Brain Workout,
An Application for
Enhancing Memory and Problem Solving Skills.

By

Daphnee Lo Kah Yii

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information Communication Technology)

SEPTERMBER 2012

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CERTIFICATION OF APPROVAL

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Approved by,

_____
(Assoc. Prof. Dr. Dayang Rohaya Bt Awang Rambli)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
SEPTEMBER 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

_____

(DAPHNEE LO KAH YII)

Abstract

The purpose of this project is to propose a mobile application that is able to enhance cognitive development among retirees by learning games that will help to stimulate their brain. Retiree that no longer remained active in their daily life faces a reduced attention span, low concentration, and reduced problem solving skills. When an individual no longer engage in their working activities, this will lead to a decrease of cognitive ability among individuals, which may result to suffering Dementia. Dementia is an illness of the brain. When someone has Dementia, brain cells are damaged and die faster than they normally would. The scope of this study is limited to retirees aged 45 to 75 years old where the transition is more likely to occur from a person that works each day turning to a person that is less active. There are several factors that will affect Dementia either positively or negatively which includes retirement. "Use It or Lose It" by Connors, Jimmy reflects a hypothesis where a person can delay or prevent normal cognitive aging or they might just lose it. Mental exercises are proven to be able to prevent or delay Dementia. The methodology used to complete this application is agile software development methodology that refers to a group of software development methodologies which based on iterative development. Tools used include MIT App Inventor which is a popular platform to develop an Android application. Surveys are done on similar games in Android and iOS platform. Online games focusing on senior adults are analyzed. Research on receptiveness of older adults towards technology and usefulness of technology to slow down Dementia were done. Considerations of design especially in the area of graphical user interface were researched to increase effectiveness of application design to suit the aging adults. Thus, an Android application in the form of brain exercise game is proposed which is used to stimulate mental exercise to enhance memory and problem thinking skills among retirees.

ACKNOWLEDGEMENT

First and foremost, the writer would like to take this opportunity to express her greatest gratitude and appreciation to her project supervisor, AP Dr Dayang Rohaya, who had continuously monitored her progress throughout the duration of the project. Her constructive comments, advices, and suggestions have lead the project towards its successful final outcome.

This gratitude also dedicated towards Universiti Teknologi PETRONAS (UTP) especially the committee of Final Year Project of Computer Information Sciences (CIS) department for excellent organization and management of this course.

She would also like to thank her friends and family that had given her continuous support and guidance to the completion of this project.

Last but not least; the writer would also like to express her acknowledgement to the participants of testing which have helped in providing feedback towards the project.

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ABBREVIATIONS AND NOMENCLATURES

IEEE	Institute of Electrical and Electronic Engineers
GUI	Graphical User Interface
BW	Brain Workout

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Background

Nowadays, the age of retirement decreases. It is more likely that individual spend a longer time having a less active life after retirement Based on MedicineNet.com (June 14, 2012), cognitive impairment is a disorder of the brain where thinking abilities are mildly impaired. Individuals that experience cognitive impairment are still able to function in everyday activities but have difficulty with memory. For example, individuals will have trouble with remembering the names of people they met recently and have a tendency to misplace things. However, the individual may be aware of these difficulties and will have an increased reliance on notes and calendars.

It is estimated that by 2050 the number of people over 65 years old will have increased to 1.1 billion worldwide where a population of 37 million will suffer from Dementia according to ScienceDaily (Mar. 27, 2012),. Dementia is a well-known disease that is prone to hit people as their age increase although age is not the main factor. Dementia is a decline is cognitive functions in line with cognitive impairment. People that have Dementia normally will experience a loss of memory, confusion which lastly leads to a situation where they will need help in their daily life such as eating, dressing up and doing daily activities

There are various ways that can be used to help to prevent Dementia from occurring such as taking good care of the brain is also a very important factor to prevent Dementia. Some of the simple way to take care of our brain includes being engaged in an active social life, exercising regularly, maintaining a healthy diet, mental stimulation, quality sleep and stress management.

Figure 1: Pillars of Brain-Healthy Lifestyle. *Source:* Helpguide.org

Stimulation of the brain is one of method to prevent Dementia. This can be done by doing mental exercises or activities that will prevent cognitive decline. Besides doing puzzles or crossword puzzles for mental exercises, games in the form of mobile application or tablets that enhance cognitive development can also be used to slow down Dementia.

Nowadays, smartphone is the current trend in every part of the world. The convenience that a smartphone bring to its owner is undeniable. Besides that, the availability of various applications in the smartphones or tablets is also one of the factors that attract people to own a smartphone. Applications such as games, document related tools,

utilities, health related applications are widely available for the users either for a fee or entirely free.

However, smartphone is not only popular among youngsters but is slowly gaining its popularity among all age group. Thus, it is possible to develop an application to encourage retirees with a smart phone or tablet to exercise their brain. By having an application in their mobile or tablet, they can just play the game anytime anywhere to perform some mental exercise to enhance cognitive development.

Based on Nielsen's third quarter survey in the U.S. of mobile users entitled "Smartphone Ownership by Age Group by James Plafke" dated November 3rd, 2011, it shows that a large amount of people are adopting smartphones. In the U.S, 43 percent of the mobile subscribers have a smartphone. The majority of the mobile market consists of 62 percent of smartphone owners being aged 25 to 34. For aged 18 to 24 and 35 to 44 is 54 percent. For younger and older ages groups, 40 percent for the age range of 12 to 17 have a smartphone, while 40 percent for those aged 45 to 54. 30 percent of those aged 55 to 64 have a smartphone. However, the percent of ownership for age group of 55 to 64 is rising rapidly where it is the second fastest-growing smartphone penetration age group. Refer to Figure 2: Smartphone Penetration by Age group. *Source:* Nielson (2011).

Therefore, the development of a game-based application for users especially retirees aged 55 and above to prevent Dementia is possible. The game must be able to stimulate the brain of the user to increase the effectiveness of preventing of Dementia.

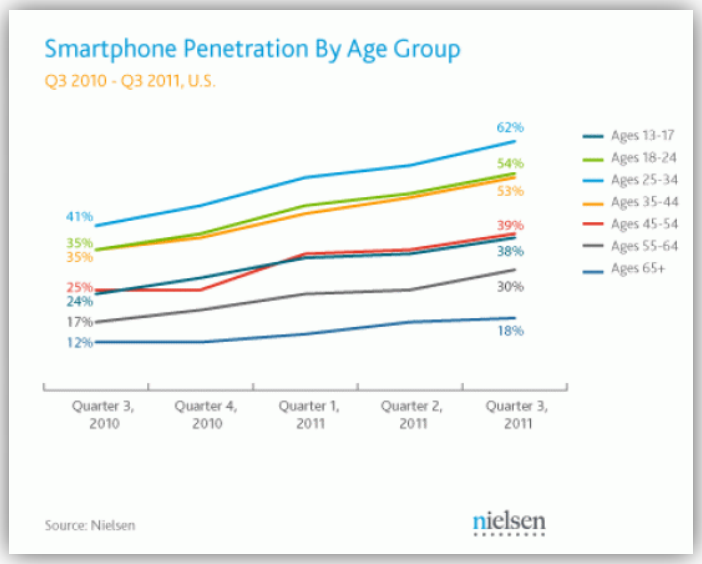


Figure 2: Smartphone Penetration by Age group. *Source:* Nielson (2011)

1.2 Problem Statement

Nowadays, there are more and more people facing the issue of Dementia as their age increase. Dementia is an illness of the brain according to Professor Marion McMurdo (2005).

The brain cells are damaged or die which causes the brain to not be able to function properly. When someone has Dementia, they will lose their ability to do things. Dementia is a decline in cognitive functions. These include mental processes such as thinking, reasoning, learning, problem solving and loss of memory.

Thus, when a person loses their ability to do things, they will require help from others or they might feel helpless and discouraged to continue carrying out their daily activities.

1.2.1 Problem Identification

Retirees that no longer remained active in their daily life face a reduced attention span, low concentration, and reduced problem solving skills. Besides that, the condition worsens when their age increases which might then leads to Dementia or worse case, Alzheimer's. Based on a recent study by The Johns Hopkins University, they estimated that one in every 85 people worldwide will suffer from Alzheimer's disease by 2050. If intervention is able to delay the progression of the disease by about one year, there would be about 3.7 million less patients with the disease in 2050. Alzheimer's disease is the one of the most common type of Dementia which negatively affects a variety of cognitive and neurological processes.

As the symptoms of disease turns into more severe, patients then lose their memory due to the loss of cholinergic neurotransmitters. This might increase the burden of the family or the individual themselves. Their brain might not be working as efficiently and effectively as before when the brain is no longer learning. According to a study which used cross-sectional data from the United States and Europe, Adam et al. (2007) found that retirees have a lower cognitive functioning as compared to working individuals. Adding to that, the authors showed that the longer the retirement period, the lower the cognitive test score. This suggests an acceleration of cognitive decline during retirement.

1.2.2 Significance of the Project

Dementia is an illness that everyone might face. It is not something uncommon but in fact is too common that people tend to ignore the symptoms thinking that it is something normal instead or taking preventive actions to overcome.

With the increase of life expectancy, people are expected to have a longer average life as compared to decades ago. The decline in cognitive functions caused an individual to lose their ability in performing certain tasks in their daily life.

It is suggested by experts that mental or brain exercises or brain exercises are one of the way to delay or prevent cognitive decline. By performing mental or brain exercises or brain exercises, it might be able to delay or prevent Dementia

1.3 Aim of Project and Objectives

1.3.1 Aim of Project

To prevent or delay the risk of Dementia among retirees by encouraging brain exercises.

1.3.2 Objectives

- ✓ To conduct a survey of brain exercise games available.
- ✓ To study the design considerations for aging adults.
- ✓ To survey aging adults perception towards such application.
- ✓ To develop an application that is simple to use with minimal instructions.

1.4 Relevancy of the Project

The topic selection is relevant to the society nowadays as it is something that is faced by people. If the project is successful, it will help people to delay or prevent the development of Dementia in line with cognitive impairment. The project is also build on an Android platform which fulfills the curricular requirements.

1.5 Scope of Study

Target Group : Adults aged 45 to 75 years old.

Platform : Android

Application : Brain WorkOut

Time Frame for development : 5 months

The scope of study is limited to adults aged 45 to 75 years old. The age group is the age where adults are slowly being affected with the risk of developing Dementia. Survey will be conducted on existing similar application, the design considerations and learning behavior of aging adults.

The application for this project is a brain exercise game running on Android build using MIT App Inventor. The application will need to be completed within the end of Final Year Project II timeline.

The project consists of two types of brain exercise which are involved with words and numbers. This application focuses on improving memory and enhancing problem solving skills.

CHAPTER 2

LITERATURE REVIEW and/or THEORY

2.0 LITERATURE REVIEW and/or THEORY

The literature review for Cognitive Development Enhancement for Retirees Using Learning Games in Mobile or Tablet covers on the effects of retirement towards cognitive functioning, how mental exercises helps to prevent or slow down Dementia and cognitive decline and lastly whether mental exercises is able to prevent Dementia.

2.1 Factors that affect Dementia

There are several factors that will affect Dementia either positively or negatively. According to Patterson et al, there are three areas that affect Dementia for lifestyle factor which are alcohol, activity, physical or mental, and the use of tobacco while the miscellaneous factors includes education, history of head injury and occupational exposure to toxins. Eating habit is also a part of lifestyle where the intake of fatty acid in food or food with high omega 3 is beneficial for the brain. People that suffers from hypertension, diabetes mellitus, stroke, required for diagnosis, silent infarctions on neuroimaging, high fat diet, hyperhomocysteinemia, depression, reduced thyroid-stimulating hormone, hypercholesterolemia, high fat diet, high omega 3 fatty acid./fish in diet, moderate consumption of wine, smoking, occupation (manual work), exposure to toxins, medications, vaccinations and other miscellaneous factors has a high probability to suffer from Dementia.

2.2 Effects of retirement towards cognitive functioning

Retirement is also one of the factors that affect cognitive functioning in an individual. Retirees faces one of the most feared diseases that is cognitive decline which can then slowly leads to Dementia. Dementia is not a new disease. When an individual retired; the retirement is likely to cause an increase in cognitive decline after an individual no longer engage in cognitive activities. According to Adam et al. there is an obvious negative impact of retirement on cognitive functioning.

Besides that, Fabrizio Mazzonna & Franco Peracchi (2012) conducted a study that shows an increase in the rate of decline of cognitive abilities after retirement. The study shows the decline of cognitive abilities increases as the period of retirement increases.

Moreover, based on a study done using cross-sectional data from the United States and Europe, Adam et al. (2007) found that retirees had a lower cognitive functioning as compared to working individuals. The authors showed that the longer the retirement period, the lower the cognitive test score which then suggests a cognitive decline during retirement.

2.3 Mental Exercises to Prevent or Delay Cognitive Decline

To prevent or delay cognitive decline, there are several ways such as maintaining a healthy lifestyle and exercising which also included mental exercises.

The popular phrase “use it or lose it” by Jimmy Connors reflects a hypothesis where a person can delay or prevent normal cognitive aging or they might just lose it. Cognitive aging is the decline of reasoning ability and speed of mental processing as a result of aging. Therefore, by engaging in cognitive activities, helps the brain to remain active which might slow down the aging of the brain.

According to a recent study published by Yan Cheng et al. (2012), cognitive training can visuospatial construction, improve memory, visual reasoning, attention and neuropsychological status among older people and it is able to help maintain their functioning over time. The study shows that cognitive training therapy may prevent mental decline amongst healthy older people and help them to continue living longer independently. Besides that, Dr Trisha Macnair (2011) advised people to improve or maintain their brain health by following a regular routine or calendar, making lists, or making links and associations in your mind. All the activities are a form of cognitive exercise to maintain a healthy brain which might prevent or delay Dementia.

Lastly, research from C. Riley-Doucet (2007), suggests that with the combination of physical and mental exercise, it is possible to reduce the progression of cognitive degeneration.

2.4 Does Mental Exercises Helps to Prevent or Delay Dementia?

According to a study done by P. Muccia et al. (1998), the result shows that mental exercises had enhanced cognitive variables. The study proposed different methods of mental rehabilitation to assess perceived changes in quality of life among healthy elderly. The participants of the study consist of thirty two elderly who were assigned to one of the four groups: combined aerobic, aerobic training, mental training and mental training and a control group. The group of mental activities participants was assigned into perceptive activity that strengthens attention, sight, hearing, concentration, and logical activity, visuo-spatial activity and exercises for immediate and long-term memory.

Adding to that, a study done by Dr. Robert Wilson (2010), that consist of 1,157 men and women at the age of 65 years old or older had found that people who remained intellectually stimulated were diagnosed with dementia later than to those who were not as cognitively active. The activities done by the study group includes playing cards or other games, visiting museums or reading.

Furthermore, Dr. Joe Verghese (2010) suggests that older people can preserve their mental acuity by exercising their brains. The researchers that were involved in the study interviewed the participants about their their mental activities, leisure activities and also their physical activities. They found out from the study that people who participated in mental activities had a reduced risk of dementia.

Thus, based on the studies performed by different experts in this area, it is proven that mental exercises are able to prevent or delay Dementia based on results of the studies done on this matter.

2.5 Aging Adults Involvement in Technology

It is possible to encourage aging adults to be involved and engaged in technology. This is based on the evidence of the upward numbers of senior citizen's adoption towards technology that proves that technology is something that is possible to be used by even everyone, including the senior citizens.

According to a study done by Nielsen, there are six million more senior citizens using the web as compared to 5 years ago. The data states that there are about 17.5 million users in November 2009. They perform various activities using the Web as shown in Figure 3: Top 10 Online Activities Performed in the Last 30 Days by People 65+ (U.S.) *Source:* Nielsen. This data shows that senior citizens are also using technology to perform their daily tasks such as paying bills online and reading news.

Top 10 Online Activities Performed in the Last 30 Days by People 65+ (U.S.)		
RANK	Profile Point: Internet Activities in Last 30 Days	Audience Composition Percent
1	Personal E-mail	88.6
2	Viewed or Printed Maps Online	68.6
3	Checked Weather Online	60.1
4	Paid/Viewed Bills Online	51.2
5	View/Posted Photos Online	50.1
6	Read General/Political News	49.2
7	Checked Personal Health Care Info	47.3
8	Planned Leisure Travel Trip Online	39
9	Searched Recipes/Meal Planning Suggestions	38.4
10	Read Business/Finance News	37.8
Source: The Nielsen Company, Nielsen @Plan Fall 2009 Release, Adults 18+		

Figure 3: Top 10 Online Activities Performed in the Last 30 Days by People 65+ (U.S.)
Source: Nielsen

Adding to that, based on a report by M. Madden (2010), the study was done in America where 47% of internet users between 50-64 years of age which is almost half of the total users. Besides that, every one out of every four users age 65 and older uses social networking sites. Studies done also proved that social networking usage is still growing among older users. Refer to Figure 4: Older Adults Engagement in Technology

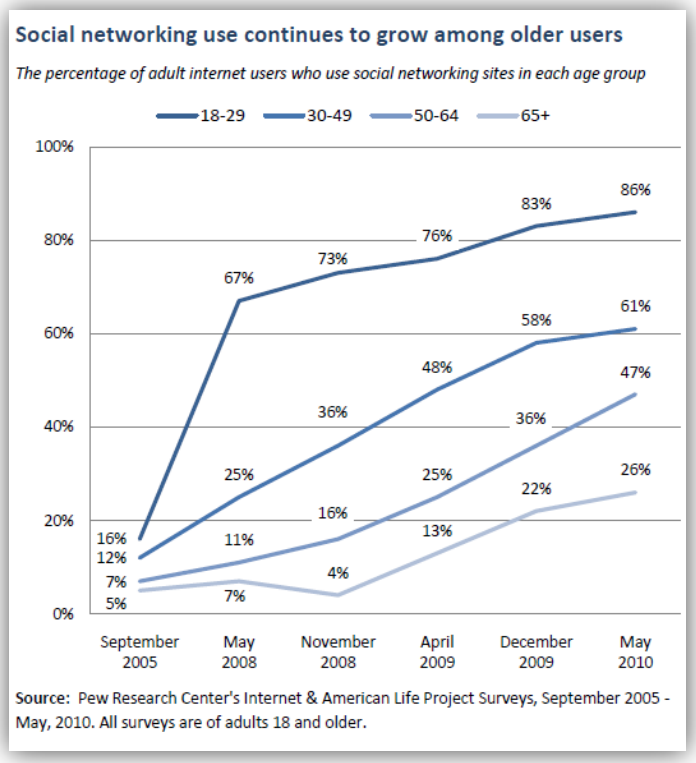


Figure 4: Older Adults Engagement in Technology *Source:* Pew's Research Center's Internet & American Life Project Survey (2005-2010)

Adding to that, based on the data released by Nielson from November 2010 to January 2011, smartphones are gaining popularity among the older adult market. Refer to Figure 5: Age and operating system share-smartphones *Source:* Nielsen (2011).

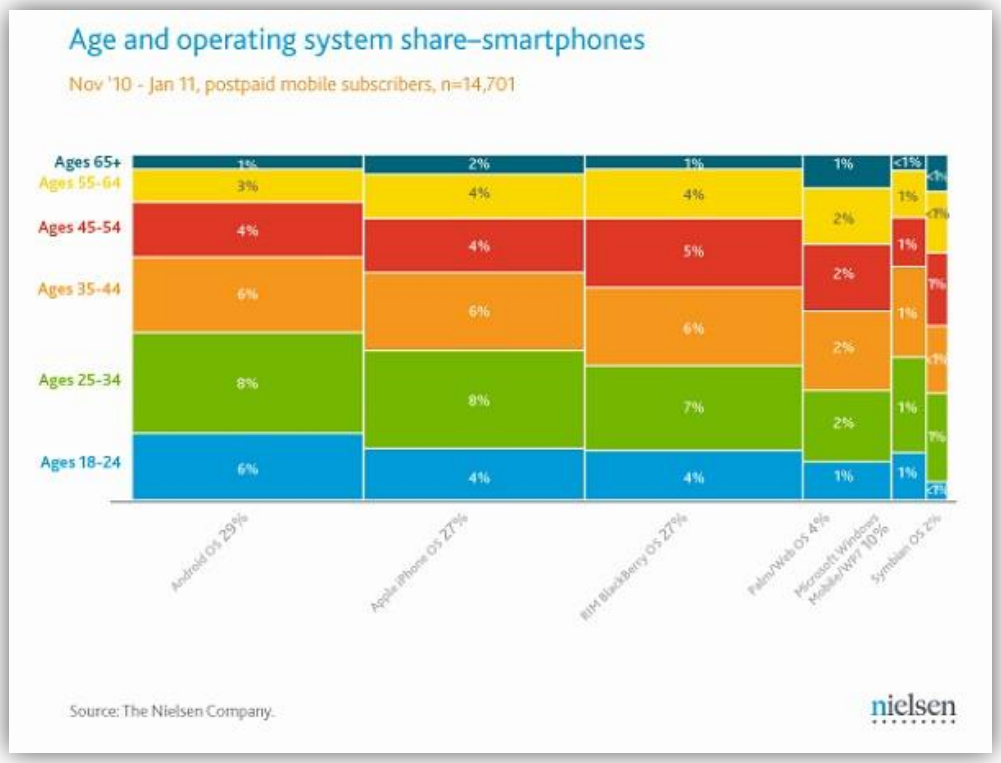


Figure 5: Age and operating system share-smartphones *Source:* Nielsen (2011)

Furthermore, a research was done by Info Solutions Group (2011) where there are a number of aging adults that are games players using their mobile phones. The data done from the research shows that 44% of the mobile phone gamers are less than 34 years old, 40% are between 35 and 54 years old, while the remaining 16% are 55 or older. Refer to Figure 6: Mobile Phone Gamer Profile Source: Information Solutions Group (2011).

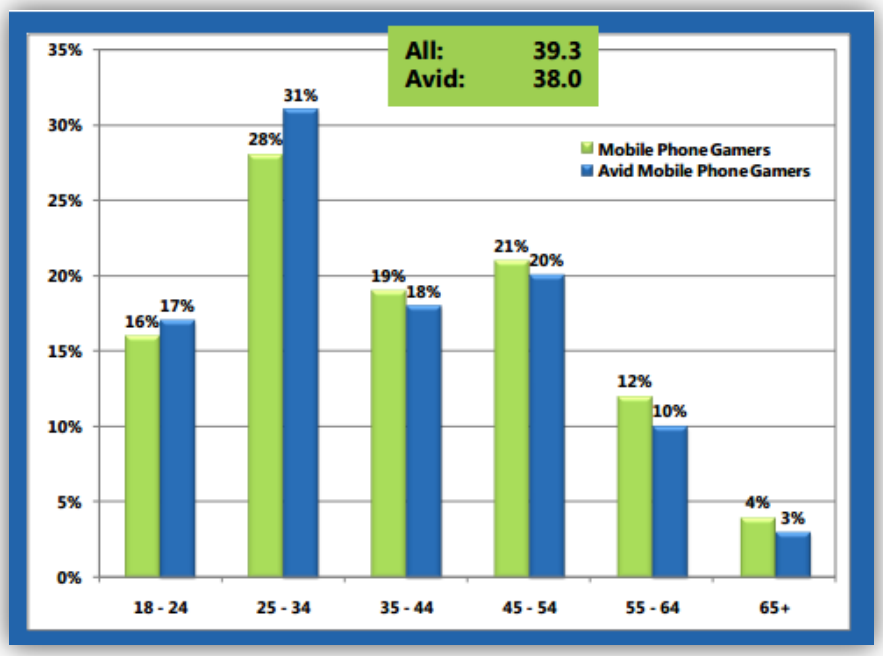


Figure 6: Mobile Phone Gamer Profile Source: Information Solutions Group (2011)

Lastly, studies done by Green and Bavelier, (2006) have used video games to train attention and perception in younger adults which were also tried in older adults to determine the effects. They argued that video games are effective because of the many features provided for successful cognitive training such as feedback, task variability, adaptivity, and motivation.

2.6 Receptiveness of Aging Adults towards Technology

"There are a very limited number of scientific reports to prevent the dementia by doing such games," said by Dr Takao Suzuki, an expert in the care of older people.

"But in an aged society like Japan and the UK, nobody wants to get dementia so even if there is a very small possibility that it might work, most elderly people will want to do something in order to prevent dementia," he said. The statement by Dr Takao shows the willingness of people to try every possible alternative to slow down Dementia.

2.6.1 Video Games

Nowadays, there are more and more aging adults being engaged in technology. One example of growing popularity of technology engagement among aging adults is the use of video games. Examples of highly ranked video games include the Nintendo Wii and Xbox 360. According to Jeff Hartman, seniors have become one of the largest groups of users playing the Nintendo Wii. Seniors at Chesterfield Heights Retirement Community in Midlothian, Virginia play Wii Bowling to socialize, stay fit and enjoy some of their favorite physical activities as a regular practice. Besides promoting a healthy mind, video games also assist in improving a better health to a fitter body. According to Basak et al, there is growing evidence for the use of video games as cognitive interventions for older adults.

2.6.2 Computer

Besides video games, the use of computers also has an increasing popularity along the aging adults. Based on a study done by Anne Aula where the study was done on 10 older adults. They felt that learning to use computer were difficult and challenging initially.

Furthermore, based on an interview done in Eldernetting program held at The Penn Stater Conference Center Hotel, the instructor Chris Rynd said "*When using a computer for the first time, there can be some frustrations and headaches,*" and "*Trying to control the mouse and even using the keyboard can be difficult.*"

Dolores Simpson, a retired teacher residing in State College, was eagerly anticipating the first class mentioned, "*I'm so excited to attend this program, because I really feel that it is important to stay current and understand this technology*". Most of the older adults wants to learn to use computer especially e-mail to keep in touch with their family members which stays in different parts of the country.

2.6.3 Internet Usage

The aging adults also use the internet for email and socializing. According to a recent research done in June 2012 by Pew Research Centre called Older Adults and Internet Use on senior adults in America, the research found out that these adults uses the Internet on a normal day. Using the internet had become part of their daily activities. They use it to surf social networking sites such as Facebook and Linked and email services which is no longer foreign to them. Figure 7: Social Networking Use by Age Group shows that 50% of adults ages 50-64 nowadays use the internet as compared to 31% previously

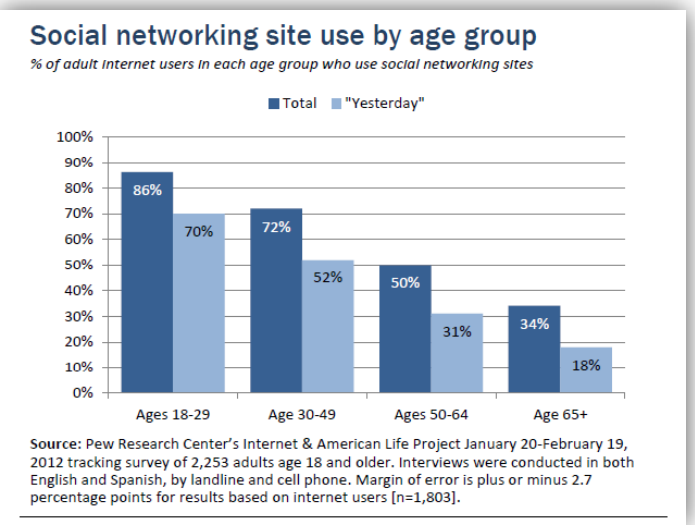


Figure 7: Social Networking Use by Age Group

Source: Pew Research Center

Figure 8: Internet and home broadband use by age group shows the internet usage and subscription to home broadband services by this age group. The internet usage was 77% while the usage of home broadband service was 62% which is very significant and high figure. The statistics proves that more half of these adults are using internet.

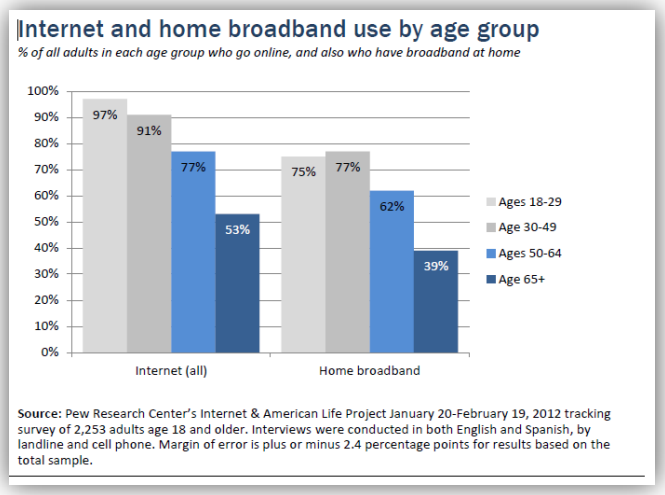


Figure 8: Internet and home broadband use by age group

Source: Pew Research Center

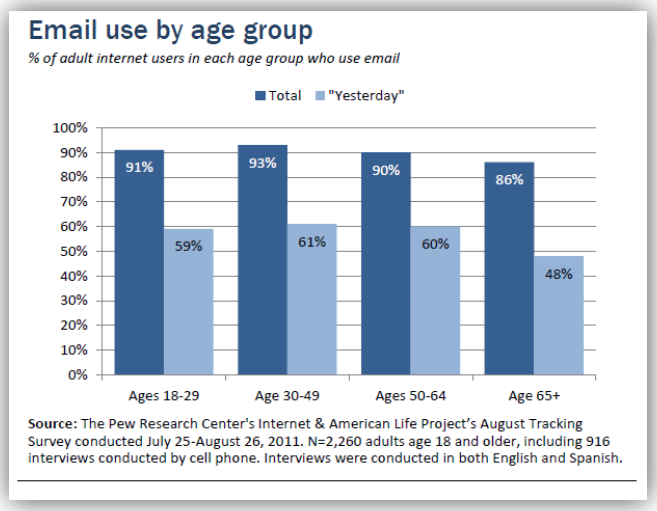


Figure 9: Email use by age group

Source: Pew Research Center

Besides socializing, email is also used as a medium of online communications for this age group. This is especially used to keep in touch with family and friends across the country. Figure 9: Email use by age group shows that the email usage had increased by 30% which was 60% to 90% now. The usage of email had grown even much more as compared to the usage of social networking sites.

This proves that once given training, tools for using the internet and exposure, they are very willing to use this technology and are now a frequent user of the Internet.

2.7 Usefulness of Technology to Delay Dementia

According to Thompson, Andrea, a study suggests that surfing or searching through the Internet might be a boost to the brain for middle aged and older adults. The study found out that adults that are engaged in web surfing activities had registered activities with areas of the brain that is responsible for decision making and complex reasoning. During web surfing, the surfer will need to make decision on what to click on which stimulates brain reasoning.

Besides surfing the internet, playing video games such as Nintendo DS is also another method that can delay Dementia. The Telegraph reports: 'The latest research will be seen as further proof that so-called "brain training" machines, such as the Nintendo DS advertised by Nicole Kidman, can help to delay brain decline."

Furthermore, Gamerzpedia stated that "Dr. Cay Anderson-Hanley, of Union College, Schenectady, New York, stated that those, who used a bike equipped with a virtual reality display, experienced a 23% reduction in progression to mild cognitive impairment compared to those who used a simple bike. He acknowledged that video games could build-up a person's mental and physical strength". The study done by Dr Cay Anderson-Hanley found out that adults that are engaged in cyber-cycling achieved more cognitive benefits as compared to adults that are engaged in normal exercises.

Lastly, Carlton Senior Living stated that a study done by the University of Illinois found that there is a significant improvement found in older adults for switching between tasks and increased performance in memory tests that are avid players of video games.

In a nutshell, the factors that affect Dementia includes lifestyle, hypertension, diabetes mellitus, stroke, required for diagnosis, moderate consumption of wine, silent infarctions on neuroimaging, reduced thyroid-stimulating hormone, hypercholesterolemia, hyperhomocysteinemia, depression, high fat diet, high omega 3 fatty acid./fish in diet, smoking, occupation (manual work), medications, vaccinations, exposure to toxins and other miscellaneous factors. When an individual is retired, the retirement is likely to cause an increase in cognitive decline after an individual no longer engage in cognitive activities. The popular phrase "use it or lose it" by Connors, Jimmy suggests where a person can delay or prevent normal cognitive aging or they might just lose it. It is proven that mental exercises are able to enhance cognitive variables. The increasing amount of older adult's involvement and receptiveness in technology further proves that these adults are more open-minded and receptive towards new technology. Lastly, based on usefulness of technology to delay Dementia, it is possible to encourage them to perform brain exercises using a smartphone.

CHAPTER 3

METHODOLOGY

3.0 METHODOLOGY

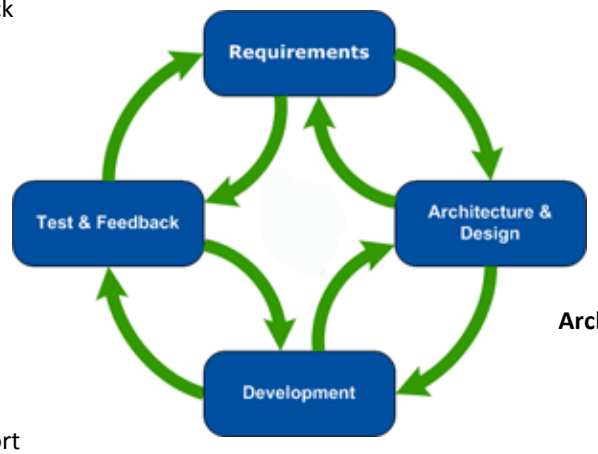
3.1 Research Methodology

Testing:

- Obtaining feedback
- Testing of functionality

Requirements:

- Gathering requirements
- Market research
- Analysis of data



Development:

- Development of application
- Preparation of report

Architecture & Design:

- Design of user interface
- Design of game flow

Figure 10: Agile Software Development Methodology Source: Managed Mayhem (2009)

The methodology used to complete this application is agile software development methodology. Refer to **Figure 10: Agile Software Development Methodology Source: Managed Mayhem (2009).**

The agile software development methodology refers to a group of software development methodologies which based on iterative development, where requirements and solutions are obtained through collaboration between self-organizing cross-functional teams. Agile software development processes are built based on iterative development.

Agile processes receive feedback rather than just merely planning to develop the project which then evolves over a period of time. The main reason for using this methodology is because it is difficult to truly get the requirements from the target market before the development of the application.

The project is divided into 4 main parts.

I. Requirements Gathering

It starts with the requirements stage where the requirements are gathered on what problem that the target market is facing. Mental exercises and brain exercises are researched to obtain more insight in this area.

II. Architecture and Design

The project then moves over to Architecture and Design. The technology needed and interface design for the user interface of the application will be determined. Suitable colors, font size and font type need to be determined so that the application will be user friendly as the target market consists of retirees. Overly complicated instructions must be avoided with minimal number of steps. The flow of the game also needs to be designed and determine before the development.

III. Development

In Development, the project will focus on the development of the application in the area of coding.

IV. Testing and Feedback

The last phase is testing where the functionalities are tested. Objectives of project will be assessed to determine whether the aim of project is met at completion of project. If there are any changes occurred in any of the phases, the activities will then interchange among themselves.

3.2 Project Activities

I. Thinking aloud

The method of thinking aloud allows us to understand how the users approach the application. During the test procedure the users are asked to verbalize and describe their thoughts, feelings while using the application. The main advantage of this method is a better understanding of the user's thoughts towards the application.

II. Questionnaires

Questionnaires are used to gather data and to conduct a quantitative analysis of results.

III. Qualitative interviews

Interviews are conducted to further ask the participants of testing for their feedback and comments towards the application.

3.3 Key Milestones

Table 1: Key Milestones FYP1 shows the key milestones of Final Year Project that had been completed.

Key Milestones	Dates
Selection of Topic	Week 1
Submission of Proposal	Week 3 – 6th June 2012
Submission of Extended Proposal	Week 6 – 27th June 2012
Proposal Defense	Week 10 – 25th July 2012
Interim Report	Week 12 – 9th August 2012

Table 1: Key Milestones FYP1

For Final Year Project 2, refer to Table 1: Key Milestones **Table 2: Key Milestones FYP2**

Key Milestones	Dates
Submission of Progress Report	Week 4 (10th October 2012)
Pre-Sedex	Week 8 (28th November 2012)
Dissertation	Week 11 (26th November 2012)
Proposal Defense	Week 12 (5th December 2012)
Final Dissertation	Week 14 (19th December 2012)

Table 2: Key Milestones FYP2

3.4 Gantt Chart

Figure 11: Gantt Chart for FYP1 shows the Gantt Chart for this first phase project. Tasks for Final Year Project I had been completed the previous semester while tasks for this semester are shown in **Figure 12: Gantt Chart for FYP2.** Tasks marked in yellow color are tasks that are planned while green color marks completed tasks.

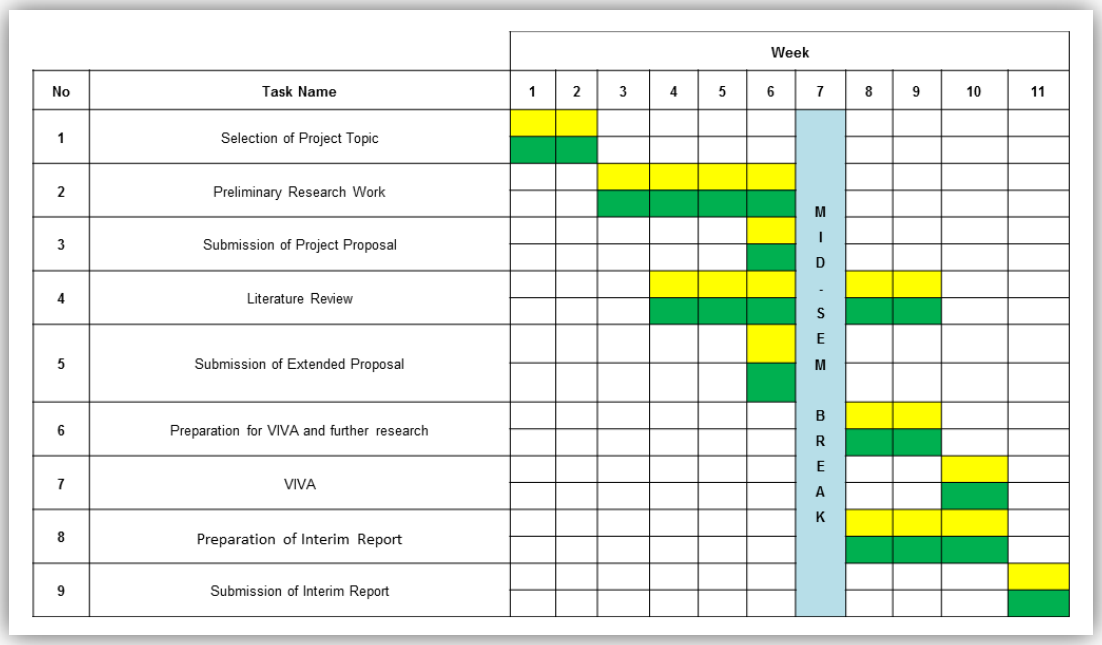


Figure 11: Gantt Chart for FYP1

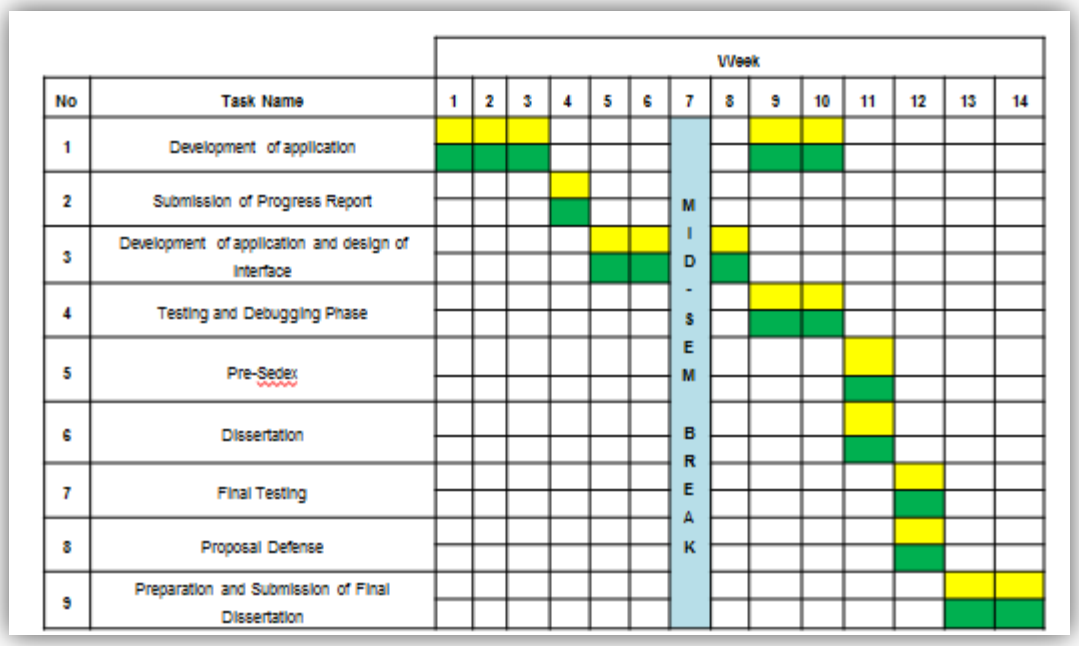


Figure 12: Gantt Chart for FYP2

3.5 Tools

3.5.1 MIT App Inventor

The programming software that is needed to develop this application is MIT App Inventor which is simple and interactive platform to develop any android Application. To develop the application, I would then need to familiarize myself with the programming language.

3.5.1 Android phone or tablet

To perform testing whether the application meets all the requirements such as user friendliness, ease of use, efficiency and effectiveness, an android phone or tablet is needed.

3.5.2 Adobe Photoshop

Adobe Photoshop is needed for designing interface and images purposes.

3.5.3 Paint

Paint is needed for editing purposes.

3.5.4 Laptop

Laptop is needed for developing and design purposes.

CHAPTER 4

RESULTS AND DISCUSSION

4.0 RESULTS AND DISCUSSION

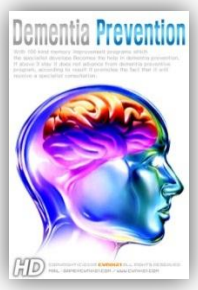
4.1 Data Gathering and Analysis

4.1.1 Survey on existing Brain exercises/ Games

Survey was conducted to survey the types and variation of brain exercise games available on Android and IOS platform. Refer **Error! Reference source not found.**

Survey is also conducted to survey the available online websites that offers games for brain exercises. Their strengths and weaknesses are compared. Refer to **Error! eference source not found.**

TABLE 3: Survey on Dementia application available on Android and IOS platform

Platform	Android (Google Play)	IOS (iTunes)
Name of application	-	Dementia Prevention
Price	-	$8.99
Description	-	- 100 types of memory improvement program - Only cater for memory enhancement
Application interface	-	 Figure 13: Dementia Prevention App Screen Shot (a) Source: CYNIX21 from iTunes  Figure 14: Dementia Prevention App Screen Shot (b) Source: CYNIX21 from iTunes

Several online games are available for senior adults. Games that only focus on senior adults are being included here.

TABLE 4: Survey on Online Games Websites for Adults

Name	Online Games for Seniors	Lumosity, reclaim your brain.
Link	http://onlinegamesforseniors.com/	http://www.lumosity.com Features: - Need to register an online account before start - Needs to answer a set of questions so that the program can be catered according to results of the user
Strengths	- Various types of games available (9 categories) - Games description is available - Number of times played is available - Attractive and large fonts	- Games are catered according to needs - Caters for speed, memory, attention, flexibility, problem solving - Reminders to continue program via email notification - Comfortable and user friendly interface
Weaknesses	- Too much unnecessary advertisements in the website - Distracting advertisements	- Requires an online account - Need to purchase to unlock full access

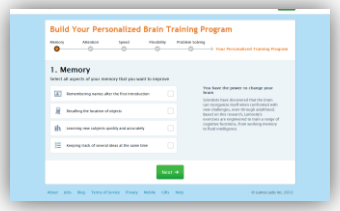
Application interface	 Figure 15: Online Games 1 Landing Page *Source:* http://onlinegamesforseniors.com/  Figure 16: Online Games 1: Weirdtris *Source:* http://onlinegamesforseniors.com/play/weirdtris/ 	 Figure 19: Online Games 2 Landing Page *Source:* http://www.lumosity.com/  Figure 20: Online Games 2 Landing Page *Source:* http://www.lumosity.com/ 

Figure 17: Online Games 1: Weirdtris Interface *Source:* http://onlinegamesforseniors.com/play/weirdtris/

Figure 18: Online Games 1: Weirdtris Game Interface *Source:* http://onlinegamesforseniors.com/play/weirdtris/

Figure 21: Online Games 2 Questionnaire Landing Page *Source:* http://www.lumosity.com/app/v4/personalization/surveys/training-program/survey_categories/your-memory/user_survey_responses/new

Figure 22: Online Games 2: Memory Matrix *Source:* http://www.lumosity.com/app/v4/current_training_session

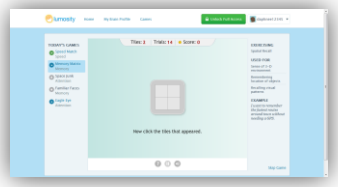


Figure 23: Online Games 2: Memory Matrix Game Interface *Source:* http://www.lumosity.com/app/v4/current_training_session

4.1.2 Survey on Design Considerations Based on Cognitive Aging

Nowadays, most application are designed by young developers where the design tend to be more towards the younger generation instead of the universal users as a whole. Poor designs can make searching the Web twice harder for seniors according to Nielsen. Thus, the design done must cater for all users of all age groups as a whole. There are a few factors that need to be taken in consideration while designing for devices or machines to be used by aging adults. Refer to

.

TABLE 4: Design Consideration for Aging Adults

Aspect	Design Consideration	Suggested method to overcome
Impairment	Auditory impairment - Auditory based interfaces may not be appropriate to users with hearing impairments	- Limit amount of spoken amount - Easily remembered instructions
	Visual impairment - Graphical user interfaces may not be appropriate to visually impaired users,	- Different colors for different pages to allow users to know where are their location.
	Limited mobility	- Design for devices that are wireless or handheld devices that gets the task done without much movement is required.
Mental Issues	Dementia - Complicated games and instructions may not be appropriate.	- Implementation and design of systems that are intuitive and feel 'natural'. - Instructions must be simple and easy to learn.

4.1.3 Survey on Learning Behavior of Aging Adults

Devices such as smart phones were generally designed for younger target market. Current mobile devices or handheld devices are designed with small buttons and screens that are more sophisticated. The designs are mostly derived from computers where younger generations might be at ease of using such devices since they are already familiar on operating a computer. Several graphical user interface (GUI) considerations are taken into consideration in designing games for the older people to cater for their learning behaviors. Refer to

.

TABLE 5: GUI Considerations in Designing Games for Aging Adults

Area of Interface	Learning Behavior
Navigation	Aging adults are unsure of where they should go in a game. i.e. they do not know the story line or process flow of a particular game.
Feedback	Participants do not expect to receive feedback for certain actions they make in a game Participants do not know what to respond towards the feedback. Participants do not know the significance of the feedback given by the game.
Interfaces	Older players prefer it to be standardized instead of too complicated because they need to take time to familiarize them with it.
Game Design	Older players do not understand objectives of games such as collecting points, weapons etc. It is better to design games that mirror daily activities for novice players.

4.2 Data Collection and Results on Application Testing

User testing is conducted to obtain their feedback and perception towards the application after the prototype of the application completed. The testing was conducted with towards 8 selected adults aged between 40-80 years old.

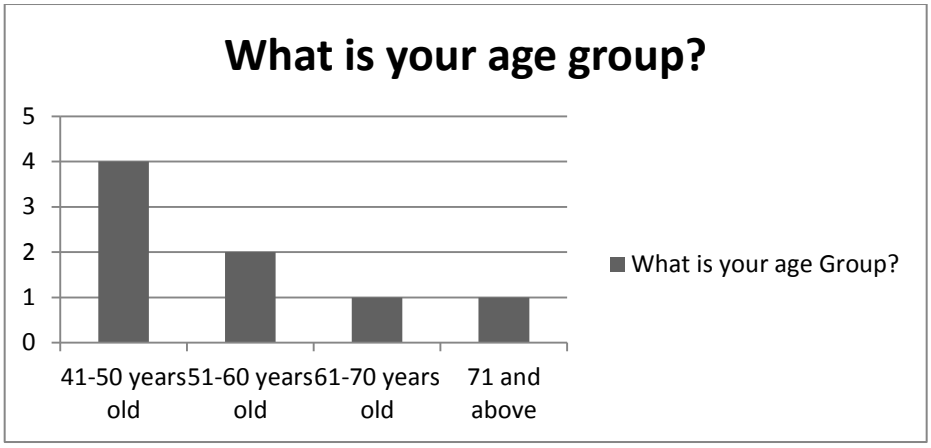


Figure 24: Graph of User Age Group

Graph of User Age Group shows the age group of the participants involved for the prototype testing. There are 4 users aged between 41-50 years old, 2 users aged between 51-60 years old, 1 user aged between 61-70 years old and 1 user aged 71 years old and above.

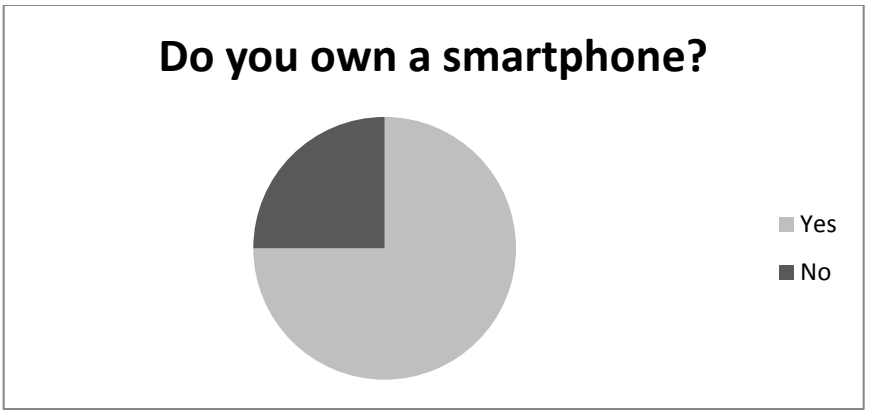


Figure 25: Graph for ownership of smartphone

Graph for ownership of smartphone shows that ¾ of the users own a smartphone. Thus, age is not a factor for them to not own a smartphone.

For the following analysis, Scale 1 represents the lowest score while Scale 5 represents the highest score.

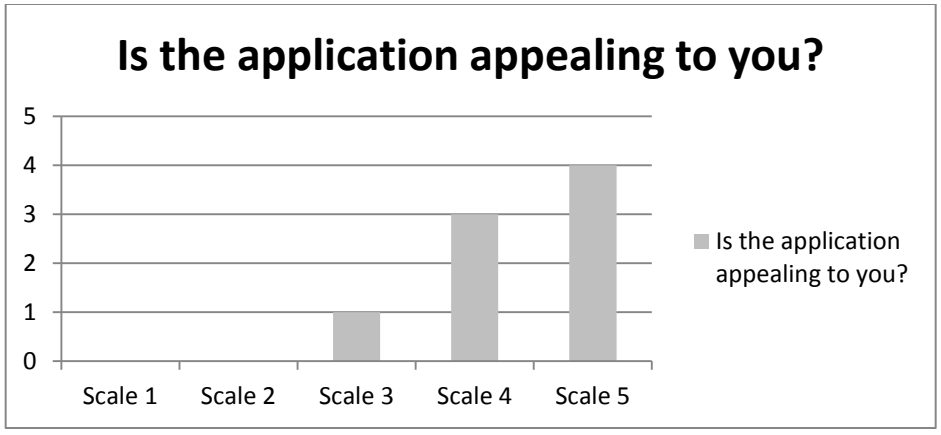


Figure 26: Graph for application appeal to user

Graph for application appeal to user shows that majority of the participants of user testing found that the application is very attractive and appealing towards them. “A very interesting and attractive application”, said Grace, 52 years old. Only 1 user gave a scale of 3 out of 5.

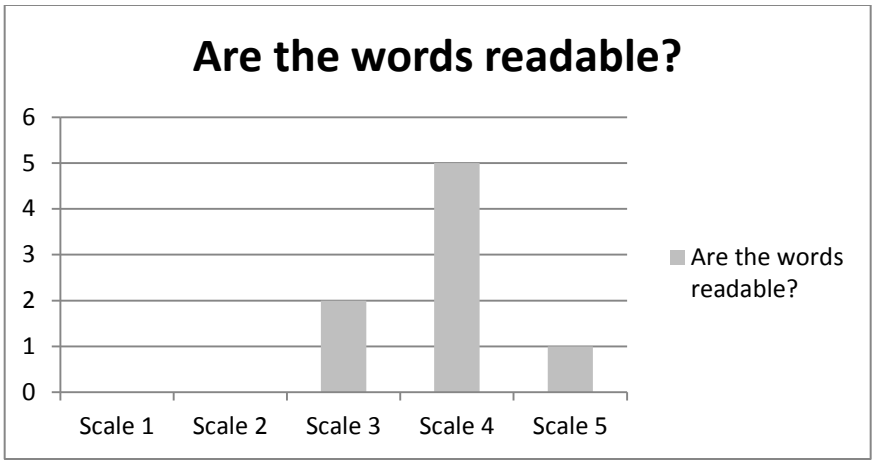


Figure 27: Graph for Application readability

Graph for Application Readability shows that most of the users rated a 4 for the application readability. Two users rated a 3 and another user rated a 5. In general, the application is readable for the user though 2 of them find it a bit difficult to read. This might due to astigmatism.

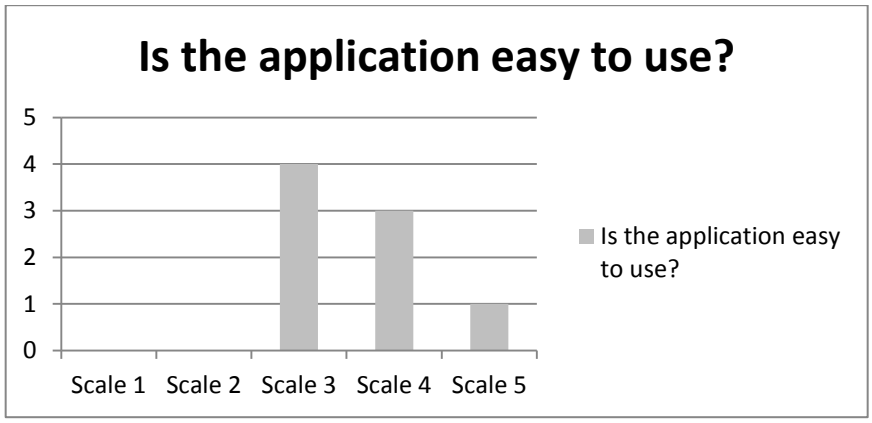


Figure 28: Graph for Ease of Use

Graph for ease of use shows that majority of the users rated a scale 3 for this aspect. This maybe some of the users do not have much exposure to playing games in their smartphone before. 3 users rated a scale 4 while one user has a full rating of 5.

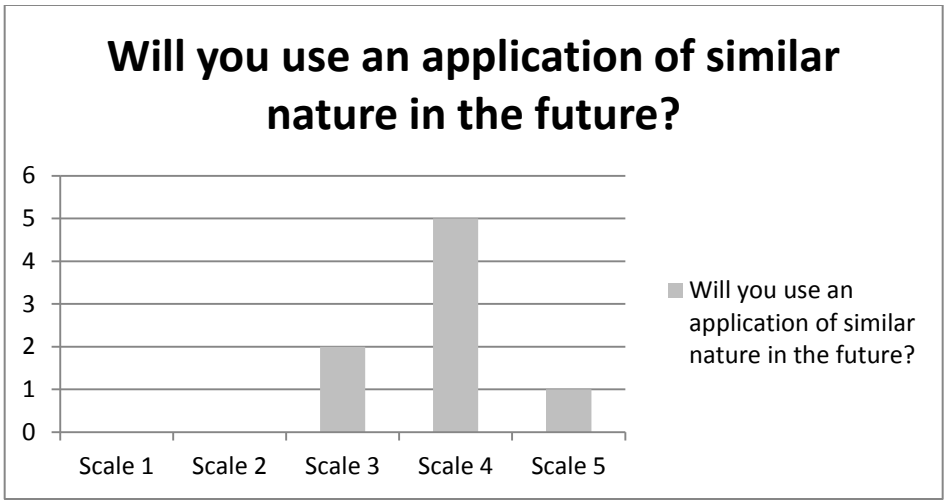


Figure 29: Graph of User's Perspective

Graph of user's perspective shows that the users are all very willing to use an application of similar nature in the future. Most of them rated a scale 4, while 2 users gave a scale 3 and 1 user gave a scale 5. Thus, an application of similar nature has a good opportunity in the future.

4.3 Flowchart of Application

The category for Guess the Word and Play with Numbers uses the similar flowchart as shown below.

The questions for the game are being coded in sequence because the game encourages the user to memorize the answers so that they are able to complete the game within the time limit.

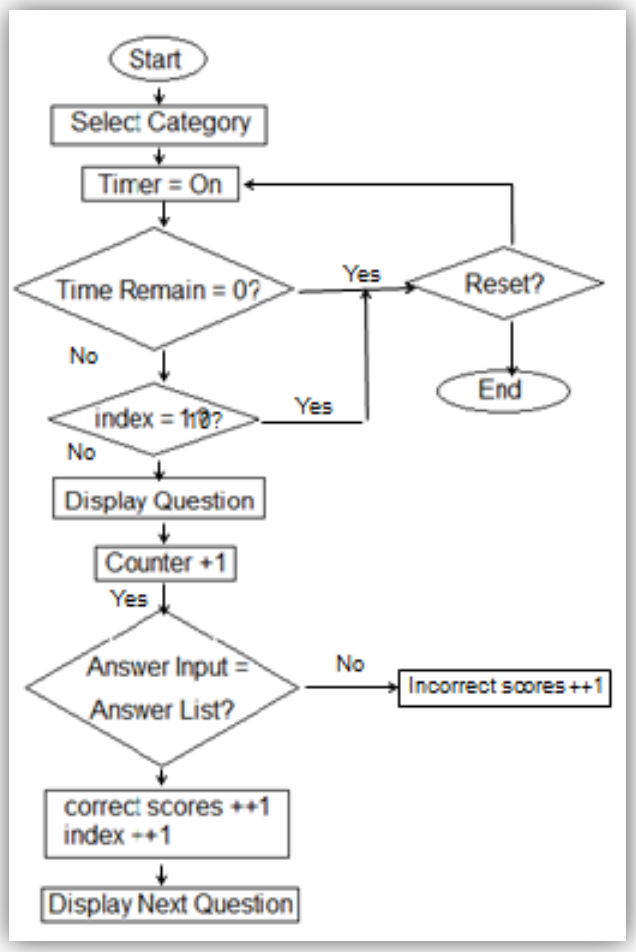


Figure 30: Application Flowchart

4.4 Application Prototype Interface

1. After the user selects the app icon in the smartphone, they will be landed on the splash screen.
2. After 5 seconds, the splash screen will be directed to the menu screen.

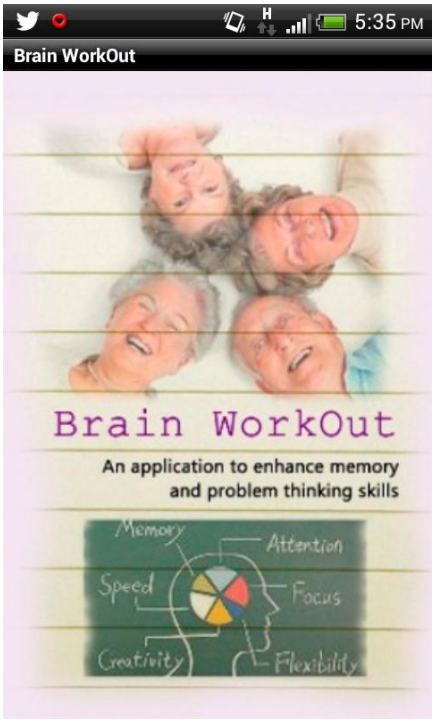


Figure 31: Splash Screen for BW

Figure 32: Menu screen for BW

3. There are 3 selections in the menu.
    - Start – The user can select the games
    - About Me – Information on the application
    - Exit – Exit from the application

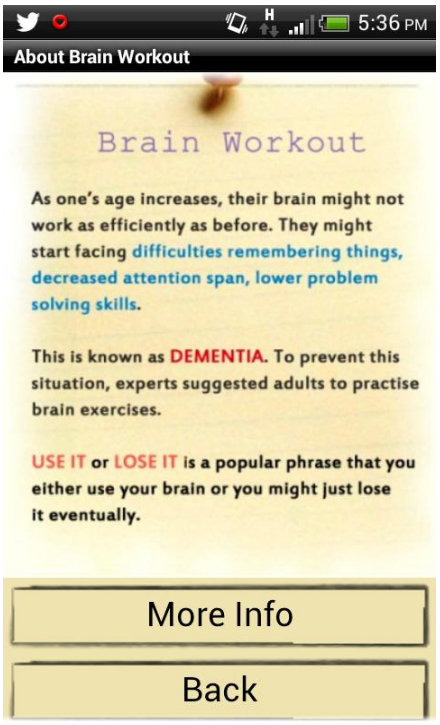


Figure 33: More Info Screen for BW

Figure 34: About Me Screen for BW

Figure 35: Games Selection Screen for BW

Figure 36: Exit Alert for BW

4. If Guess the Word is selected, the user will be directed to the category screen.
5. There will 4 categories for Guess the Word.
    - Animals
    - Common Food
    - Fruits
    - Vegetable
6. How to play instructions are also available.

Figure 37: Guess the Word Category Screen

Figure 38: How to Play for Guess the Word

7. If the user selects;
    - Animal, the user will be directed to the Animals Screen.
    - Common Food, the user will be directed to the Common Food Screen.
    - Fruits, the user will be directed to the Fruits Screen.
    - Vegetable, the user will be directed to the Vegetable Screen.
8. Time limit for each category is 60 seconds. If the time is up, user is not allowed to submit their answer, they can either RESET to replay the category or press Back to play another category.

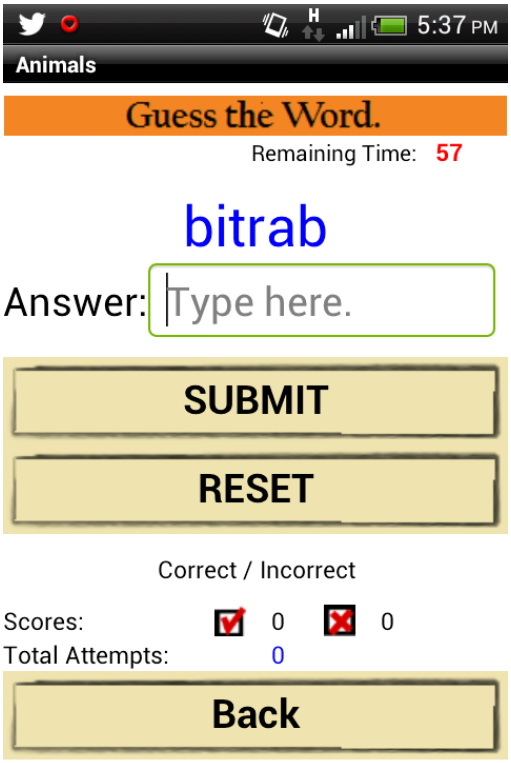


Figure 39: Guess the Word (Animals Category)

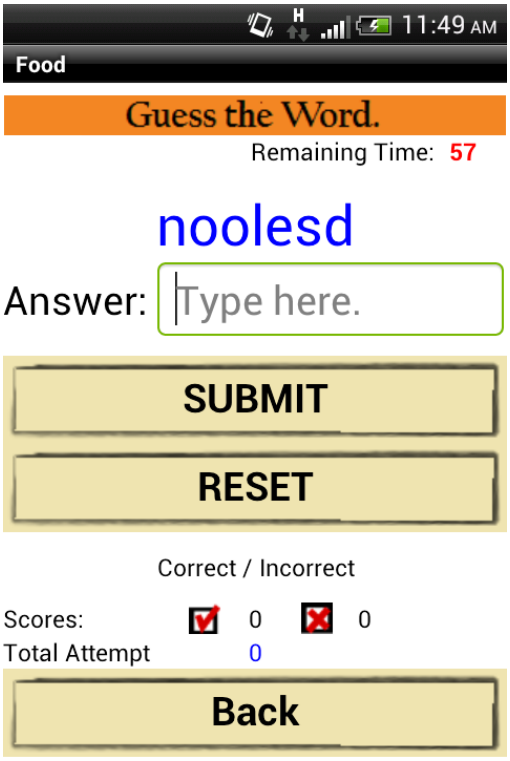


Figure 40: Guess the Word (Food Category)

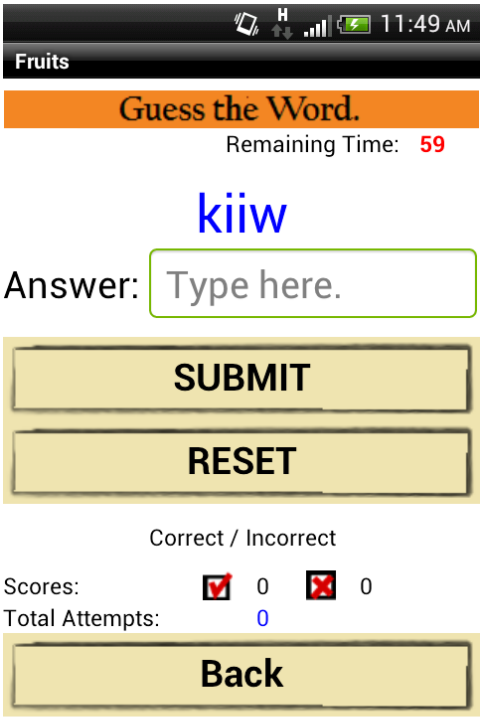


Figure 41: Guess the Word (Fruits Category)

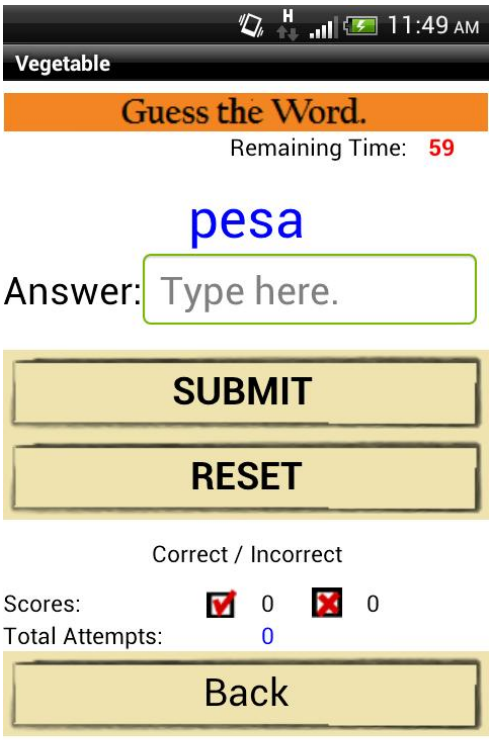


Figure 42: Guess the Word (Vegetable Category)

9. If Play with Numbers is selected, the user will be directed to the category screen.
10. There will 5 categories for Play with Numbers.
    - Addition
    - Subtraction
    - Addition and Subtraction
    - Multiplication
    - Division
11. How to play instructions are also available.

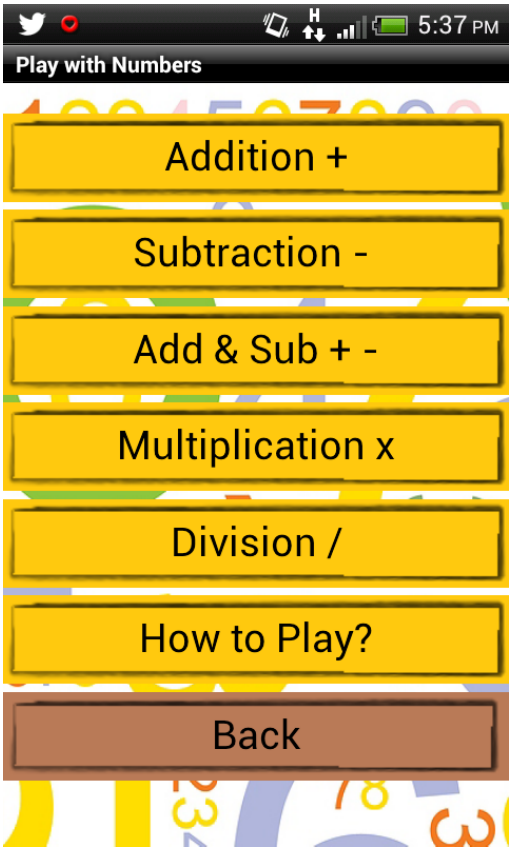


Figure 43: Play with Numbers Category Screen

Figure 44: How to Play for Play with Numbers

12. If the user selects;
    - Addition, the user will be directed the Addition Screen.
    - Subtraction, the user will be directed to the Subtraction Screen.
    - Subtraction and Addition, the user will be directed to the Addition and Subtraction Screen.
    - Multiplication, the user will be directed to the Multiplication Screen.
    - Division, the user will be directed to the Division Screen.

13. Time limit for each category is 30 seconds. If the time is up, user is not allowed to submit their answer, they can either RESET to replay the category or press Back to play another category.

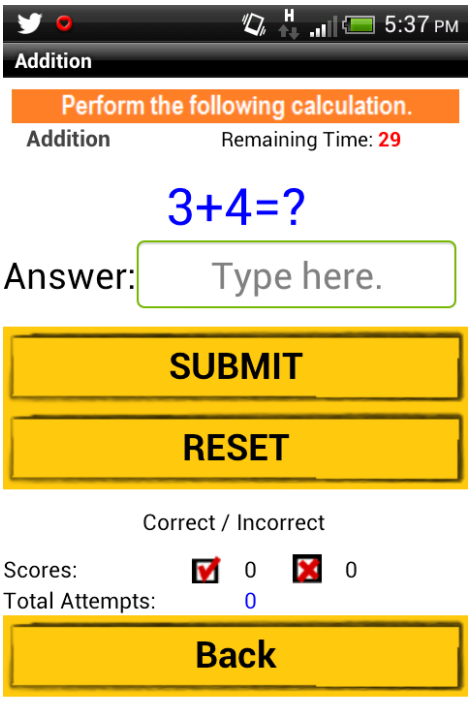


Figure 45: Play with Numbers (Addition Category)

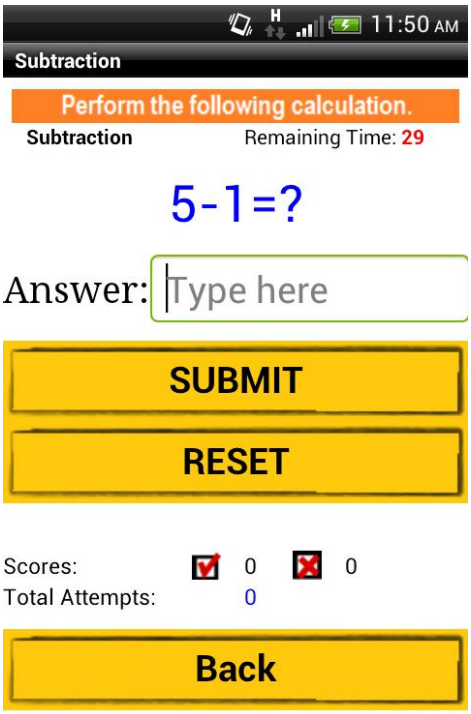


Figure 46: Play with Numbers (Subtraction Category)

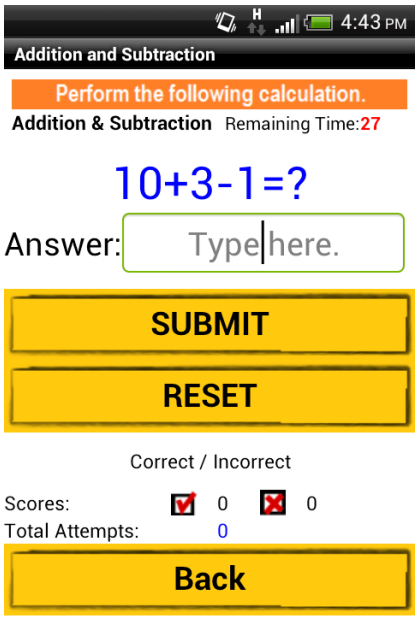


Figure 47: Play with Numbers (Add Sub Category)

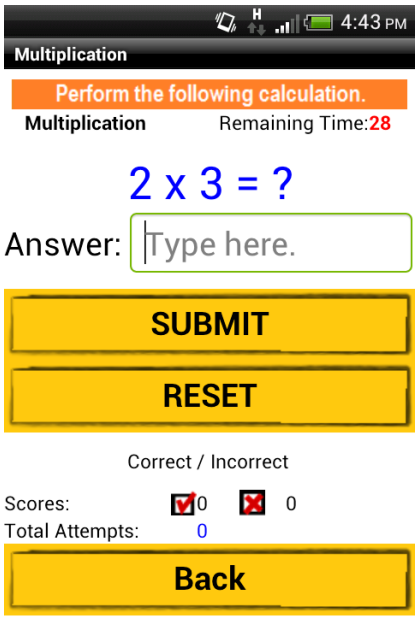


Figure 48: Play with Numbers (Multiplication Category)

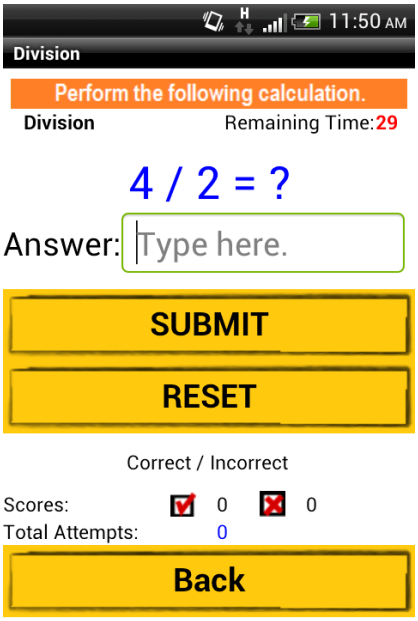


Figure 49: Play with Numbers (Division Category)

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 CONCLUSIONS AND RECOMMENDATIONS

Relevancy to the Objectives

As life expectancy increases, people nowadays have a longer life living with the advancement of social benefits and a better medical assistance. The age of retirement also decreases as more people choose to work less and enjoy life at an earlier age. Retirement which is one of the factors of Dementia development causes an individual to develop the illness earlier when they no longer remain active in their daily activities as before. They face a cognitive decline which might then lead to Dementia.

There are several of methods to prevent or delay Dementia which include mental exercises. Mental exercises such as puzzles and crosswords are proven to be able to able to enhance cognitive development. It is also advised that the retirees practice a healthy lifestyle and also including exercise routines into their daily activities besides doing brain exercises to further slowdown the development of Dementia. Learning a new language or picking up a new hobby are also some method to stimulate the brain.

Thus, Brain Workout is an application in the form of brain exercise that focuses on memory and problem thinking skills. By the end of the project, the completion of the projects hopes to achieve the following objectives:

- ✓ To conduct a survey of brain exercise games available.
- ✓ To study the design considerations for aging adults.
- ✓ To survey aging adults perception towards such application.
- ✓ To develop an application that is simple to use with minimal instructions.

Smartphone are gaining its popularity among all age group. Therefore, developing a Android mobile application that encourages mental exercise to slow down or prevent Dementia possible. To further enhance the project, puzzles games and strategy games can be included so that the application will be a complete set of brain exercises. Hopefully, this application will be able to delay or prevent development of Dementia.

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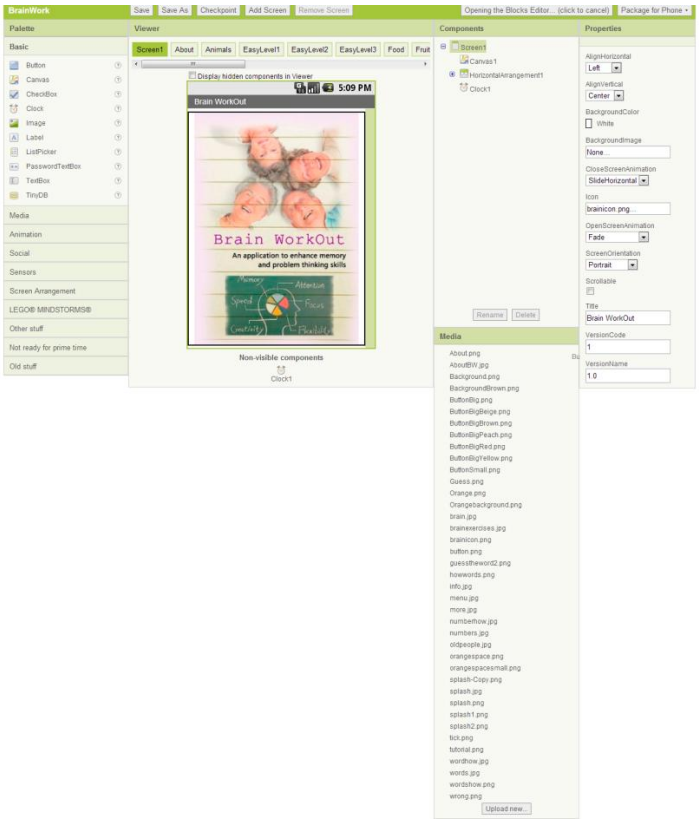
[2] Online Games for Seniors Retrieved: 5 August, 2012, from http://onlinegamesforseniors.com/

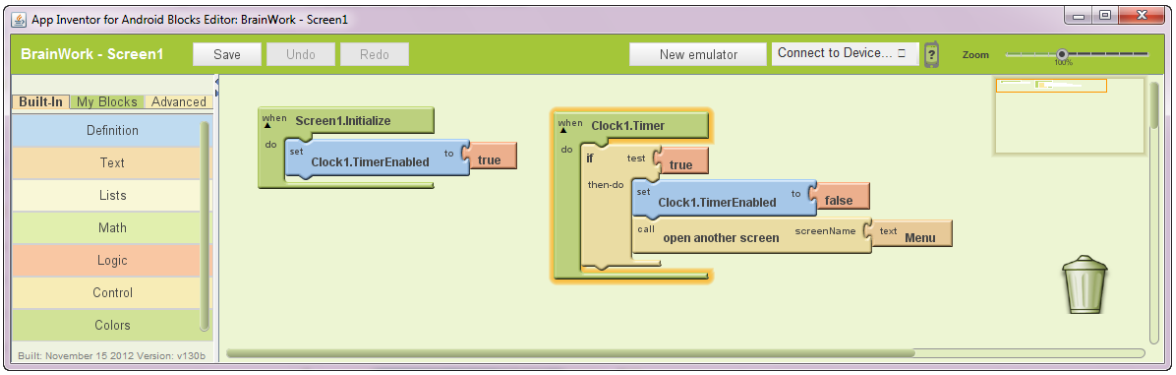
APPENDICES

Application Code

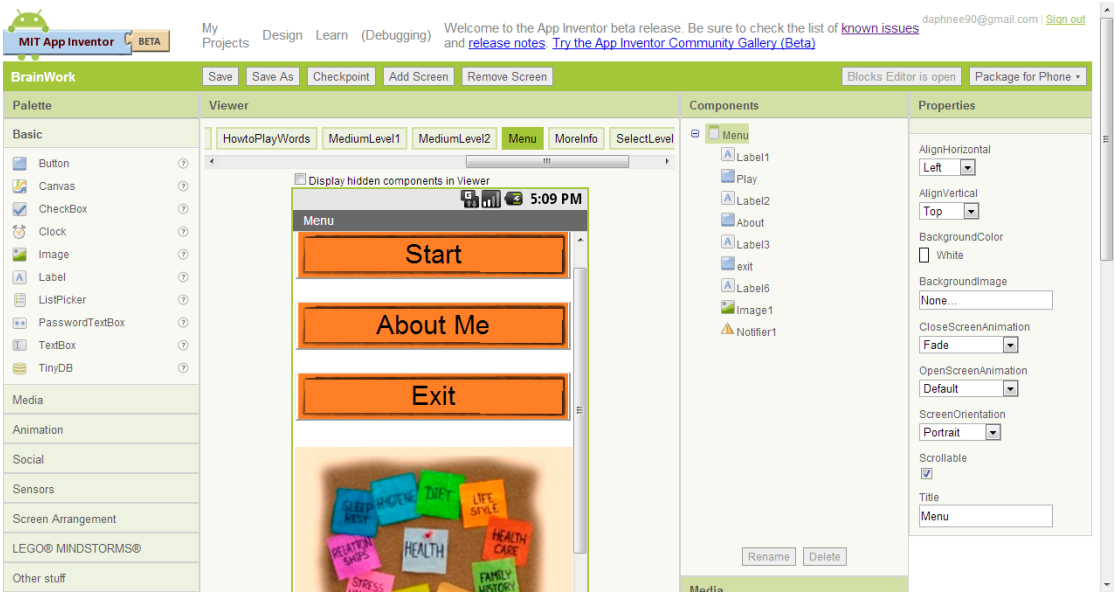
The application was coded in MIT App Inventor and Blocks Editor.

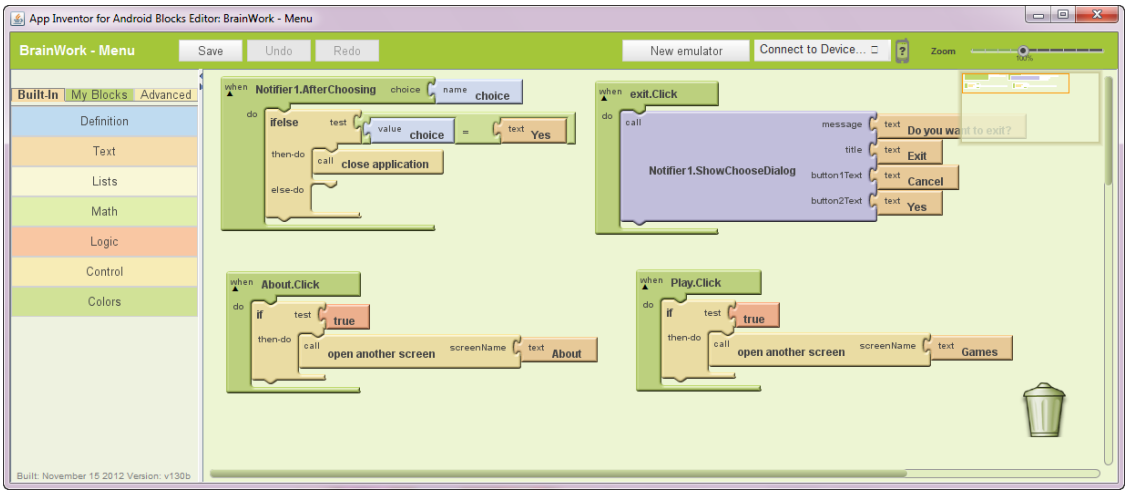
1. Splash Screen



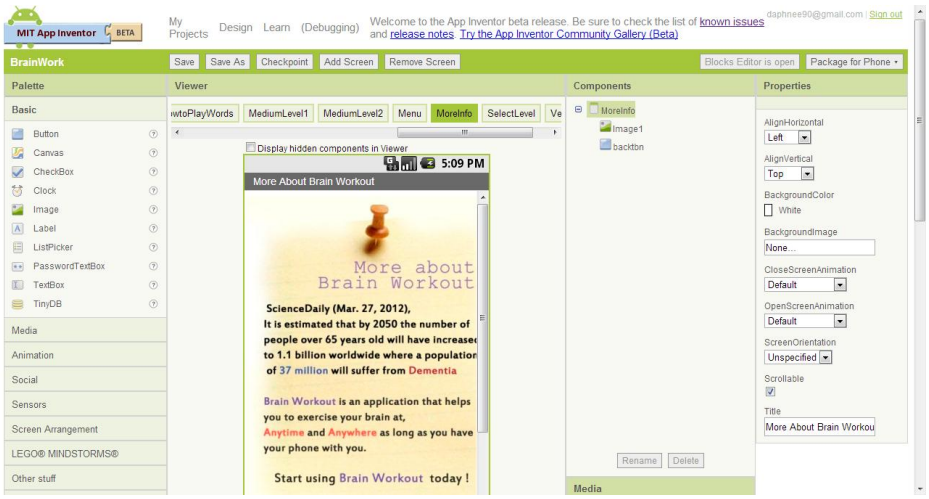


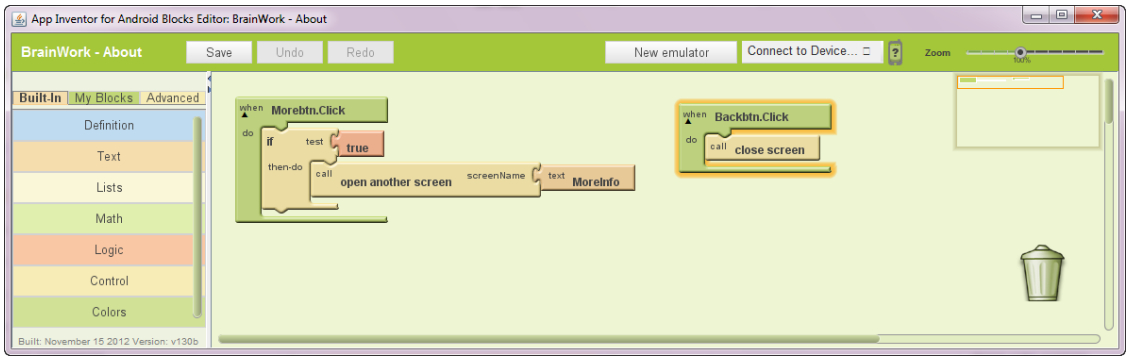
2. Menu screen

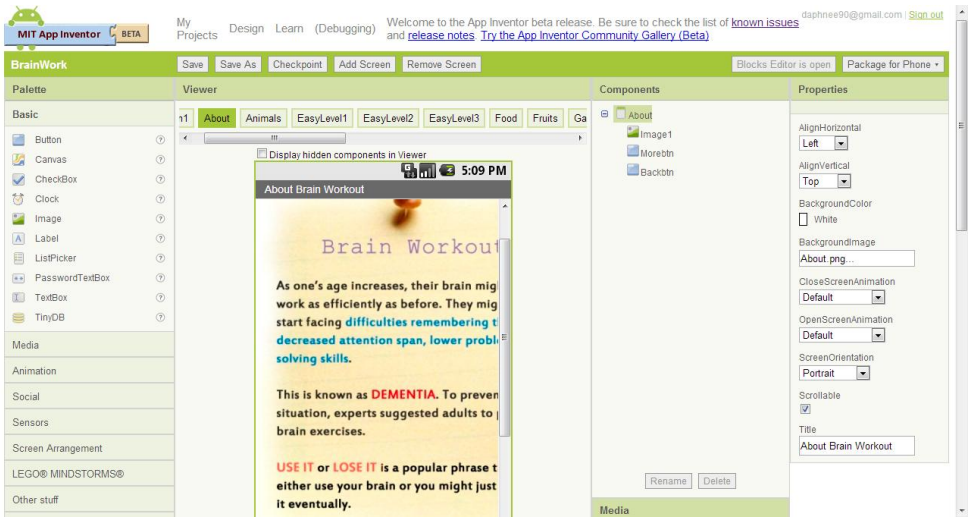


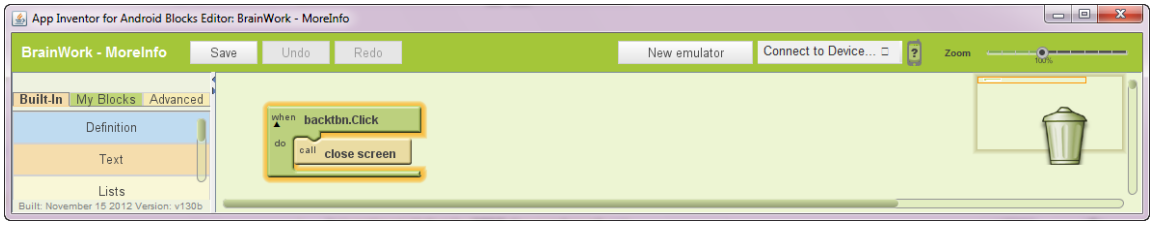


3. About Me Screen

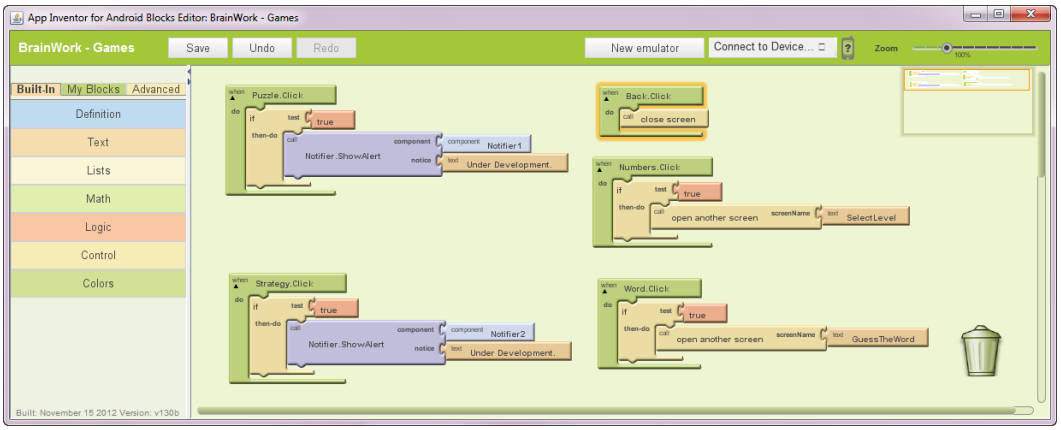



App Inventor for Android Blocks Editor: BrainWork - About
BrainWork - About
Save
Undo
Redo
New emulator
Connect to Device...
Zoom
Built-In
My Blocks
Advanced
Definition
Text
Lists
Math
Logic
Control
Colors
when Morebtn.Click
do
if
test
true
then-do
call
open another screen
screenName
text
MoreInfo
when Backbtn.Click
do
call
close screen
Built: November 15 2012 Version: v130b

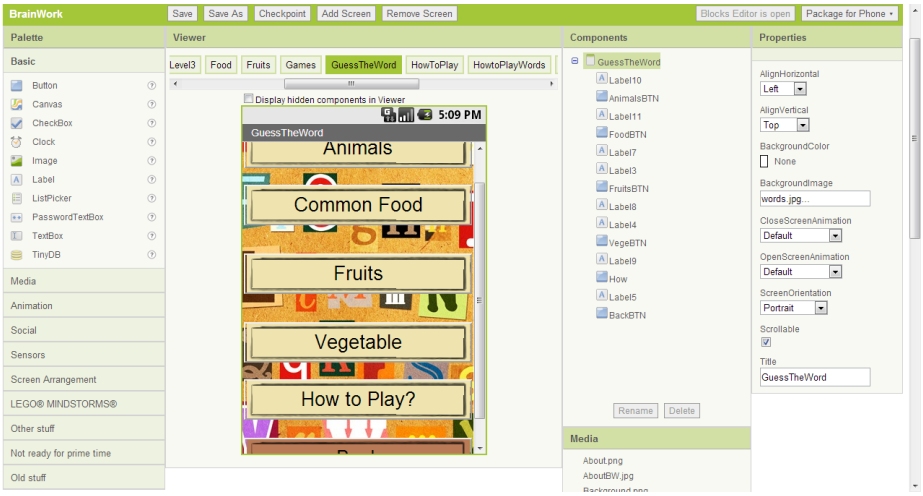

MIT App Inventor
BETA
My Projects
Design
Learn
(Debugging)
Welcome to the App Inventor beta release. Be sure to check the list of known issues and release notes. Try the App Inventor Community Gallery (Beta)
daphnee90@gmail.com | Sign out
BrainWork
Save
Save As
Checkpoint
Add Screen
Remove Screen
Blocks Editor is open
Package for Phone
Palette
Basic
Button
Canvas
CheckBox
Clock
Image
Label
ListPicker
PasswordTextBox
TextBox
TinyDB
Media
Animation
Social
Sensors
Screen Arrangement
LEGO® MINDSTORMS®
Other stuff
Viewer
About
Animals
EasyLevel1
EasyLevel2
EasyLevel3
Food
Fruits
Display hidden components in Viewer
5:09 PM
About Brain Workout
Brain Workout
As one's age increases, their brain mig
work as efficiently as before. They mig
start facing difficulties remembering t
decreased attention span, lower probl
solving skills.
This is known as DEMENTIA. To preven
situation, experts suggested adults to
brain exercises.
USE IT or LOSE IT is a popular phrase t
either use your brain or you might just
it eventually.
Components
About
Image1
Morebtn
Backbtn
Rename
Delete
Media
Properties
AlignHorizontal
Left
AlignVertical
Top
BackgroundColor
White
BackgroundImage
About.png...
CloseScreenAnimation
Default
OpenScreenAnimation
Default
ScreenOrientation
Portrait
Scrollable
Title
About Brain Workout

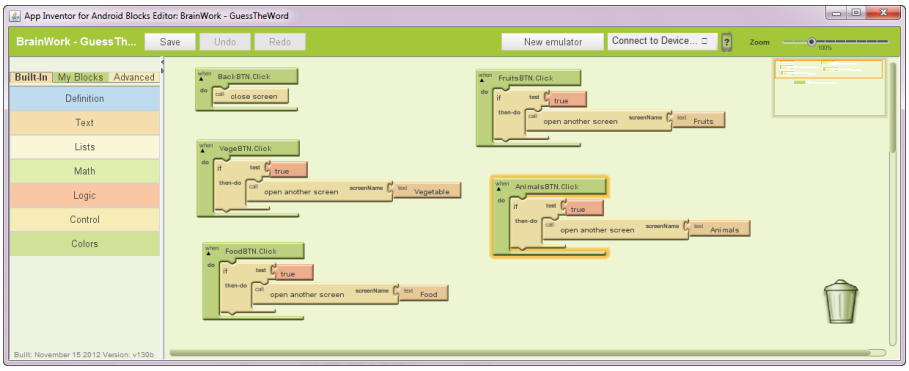

App Inventor for Android Blocks Editor: BrainWork - MoreInfo
BrainWork - MoreInfo
Save
Undo
Redo
New emulator
Connect to Device...
Zoom
Built-In
My Blocks
Advanced
Definition
Text
Lists
when backbtn.Click
do
call
close screen
Built: November 15 2012 Version: v130b

4. Select Game Screen

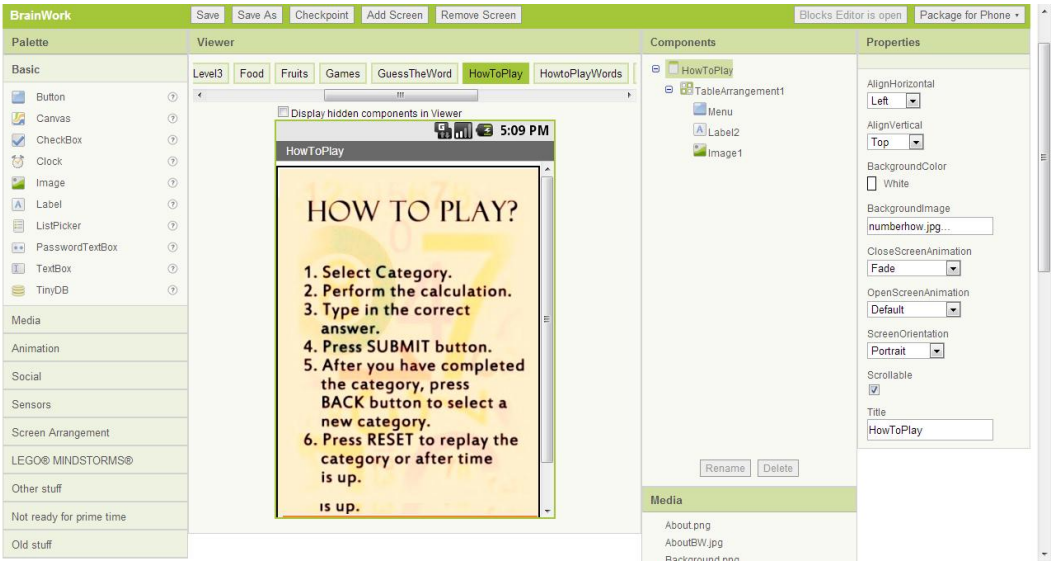


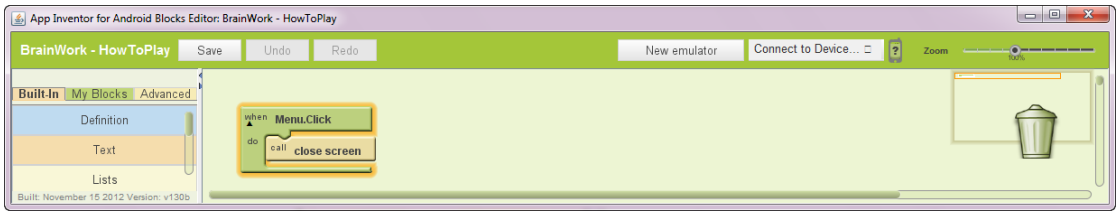
5. Guess The Word Category Screen





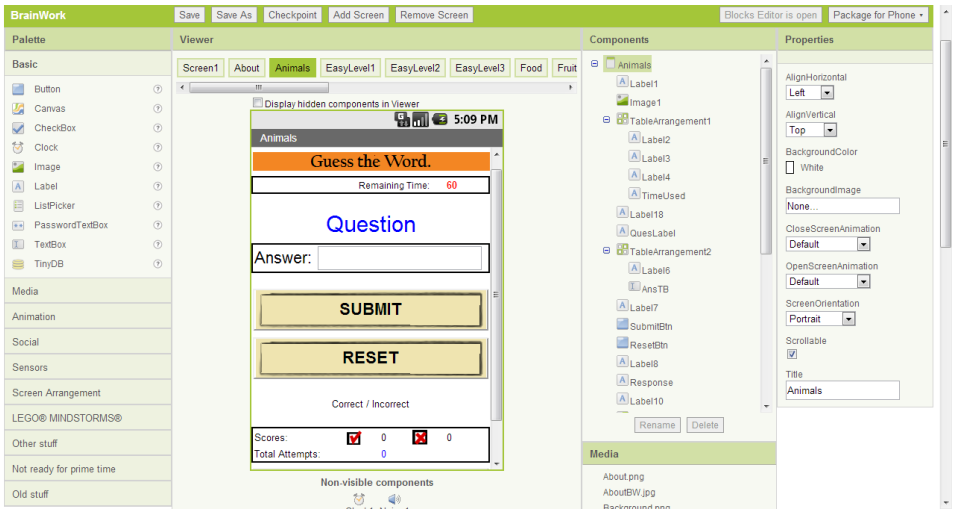
6. Guess The Word (How to Play Screen)

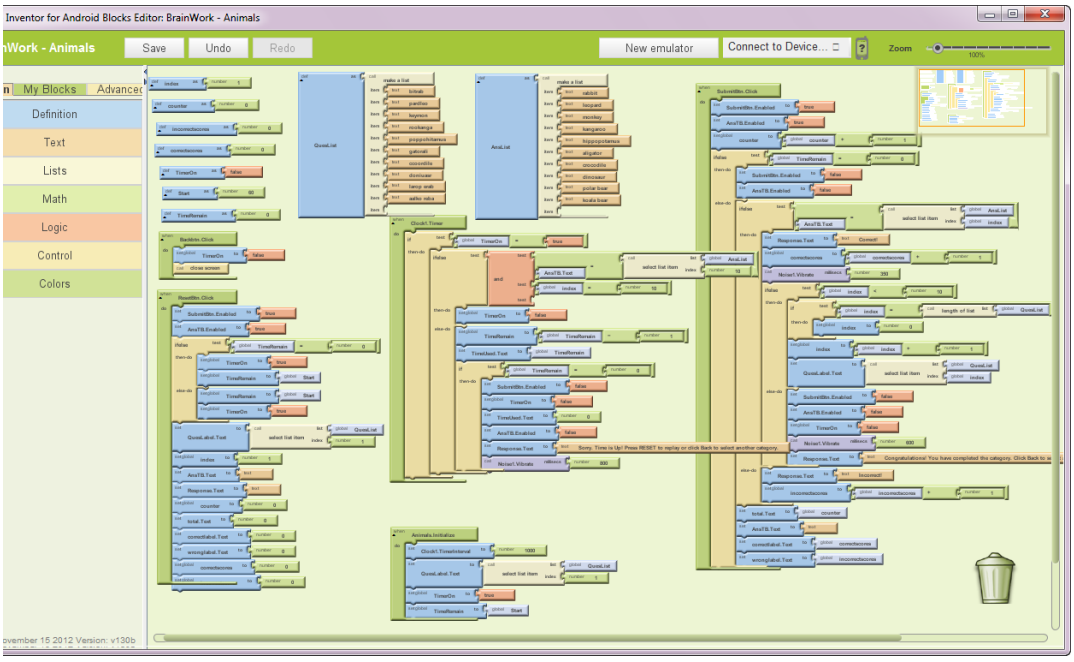




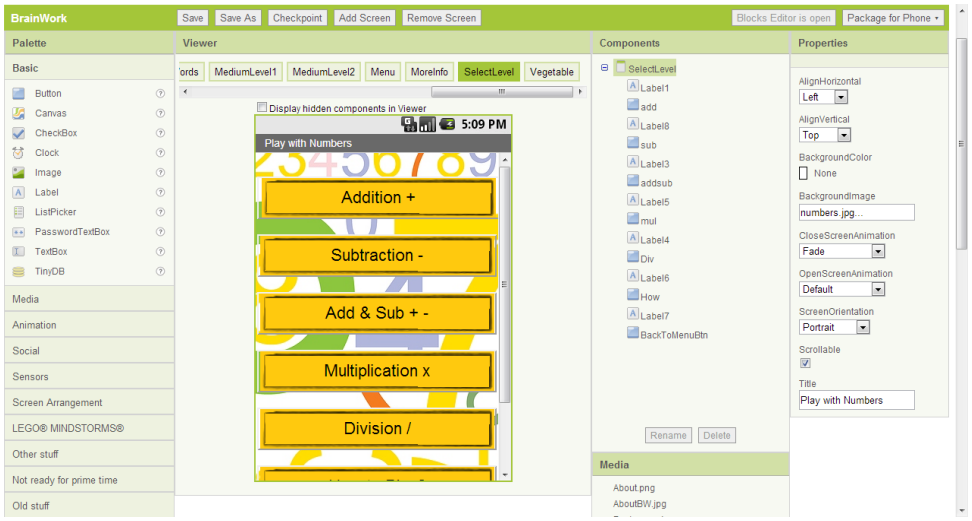
7. Animals Category Screen

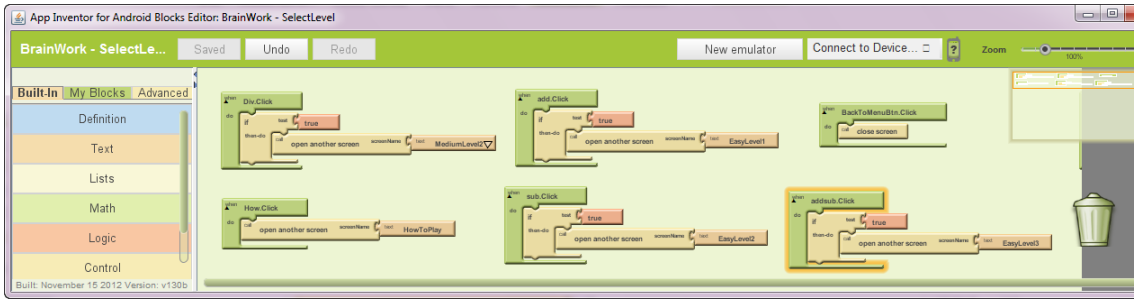
All category screens for Guess the Word are similar. Only the question varies.



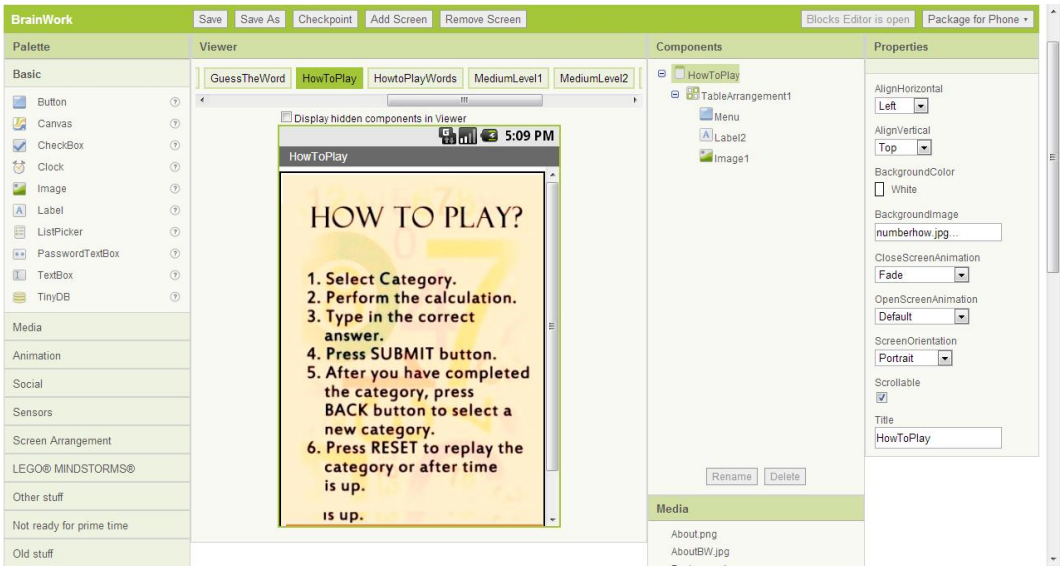


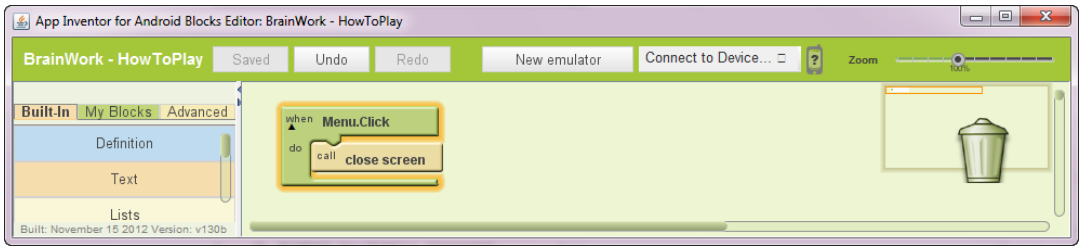
8. Play With Numbers Category Screen





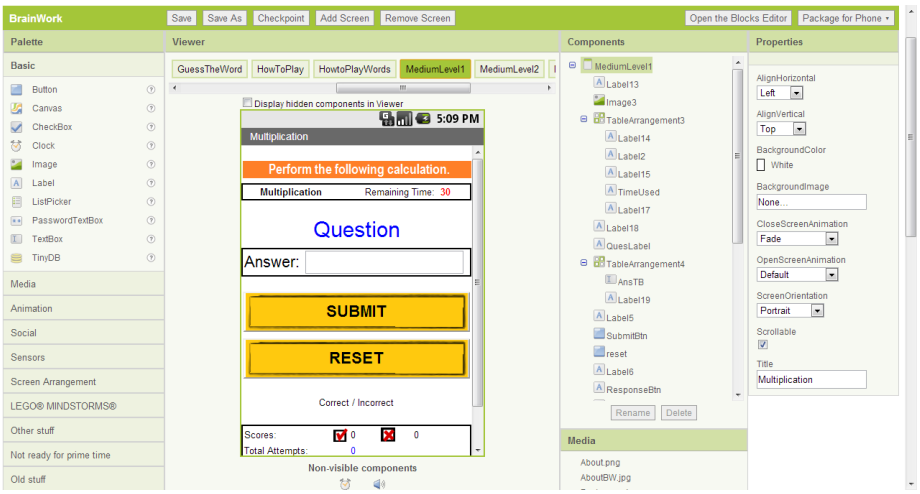
9. Play With Numbers (How to Play Screen)

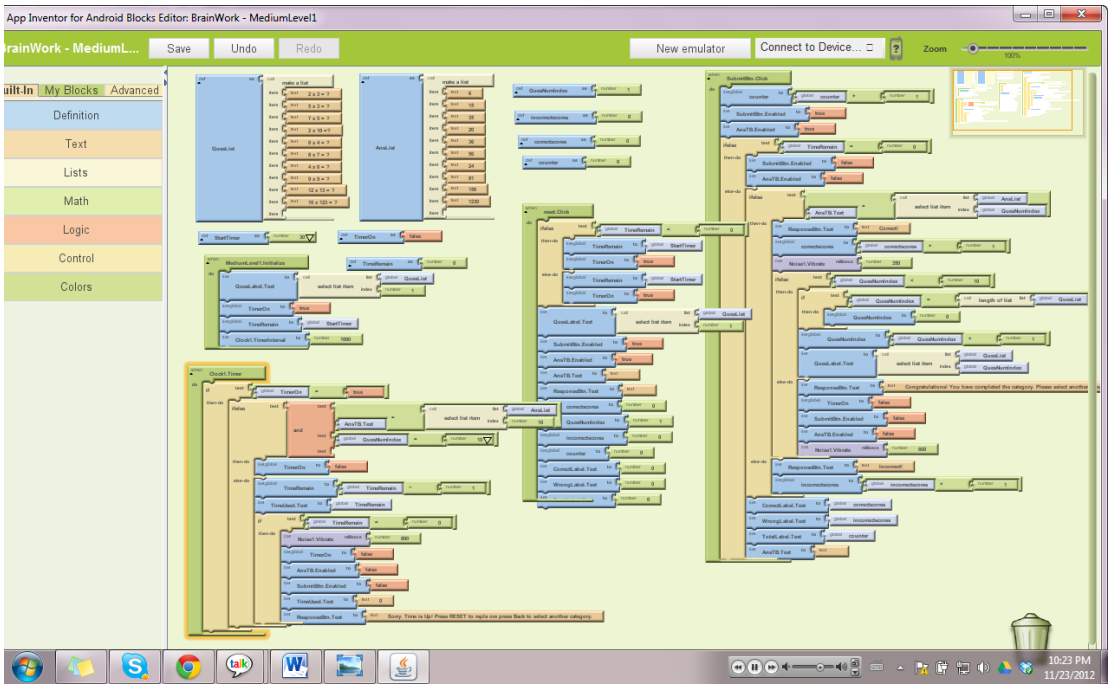




10. Multiplication Category Screen

All category screens for Play with Numbers are similar. Only the question varies.


BrainWork
Save
Save As
Checkpoint
Add Screen
Remove Screen
Open the Blocks Editor
Package for Phone
Palette
Basic
Button
Canvas
CheckBox
Clock
Image
Label
ListPicker
PasswordTextBox
TextBox
TinyDB
Media
Animation
Social
Sensors
Screen Arrangement
LEGO® MINDSTORMS®
Other stuff
Not ready for prime time
Old stuff
Viewer
GuessTheWord
HowToPlay
HowtoPlayWords
MediumLevel1
MediumLevel2
Display hidden components in Viewer
5:09 PM
Multiplication
Perform the following calculation.
Multiplication
Remaining Time: 30
Question
Answer:
SUBMIT
RESET
Correct / Incorrect
Scores:
Total Attempts:
Non-visible components
Components
MediumLevel1
Label13
Image3
TableArrangement3
Label14
Label2
Label15
TimeUsed
Label17
Label18
QuesLabel
TableArrangement4
AnsTB
Label19
Label5
SubmitBtn
reset
Label6
ResponseBtn
Rename
Delete
Media
About.png
AboutBW.jpg
Properties
AlignHorizontal
Left
AlignVertical
Top
BackgroundColor
White
BackgroundImage
None...
CloseScreenAnimation
Fade
OpenScreenAnimation
Default
ScreenOrientation
Portrait
Scrollable
Title
Multiplication


App Inventor for Android Blocks Editor: BrainWork - MediumLevel1
Save
Undo
Redo
New emulator
Connect to Device...
Zoom
My Blocks
Advanced
Definition
Text
Lists
Math
Logic
Control
Colors
10:23 PM
11/23/2012

Brain Workout Prototype Testing Feedback Form * Required

1. What is your age group? *

- 41-50 years old
- 51-60 years old
- 61-70 years old
- 71 and above

2.Do you own a smartphone? *

- Yes
- No

Application Feedback

This section is related to application testing.

3. Is the application appealing to you? In terms of color selection and design. *

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

4. Is the application easy to use? *

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

5. Are the words readable? *

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

6. Will you use application of similar nature in the future? *

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

7. Comments