

AI-Based Conversational Large Language Models

Subjects: [Computer Science](#), [Artificial Intelligence](#) | [Linguistics](#)

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The demand for psychological counselling has grown significantly in recent years, particularly with the global outbreak of COVID-19, which heightened the need for timely and professional mental health support. Online psychological counselling emerged as the predominant mode of providing services in response to this demand. The Psy-LLM framework, an AI-based assistive tool leveraging large language models (LLMs) for question answering in psychological consultation settings to ease the demand on mental health professions.

psychological counselling

artificial intelligence

large language models (LLMs)

natural language processing (NLP)

1. Introduction

The field of AI utilising dialogue technology has witnessed significant growth, particularly in the domain of automatic chatbots and ticket support systems ^[1]. This application of dialogue technology has emerged as a cutting-edge and increasingly popular approach in the realm of AI-powered support systems. With changing global dynamics, the severity of the ongoing pandemic, and an upsurge in psychological challenges faced by the public, the mental well-being of young individuals, in particular, is a cause for concern. The pressures of urbanisation and the internet have led to various psychological issues ^[2], including depression, procrastination, anxiety, obsessive–compulsive disorder, and social phobia ^[3], which have become prevalent ailments of our time.

Psychological counselling involves the utilisation of psychological methods to provide assistance to individuals experiencing difficulties in psychological adaptation and seeking solutions. The demand for psychological counselling has witnessed a significant surge in recent years ^[4], while the availability of professional psychological consultants remains insufficient. The profession of psychological consulting imposes high standards and qualifications. For instance, registered psychologists within psychological associations require students to possess a Master's degree in psychology-related disciplines, undergo a minimum of 150 h of direct counselling, and receive face-to-face supervision by registered supervisors for no less than 100 h ^[5]. Additionally, the burnout rate among mental health professionals further exacerbates this shortage ^[6].

In 2020, the global outbreak of COVID-19 exacerbated the need for timely and professional psychological counselling due to the tremendous stress it imposed on society ^[7]. Consequently, online psychological counselling through the internet has progressively become the dominant mode of delivering counselling services ^[8]. AI-based

assistive psychological support not only addresses the severe supply–demand gap in the consulting industry, but also enhances the responsiveness of online psychological counselling services, thereby promoting the implementation of mental health strategies. Such an assistive tool serves to ease the shortage of mental health support when no human counsellors are available to help.

In light of these circumstances, the team is determined to develop an assistive mental health consulting framework to serve as a constant source of support. Creating an AI-powered framework can allow users to engage with it comfortably, given its non-human identity, thereby reducing feelings of shame among users ^[9]. In particular, with the absence of available psychological support, the framework serves as the second-best approach to providing timely support to patients. Amid the challenges posed by the pandemic, online psychological counselling has proven instrumental and has gradually become the predominant form of counselling. However, the growing disparity between supply and demand within our society's psychological consultation industry is a pressing concern. The application of AI technology to mental health and psychological counselling is an emerging and promising field. Conversation frameworks, chatbots, and virtual agents are computer programs that simulate human conversation ^[10]. They can engage in natural and effective interactions with individuals, providing them with emotional experiences through the incorporation of emotional and human-like characteristics. In practical terms, dialogue frameworks hold significant potential for supporting the demand in online consultations and addressing supply–demand imbalances.

An AI-based **Psychological Support with Large Language Models (Psy-LLM)** framework designed for question answering, with the purpose of providing online consultation services to alleviate the demand for mental health professionals during pandemics and beyond. Psy-LLM is an online psychological consultation model pre-trained with large language models (LLMs) and further trained with questions-and-answers (Q&A) from professional psychologists and large-scale crawled psychological articles. The framework can provide professional answers to users' requests for psychological support. In particular, Psy-LLM can provide mental health advice, both through recommendations for health professionals and as standalone tools for patients when no human counsellors are available due to time constraints or staff shortages.

2. AI-Based Conversational Large Language Models

In recent years, there has been increasing interest in utilising AI for tackling difficult problems in traditional domains like adopting AI in the construction industry ^[11], localisation in robotic applications ^[12], assistance systems in the service sector ^[13], financial forecasting ^[14], improving workflow in the oil and gas industry ^[15], planning and scheduling ^[16], monitoring ocean contamination ^[17], remote sensing for search and rescue ^[18], and it has even been used in the life cycle of material discovery ^[19]. The health care industry has adopted AI-based machine-learning techniques for classifying medical images ^[20], guiding cancer diagnosis ^[21], as screening tools for diabetes ^[22], and ultimately to improve the clinical workflow in the practice of medicine ^[23].

One area of research focuses on using conversational agents, also known as chatbots, for mental health support. Chatbots have the potential to provide accessible and cost-effective assistance to individuals in need. For example,

Martinengo et al. (2022) [24] qualitatively analysed user-conversational agents and found that these types of chatbots can offer anonymous, empathetic, and non-judgemental interactions that align with face-to-face psychotherapy. Chatbots can utilise NLP techniques to engage users in therapeutic conversations and provide personalised support. The results showed promising outcomes, indicating the potential effectiveness of chatbots in delivering mental health interventions [25]. Pre-trained language models have also gained attention in the field of mental health counselling. These models, such as GPT-3 [26], provide a foundation for generating human-like responses to user queries. Wang et al. (2023) [27] explored the application of LLMs in providing mental health counselling. They found that LLMs demonstrated a certain level of understanding and empathy, providing responses that were perceived as helpful by users. However, limitations in controlling the model's output and ensuring ethical guidelines were highlighted.

Furthermore, there is a growing body of research on using NLP techniques to analyse mental-health-related text data [28]. Researchers have applied machine-learning algorithms to detect mental health conditions [29], predict suicidal ideation [30], and identify linguistic markers associated with psychological well-being [31]. For instance, de Choudhury et al. (2013) [32] analysed social media data to predict depression among individuals. By extracting linguistic features and using machine-learning classifiers, they achieved promising results in identifying individuals at risk of depression. Additionally, several studies have investigated the integration of modern technologies into existing mental health interventions. For instance, Lui et al. (2017) [33] investigated the use of mobile applications to support the delivery of psychotherapy.

Shaikh and Mhetre (2022) [34] developed a friendly AI-based chatbot using deep learning and artificial intelligence techniques. The chatbot aimed to help individuals with insomnia by addressing harmful feelings and increasing interactions with users as they experienced sadness and anxiety. In another line of research, chatbots have been extensively studied in the domain of customer service. Many companies have adopted chatbots to assist customers in making purchases and understanding products. These chatbots provide prompt replies, enhancing customer satisfaction [35]. Furthermore, advancements in language models such as BERT and GPT have influenced the development of conversational chatbots. Researchers have leveraged BERT-based question-answering models to improve the accuracy and efficiency of chatbot responses [36]. The GPT models, including GPT-2 and GPT-3, have introduced innovations such as zero-shot and few-shot learning, significantly expanding their capabilities in generating human-like text [26]. However, limitations in generating coherent and contextual responses and the interpretability of the models have been identified. The model incorporated a 48-layer transformer stack and achieved a parameter count of 1.5 billion, resulting in enhanced generalisation abilities [26].

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