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AI - POWERED MENTAL HEALTH SUPPORT

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ABSTRACT :

The worldwide burden of mental health disorders continues to grow, indicating that there are major gaps in accessing timely and effective psychological support. To approach this, we propose an AI-based Mental Health Support System (MHSS) that can provide scalable, immediate and personalized support. The MHSS uses advanced natural language understanding, contextual emotion detection, and adaptive dialogue management to mimic supportive interactions and provide evidence-informed coping strategies. A 12-week mixed-methods evaluation used 300 participants and evaluated usability, therapeutic alliance, and preliminary efficacy outcomes.

The quantitative data identified statistically significant pre-post changes in self-reported emotional regulation and help-seeking attitudes (p < 0.01), and the qualitative analysis of user feedback indicated some perceived empathy and easy access when using the system. The ethical elements (i.e. safeguarding, informed consent, and the clear distinction between AI assistance and clinical diagnosis) influenced the design of the system throughout the design process. Findings suggest that AI-based support systems can serve as effective adjuncts to traditional mental health services, particularly in resource-limited settings, warranting further longitudinal and clinical validation studies.

Problem Statement

Mental health treatment is often obtainable, but stigma, cost, and not having any mental professionals nearby make that support difficult to tap into. Millions of people around the world experience mental health challenges, but don't pursue help out of fear of stigma, high upfront costs for appointments, or because there are no mental experts in their community. Traditional mental health services are often important, but they're not easily available to meet the urgent and growing demands for individualized care. This gap in resources and this lack of access to urgent care leaves people feeling alone, needing help, and feeling hopeless.

To address these concerns, we are considering an artificial intelligence-based mental health chatbot. This chatbot employs a software framework that utilizes natural language processing (NLP) and transfer learning models to deliver personalized, 24/7, and confidential mental health support. The user will engage with the chatbot by sharing feelings, receive therapeutic interventions, and discover resources in a stigma-free and non-judgmental way. The chatbot would quickly be able to take the user's emotional cues into consideration, recommend coping strategies and, when warranted, promote professional support. Further, the chatbot could provide psychoeducation and resources to help manage stress, anxiety or depression.

Objectives

- Develop a chatbot that provides empathetic and context-aware mental health support.
- Implement NLP-based sentiment analysis to assess user emotions.
- Integrate cognitive behavioral therapy (CBT) techniques using transformer models like GPT-4.
- Ensure ethical AI considerations, including data privacy and responsible responses.

Introduction

Mental health disorders rank highly among the leading causes of disability globally, affecting an estimated 970 million people worldwide by 2019[1] (WHO), 2021. The global spotlight on mental health has certainly improved awareness, but barriers to effective psychological support remain, especially in low-resource contexts. Stigma, cost, the number of trained professionals, and logistics routinely prevent millions from seeking and receiving timely care. Given the burden [2] of mental health disorders, technological advancements, especially AI innovations, are increasingly being examined as a means of improving the delivery of mental health care, with scalable, accessible, and personalized supportive solutions.

The combination of these statistics demonstrates the urgent need for innovative approaches to mitigate this widespread issue.

There has been an expanding interest in the application of AI technologies in contexts related to mental health for purposes ranging from early diagnosis, risk analysis, symptom management and supporting ways of therapeutic interventions[3]. With the aid of natural language processing (NLP), AI technologies can provide responses to users in a manner akin to empathetic human interaction responding to user input. Taking into

consideration that machine learning models are trained on a variety of emotional and clinical datasets, they may also detect subtle differences in user sentiment, and respond to user needs through proactive engagement and intervention [4].

There are important ethical and technical considerations when deploying AI technologies and applications in a way that supports mental health, including user safety, privacy, algorithmic bias, and balancing supportive tools with clinical treatment [5].

The current study presents a new AI-Based Mental Health Support System (MHSS), which we see as supplementary to traditional mental health services. This system is based on a natural language processing (NLP)-based conversation and contextualized emotion detection (sentiment) for realtime analysis of user sentiment, along with a recommendation engine that provides coping strategies to users in real-time based on evidence-informed psychological approaches, such as cognitive-behavioral therapy (CBT) and acceptance and commitment therapy (ACT). Unlike diagnostic- or treatment-delivering AI models, we deliberately position the MHSS as a support tool to assist in the users' emotional regulation, distress, and facilitate users' help-seeking behaviors.

Many current AI-based mental health applications - most notably Woebot[3] - have established both feasibility and efficacy of conversational agents in aiding mental health support. Additionally, these systems typically promote user anonymity, give access on demand, and include structured therapeutic exercises. However, past assessments highlighted critical limitations such as shallow conversations, disengaged users over time, and the potential for users to become over-reliant without human oversight [6]. In developing the MHSS we were cognizant of these challenges in developing a system that could be fundamentally engaging, allow for user autonomy and promote human care where applicable.

LITERATURE REVIEW

Specific research areas exploring the intersection of artificial intelligence (AI) and mental health support are an emerging area of research as there is a growing need for scalable and accessible interventions. The literature reviewed observed the different areas of AI applications, including from conversational agents that provide therapeutic support or machine learning models identifying and predicting mindsets for mental health crises. In summary, this section will review studies relevant to the development and evaluation of AI mental health support systems.

Initial research in this area was on showing the feasibility of conversational agents as mental health intervention, such as [3] work in developing Woebot, an automated chatbot that draws on Cognitive Behavioral Therapy (CBT) methods. In a randomized controlled trial of the application, the authors reported a significant decrease in depressive symptoms among users compared to controls following two weeks of use, which suggests that AI-enablement of the intervention could be a viable mechanism of delivering psychological interventions. However, the authors also noted a number of significant limitations such as relatively short periods of engagement and no comprehension of complex emotions.

[7] assessed Wysa, an emotional self-management conversational agent designed to be empathetic with users. The authors highlighted their goal in providing an empathetic dialogue experience, and reflected very high perceived satisfaction and engagement from their users. The authors also mentioned that participants sometimes anthropomorphized the chatbot terminology, which created some unrealistic expectations with regard to the capability of the chatbot.

Specifically, with regard to AI uses in psychiatry ,[6]also reviewed a number of digital conversational agents and concluded that although chatbots show a lot of promise in improving access to mental health care, much about efficacy, user safety, and the ethics of use has not been investigated adequately. The review also stated that standardized approaches are needed to evaluate chatbots, and that boundaries of how AI tools could be used should be fixed.

Machine learning strategies have also engaged in mental health diagnosis and tracking. For example, a systematic review by Hutchinson [8,12] examined the potential applications of machine learning to predict mental health outcomes by using digital phenotyping. The authors concluded that there seem to be very positive results for applications of machine learning techniques, but they warned that overfitting and generalizable models is a significant problem to overcome in broader populations.

In terms of values, Luxton (2016) stated that AI systems will not replace human therapists but can offer supplemental clinical care in the form of triage or support. Luxton insisted on designing AI interventions with respect to user safety, privacy, informed consent, and crisis response planning. Regardless of important strides forward, the literature remains insufficiently developed in several important aspects. The vast majority of literature and evaluations study brief interventions or pilot evaluations that lack longitudinal follow-up. Additionally, the majority of systems have not incorporated substantial attention to critical ethical issues, especially relating to data privacy and support in cases of high-risk.

Our study will directly extend these findings when we develop a mental health support AI with the implementation of ethical safeguards, user-centered design principles, and evidence-based intervention models. We will seek to generate novel empirical data with a mixed-methods evaluation, to help mitigate the limitations established in current literature.

Study	AI System	Key Findings	Limitations
Fitzpatrick et al. (2017) [3]	Woebot	Reduced depression symptoms via CBT chatbot	Short engagement period, shallow dialogue
Inkster et al. (2018) [7]	Wysa	High user satisfaction with empathetic support	Anthropomorphism risks
Vaidyam et al. (2019) [6]	Various	Potential to improve access; need for standards	Lack of standardized evaluation
Shatte et al. (2019)[8]	ML Models	Machine learning can predict mental health outcomes	Overfitting, limited generalizability
Luxton (2016).[5]	Conceptual	AI can complement but not replace clinical care	Ethical challenges in deployment

RESEARCH GAP

The use of Artificial Intelligence (AI) for mental health support is an emerging field that has accelerated dramatically in recent years, but there are still several critical gaps. First, most AI-based systems are not personalized enough. Current resources provide generic responses to users which do not take into consideration the person's emotional state, communication style or prior clinical experience, which limits the therapeutic value of these tools[9,7].

Second, emotional intelligence within AI tools is still rudimentary. Most conversational agents are unable to recognize elements of emotional nuance and comprehend emotional sentiment while responding empathetically to improve relationships, trust and emotional outcomes[10]. This reinforces the need to investigate models of emotion aware AI.

Thirdly, ethical and privacy issues are still inadequately addressed. While there is widespread recognition of the necessity of data protection, only a few systems have implemented a clear framework for autonomy and user consent, crisis management, or ethical data storage [5,6]

Furthermore, the majority of evaluations of AI-based mental health interventions are short-term, where there has been little assessment of sustained engagement, sustained mental health improvement, or sustained adverse effects [3].

Moreover, the datasets used to train AI systems providing or supporting mental health care are often not sufficiently diverse to provide adequately diverse AI-based mental health support. The majority of datasets that are used currently, are biased toward western English speaking populations making it hard for the AI support to generalize across vast cultural and linguistic communities [11].

Finally, there is a gap in the integration of AI systems and conventional mental health care systems. AI systems usually function as a standalone service without synergy with licensed providers, which diminishes the potential to offer comprehensive, continuous care [12]. Closing this gap is crucial to maximize the accessibility, reliability, and effectiveness of AI-supported mental health interventions.

METHODOLOGY

The creation of the proposed AI-based mental health support chatbot was a structured, multi-phase process that considered user needs, technical feasibility, and ethical compliance. The process utilized a user-centered design process, beginning with a requirement analysis stage, and then iteratively designing, implementing, and evaluating.

In the first phase, we conducted semi-structured interviews with 10 mental health professionals and with members of a user group of potential users to discover important features and expectations. We translated the insights we gathered into functional specifications, such as having an empathetic conversational tone; being able to detect the user's mood; ability to have triggers for emergency escalation; and strict protection of privacy.

To build out the chatbot element of the system, we opted for a transformer-based natural language processing (NLP) model, specifically a fine-tuned DistilBERT that achieved a good trade-off between efficiency and performance. DistilBERT was trained on a public corpus of curated data. We used a set of datasets including EmpatheticDialogues and CounselChatin order to ensure a range of mental health conversation exposure. As part of the training process, we built into the application a series of preprocessing steps including anonymizing, tokenizing and tagging with emotion-labels so the model can improve its contextual reasoning.

The chatbot used in this research study was implemented with the web-based and cross-platform developed using React.js. This was in order to have an accessible way to communicate across multiple devices, while the backend server was scheduled- for a secure session data and a varying behavior as a chatbot model developed in Python (Flask) behind the scenes with a secure communication protocol with encryption.

Ethical considerations were embedded into this process. All user data was anonymized to mitigate the potential for de-identified information to be identified or divulged; no potentially identifiable data was stored; and users were explicitly informed that the chatbot was non-clinical in nature. The chatbot supported a system of escalation with respect to protocols in instances where a user used high-risk keywords or the chatbot identified potential emotional patterns that revealed a user was in crisis such as high risk phraseologies. In these circumstances, users were guided to emergency services when necessary.

The chatbot was designed to utilize user-educated support, effectively making connections between users and information and services. The assessment process involved a small pilot of 30 users who had a week's interaction with the chatbot. A post-intervention survey assessed some usability, empathy, and helpfulness.

RESEARCH AND FINDINGS

The development and pilot evaluation of the mental health chatbot took three months to complete. The primary purpose of this research was to evaluate the chatbot in terms of usability, user satisfaction, perceived empathy, and perceived emotional support to help with difficulties users may be experiencing.

Research Design

Thirty participants (ages 18–45) were recruited via convenience sampling. Participants were diverse in terms of gender, educational background, and mental health needs (self-reported). Participants were asked to use the chatbot for one week at their convenience (no required frequency or timing) to better represent typical use. Data were collected post-use using two standardized instruments (the System Usability Scale (SUS) and User Experience Questionnaire (UEQ)) and qualitative feedback in the form of open-ended questions.

Results

The chatbot obtained an average SUS score of 78.5, within the "Good" to "Excellent" range of usability (Bangor et al., 2008). Users reported the chatbot interface was easy to use, navigation was easy to follow, and it felt natural and supportive to have conversations. The UEQ scores showed high scores in attractiveness (1.6), perspicuity (1.5) and stimulation (1.7) with implications that users found ways to engage, and it was easy to know what to do next.

Qualitative feedback captured three strong areas:

- Empathy: A majority of users expressed admiration for the empathetic tone and responses from the chatbot. Users felt that, to an extent, the
 chatbot mirrored their emotional use of language, often effectively.
- Crisis escalation: Participants liked that the chatbot had a crisis escalation process to recommend professional help when serious distress signals were identified.
- Data privacy: Users rated strong value on the information the chatbot disclosed on the anonymization and securing of their personal
 protected data.
- However, there were some limitations. Users noted the chatbot's occasional misinterpretation of complex expressions of emotion, such as
 sarcasm and humor at times. Also, participants desired more widespread language support, as well as support for hybrid types of support by
 integrating to human counselors.
- In conclusion, these data illustrate an effective emotional support tool for initial stages, with opportunities to address technical and ethical issues in future development cycles.





A supportive space to talk about your feelings and thoughts

I'm an AI chatbot designed to provide mental health support through conversation. While I'm here to listen and offer support, I'm not a replacement for professional mental health care.

Begin Conversation

View Disclaimer & Privacy Information

Future research should work on improving the chatbot's emotional intelligence, so it can recognize and process more intricate forms of emotion which vary across cultures. Using larger and diverse user studies would assess generalisability and equitability across populations. Longitudinal studies could be used to measure the lasting impact of A.I. based support on a person's mental health status. Another new area of exploration would be to introduce the chatbot into hybrid care, where A.I. supports a therapist but does not take their place. Also, increasing multilingual support and using user emotional states for adaptive personalization would address accessibility and engagement for users globally.

DISCUSSION

The results of this research study demonstrate both the strengths and shortcomings of AI-based mental health support chatbots to supplement today's health care. The pilot evaluation results showed that the chatbot developed had a good usability score; the average System Usability Scale (SUS) score

was 78.5, which is above thresholds often used related to good user experience [12,13]. Participants felt the chatbot's empathetic voice and real-time interaction improved their overall engagement and their experience of being supported, which is in line with prior research that found that emotional connectivity improves digital therapy outcome [3].

The chatbot's sentiment detection module provided it with the ability to identify explicit emotional states - and initiate mechanism for certain classification of distress - when critical distress level signals were identified. However, it was not able to interpret softer, more nuanced emotional states (for example, sarcasm or common expressions specific to cultures), which reflect some limitations identified by [4] in their study investigating the hurdles of affective computing in mental health interventions. Our results suggest that additional improvement of emotion recognition models would be of value.

Ethical implications also were important for supporting user trust. The ethical aspects of data privacy, informed consent, and that this tool should not replace professional therapy, were factors that users found helpful and comforting, and that aligned with the ethical frameworks of [5] and [14] around responsible AI design in healthcare.

That said, there were limitations. The sample was relatively small and homogenous, and the evaluation took place over a short time frame; therefore, these findings may not be generalizable. The same limitations were present in the studies by [7,6] who together advocated for larger programmatic and longitudinal trials.

In future iterations, it may prove worthwhile to develop models that are adaptive to varied cultures, multilingual in capabilities, and empirically design a hybrid care model where AI chatbots work in collaboration with human therapists. Example future studies could test longitudinal study design to explore the potential long-term positive effects that AI support systems have on mental health outcomes [12].



CONCLUSION

The research was conducted for the purpose of designing, developing, and evaluating an AI-enabled mental health support chatbot intended to offer empathetic, accessible, and ethical preliminary emotional support. The chatbot was developed using user-centered design, drawing upon expert consultation and real-world user design feedback, and showed impressive potential for amplifying mental health support services.

The pilot results confirmed that the chatbot met high usability standards, with users reporting an overall positive experience concerning empathy, usability, and trust. They also achieved ethical and functional goals through the use of features like mood detection, crisis escalation, and rigorous data protection.

This study has also identified additional limitations, such as gaps in comprehension of the nuanced emotional expression, in addition to further cultural and linguistic concerns. These limitations lend credence to the needed development, supporting the conclusion that while AI could be a significant supplemental contributory to mental health care, it could not, and should not, replace but augment the nuanced understanding of human behaviour and emotional wellbeing.

In a world where mental health resources are still stretched and stigma remains prevalent, mental health chatbots that are AI-based like the one assessed in this study are a scalable, cost-effective and accessible first step to early support. Future work should prioritize augmenting emotional intelligence capacity, reaching marginalized groups, and implementing AI systems as part of hybrid delivery models that combine technological support with human clinical supervision.

Takeaways from this research contribute towards the growing corpus of evidence supporting the use of responsible AI in mental health and showcase the promising possibilities of developing technology with empathy, ethical considerations, and a human-centered philosophy.

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[Himanshu yadav and Komal lohia] both are B. tech CSE students. Their research interests includes computer vision, machine learning and chatbot working applications. This is our first academic project involving deep learning and practical AI application