Voice Assistant for Quality of Life and Healthcare Improvement in Aging Populations

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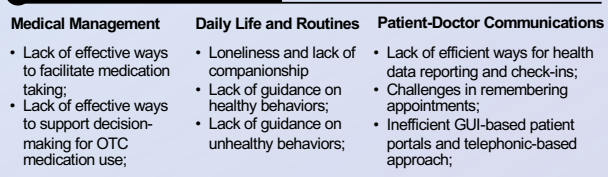
Overview

Technology can play a pivotal role in meeting the needs of older adults to preserve their independence. **Voice** is the most basic and natural interaction method for humans, and we believe it can be a powerful method for aging individuals to optimally interact with computerized digital assistance systems, particularly those with neuro-musculoskeletal or visual impairment.

We are working on a *personalized* and *context-aware* voice-based digital assistant to improve the quality of life and the healthcare management needs of older adults, and consequently, to reduce caregiving burden and optimize the interactions with healthcare and service providers.

Formative Needs Finding Interviews

Individual Virtual Assistants (IVAs) have promised to improve healthcare management and quality of life (QoL) through hands-free and eye-free interactions. However, there has been little understanding regarding the needs for designing such systems for older adults, especially when it comes to activities going beyond mundane tasks. In this work, we are the first to address the processes of healthcare management and QoL enhancements for older adults as distributed collaboration tasks between patients and providers. By interviewing 16 older adults and 5 healthcare providers, we identified 12 barriers that older adults might encounter while managing activities related to their health and daily life. We highlight the importance of considering the abilities of older adults when designing IVA-powered assistive devices for health management and QoL enhancements. We contextualize our analysis with a focus on ability-based design, eliciting 12 needs to help address key accessibility concerns. Our contributions also provide insights into the design and integration of IVAs with Electronic Health Records, an approach that is relevant for today's healthcare systems.



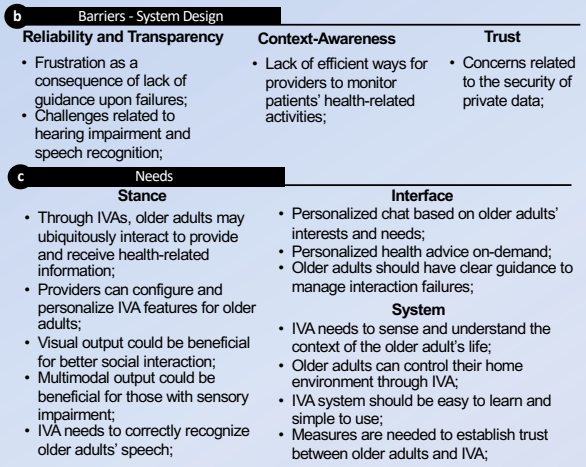


Figure 1. Findings of Barriers and Needs

System Design

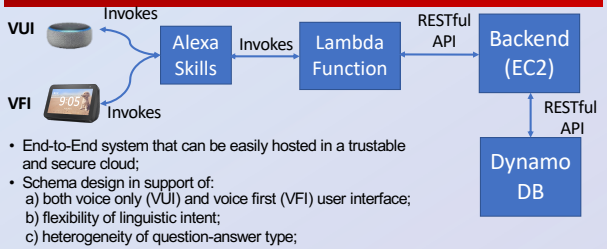


Figure 2. System Architecture

Natural Language Processing

Tree-structured representations are used on a wide range of tasks including sentiment analysis and text classification. We introduced a novel recursive, tree-structured self-attention model for answer sentence selection, where the goal is to select the best answer to a question. Our method achieves state-of-the-art results in two widely used question answering (QA) benchmark datasets (TrecQA and WikiQA), but not in community question answering datasets, where text is user-written, long, and informal. Through probing tasks, we showed that absorbing syntactic information led to increase in performance in QA. Thus, we demonstrated a weakness in a popular NLU architecture to generalize to everyday speech.

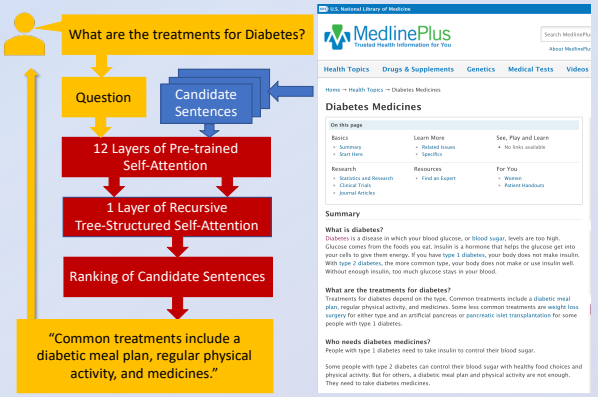


Figure 3. Answer Sentence Selection

We aim to enable IVAs to understand everyday speech to increase user retention. Thus, we worked on translating a user query into a formal question. Our approach is to augment datasets to cover both question summarization and recognizing question entailment, and to train fully shared parameters using a simple multi-task loss objective combining both tasks. We showed across 4 medical datasets (MeQSum, HealthCareMagic, iCliniq, and MEDIQA RQE) that our approach is efficient in low-resource settings and performs better than the BART baseline in at least one of human evaluation or ROUGE scores.

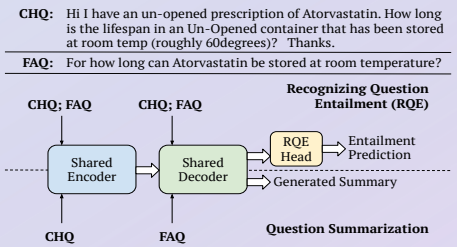


Figure 4. Example medical question pair: Consumer Health Question (CHQ) and Frequently Asked Question (FAQ)

Next Steps

We are waiting for IRB approval to launch a human subjects pilot study to investigate: (1) the acceptability of IVAs for the aging population and the efficacy of different embodiments, (2) feasibility of using IVAs to self-report vital signs and perform frequent Ecological Momentary Assessments, and (3) how natural language processing and machine learning can produce and comprehend health-related conversations.

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