



## **AyuAI Technical Report**

**MSIS 547 Generative AI**  
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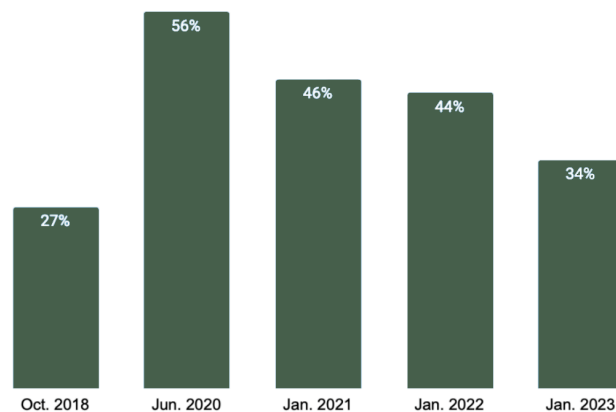
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## I. Business Problem

In October 2022, the World Health Organization released a fact sheet on aging and health that illuminated a significant global trend: people worldwide are living longer. Today, most individuals can expect to live into their sixties and beyond, a testament to advancements in healthcare and improvements in quality of life. However, this achievement is shadowed by a growing concern—every country is witnessing an increase in both the size and the proportion of their elderly populations. This demographic shift brings to the forefront the issue of social isolation.

A January 2023 survey conducted by the University of Michigan's National Poll on Healthy Aging sheds light on the magnitude of this problem. It found that 34% of adults aged 50 to 80 felt isolated from others at least some of the time, underscoring the pervasiveness of loneliness among older generations.



The following factors contribute to this issue:

- **Medical** - low vision, hearing loss, fall risk
- **Geographical** - relocation, lack of public transportation, severe weather
- **Financial** - fixed or low income
- **Technological** - stereotypes, privacy concerns, accessibility
- **Social** - poor family dynamics, death of spouse, lack of friends

## II. Ideal Customer Profile

The target market for our generative AI-driven chatbot is composed of elderly individuals living alone in senior living communities and those experiencing social

isolation. It's intended to provide companionship, emotional support, cognitive entertainment, caregiver relief, and actionable advice to help this population build new relationships or heal existing ones. Some members of our target market will be excited to adopt this product. Others may be encouraged to try the chatbot at the suggestion of trusted adults, such as healthcare providers or their children.

### III. Business Model and Monetization Strategies

Our intention in building AyuAI is to offer solutions that can help ease the “loneliness epidemic” identified by the Surgeon General of the United States, Dr. Vivek H. Murthy. We plan to employ a freemium business model. This will ensure that the basic functionality of our chatbot is available at no cost for those who need it but also provides us with an opportunity to generate consistent revenue via the paid tier. We plan to offer step-by-step instructions for getting started to reduce friction, and in addition, we're looking to partner with local organizations to spread the word and offer support.



## **IV. Development Process**

In the pursuit of developing a conversational chatbot that delivers interactive, personalized responses, and understands its users comprehensively, our team embarked on the AyuAI project. The project's development process was divided into three crucial segments: (1) transcribing speech to text, (2) converting text to generated text, and finally, (3) converting the generated text back to audio. This report details the development process, the ultimate goal, the selection of technologies, challenges encountered, and the solutions devised to overcome these hurdles.

### **Segment 1: Speech to Text**

The first segment of the AyuAI project involved the transcription of speech to text. For this task, it was essential to identify a Large Language Model (LLM) that excelled in accurately interpreting and transcribing spoken language into written form. After thorough research, we opted for OpenAI's Whisper model that was available on HuggingFace. Whisper is renowned for its robust performance in speech recognition across various languages and dialects, making it an ideal choice for our project's diverse user base.

### **Segment 2: Text to Generated Text**

The second segment focused on converting the transcribed text into generated text that would form the basis of the chatbot's responses. The core of this process involved selecting an LLM capable of understanding context, generating coherent and relevant responses, and maintaining a conversational tone. After evaluating several models, we selected Mistral-7B for its efficacy in generating high-quality text that could mimic human-like interactions.

### **Segment 3: Text to Speech**

The final segment of our development process entailed converting the generated text back into audio to facilitate a seamless conversational experience. Suno Bark, an open-source text-to-speech model, was chosen for its natural-sounding voice outputs and its ability to convey emotions and intonations effectively, thereby enhancing the

user experience. However, we eventually decided to replace this with a simple python package of gTTS, Google's Text-To-Speech conversion for a quicker inference speed.

## **Selection of Technologies**

The overarching goal of the AyuAI project was to create a chatbot that not only engages users in interactive conversations but possesses a personality of a caretaker. also offers personalized responses tailored to each user's preferences and history. To achieve this, we explored prompt engineering to shape the personality of the model<sup>1</sup>. We also incorporated LangChain to keep track of the dialogue between the user and the chatbot, assisting the chatbot in providing contextually relevant responses in subsequent interactions.

Our decision to not rely on third-party vendor API calls was driven by three main considerations: privacy concerns, the desire for control over the chatbot's responses, and cost considerations. Privacy was a paramount concern, especially when personalizing responses, as it involved processing sensitive user information. By hosting the models ourselves, we could ensure data privacy and implement robust cybersecurity measures. Furthermore, using open-source models allowed us the flexibility to fine-tune the models' weights and prompts, providing us with greater control over the chatbot's conversational style. Lastly, the cost of API calls to third-party vendors could be prohibitive, whereas hosting open-source models incurred only the cost of cloud hosting, making it a more economical choice. However, due to technical difficulties in hosting the model locally, we had to eventually rely on the HuggingFace API inference as elaborated in the subsequent segment.

## **Link to AyuAI's full code:**

**<https://github.com/sweishun/Conversation-Chatbot-Elderly/tree/main>**

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<sup>1</sup> We will continue to explore the incorporation of Retrieval Augmented Generation (RAG) to create a more personalized user experience. We will also explore fine-tuning the text generation model to shape the way that the output texts are generated.

## **V. Challenges and Mitigation Strategies**

### **Challenge 1: Model Size and Local Environment Limitations**

Running the Mistral-7b text generation model locally posed significant challenges due to its sheer size. Our first attempt in mitigating this problem was to employ quantization techniques to reduce the model's size without significantly compromising its performance. However, while this method works on Google Colab running on T4 GPUs, it would not work on a Mac device<sup>2</sup>. Therefore, we had to fallback on the usage of the Mistral-7b inference API hosted on the HuggingFace website.

### **Challenge 2: Slow Inference Times**

The process of parsing a single user input through several language models resulted in slow inference times, approximately 6 seconds, which could hinder the chatbot's responsiveness. To address this, we replaced the speech-to-text model with gTTS, a Python library that offers faster processing times, thereby improving the overall speed of the chatbot's responses.

### **Challenge 3: Manual Audio Playback**

Initially, the text-to-speech models did not support autoplay, requiring users to manually click on an audio file to play it. This interrupted the flow of conversation and detracted from the user experience. To overcome this, we hosted the chatbot on Streamlit and conducted research to implement audio autoplay functionality. This enhancement allowed the chatbot to deliver audio responses automatically, creating a more seamless conversational experience.

### **Summary of Challenges and Mitigation Strategies**

The development of AyuAI presented a unique set of challenges, from selecting the appropriate LLMs for each segment of the process to overcoming technical hurdles related to model size, inference times, and audio playback. By adopting a strategic

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<sup>2</sup> The bitsandbytes package which was essential for the quantization process apparently only works on CUDA GPU and not Metal Performance Shaders (MPS) GPU, which was what Mac runs on.

approach to technology selection and devising innovative solutions to encountered challenges, we were able to create a conversational chatbot that meets our goal of providing interactive, personalized, and user-understanding conversations. AyuAI represents a significant step forward in the field of conversational AI, demonstrating the potential of advanced language models and the importance of privacy, control, and cost-efficiency in chatbot development.

## VI. Evaluation and Results

To evaluate the effectiveness of AyuAI in achieving its goals of providing companionship, emotional support, and user-friendliness for the elderly population, we conducted a user survey. Recognizing the limitations of directly testing our solution on a senior demographic due to technical navigation challenges, we opted for an indirect evaluation approach.

### Survey Methodology:

- **Participants:** 30 University of Washington (UW) students and their parents/grandparents (50 total participants, with an age range of 22 to 70+).
- **Survey Format:** Online survey with a mix of multiple-choice and open-ended questions. The survey assessed perceptions of a hypothetical AI companion designed for seniors, closely mirroring AyuAI's functionalities.

### Survey Results:

- **Increased perceived companionship:** Compared to traditional communication methods (phone calls, emails), a significant portion of respondents (15%) indicated a belief that the AI companion would provide a more engaging and interactive experience for seniors.
- **Improved emotional support potential:** 55% of respondents felt the AI companion's ability to hold conversations and respond to emotional cues could offer valuable support to seniors experiencing loneliness.



- **Ease of use perception:** 50% of respondents believed the AI companion, based on the survey description and the functionality of a user-friendly interface, would be easy for seniors to learn and navigate.
- Open-ended responses revealed themes of appreciation for features like potential for social connection and caring nature of the model.
- Some concerns emerged regarding data privacy, over-reliance on technology, and replacement of human interaction.

## **VII. Strengths and Unique Value Propositions**

As a novel generative AI product designed for a group of the population traditionally underserved by technology, AyuAI will have an array of strengths and weaknesses. With only one other competitor in the product space, ElliQ that just launched in 2022, the market is still largely untapped especially outside of the US. Our unique value proposition from ElliQ is the personable context of AyuAI. Though it is always programmed to be caring and easily approachable for an elderly, AyuAI is programmed to learn from its interactions and develop a personality that matches its customer. While AyuAI leverages advanced technology in generative AI, it is purposefully designed to be convenient, easy to use, yet very interactive. With no physical button to press, straightforward UI, and an emphasis on approachability, AyuAI is created with effectiveness and simplicity in mind. Lastly, with our intentional use of open source APIs, we are able to keep costs low, and therefore keep a relatively low price for our freemium pricing model. This allows for more rapid adoption as a startup.

## **VIII. Limitations and Future Improvements**

As the first version of the product, AyuAI currently has several limitations. Its current technical capabilities only allow for chatbot usage from a desktop. This might not be ideal for elderly people to navigate the technology themselves, as they might require assistance to go through the computer's or phone's interface to get to AyuAI. With its current English-only functionality, our target market is also currently limited to just

English speaking countries. However, with future plans to integrate multilingual support, we would be able to tap into other big markets. As a product catered towards a demographic group that has the lowest interactions with technology, it might be hard to convince them to adopt the technology due to their hesitancy with data privacy, change from human companionship to a nontraditional AI companionship, etc. However, we plan to work together with senior living communities and medical facilities to help guide that transition from a trustworthy source.

Some future improvements that we plan to implement to AyuAI include having auditory medication reminders, having camera abilities to assist with identifying labels or general vision questions, emergency detection, more curated personalization especially for regional differences, multilingual support, and integration with other services. Successful implementation of these features would differentiate AyuAI to not only become a social companion, but also a full-functioning daily life assistant and caretaker.

## **IX. Societal and Ethical Implications**

The development and implementation of AyuAI touch upon various societal and ethical considerations, particularly in addressing the loneliness epidemic among the elderly. On one hand, AyuAI, presents a promising solution to mitigate social isolation by providing companionship, emotional support, and cognitive engagement through advanced AI technology. This initiative aligns with the ethical principle of beneficence, aiming to improve the quality of life for a vulnerable segment of the population. However, it also raises concerns around the substitution of human interaction with AI, potentially leading to a deeper reliance on technology for emotional and social needs. There's the ethical dilemma of data privacy and security, given the sensitive nature of the interactions between the users and AyuAI, highlighting the importance of stringent measures to protect user information. Additionally, AyuAI underscores the need for inclusive technology that respects user autonomy, ensuring that elderly individuals have control over their engagement with the AI and that their dignity is preserved.

Future developments must consider the diversity within the elderly population, including language, cultural nuances, and varying degrees of technological literacy, to avoid exacerbating existing inequalities. Overall, while AyuAI represents an innovative approach to a pressing social issue, it also serves as a reminder of the ethical responsibility to develop and deploy AI technologies in a manner that respects and enhances human dignity and social equity.

## **X. Contributions of Each Team Member**

Whole Team:

- Ideation of product
- Project proposal deliverable
- Contents of demo day pitch deck
- Presentation of demo day day pitch deck

Wei Shun Soong:

- Software development of AyuAI
- Recording of demo video deliverable
- Report - Development process, challenges and mitigation strategies

Alice Marshall:

- Report - Business problem, ideal customer profile, business model and monetization strategies

Adiva Zahira:

- Design of demo day pitch deck
- Report - Strengths and unique value propositions, limitations and future improvements, formatting

Bethany Ortiz:

- Report - Societal and Ethical Implications

Devesh Khurana:

- Report - Evaluation and Results

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