THE HONG KONG
POLYTECHNIC UNIVERSITY
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DEPARTMENT OF COMPUTING
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COMP4431 GROUP PROJECT PROPOSAL

PART I. Group Information

Project Title	*NightWhisper* - An LLM-Empowered and Psychology-Guided Emotional Support Platform for Personalized and Instant Nighttime Companionship
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Abstract

Young adults today face rising academic and social pressures that often lead to anxiety, mood instability, and insomnia, especially during solitary nights when emotional regulation is most difficult. Existing mental health systems, limited by time, cost, and privacy, fail to provide timely and accessible support, leaving users without safe outlets for distress. To address this gap, we propose *NightWhisper*, an LLM-driven emotional companionship system offering psychology-guided, instant, and personalized late-night support. Leveraging the empathetic conversational capability of advanced LLMs, *NightWhisper* integrates *Retrieval-Augmented Generation (RAG)* for evidence-based guidance, *prompt-engineered animal personas* for tailored empathy, and *multimodal interaction* through soothing voice and 2D avatar responses. Grounded in validated frameworks such as *Cognitive Behavioral Therapy (CBT)* and *Mindfulness*, the system delivers context-aware, evidence-informed dialogue that balances empathy with psychological accuracy. Evaluations will assess empathy, safety, and user comfort, demonstrating *NightWhisper*'s potential to foster reflection, relief, and long-term resilience.

PART II. DETAILS OF THE RESEARCH PROPOSAL

1. Background, Motivation & Impact

1.1 Domain of Application - Psychotherapy and Emotional Companionship

1.2 Motivation

In recent years, increasing academic and social pressures have led to mood swings, anxiety, and insomnia among young people. Individuals struggle to regulate their emotions, leading to psychological disorders that impact both their studies and their lives. However, the existing mental health support systems are limited by accessibility, cost, and privacy concerns, leaving users feeling isolated and lacking outlets for emotional release. To bridge this gap, we propose *NightWhisper*, an LLM-driven emotional support system designed for instant, flexible, and personalized late-night companionship, delivering on-demand, context-aware dialogue that adapts to users' tone, mood, and needs. Its modular design integrates evidence-based reasoning through personalized *prompt-engineered personas*, *RAG, multimodal interaction* (visual and audio), and a *warm, user-friendly interface*. Together, these components provide emotionally intelligent and psychologically grounded support.

1.3 Purpose & Target Users

- **Purpose.** Develop an AI platform that offers on-demand, low-barrier emotional support at night, pairing users with personalized animal-style companions that listen empathetically, provide psychology-guided coping suggestions, and encourage self-reflection to strengthen long-term resilience.
- **Target Users.** Young adults experiencing nighttime unrest, stress-related insomnia, or anxiety who seek private, stigma-free, and instantly accessible emotional support.

1.4 Potential Impact

NightWhisper offers immediate emotional relief and improved sleep quality while promoting long-term psychological resilience. Continuous engagement helps users strengthen self-regulation, emotional stability, and focus, encouraging healthier coping habits and sustainable well-being through evidence-based emotional guidance. Meanwhile, *NightWhisper* can be expanded to broader age groups and psychological contexts, integrating advanced multimodal sensing and personalization for deeper empathy in the future.

2. Features and Functionalities

2.1 Project functionality

- **Instant Emotional Support and Companionship.** Provide 24/7 anonymous and on-demand conversations to

relieve nighttime emotional distress through empathetic listening and constructive guidance.

- **Personalized AI Avatar Interaction.** Provide virtual animal companions with unique personalities, voices, and dialogue styles, allowing users to choose one matching their emotional needs and comfort level.
- **Psychology-Guided Counseling.** Apply RAG to anchor responses in validated psychological principles, providing safe, evidence-based guidance for emotion regulation and cognitive reframing.
- **Multimodal Immersive Experience.** Combine soothing voice responses, a soft-toned visual interface, and ambient background sounds to create a calm, emotionally supportive environment.

2.2 Technique Features
- **Basic Features.** *NightWhisper* enables multilingual, natural and emotionally coherent conversations powered by LLMs. It can recognize user intent and emotional state, delivering context-aware responses that combine empathy with psychology-based guidance. Through a knowledge base supported by Retrieval-Augmented Generation, it provides users with timely, personalized, and evidence-informed emotional support.
- **Additional Features.**
  - ◆ **API Integration**. Connect to advanced LLM APIs to perform deep semantic analysis of user conversations, providing more insightful and psychologically aligned responses.
  - ◆ **Retrieval-Augmented Generation (RAG).** Retrieve the information in the psychological theory knowledge base based on the user's query input and embed it together with the user query into prompt.
  - ◆ **Prompt-Engineered Role Crafting.** Utilize structured prompts to define AI "healers" with distinct animal personas and therapeutic tones, creating personalized emotional interactions
  - ◆ **Speech Synthesis and Voice Customization.** Integrate TTS and voice cloning to generate verbal responses in soothing, character-specific voices that enhance emotional immersion
  - ◆ **User-Friendly UI.** Feature a minimal-cognitive-load interface with soft colors and intuitive interactions.
  - ◆ **Text-to-Image 2D Avatar Generation.** Create personalized 2D avatars for each AI healer, visually reflecting their unique personality and therapeutic style.

3. Implementation Method
3.1 Model and Technique Framework Selection
- **Model Selection.** *NightWhisper* adopts **GPT-4o (API Integration)** as the system's core conversational model, ensuring stable, emotionally coherent interactions with contextual accuracy.
- **Key Technical Components**
  - ◆ **RAG (LangChain-based)**. Implemented through *LangChain* framework to manage retrieval and context injection locally, fetching relevant psychological knowledge and embedding them into prompts.
  - ◆ **Prompt Engineering.** Structured prompt templates define each animal-themed healer's persona, while also specifying how retrieved psychological knowledge is applied for emotional coherence and precision.
  - ◆ **Text-to-Speech Module (ComfyUI).** Employs *ComfyUI* for TTS synthesis, transforming each healer's response into a soothing, fixed voice style that matches its personality, enhancing immersion.
  - ◆ **UI Implementation (Streamlit).** Built with *Streamlit* to deliver a soft-tone, minimal-distraction chat environment. It displays both text and voice responses.
  - ◆ **2D Avatar Generation (DALL·E3 API).** Utilizes *DALL·E3* to create 2D avatars for each healer. Future upgrades may incorporate *Sora* for short 3D animated versions to enrich user engagement.

3.2 Data & Knowledge Source
The knowledge base of *NightWhisper* is constructed from publicly accessible and academically validated resources, including materials on *Cognitive Behavioral Therapy (CBT)*, *Mindfulness*, and *Positive Psychology*. These texts are cleaned, segmented, and transformed into structured knowledge units for the RAG module.
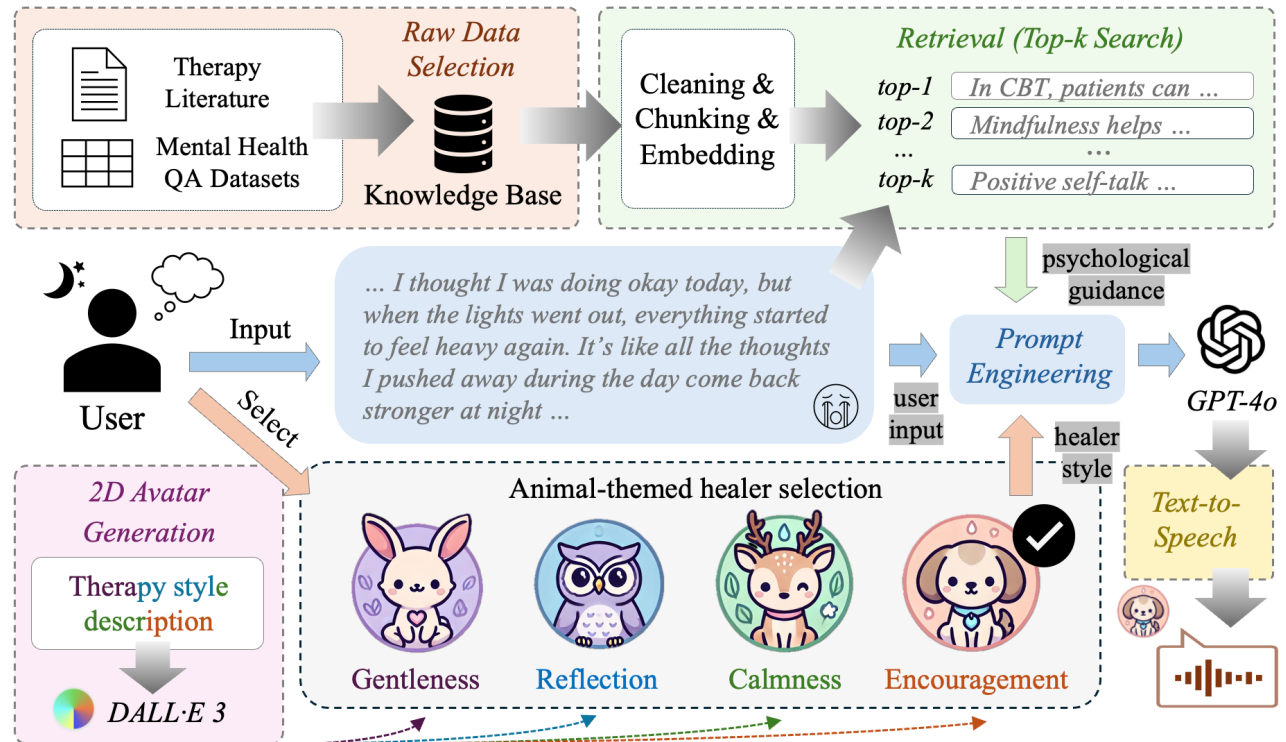
3.3. Evaluation
We will conduct qualitative case studies and small-scale user evaluations to assess both the technical and psychological performance of *NightWhisper*. The evaluation will compare baseline LLM and RAG-enhanced responses across criteria such as empathy, relevance, specificity, and safety, while user studies will collect feedback on emotional comfort, perceived supportiveness, and practical usefulness through Likert-scale surveys.

Appendix
A1. Overall architecture of *NightWhisper*

Figure A1. Illustration of the overall architecture of **NightWhisper,** an LLM-driven emotional support system. The framework integrates Retrieval-Augmented Generation (RAG) for psychology-grounded guidance, animal-themed healer personas, and multimodal interaction modules including avatar generation and text-to-speech synthesis.