Developing a Voice Assistant for Users with Dementia

# Introduction

Dementia is one of the leading causes of disability among the global elderly population which causes the deterioration of cognitive functioning. As modern advances in healthcare cause the average age of the world’s population to rise, so too is the number of elderly persons living with dementia that require care and support (World Health Organization 2019). There are estimated to be over 885,000 people in the UK diagnosed with dementia (Wittenberg *et al*. 2019) and over 50 million worldwide (Prince *et al.* 2015). People living with dementia require constant care and, although the nursing care industry is growing, training care-workers is difficult, time-consuming, and expensive. As a result, the number of care-workers is not sufficient to match the growing number of dementia cases.

There is great promise for voice assistants[[1]](#footnote-1) (VAs) such as Apple’s Siri and Amazon’s Alexa to support care-workers and patients by managing routine tasks such as setting medication reminders, carrying out mental stimulation exercises, and alerting human carers when needed. These products are operated through voice commands and can run on existing internet-enabled devices or dedicated hardware. They are capable of monitoring the wellbeing of vulnerable people at a lower cost of time and money than training a care-worker. Such devices could serve as a buffer on the workload placed on care-givers and enable persons living with dementia to have more independence. Unfortunately, current consumer products are not sufficiently reliable enough to provide support in this capacity. Despite being marketed as easy-to-use, these products still require a degree of technical understanding to be used effectively. While younger users (“Digital Natives”) of these products may find it easy to adapt to their use, older generations (“Digital Immigrants”) have more difficulty learning the technology. Furthermore, as these products are intended for general use, they are not suitable for users with special needs.

This project aims to develop a prototype VA that is tailored for users living with dementia. This prototype will include features common to current VAs such as setting reminders, performing search queries, and calling contacts, as well as ease-of-use considerations made for elderly users in general. A shortlist of additional features designed to maintain user independence, monitor wellbeing, and reduce the effects of cognitive decline will be created following a review of best practices and the viability of implementing these features on limited hardware will be assessed.

In this paper, I review current literature surrounding the challenges caused by dementia for sufferers and carers and review the current state of VA technology including its shortcomings. This research is used to list potential features and requirements of a VA to assist people living with dementia. Next, a simple VA that will serve as the foundation of the selected features is designed and presented. This paper then describes the research and implementation of each feature, the difficulties faced, and evaluates their effectiveness. Finally, an evaluation of the feasibility of the entire developed prototype is given and future areas of work are considered.

[Roadmap of project]

# Working Notes

Companionship and social relationships have been consistently shown to be very important for maintaining both physical and mental health. For the elderly, social relationships are hampered by difficulty communicating (A. Palmer et al. 2016). The proposed VA could help overcome this obstacle and assist early-stage dementia sufferers with maintaining their social relationships and health. The VA could also provide a degree of companionship itself. Improved voice synthesis will make VA’s more relatable.

Even healthy elderly users have difficulty using these products comfortably (A. Reis*et al.* 2018). These products are primarily cloud-based, leaving users unable to utilize many of their features if disconnected from the internet.

It has been extensively shown that non-pharmacological approaches to treating dementia such as cognitive behavioural therapy, reality orientation, and validation therapy are prospective solutions.

* The current state of voice synthesis is also lacking and can be hard to relate to for users who require companionship
  + Research shows that companionship is important
  + Historically, users have been able to relate to even less advanced AI.
* Virtual assistant can offer brain-training exercises that could help elderly users keep focused
* Ethical concerns – Collecting and storing data
* Product implementation?: Raspberry Pi or Mobile

Considerations to make for users living with dementia:

* Poor speech makes speech detection difficult
* Poor understanding of technology and confusion means commands may be complex or indirect
* Certain terminology or phrasing should be used
* The current state of voice synthesis is also lacking and can be hard to relate to for users who require companionship
  + Research shows that companionship is important
  + Historically, users have been able to relate to even less advanced AI.
* VA can offer brain-training exercises
* The ability to perform critical tasks without requiring an internet connection. Current options are primarily cloud-based, leaving vulnerable users unable to utilize them if web connection goes down.
* Be able to infer a task from a less explicit statement. For example, a confused question such as, “Where did Alice go?” while Alice is not present should be treated as a command to call Alice.

# Literature Review

* Gather and summarize papers on the prevalence of dementia as a problem and the benefits of VAs
* Use a repeatable process to collect papers
* Differences between digital immigrants and digital natives
* Differences between elderly and people living with dementia

# Project Plan

Outline of project

# Requirements of a VA / Potential Features

# Basic Voice Assistant

## Introduction

* Short paragraph explaining how an extendable VA will be developed

## Research

* VA technology

## Implementation

* Process of selecting the technology and creating the VA

## Evaluation

* Address limitations of implementation

# Feature 1

## Introduction

## Research



## Implementation

## Evaluation

# Feature 2

## Introduction

## Research



## Implementation

## Evaluation

# Feature 3

## Introduction

## Research



## Implementation

## Evaluation

# Physical Product

## Introduction

## Research



## Implementation

## Evaluation

# Evaluation of Developed System

While persons suffering with late-stage dementia will likely still require constant support, this system should allow persons with early stage dementia and pre-dementia to continue living independently for a longer period before requiring more consistent care.

# Further Research

Most dementia cases are present in countries with low income. Sufferers in these countries would not directly benefit from the development of the proposed voice assistant; however reducing the dependency on human care-workers in developed countries will open the possibility of aid for lower income countries.

Studies on dementia are often done in high income countries, how effective the techniques developed are for low income countries is uncertain.

# Appendices

## References

## Bibliography

1. There is no consensus on a general term for this class of products. Alternative terms include intelligent virtual assistant (IVA), intelligent personal assistant (IPA), and smart speaker. For this document the term voice assistant (VA) will be used. [↑](#footnote-ref-1)