MAGAJ - EECS 410 Final Project Report

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Abstract—Our final project, MAGAJ, is an application which helps the elderly and patients with bad memory problems improve their memory abilities.It consists of multiple modules which include games,food and sleep information.Each of this modules address a specific aspect of memory as we have determined memory is based on multiple factors.The food section gives out tips about food that has shown to have postive effects on memory. The sleep calculator determines optimal sleep time for better memory. The games will help improve aspects of memory like speed and recall.

Index Terms—Memory , recall ,food , sleep

1 INTRODUCTION

Memory is the faculty of the brain by which data or information is encoded, stored, and retrieved when needed. It is the retention of information over time for the purpose of influencing future action. If past events could not be remembered, it would be impossible for language, relationships, or personal identity to develop. Memory loss is usually described as forgetfulness or amnesia.

Memory is not a perfect processor, and is affected by many factors. The ways by which information is encoded, stored, and retrieved can all be corrupted. The amount of attention given new stimuli can diminish the amount of information that becomes encoded for storage. Also, the storage process can become corrupted by physical damage to areas of the brain that are associated with memory storage, such as the hippo-campus. Finally, the retrieval of information from long-term memory can be disrupted because of decay within long-term memory. Normal functioning, decay over time, and brain damage all affect the accuracy and capacity of the memory[1].

As you grow older, you experience physiological changes that can cause glitches in brain functions you've always taken for granted. It takes longer to learn and recall information. You're not as quick as you used to be. In fact, you may mistake this slowing of your mental processes for true memory loss. But in most cases, if you give yourself time, the information will come to mind. So, while it's true that certain brain changes are inevitable when it comes to aging, major memory problems are not one of them. That's why it's important to know the difference between normal age-related forgetfulness and the symptoms that may indicate a developing cognitive problem[2].

1.1 Age-related memory loss

The brain is capable of producing new brain cells at any age, so significant memory loss is not an inevitable result of aging. But just as it is with muscle strength, you have to use it or lose it. Your lifestyle, habits, and daily activities have a huge impact on the health of your brain. Whatever your age, there are many ways you can improve your cognitive skills, prevent memory loss, and protect your grey matter.

Furthermore, many mental abilities are largely unaffected by normal aging, such as:

Your ability to do the things you've always done and continue to do often The wisdom and knowledge you've acquired from life experience Your innate common sense and your ability to form reasonable arguments and judgments

3 causes of age-related memory loss:

1. The hippocampus, a region of the brain involved in the formation and retrieval of memories, often deteriorates with age. 2. Hormones and proteins that protect and repair brain cells and stimulate neural growth also decline with age. 3.Older people often experience decreased blood flow to the brain, which can impair memory and lead to changes in cognitive skills.

Seeing as this was a widespread problem,We decided to make an application for the people who were suffering with this problem.

2 RELATED WORK

2.1 Current research about memory

National Institutes of Health[3] claims Mild cognitive impairment represents a more severe form of memory loss and is often defined by important memory deficits without functional impairments. Although patients with mild cognitive impairment are able to continue to live independently, they show objective memory impairments similar to those seen in people with very mild Alzheimer's disease.2 About 10 percent of people aged 65 years or older have mild cognitive impairment, and nearly 15 percent of them develop Alzheimer's disease each year. Studies of drugs to treat mild cognitive impairment in order to delay the onset of Alzheimer's disease are currently in progress.

As people live longer, the risk for developing Alzheimer's disease increases dramatically. Although it is the most common cause of late life dementia, other causes, particularly vascular disease, contribute to the occurrence of dementia, often defined as impairment in several cognitive domains including memory to the extent that it interferes with daily life

The first assessment step is to determine if the patient falls into one of the three main categories of memory loss: age associated memory impairment, mild cognitive impairment, or dementia. It is helpful to obtain a standardised score of cognitive ability using rating scales like the mini-mental state examination, which consists of 30 items that rate memory, orientation, attention, calculation, language, and visual skills.4 The test takes only about 10 minutes, but is limited because it will not detect subtle memory losses, particularly in college graduates. More detailed memory assessments, known as neuropsychological tests, will provide a

better idea about subtle memory deficits. In the memory clinic at University of California, Los Angeles, doctors ask patients to perform a task involving delayed recall (for example, giving the patient a list of words and testing them 20 minutes later) to identify subtle memory loss in educated people. Such tests have been standardised and can provide a preliminary diagnosis of mild cognitive impairment. In the United States, positron emission tomography is sometimes used to help in the diagnosis of dementia because it has high diagnostic accuracy and sensitivity for detecting Alzheimer's disease early in its course.

Based on this research many attempts of gamifiying memory tools have been created.

2.2 Gamification in the 2000s

In the years leading up to the end of the millennium, the power of game mechanics was slowly gaining recognition. During the latter part of the 20th Century, people were beginning to consider games as a way to increase productivity in the workplace. With the conception of Frequent Flier rewards, the power of game mechanics to engage customers was also realised.

We had our successes and we had an inkling of a truly effective model for engagement.

- 2002 – 'Gamification' is born
  While designing a game-like user interface for commercial electronic devices (ATMs, vending machines, mobile phones) Nick Pelling coins the 'deliberately ugly' word, gamification. With a name, the history of gamification truly begins.
- 2005 – The First Modern Gamification Platform
  Rajat Paharia founded Bunchball, a platform designed to boost engagement on websites by adding a layer of game mechanics. It would be another 3 years before they adopt the term 'gamification'
- 2010 – Gamification changes the world
  Jane McGonigal delivers her groundbreaking TED Talk, Gaming Can Make a Better World, in which she prophesies a game-based paradise: "When I look forward to the next decade, I know two things for sure: that we can make any future we can imagine, and we can play any games we want, so I say: Let the world-changing games begin." This talk could well be the defining moment in the history of gamification.
- 2013 – More Gamification Research
  Gamification 2013 is held at the University of Waterloo Stratford Campus. This conference brings together research in a variety of fields from not-for-profit to customer engagement.
  Seminars and presentations throughout the conference examine ways to better use game mechanics and look to a future where gamification is applied to almost every industry.[4]

The biggest competitor in this space of memory is Lumosity[5].

2.3 The faults in major memory improvement solutions

Lumosity (and similar products)provides with personalized daily workouts and 60+ adaptive games always meet you at your current skill level, so you stay challenged.Though this has a significant improvement on one's memory,research shows that this alone is not enough.If you're feeling forgetful, it could be due to a lack of sleep or a number of other reasons, including genetics, level of physical activity and lifestyle and environmental factors[6].

Sleep also has an extreme affect on memory.While you snooze, your brain cycles through different phases of sleep, including light sleep, deep sleep, and rapid eye movement (REM) sleep, when dreaming often occurs. The cycles repeat about every 90 minutes.

The non-REM stages of sleep seem to prime the brain for good learning the next day. If you haven't slept, your ability to learn new things could drop by up to 40 percent. "You can't pull an all-nighter and still learn effectively," Walker says. Lack of sleep affects a part of the brain called the hippocampus, which is key for making new memories.

You accumulate many memories, moment by moment, while you're awake. Most will be forgotten during the day. "When we first form memories, they're in a very raw and fragile form," says sleep expert Dr. Robert Stickgold of Harvard Medical School.

But when you doze off, "sleep seems to be a privileged time when the brain goes back through recent memories and decides both what to keep and what not to keep," Stick gold explains. "During a night of sleep, some memories are strengthened." Research has shown that memories of certain procedures, like playing a melody on a piano, can actually improve while you sleep[7].

We decided to make an application that will help address these issues.

3 System design

Our application, MAGAJ is our application that we hope will help solve the problems detailed so far.

Fig. 1. Our application

MAGAJ is a memory improvement tool that contains games to improve specific aspects of memory like speed along with offering food and sleep tips.

It has core modules 1)game 1)food and 3)sleep.The game module has two games which target two major aspects of memory speed and recall.Both games collect score to maintain a progress report to show visually how the user improves over time.

The food section will provide tips about the optimal diet and the kind of food that will help improve main activity.The sleep module will calculate your sleep time and tell you what the optimal time of sleep should be.

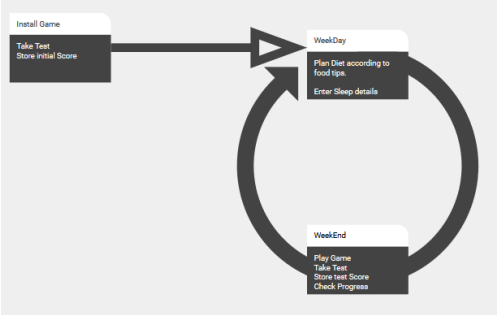

Fig. 2. Flowchart

The flow of the program is as follows:When the user first installs the app.The user plays a few test games to measure their initial score.During the week the user follows the food and sleep tips and plays the games while their scores are being saved.By the end of the week they can see their improvements over time plotted on a graph.

4 User Guide

This application will help a user improve their memory. When you start the application it will conduct a simple test that will determine your initial scores.You can start the tests by entering your details. You will be tested in two aspects speed and memory

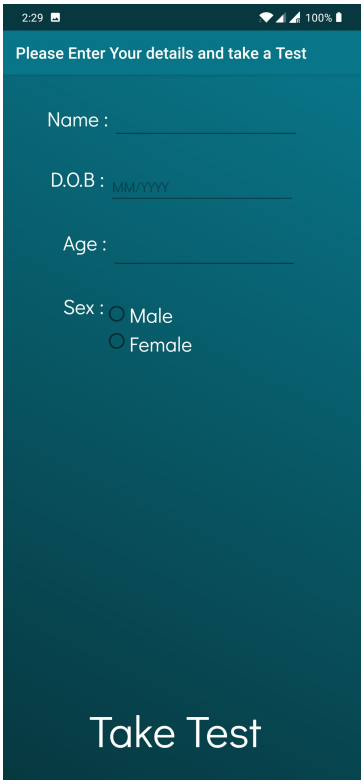

Fig. 3. test screen 1

using two games play them to see how well you do initially. The first one will test your memory.You need to remember the pattern shown and press the right buttons. The second one will test your speed by asking you simple math questions.you need to answer them in time. This will lead you to the home screen where you can

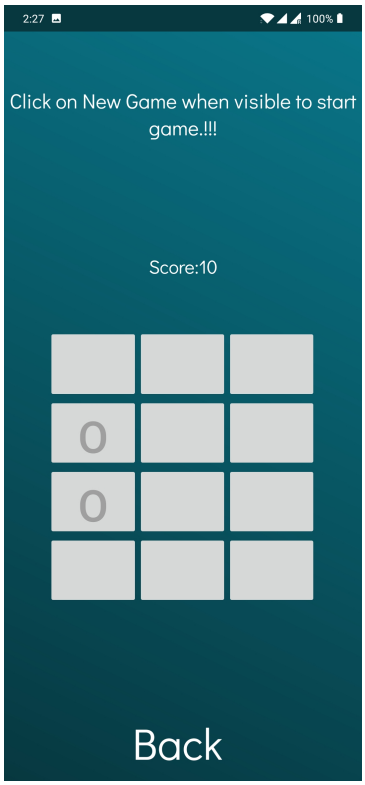

Fig. 4. game 1

Fig. 5. game 2

choose to play games to improve your score or go to the options and discover food and sleep tips. The food section will give you a list of food you should add into your diet to help improve your

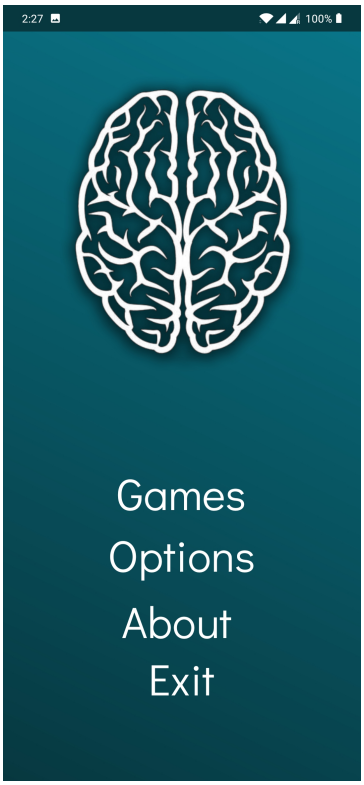

Fig. 6. Home screen

memory. The sleep section will calculate the optimal amount of

Fig. 7. Food tips screen

sleep you need based on your age and input to help improve your memory. You can check your progress to see how well your doing

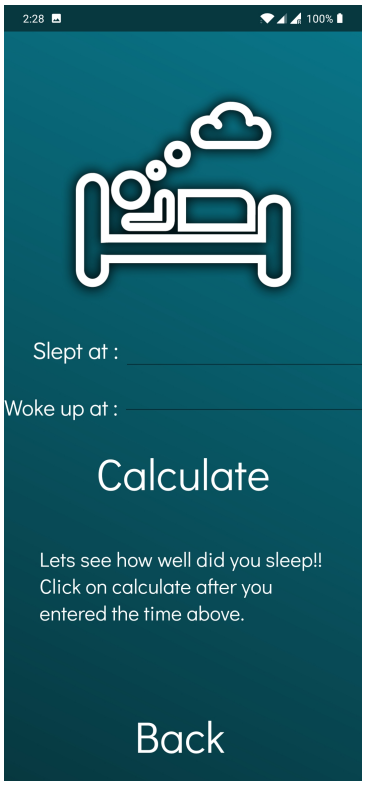

Fig. 8. sleep screen

compared to your previous scores.

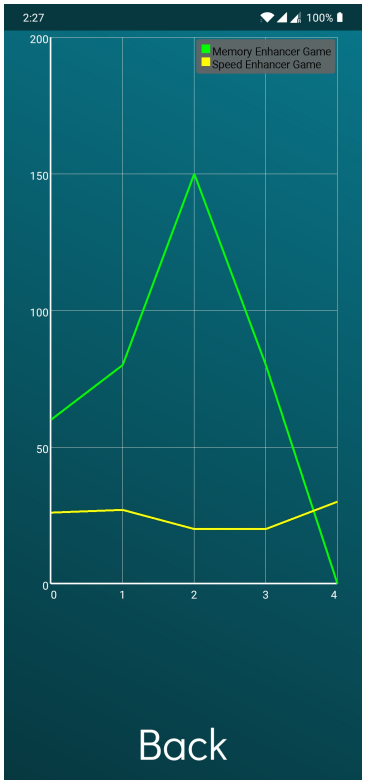

Fig. 9. Progress screen

5 Challenges faced and Tradeoffs

We faced many challenges while Developing this project. The major challenge was of Overscoping the project.We were unfamiliar with many of the components that were required to be implemented in the project ie game development,creating image listviews,creating alarm based notification systems etc. It took us longer to figure everything out than anticipated. We tried multiple frameworks for game development like LibGDX, processing etc. They came with unexpected problems and bloated the application so we had to throwaway a major part of the project and start from scratch. Having multiple graphic heavy games in a app caused it to crash so managing multiple games in the same app was a problem. A similar problem was faced with alarm notification systems. We were unfamiliar with alarm based implementations. Our implementation should have worked but did not work as they we intended it to work and due to that reason we had to remove them from the application.

Due to datatype mismatch during file reading, plotting graphs created a problem as well.

6 Results

The member of this team was the test group for the functioning. As we can see in Fig. 10 initially there was a good progress, but due to assignments and other final submissions the sleep schedule was not consistent and not complete with random food habits (due to lack of time) and that has affected the performance during that period. After that the progress again started climbing till there was another phase of sleep reduction but luckily it was short and hence did not effect the performance drastically.

By this result we can see how sleep and food are very much connected to the cognitive ability in both speed and memory manner.

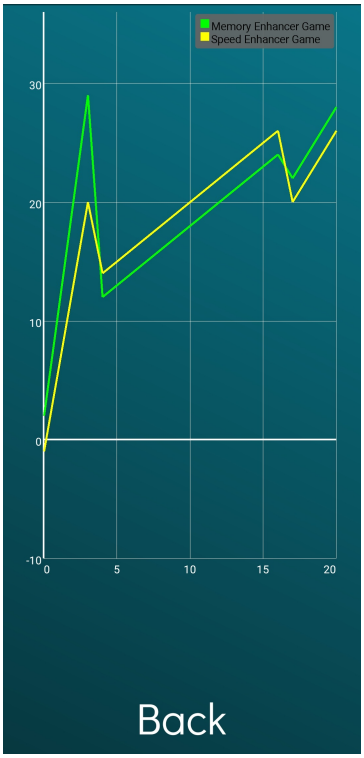

Fig. 10. results

Since the data set was very small it can not be verified that sleep and food are the main key factor but it was for this test user and hence with the larger data set it will be possible to verify it.

7 Conclusion and Future Work

In this project we were successful in developing an application for memory improvement.We looked into current research in the field and saw the need for a tool that considers all aspects of memory including food and sleep.We familiarised ourselves with various game frameworks and figured out the pros and cons of using them.We were able to draw from our previous lab experience s and implement graph views so that the users can have a better visual feedback about their performance.

Though we have over scoped and had to try and implement various new things that we did not previously learn and had to face some technical challenges,We have created a fine working model of our proposal.

In the future we would like to implement multiplayer social in traction to boost the learning environment along with adding multiple, more complicated games to increase variety and test more minute aspects of memory.We would also like to add more elaborate data processing like including machine learning algorithms to generate interesting data patterns to create sophisticated performance predictions.

8 Citations

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