

Figure 3.1: Work Breakdown Structure representation of the project tasks (1)

24	**AI intetgration**	**24 days**	**Mon 11/10/2**	**Thu 12/11/2!**		
25	RAG setup	6 days	Mon 11/10/2	Mon 11/17/2	22	Joud,Sara
26	ChatGPT API Integration	7 days	Tue 11/18/25	Wed 11/26/25	25	Sara
27	Personality Train Aalyzer	11 days	Thu 11/27/25	Thu 12/11/25	26	Sara
28	**Pepper robot integration**	**7 days**	**Fri 12/12/25**	**Mon 12/22/25**		
29	Emotion sensing	4 days	Fri 12/12/25	Wed 12/17/25	27	Joud
30	Voice interaction	3 days	Thu 12/18/25	Mon 12/22/25	29	Joud
31	**Feedback system**	**3 days**	**Tue 12/23/25**	**Thu 12/25/25**		
32	Accuracy report	1 day	Tue 12/23/25	Tue 12/23/25	30	Sara
33	Referral suggestion engine	2 days	Wed 12/24/25	Thu 12/25/25	32	Sara,Faris
34	**Interface output**	**5 days**	**Fri 12/26/25**	**Fri 1/2/26**		
35	Display output on	3 days	Fri 12/26/25	Tue 12/30/25	33	Muhammed
36	Logging user interface	2 days	Wed 12/31/25	Thu 1/1/26	35	Faris
37	Development Phase	0 days	Fri 1/2/26	Fri 1/2/26	36	
38	**Testing**	**5 days**	**Sat 1/3/26**	**Sun 1/11/26**		
39	Unit Testing	1 day	Sat 1/3/26	Sat 1/3/26	35	Faris
40	Integration testi	2 days	Mon 1/5/26	Tue 1/6/26	39	Faris
41	User acceptance	1 day	Wed 1/7/26	Wed 1/7/26	40	Faris,Joud
42	Privacy and security testing	1 day	Thu 1/8/26	Thu 1/8/26	41	Faris,Joud
43	Test Plan Approv	0 days	Sun 1/11/26	Sun 1/11/26	42	
44	**Deployment**	**5 days**	**Mon 1/12/26**	**Mon 1/19/26**		
45	Final deployment on	2 days	Mon 1/12/26	Tue 1/13/26	43	Muhammed,Sara
46	Demo for stakeholders	1 day	Thu 1/15/26	Thu 1/15/26	45	Muhammed,Sara
47	Documentation	1 day	Fri 1/16/26	Fri 1/16/26	46	Faris,Joud,Muhammed
48	Deployment review	0 days	Mon 1/19/26	Mon 1/19/26	47	Faris,Joud,Muhammed

Figure 3.2: Work Breakdown Structure representation of the project tasks (2)

3.3 Gantt Chart

The upcoming figures will showcase the Gantt chart, depicting the project activities (Y-axis) aligned with the project's timeline (X-axis). It will highlight the interconnections and dependencies among various tasks and increments. Additionally, the Gantt chart will emphasize the utilization of an incremental process model that has been chosen for this project. Figure 3.3 presents the Gantt chart of this project:

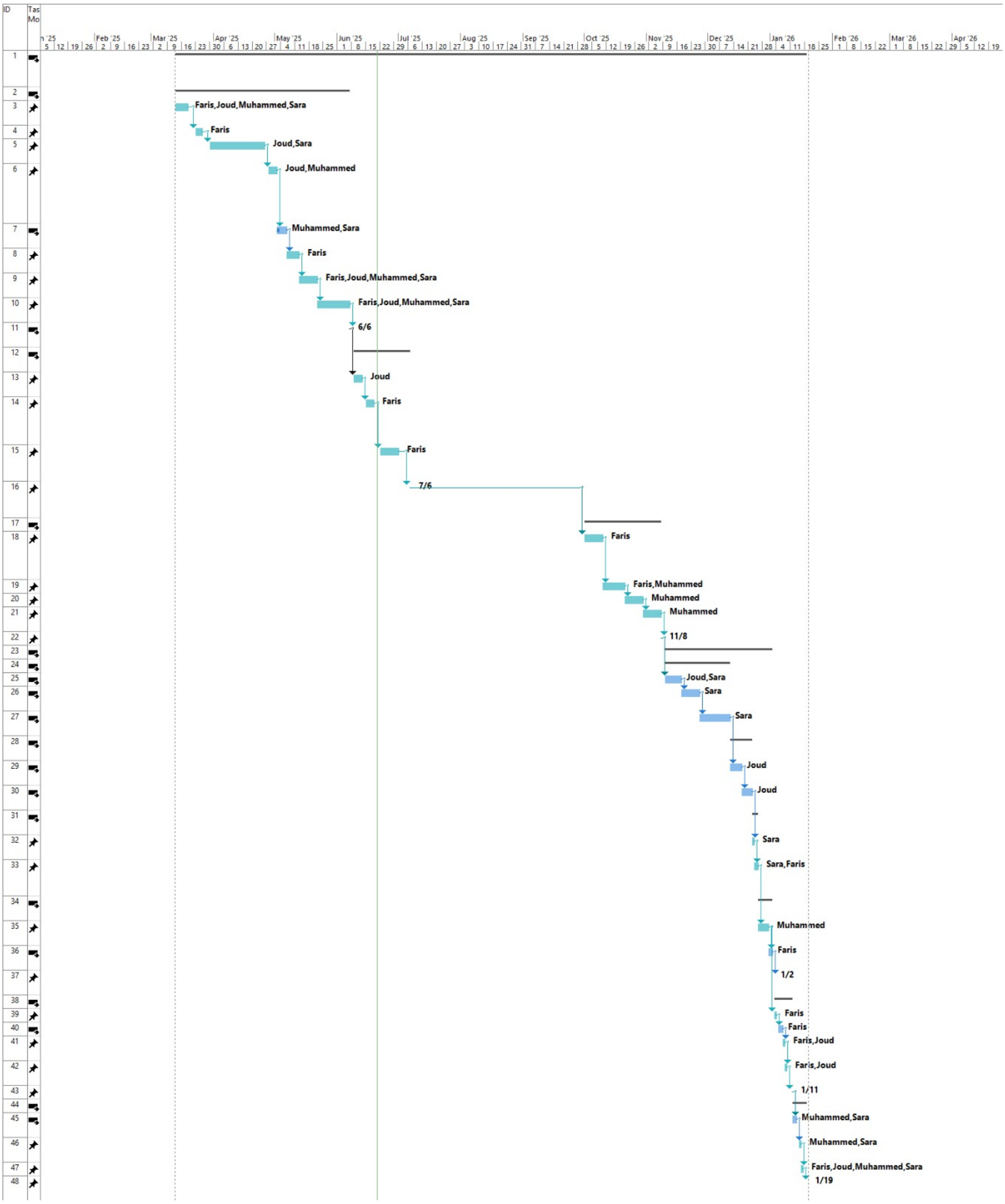

Figure 3.3: Gantt Chart Representation of the Project Schedule

3.4 Resource Sheet

Table 3.1 demonstrates resources names, types and cost:

Resources Name	Resource Type	Cost
Developer 1 (Faris)	Work	$1530.00/Month
Developer 2 (Sara)	Work	$1440.00/Month
Developer 3(Joud)	Work	$1440.00/Month
Developer 4 (Muhmmad)	Work	$1408.00/Month
GitHub	Material	$0.00
Open AI	Material	$100 (monthly subscription)
Microsoft Project	Material	$0.00
Python	Material	$0.00
Node.Js	Material	$0.00
OverLeaf	Material	$0.00
Laptops	Material	$4000.00
Pepper Robot	Material	$49,900.00

Table 3.1: Shows Resource Name, Type and Cost for each of the Resources.

Resource overview is summarized in Figure 3.4:

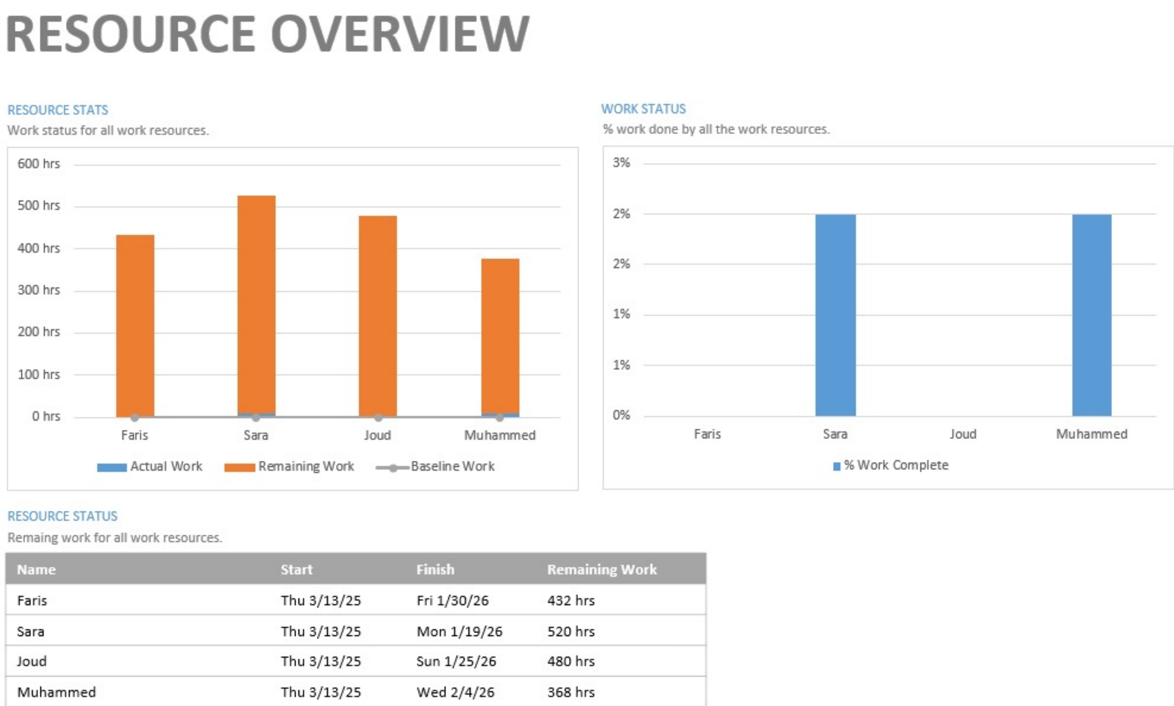

Figure 3.4: Shows the Resource Overview of the Project

3.5 System Development Requirements

The section dedicated to system development requirements in the document describes the precise needs and specifications of the system under development. It is of utmost importance to ensure that the final system adequately fulfills the requirements of the users and stakeholders. In this particular section, we will present a list of the system development requirements for our project, aiming to satisfy the needs of all stakeholders involved. Table 3.2 presents types of resources used in this project :

Resource Type	**Resource**
Human Resource	Joud Abu Laban Fares Edkaidek Sara Manasrah Muhammad Al Gharir
Software	GitHub Chat GPT OpenAI Microsoft Project Microsoft Teams Python Node.JS
Hardware	Laptop Pepper Robot

Table 3.2: Types of resources used in the project

Table 3.3 shows resources names, use, specifications, price and quantity :

Name	**Use**	**Specifications**	**Price**	**Quantity**
Laptops	For Documents and Developments	• Processor: Intel Core i7 • RAM: 16–32 GB • System Type: 64-bit Operating System	$600	2
Pepper Robot	To interact with users	Full functionality	Provided from the university	1
Operating system	For Documents and Development	Windows 10	$30	2
Microsoft Office	For Documents	• Word • Excel • PowerPoint	$8.25/month	2
Microsoft Project	For planning documents	Full access version	$55/month	2
GitHub	For change control and team collaboration	Shared repository	Free	4
Python	For programming	Latest version	Free	4
Overleaf	Work documentation	Text live 2024	Free	4
Node.JS	Framework for JavaScript	Latest version	Free	4
Choregraphe Suite	For Pepper simulation	Windows operation system version	Free	1

Table 3.3: Resources names, use, specifications, price and quantity

3.6 Cost Estimation and Budgeting

Cost estimation and budgeting are critical elements of project management, as they help to determine the feasibility of a project and ensure that it stays within financial constraints. This section of the document outlines the estimated costs of the project and the budget allocated for it. It includes information such as the costs of materials, labor, and any other expenses that will be incurred during the project. It also provides a breakdown of the budget, and a detailed explanation of how the costs were calculated. In this section, an accurate and comprehensive cost estimation and budgeting plan for this project will be presented, to ensure that it stays within the allocated budget.

A detailed overview of the human and material resource cost structure is provided in Table 3.4:

Human Resources			
#	**Name**	**Monthly Cost**	**Entire Project**
1	Faris	$7.50/h	$645.33
2	Sara	$8.00/h	$1,306.67
3	Joud	$7.50/h	$814.67
4	Muhammad	$8.00/h	$1,750.00
Materials			
#	**Name**	**Cost**	
1	Python	Free	
2	Node.JS	Free	
3	Chat GPT OpenAI	$100/month	
4	Microsoft Project	Free	
5	Microsoft Teams	Free	
6	Overleaf	Free	
7	Pepper Robot	$49,900.00	
8	Laptop 1	$1000	
9	Laptop 2	$1000	
10	Laptop 3	$1000	
11	Laptop 4	$1000	
12	GitHub	Free	
Total Cost		**$54,100**	
Net Total		**$58,616.67**	

Table 3.4: Combined table of Human and Material Resource Costs

Figure 3.5 and Figure 3.6 provide summary of the cost distribution within the project.

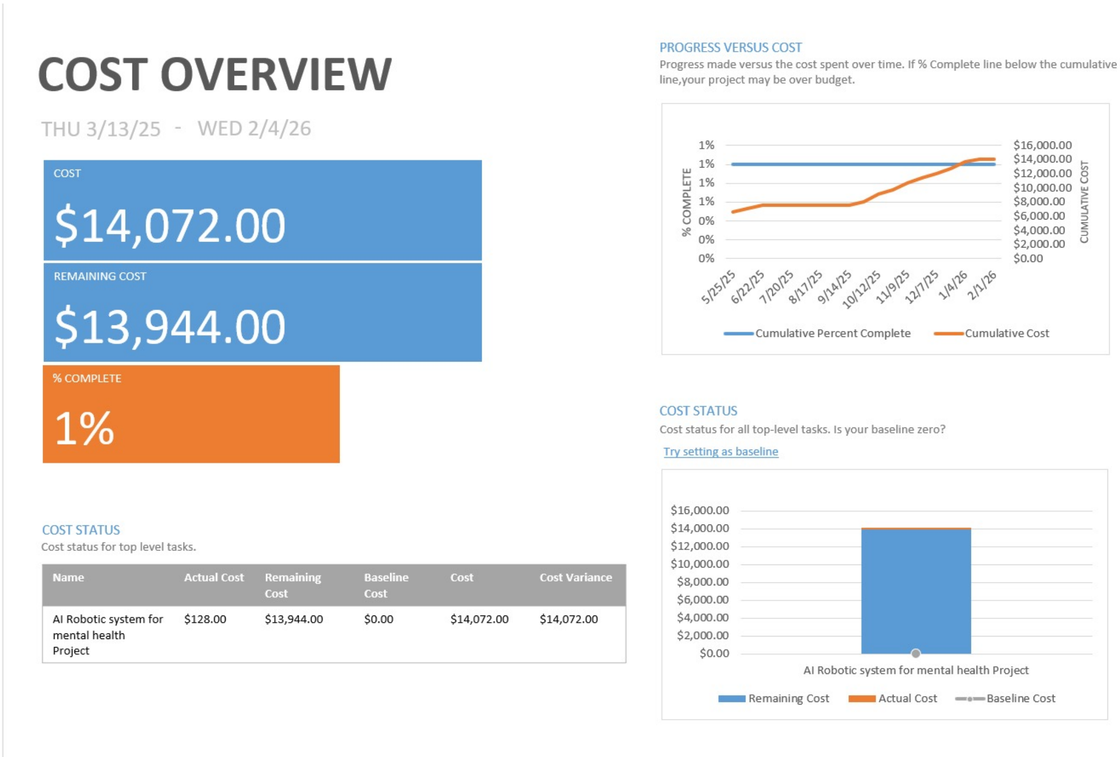

Figure 3.5: Cost overview of the project.

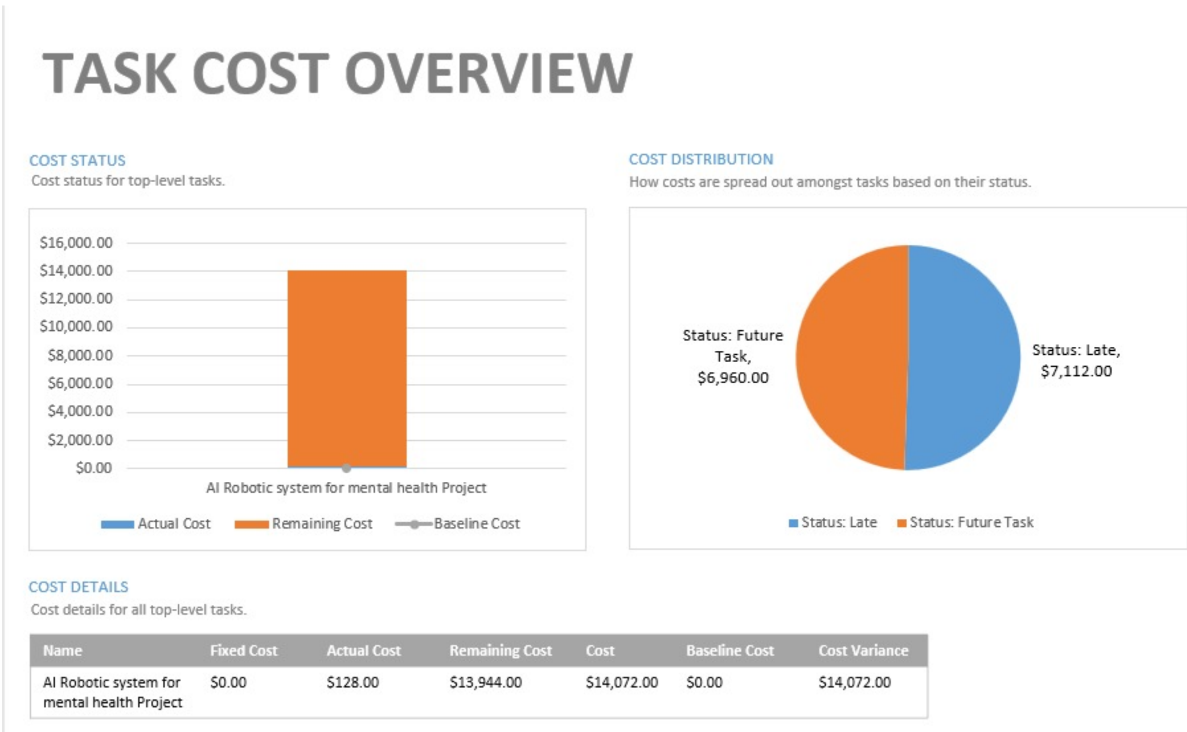

Figure 3.6: Task cost overview of the project.

3.7 Risk List

- Integration Issues Between Pepper and AI : There's a risk that Pepper Robot may not integrate smoothly with RAG and ChatGPT, which could cause delays or failure in system functionality.
- Inaccurate Emotion Detection: Pepper might misread user emotions, leading to incorrect feedback and reducing the reliability of the mental health assistant.
- Lack of Technical Experience: The team may face challenges due to limited experience with robotics and AI, which can slow down development or cause errors.
- API and Tool Costs: Using tools like ChatGPT can become expensive if not managed properly, risking budget overruns and limiting future use.

3.8 Identify the Risks

Team brainstorming: the project manager met and discussed the risks based on his experience with similar previous projects that used similar technologies, such as AI integration, robotics, and user-facing systems.

Review of project scope and WBS: each phase of the project's WBS was examined to identify where technical, resource, or time-based risks could occur.

Research on Literature papers for Similar Projects: We reviewed challenges faced in similar AI and robotics projects to understand common risks, especially with Pepper Robot and ChatGPT API.

Chapter 4

Design and analysis

In this chapter, the focus will be on the design and analysis phase of the project. It will include de-tailed diagrams and models to illustrate the system architecture and its components. The chapter will also cover the design principles, methodologies, and tools used, alongside a thorough analysis of the system's functionality and performance. Additionally, the chapter will present a risk assessment and mitigation strategies to address potential issues during the design phase.

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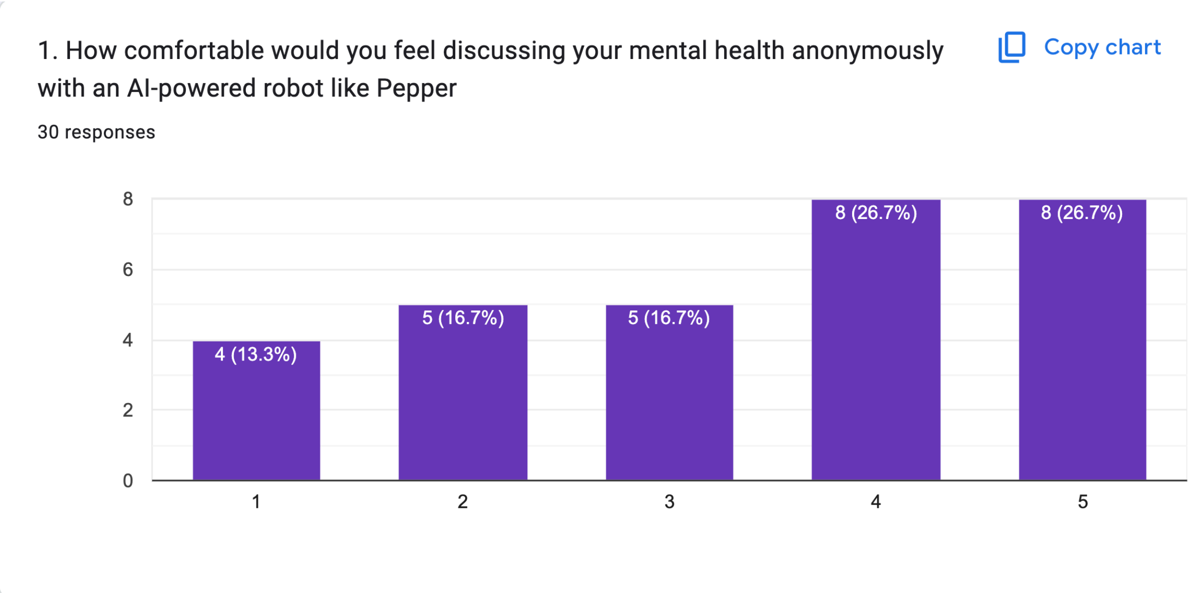
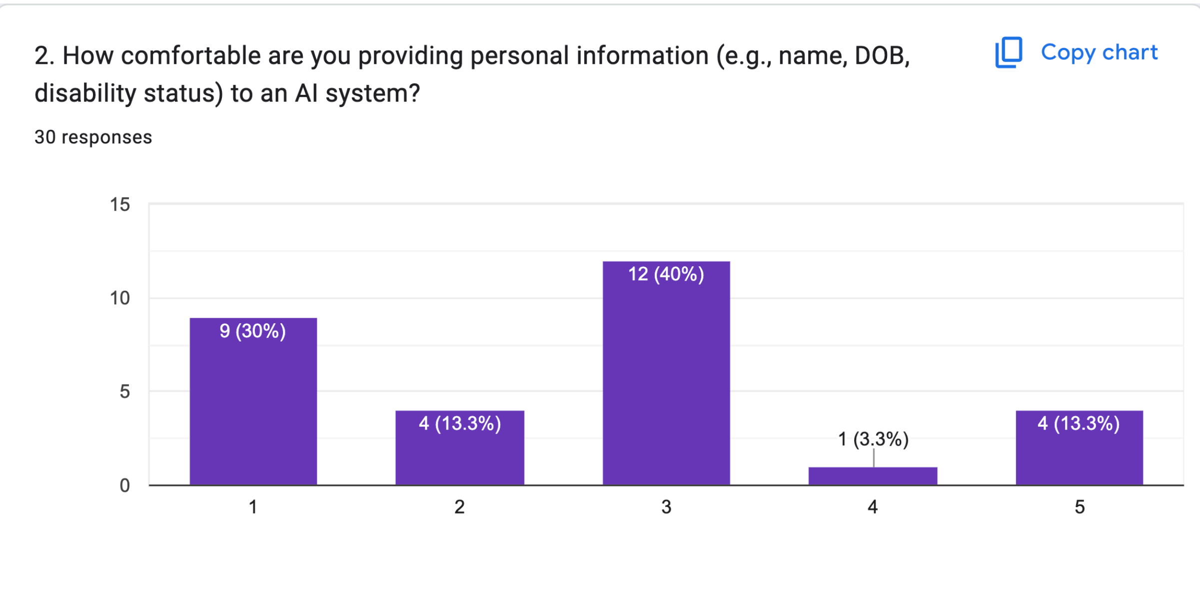
Appendices

Appendix A: Questionnaire Answers Graphs

This appendix contains the survey questions used in the study.

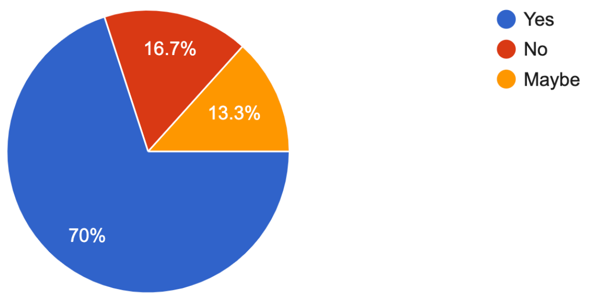




3. Would you like to receive personal feedback from the system based on your messages?

Copy chart

30 responses



4. How would you prefer to interact with the robot?

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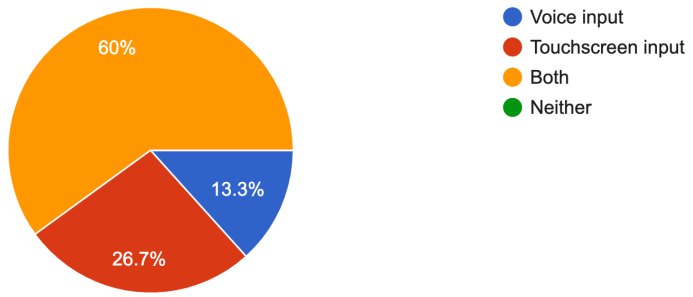
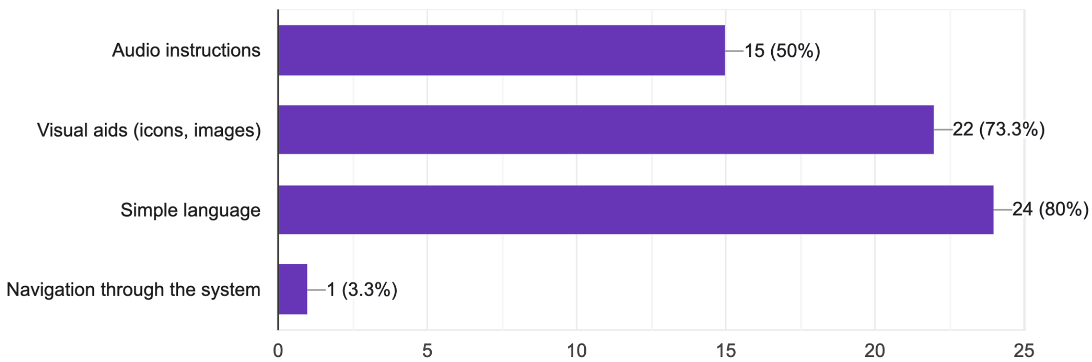
30 responses



5. Which features would make the system easier to use? *(Select all that apply)*

Copy chart

30 responses



6.If the robot adapts its questions based on your earlier answers (dynamic flow), would that improve your experience?

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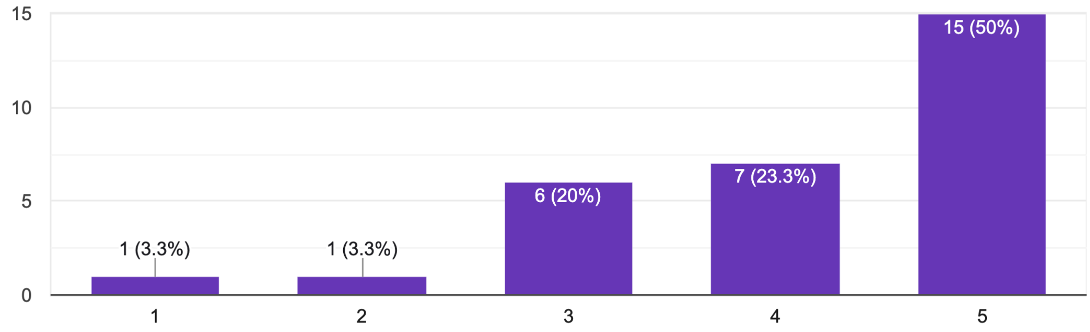
30 responses



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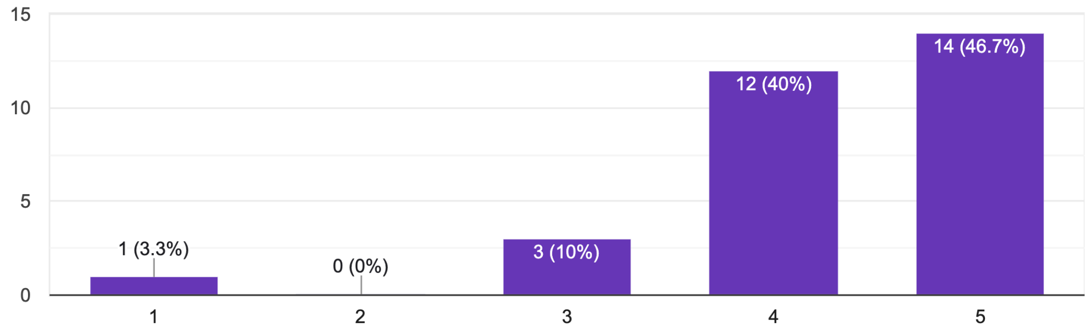
7. How important is it that the robot asks for your consent before starting the assessment?

30 responses



8. Would you be willing to skip or decline specific questions during the assessment?

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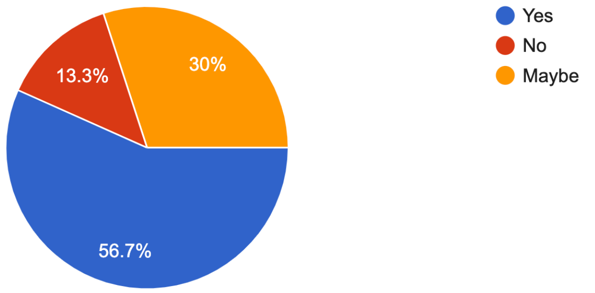
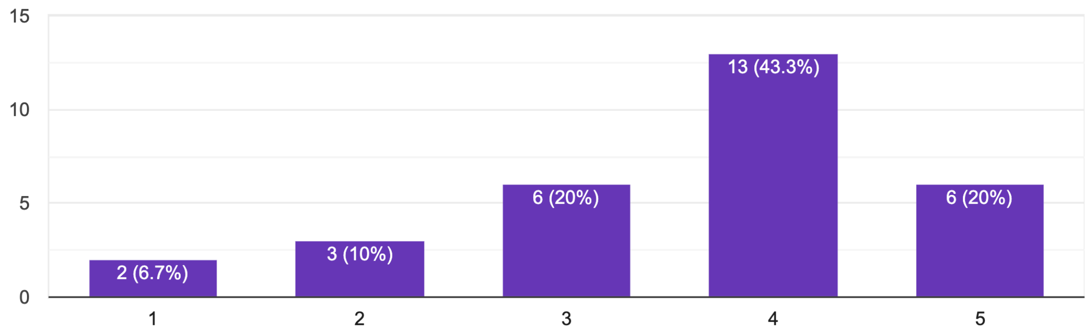
30 responses



9. How important is it for a robot to use friendly gestures (e.g., waving, smiling) when interacting with you?

Copy chart

30 responses



10. Would you prefer a quick 10-minute session or a more detailed longer session?

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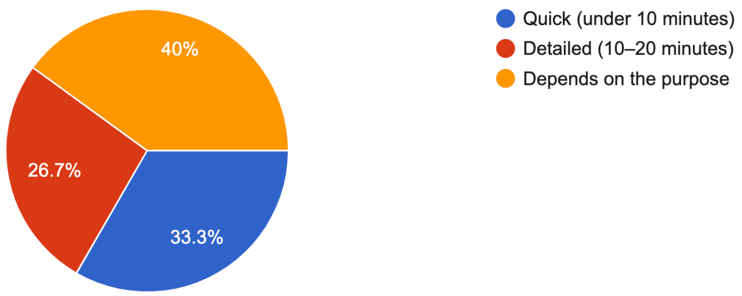
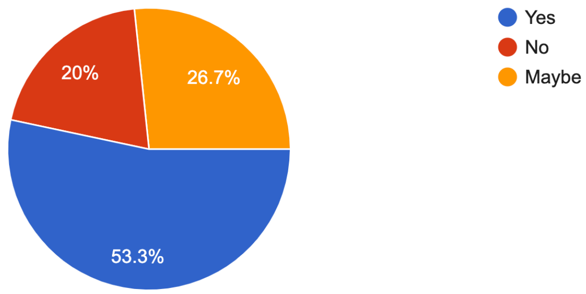
30 responses



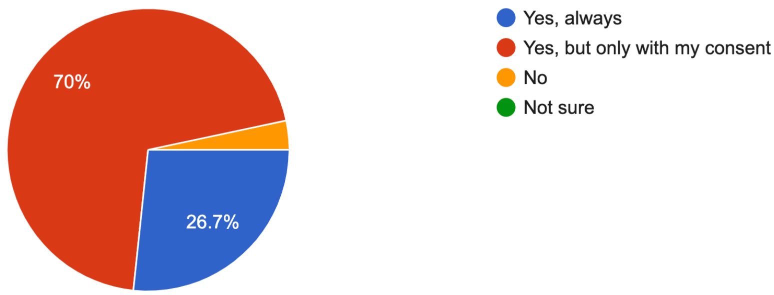
11. Would cultural relevance increase your comfort level using the system? Copy chart

30 responses



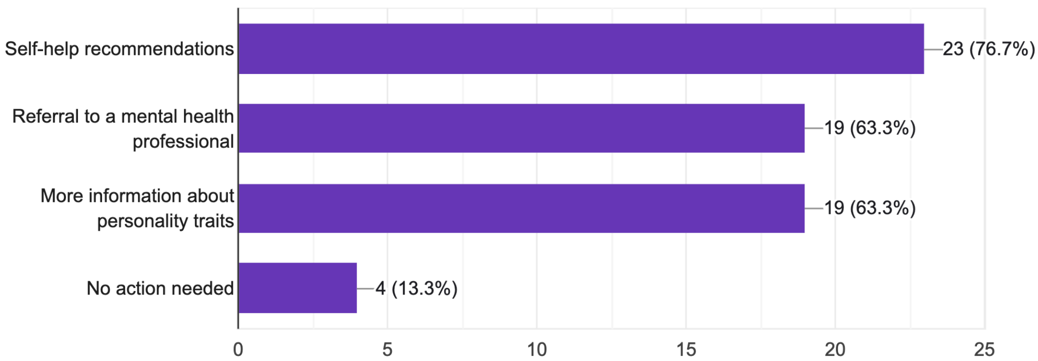
12. Should the system link you with a mental health professional if it detects high-risk responses? Copy chart

30 responses



13. What actions would you expect after receiving results? *(Select all that apply)* Copy chart

30 responses



14. Are there any specific features or services you would add to the system that were not mentioned in this survey?

12 responses

No
Listing the accuracy percentage
Make it empathize with the user
no
No
Nope
كامل مكمل و الكمال لله
Accuracy

Appendix B: Interview report (Dr. Rita Assad)

Interviewee: Dr. Rita Assad - Psychiatrist **Date:** 22/4

Interviewer: Sara Manasra **Subject:** Student Behavioral Evaluation in Mental Health Assessment

Objectives of the interview:

- Understand how to assess students' sleep quality.
- Explore childhood background for signs of trauma or developmental issues.
- Learn how to detect addiction behaviors in students without alerting or alarming them.
- Evaluate the importance of observing speech patterns and body language during interviews

Were objectives met?

The interviewee provided detailed guidance on how to observe and question students in a sensitive way. She emphasized the importance of indirect questioning when exploring sleep quality and childhood experiences and traumas. Dr. Rita explained how to recognize behavioral cues that may indicate underlying addiction or psychological distress. She also noted that a student's tone, pacing, and interactions with figures—such as responding to individuals like ”Pepper”—can reveal emotional states or hidden discomfort

Objectives for follow-up interview:

Address any unanswered questions that emerged during the initial interview.

Main Points of Interview:	Interviewer's Opinion:
• Evaluating sleep quality is a crucial part of student mental health assessment. • “Childhood history holds keys to present-day behavior and emotional health.” • “Observation is necessary when identifying addiction without raising suspicion.” • “The way a student speaks and behaves around Pepper can reveal inner states.”	Realized how important it is to pay attention to behaviors and the voice. Interested in applying these techniques in real settings to better support student mental health using a robot and AI system.