

# Application of Virtual Reality in the Detection and Analysis of Age-Related Diseases

Detailed Project Plan



Supervisor: Dr. Loretta Choi

CHENG Yig Chen Jaime (UID 3035372218)

CHOW Bo Ngai Janssen (UID 3035120873)

## Contents

Background .....	2
Rationale .....	3
Objective .....	3
Value of Project.....	3
Methodology.....	4
Project Scope .....	5
Tools / Technology.....	6
Project Timeline .....	7
References .....	8

## Background

With longer life expectancy and lower fertility rate, ageing population has become a common problem globally, and the pace of such ageing has been drastically increasing [1]. Statistics from the World Health Association in 2015 has predicted the proportion of people over the age of 60 to nearly double from 12% to 22% within 35 years of time [1].

As for Hong Kong, according to the “Hong Kong Population Projections 2015-2064”, the rising trend of aging population is reflected by the increasing median age, which is predicted to rise from 43.7 in 2014 to 53.5 in 2064; while those of age 65 or older is projected to reach 35.9% of the population in Hong Kong by 2064 [2]. With the increasing number of elderly, this would result in a rise in demand for elderly-related services, including the need of medical services for the elderly [3].

Medical services are crucial for elderly due to the wide range of aging-associated diseases, such as Arthritis and Kidney and bladder problems. With aging-associated diseases being so common for elderly, the health condition of the elderly is greatly influenced by such diseases, hence the detections of related diseases are crucial and necessary.

Currently, the usual practice for elderly to find out the problem about their health is during regular body checks, or if serious problems have appeared which forces them to see the doctor. However, some elderly would refuse to see the doctor as they may think they are still fine, or they may be conservative and believe in the traditional treatments and think they will be fine after a few days [4]. Some may even think the doctors are not trustworthy, and are not comfortable for doctors whom they do not know find out the problem of their bodies [4].

## Rationale

Due to the current gap between the need of elderly and the healthcare and medical services provided, the 2 main rationales of this project is to:

- Help provide an easily accessible mean to discover potential health issues that elderly may have
- Be able to derive an accurate system for early detection of common elderly diseases such as Alzheimer's or Parkinson's via data collected from a VR related gamification approach in collaboration with local retirement homes.

## Objective

The objective of this project is to assess and analyze the performance of elderly within a designed VR game; and provide elderly with suggestion of possible aging-associated diseases.

Furthermore, another objective is to also analyze and organization of the progress of individual elderlies regarding their diseases.

The design and testing of such an application would be done in collaboration with local retirement houses.

## Value of Project

The main values in this project can be concluded as below:

1. To easy the process of detection especially in retirement hoes as there is no such system in place
2. To monitor the health condition and to see if there are any have improvements being achieved
3. To provide a game ad sociable means of checking for such diseases than the undesired traditional methods as there is typically a negative connotation connected with it.

## Methodology

In order to analyze the conditions and performance of users, different data would have to be collected, including users of different age ranges and users with or without certain illnesses. A set of standards of good (normal) performance and bad ('abnormal') performance could then be established, and by mapping the data to the set standards, prediction and suggestion of age-related diseases could be provided.

The data collected could be mapped to age-related diseases in 3 main categories:

### 1. Motion

By collecting data from VR devices on the time spent and motion detected in performing certain designated tasks within the application, analysis could be done on evaluating the performance of the user.

Within the application, some tasks are designed to require users to move in specific ways, for example to stretch out their arms and reach a certain object from a far. When the user tries to complete the task, data can be collected from sensors on the time and the position of their hands. By analyzing and calculating where their hands are placed in a timeframe, results can be obtained for their range of movement, speed and smoothness of their motion, and the stability of doing the action. Difference in score for stability, speed and range may suggest different types of diseases. For example, a patient suffering from arthritis would demonstrate stiff joints by the limited range of movement, and the lack of stability as the patient reaches the limit of their range. The combination of different scores of parameters would be mapped to different diseases for suggestions to be given to users.

### 2. Memory

The memory of users can be evaluated by time spent and correctness in answering certain questions.

For example, some tasks would require users to reproduce seen items in a specific order after a designated time. Different stages of the number of items to remember and time

span can be factors to be calculated and analyzed. A poor result with these two parameters may suggest diseases that affects the users' memory such as Alzheimer's.

### 3. Eyesight

Eyesight of the user can be tested by designing tasks that require users to distinguish items in various distance and colors.

The correctness and time needed for users to identify the objects would suggest whether the user have normal or 'abnormal' eyesight. The inability to distinguish different colors or see from far distances may suggest diseases like glaucoma.

## Project Scope

This application can be used in different age groups and different health conditions. However, the main scope of the project would be targeted on evaluating the health of older age users, and mapping to age-associated diseases that are motion, memory or eyesight related.

Such categories of diseases are focus and emphasized on as the use of Virtual Reality tools would be able to provide physical data for the evaluation of these diseases; while other chronic illnesses that are age-related such as heart diseases or diabetes would not be under the scope of the project as there would be lack of physical data to evaluate and suggest the likelihood of these illnesses.

## Tools / Technology

For this project, technology of Virtual Reality (VR) will be used. VR is chosen as the tool for the implementation of the idea due to its uniqueness to provide users with a simulated environment to perform actions and move as normal, while the users' movement and different data can be collected through VR equipment. By designing computer simulated environments and tasks to be performed to mimic the medical evaluations done by doctors, users' data can be collected for analysis and performance evaluation.

The VR equipment to be used is HTC vive, which includes a headset and a motion tracked hand-held device [5]. Such headset would be able to provide users with 360-degree view for a realistic experience, as well as the use of a pair of "base stations" to track physical location of the headset as well as the hand-held controllers in a designated space [5]. The headset also uses gyrosensor, accelerometer and laser pointer sensor which tracks head movements [5].

For more precise evaluation and suggestion of diseases, a wider scope of data could be collected by extra sensors attached within the system.

## Project Timeline

29 September 2019	Deliverables of Phase 1 (Inception) <ul style="list-style-type: none"><li>• Detailed project plan</li><li>• Project web page</li></ul>
October	<ul style="list-style-type: none"><li>• Research on scope of diseases to be included</li><li>• Define logic to derive results from raw data</li></ul>
November - December	Design of application to obtain useful raw data
13-17 January 2020	First presentation
2 February 2020	Deliverables of Phase 2 (Elaboration) <ul style="list-style-type: none"><li>• Preliminary implementation</li><li>• Detailed interim report</li></ul>
19 April 2020	Deliverables of Phase 3 (Construction) <ul style="list-style-type: none"><li>• Finalized tested implementation</li><li>• Final report</li></ul>
20-24 April 2020	Final presentation
5 May 2020	Project exhibition



## References

- [1 World Health Organisation, "Ageing and Health," World Health Organisation, 5 February 2018. [Online]. Available: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>. [Accessed 28 September 2019].
- [2 Census and Statistics Department, "Hong Kong Population Projections 2015-2064," Census and Statistics Department of The Government of the Hong Kong Special Administrative Region, 25 September 2015. [Online]. Available: [https://www.censtatd.gov.hk/press\\_release/pressReleaseDetail.jsp?charsetID=1&pressRID=3799](https://www.censtatd.gov.hk/press_release/pressReleaseDetail.jsp?charsetID=1&pressRID=3799). [Accessed 28 September 2019].
- [3 J. Mok, "Hong Kong faces challenge in how to manage its ageing population," South China Morning Post, 18 May 2018. [Online]. Available: <https://www.scmp.com/news/hong-kong/education/article/2146677/hong-kong-faces-challenge-how-manage-its-ageing-population>. [Accessed 28 September 2019].
- [4 M. Robert Stall, "A Geriatrician's Take on Elders Who Refuse to Go to the Doctor," Aging Care, 24 October 2018. [Online]. Available: <https://www.agingcare.com/articles/elders-who-refuse-to-go-to-doctor-150568.htm>. [Accessed 29 September 2019].
- [5 D. D'Orazio and V. Savov, "Valve's VR headset is called the Vive and it's made by HTC," The Verge, 1 March 2015. [Online]. Available: <https://www.theverge.com/2015/3/1/8127445/htc-vive-valve-vr-headset>. [Accessed 29 September 2019].
- [6 E. Kao, "Sharp growth in Hong Kong's elderly population worries census chief," South China Morning Post, 27 February 2017. [Online]. Available: <https://www.scmp.com/news/hong-kong/education-community/article/2074440/sharp-growth-hong-kongs-elderly-population>. [Accessed 28 September 2019].