

Project No. 28

Project 150: Rhythm Action Arcade Game

Presented by

1. Mr. Jitprasert Chunghanacharoen 55070503404
2. Mr. Napat Wongchurairat 55070503479

Advisor

Assoc. Prof. Natasha Dejdumrong, Ph.D.

“I’ve read and approved the content of this report”

.....

(.....)
Advisor



Project 150: Rhythm Action Arcade Game

Mr. Jitprasert Chunghanacharoen

Mr. Napat Wongchurairat

A Project Submitted in Partial Fulfillment of the Requirements

For the Degree of Bachelor of Engineering

Department of Computer Engineering, Faculty of Engineering

King Mongkut's University of Technology Thonburi

Academic Year 2015

Project 150: Rhythm Action Arcade Game

Mr. Jitprasert Chungthanacharoen

Mr. Napat Wongchurairat

A Project Submitted in Partial Fulfillment of the Requirements

For the Degree of Bachelor of Engineering

Department of Computer Engineering, Faculty of Engineering

King Mongkut's University of Technology Thonburi

Academic Year 2015

Project Committee

..... Advisor
(Assoc. Prof. Natasha Dejdumrong, Ph.D.)

..... Committee
(Asst. Prof. Nuttanart Facundes, Ph.D.)

..... Committee
(Dr.-Ing Priyakorn Pusawiro)

..... Committee
(Khajonpong Akkarajitsakul, Ph.D.)

Project Title	Project 150: Rhythm Action Arcade Game
Project Credit	3 credits
Project Participant	Mr. Jitprasert Chungthanacharoen Mr. Napat Wongchurairat
Advisor	Assoc. Prof. Natasha Dejdumrong, Ph.D.
Co-Advisor	-
Degree of Study	Bachelor's Degree
Department	Computer Engineering
Academic Year	2015

Abstract

Project 150 is a Rhythm Action Arcade Game running on arcade platform. The game is equipped with brand-new gameplay that have never existed before. Project 150 tries to enhance skills of sense coordination and concentration of player. And at the same time, being a potential game-service provider in the game market. As the game is an arcade game, it means that players have to pay or insert coins to play. This will challenge players in survivability.

In the game, player will play the role of music creator and mixer. The game has no specific story, but offers variety of songs and challenges for player to beat and develop themselves to be a master of senses and music. Variety of songs provided by the games are ranged from eye catching genre like pop music to mental rocking songs like electronics or rock songs. Creating diversity in song selection choice.

Acknowledgement

This project cannot be a success without helps from many sources. The first and the most important help is from Assoc. Prof. Dr. Natasha Dejdumrong, the advisor of this project, who provided us with essential knowledge, helpful suggestions, and comments from the very first step of this project to the very last. So that in the end, we can finish this project smoothly. Even it means that she will have to share her time, she is willing to do it, we feel so thankful.

Next, we need to thank our university, King Mongkut's University of Technology Thonburi that provide us working space, that without whom, we cannot carry out this project.

Furthermore, we need to grant our special thanks to these people that help shaping this project of us into success. The first person is Mr. Thanik Sitthichoksakulchai, one of our friend who helped us in giving advices in programming and hardware. Second is Team SIAKON, a group of people who provides important resources, which are songs that are used in the game. Third is the group of testers that participated in testing our project prototype and giving useful feedbacks.

Last is our parents, who are consistently giving both physical and emotional supports. Without them whom we might possibly give up on this project. For many people that are not mentioned here, we are so thankful for your kind support.

Table of Contents

	Page
Chapter 1 Introduction	1
1.1 Problem Statement and Approach	1
1.2 Objectives	1
1.3 Scope	2
1.3.1 Scope Description	2
1.3.2 Acceptance Criteria	2
1.3.3 Deliverables for the 1 st Semester	2
1.3.4 Deliverables for the 2 nd Semester	3
1.3.5 Exclusions	3
1.3.6 Potential Benefit	3
1.4 Tasks and Schedule	4
1.4.1 Task Breakdown	4
1.4.2 Schedule	5
Chapter 2 Background, Theory and Related Research	7
2.1 Rhythm/Music Game	7
2.2 Arcade Game	8
2.3 Literature Review of Music Games	9
2.4 Unity 5 Game Engine	13
2.5 Arduino	13
2.6 BPM	13
2.7 Offset	13
2.8 Isometric	13
Chapter 3 Design and Methodology	14
3.1 General Requirements	14
3.1.1 Platform	14
3.1.2 System Requirements	14
3.1.3 Gameplay Requirements	14
3.1.4 Data Access Requirements	14
3.1.5 Database Requirements	14
3.2 Use Case Analysis	15
3.2.1 Use Case Diagram	15
3.2.2 Use Case Narrative	16
3.3 High Level System Architecture Design	20

3.4 Game Design	21
3.4.1 Summary	21
3.4.2 Gameplay	21
3.4.3 Mindset	21
3.4.4 Potential	22
3.5 Technical Design	24
3.5.1 Game Flow	24
3.5.2 Controls	28
3.5.3 User Interfaces, Screens Layout and Navigation	30
3.5.4 Mode Design	39
3.5.5 Mechanics	39
3.5.6 Database Design	46
3.6 Hardware Design	47
3.6.1 Controller	47
3.6.2 Cabinet	51
3.6.3 Software Integration	52
3.7 Graphics	56
3.8 Sound and Music	57
3.9 Software Prototype Evaluation	58
3.10 Hardware Prototype Evaluation	58
Chapter 4 Results and Discussion	59
4.1 Results	59
4.1.1 Game Software Prototype	59
4.1.2 Controller Prototype	61
4.1.3 Official Software	63
4.1.4 Final Machine	69
4.2 Functionality	70
4.2.1 Software Functionality	70
4.2.2 Software Prototype	70
4.2.3 Software Prototype Evaluation	70
4.2.4 Hardware Functionality	78
4.2.5 Hardware Prototype Evaluation	79
4.2.6 Cabinet Evaluation (Integrated Prototype)	83
Chapter 5 Conclusion	92
5.1 Project Conclusion	92
5.2 Project Evaluation	92

5.3	Problems Encountered and Resolves	92
5.3.1	Technical Problem	92
5.3.2	Cooperation Problem	93
5.3.3	External Problem	93
5.4	Project Expectations	93
5.5	Future Plan	93
5.6	Project's Benefits	94
5.7	Project's Status	95
References		96
Appendix A User's Experience Evaluation		97
Software Prototype Evaluation		98
Controller Prototype Evaluation		100
Cabinet Evaluation		101

List of Figures

Figure	Page
Figure 2-1 Music Game Example.....	7
Figure 2-2 Arcade Pinball Machine.....	8
Figure 2-3 Dance Dance Revolution Logo.....	9
Figure 2-4 Dance Dance Revolution Gameplay.....	10
Figure 2-5 Dance Pad	10
Figure 2-6 Guitar Hero Logo.....	11
Figure 2-7 Guitar Hero Gameplay.....	12
Figure 2-8 Guitar Hero Guitar Controller	12
Figure 2-9 Unity Supported Multiplatform	13
Figure 3-1 Use Case Diagram	15
Figure 3-2 System Architecture Diagram.....	20
Figure 3-3 Sample Gameplay with Notes	21
Figure 3-4 Maslow's Hierarchy of Needs.....	22
Figure 3-5 Arcade Mode User Flow (1)	24
Figure 3-6 Arcade Mode User Flow (2)	25
Figure 3-7 Arcade Mode System Flow (1)	26
Figure 3-8 Arcade Mode System Flow (2)	27
Figure 3-9 PC Prototype Keyboard Control.....	28
Figure 3-10 Sample Gameplay Screen	28
Figure 3-11 Real Machine Controller Button Planning.....	29
Figure 3-12 Screen Sequence Chart	30
Figure 3-13 Title Screen Layout.....	31
Figure 3-14 Login Screen - No ID Card Accessed.....	32
Figure 3-15 Login Screen - ID Card Accessed.....	32
Figure 3-16 Mode Selection Screen - Arcade Mode	33
Figure 3-17 Mode Selection Screen - Medley (Technical) Mode	33
Figure 3-18 Song Selection Screen	34
Figure 3-19 Gameplay Screen	35
Figure 3-20 Gameplay Screen with Notes.....	35
Figure 3-21 Result Screen	36
Figure 3-22 Final Result Screen	36
Figure 3-23 Thank You for Playing Screen	37
Figure 3-24 Game Over Screen	38
Figure 3-25 Difficulty Multiplier	40
Figure 3-26 Experience Point in Associated with Grades	40
Figure 3-27 Note Judgement in Associated with Health Regeneration or Reduction	41
Figure 3-28 Mistimed Hit Range.....	42
Figure 3-29 Cumulative Score Proportion	43
Figure 3-30 Note Accuracy and Score Multiplier	43
Figure 3-31 Grades associated with Accumulated Score	45
Figure 3-32 Database Design	46
Figure 3-33 Controller Layout in Inches	47
Figure 3-34 Controller Circuit (1)	48

Figure 3-35 Controller Circuit (2)	48
Figure 3-36 Arduino MEGA Layout	48
Figure 3-37 45 mm Illuminating Flat-Panel Rectangular Push Buttons	49
Figure 3-38 LED.....	49
Figure 3-39 100g Pushbutton Spring.....	50
Figure 3-40 Omron Micro Switch - 25 g Pressing	50
Figure 3-41 32-Inch LED Monitor with Measurements.....	51
Figure 3-42 Draft Cabinet Architecture - Side View & Front View (Inches).....	52
Figure 3-43 Block Diagram shows hardware and software linkage.....	52
Figure 3-44 Linkage of hardware and Start Screen.....	53
Figure 3-45 Linkage of hardware and Mode Selection Screen	53
Figure 3-46 Linkage of hardware and Song Selection Screen	54
Figure 3-47 Linkage of hardware and Gameplay Screen	54
Figure 3-48 Linkage of hardware and Result Screen	55
Figure 3-49 Linkage of hardware and Total Result Screen	55
Figure 3-50 Single Notes.....	56
Figure 3-51 Hold Notes	56
Figure 3-52 FX Notes.....	56
Figure 3-53 Gear.....	57
Figure 3-54 Hit Burst Animation.....	57
Figure 4-1 Game Software Prototype - Start Screen	59
Figure 4-2 Game Software Prototype - Song Selection Screen	59
Figure 4-3 Game Software Prototype – Gameplay Screen (1).....	60
Figure 4-4 Game Software Prototype – Gameplay Screen (2).....	60
Figure 4-5 Game Software Prototype - Result Screen	60
Figure 4-6 Controller Prototype (1).....	61
Figure 4-7 Controller Prototype (2).....	61
Figure 4-8 Official Software - Title Screen	63
Figure 4-9 Official Software - Mode Selection Screen	64
Figure 4-10 Official Software - Song Selection Screen (1).....	65
Figure 4-11 Official Software - Song Selection Screen (2).....	65
Figure 4-12 Official Software - Gameplay Screen	66
Figure 4-13 Official Software - Result Screen	67
Figure 4-14 Official Software - Total Result Screen	68
Figure 4-15 Official Software - Game Over Screen.....	68
Figure 4-16 Final Machine	69
Figure 4-17 Doughnut Chart shows the gender of participants.....	71
Figure 4-18 Doughnut Chart shows age range of participants.	71
Figure 4-19 Bar Chart shows Overall Satisfaction.....	72
Figure 4-20 Bar Chart shows Songs Satisfaction	72
Figure 4-21 Bar Chart Shows Scoring Satisfaction.....	73
Figure 4-22 Bar Chart shows Graphics Satisfaction	73
Figure 4-23 Bar Chart shows Sound Effect Satisfaction	74
Figure 4-24 Bar Chart shows Physical Fun Satisfaction	75
Figure 4-25 Bar Chart shows Mental Fun Satisfaction	75
Figure 4-26 Bar Chart shows Social Fun Satisfaction.....	76
Figure 4-27 Bar Chart shows Fun and Usability Satisfaction	77

Figure 4-28 Doughnut Chart shows the gender of participants.....	79
Figure 4-29 Doughnut Chart shows the age of participants.....	79
Figure 4-30 Bar Chart shows Controller Base Evaluation	80
Figure 4-31 Bar Chart shows Buttons Evaluation	80
Figure 4-32 Bar Chart shows Gameplay Support Evaluation	81
Figure 4-33 Bar Chart shows Health Issue Evaluation	82
Figure 4-34 Doughnut Chart shows the gender of the participants.....	83
Figure 4-35 Doughnut Chart shows the age range of the participants.	83
Figure 4-36 Bar chart shows the satisfaction towards the impression of the cabinet.....	84
Figure 4-37 Bar chart shows the satisfaction toward the usability of the cabinet.....	85
Figure 4-38 Bar chart shows the satisfaction toward the security of the cabinet.	86
Figure 4-39 Bar chart shows the satisfaction toward the health issue of the cabinet.....	87
Figure 4-40 Bar chart shows the satisfaction toward the overall of the game.	88
Figure 4-41 Bar chart shows the satisfaction toward the song in the game.	89
Figure 4-42 Bar chart shows the satisfaction toward the scoring mechanic in the game....	90
Figure 4-43 Bar chart shows the satisfaction toward the graphics in the game.	91

Chapter 1

Introduction

1.1 Problem Statement and Approach

The passionate interest in playing games and game designing has been a strong motivation for the researchers to come up with this game project. Since 20's has been a golden age of game, which its industry has significant growth. Hence, it comes to a need of the researchers to create our own game, the game that we will absolutely love to play. In that case, we are taking our interest in music and integrate it in the process of consideration of our game category. So, this game project will be a "Rhythm Action Game."

Furthermore, the researchers concern about the market of rhythm game. In the present, there are not so many choices of game in this genre for people to choose comparing to other genre of games, like RPG. Not that this genre of game is not popular among people in this decade, but because of the uniqueness of the design of each game made this kind of game does not have much diversity. Also, the way of designing and implementing is complicated. Hence, from all the reasons that have been stated, the researchers can conclude that, aside from creating our own game, the researchers also wanted to increase the diversity of this genre of game in the market and challenge ourselves in designing and implementing this complex genre of game.

Lastly, the project type of this project is "Potential Commercial Product". The project is going to be in the market, making money and compete with other games. So, the contents about designing game to be compatible in competing in the market are important and needed to be considered. For example, the nature of the market, market mechanism and ergonomic design.

1.2 Objectives

The researchers' objectives in doing this project is to create a game that is our own design. The researchers are going to create a "Rhythm Game" or can be called "Music Game" that is our field of interest. The researchers have selected an "Arcade Platform" to be a host platform for this game, means that it will be on a stand-alone big machine, not a console. In developing this game, it is planned that the design will be different from the existing game in the market. The researchers planned to integrated "Isometric Point of View" into the game, which no one has never done it before. So, it will be brand new.

Moreover, the researchers aim to implement this game to have a potential in the real market. The theory of game design that can be referenced for a good design of game will be used in the stage of design to make the game has full potential in its fun. For the machine, "Economic Design" and "Ergonomic Design" will be used to develop the design of machine that will attract people to play and also be user-friendly at the same time.

1.3 Scope

1.3.1 Scope Description

The final result of this project will be a Rhythm Action Arcade Game that can be functioned without fatal errors. The game will be delivering fun and recreation to the users and offering challenges for users to develop themselves according to the aspect that the game proposed.

1.3.2 Acceptance Criteria

The acceptance criteria of this project will be evaluated based on following:

1. Functionality of the Game Software
2. Functionality of the Hardware Controller and Cabinet
3. Usability of the Integrated System
4. User Satisfaction Evaluation

1.3.3 Deliverables for the 1st Semester

1. Game Design

1.1. Gameplay Design

- 1.1.1. Isometric Scenes which will be the base gameplay of this game.
- 1.1.2. Sound and Visual Synchronization System to synchronize between the visual markers that will indicate the right timing of action. At the right timing along the song, the programmed markers must be at the appropriate position.
- 1.1.3. Rhythm of the song and the markers grading system. The system that will synchronize between the programmed markers and rhythm of the song not off-sync more than 300 milliseconds.
- 1.1.4. Scoring and Result Grading System. The system will calculate the result of each play by calculation algorithm and will be displayed as grade ranged from F, D, C, C, B, A, S and SS.
- 1.1.5. Visualization System. The module that will display the Animated Music Video along the song.

1.2. System Design

- 1.2.1. Profile System. The system that will display each player's information. For example, nickname, levels, avatar and so on.
- 1.2.2. Unlocking System. The system that provides unlockable that can be unlocked by achieving specific goals or passing missions.

1.3. Database Design

- 1.3.1. Player's Profile
- 1.3.2. Player's Record
- 1.3.3. Log File

1.4. User Interface Design

- 1.4.1. Start Screen
- 1.4.2. Mode Selection Screen
- 1.4.3. Song Selection Screen
- 1.4.4. Gameplay Screen
- 1.4.5. Result Screen
- 1.4.6. Thank You for playing Screen

1.5. Controller and Cabinet Design

- 1.5.1. Draft Controller Design. Draft for the appropriate controller that will

be suit the gameplay and follow the principle of Ergonomic Design.

1.5.2. Draft Cabinet Design. Cabinet that will attract people to play the game.

The cabinet should be design to be accurate to the physical appearance of target player group. This give the friendly gameplay experience to the player.

2. Prototype

2.1. Gameplay Prototype. The gameplay prototype that can be played using keyboards. The reason to make a prototype first is to test whether the game is fun or not.

1.3.4 Deliverables for the 2nd Semester

1. Design

1.1. Circuit Design

2. Prototype

2.1. Controller Prototype

2.2. Cabinet Prototype

3. Final Product

3.1. Game Software that is developed using the designed written in 1.3.3.

3.2. Controller and Cabinet that is designed to suit with the game software in 1.3.3.

1.3.5 Exclusions

The game will not be implemented to be a cross-platform software. Because the design of the game will require specific hardware controller that cannot be simulated by other platform.

1.3.6 Potential Benefit

1. New type and design of game in the market.
2. Developing sense coordination and concentration.
3. Can reduce the rate of ADHD (short concentration) in kids and teenagers.
4. Enhance skills of some specific job that requires a lot of concentration.
5. Enhance skills of developers in developing big scale software.
6. Enhance skills of developers in designing game.
7. Enhance skills of developers in game programming.
8. Enhance skills of developers in teamwork aspect.

1.4 Tasks and Schedule

1.4.1 Task Breakdown

#	Task	Prerequisite
1	Survey	
2	Design Survey	
3	Conduct Survey	
4	Requirement Analysis	1
5	Concept Development	4
6	Project Proposal	
7	Game Design	6
8	Software Design	
9	Gameplay Design	
10	System Design	
11	Database Design	
12	User Interface Design	
13	Network System Design	
14	Hardware Design	
15	Controller and Cabinet Design	9
16	Implementation	
17	Software Implementation	8
18	Software Test Play	17
19	Test Play Evaluation	18
20	Hardware Implementation	19
21	Testing	16
22	Self-Testing	
23	Location Test	
24	Evaluation	21
25	Feedback Analysis	
26	Conclude the Result	
27	Future Plan	24
28	Future Updates	
29	Business Plan Update	
30	Project Report	

1.4.2 Schedule

1.4.2.1 1st Semester

1.4.2.2 2nd Semester

Chapter 2

Background, Theory and Related Research

2.1 Rhythm/Music Game

Rhythm Games or Music Games [1] are sub-type of an action game. Action games are usually games that challenges physical senses like coordination between eyes and hands are the reaction time. The best example of action game is fighting game that emphasizes players to react when the opponent launched attacks like punches or kicks targeting the player. In the same way, Music Game challenges players to react when the screens dictated actions to be performed by the player according to the rhythm. This type of game usually comes in form of dance simulation or musical instrument simulation. In dance simulation type, the game focused on telling user to dance along navigation on the screen and measure the accuracy of the dance moves to the beat of the song. In musical instrument simulation, there are many types of instrument that have been used as inspiration for this type of music game. For example, guitar, bass, drums, piano and so on. As shown in Figure 2-1, that the game imitates the experience of playing guitars. The aim of this type of game is to have players play the instrument in the time shown on the screens. The screen usually shows the marker that will flow to indicating line for playing the notes of the instrument.



Figure 2-1 Music Game Example

[Source: http://www.videogamer.com/ps4/guitar_hero_live/screenshots.html]

2.2 Arcade Game

Arcade Game [2] is a type of game platform, that is a stand-alone platform without using any existing game platform. This type of game is usually located in public places, like clubs, restaurants or department stores. Arcade Game is a coin-operated game platform. Means that the game can be played only in the condition that the coins have been inserted equal to the designated cost or credit. For example, if a game needs 2 credits, the player has to insert 2 coins. This kind of game is good for entertaining because the player does not play the game alone. There will usually be a crowd of people crowded around and watch the player while playing. The examples of arcade games are such as Pinball Machine as shown in Figure 2-2, Basketball Machine and so on.



Figure 2-2 Arcade Pinball Machine

[Source: <https://www.webuypinball.com/wp-content/uploads/2013/09/monster-bash-pinball-machine-full-view.jpg>]

2.3 Literature Review of Music Games

1. Dance Dance Revolution



Figure 2-3 Dance Dance Revolution Logo

[Source: https://en.wikipedia.org/wiki/Dance_Dance_Revolution]

First Published: 1998

Publisher: Konami

Platform: Arcade, Playstation 1, Playstation 2, Playstation 3, Nintendo Wii, XBOX 360 and iOS

Description:

Dance Dance Revolution or DDR [3][4] is a dancing to the music on the dance pad game that was developed by Konami and released back in 1998. The game was first released as an arcade machine and received a lot of attention because the game was the first of its kind. Later, the game was ported to many other platforms due to its popularity and the game has new version every single year. Until now, the game already has over 20 versions on 6 or more different platforms. The game logo can is shown in Figure 2-3.

The game can be played using platform's controlling devices such as Playstation's DualShock¹ or XBOX joystick but the game prefers the player to play using dance pad.

Gameplay:

The gameplay of DDR will be described using the gameplay screen in Figure 2-4. The game will mainly consist of 2 kinds of notes, step and hold. For the step note, the note will be displayed as single arrow without any trail as marked with red circle in Figure 2-4. The player is required to step on the right arrow on the dance pad in Figure 2-5 according to the note displayed on the screen to get the score. For the hold note, the note will be displayed as the arrow with tail as shown with yellow rectangle in Figure 2-4. The player will have to step on the right arrow and hold until the tail of the note on the screen disappeared to get the score. The score will be graded by the accuracy of stepping of the note and the duration the player can maintain holding the hold note. Moreover, single note can be combined using 2-5 position arrows which will create double, triple or quad note which player has to step all of the arrow on the pad at the same time.

¹ Joystick for Playstation System.



Figure 2-4 Dance Dance Revolution Gameplay

[Source: <https://www.konami.com/ddr/>]



Figure 2-5 Dance Pad

[Source: <http://www.ddrgame.com/>]

2. Guitar Hero



Figure 2-6 Guitar Hero Logo

[Source: https://en.wikipedia.org/wiki/Guitar_Hero]

First Published: November 8, 2005

Publisher: Red Octane

Developer: Harmonix

Platform: Arcade, Playstation 2, Playstation 3, Playstation 4, Nintendo Wii, XBOX 360 and iOS

Description:

Guitar Hero is a guitar-inspired game. [5][6] The player can play this game using guitar simulation device. The game uses a highway style of interface to display the notes. The game has received a lot of love from the player around the world because the game provides the old times rock songs that is loved by most rocker around the world. The game logo is shown in Figure 2-6.

Gameplay:

The gameplay of Guitar Hero resembles a guitar frets. The note will fall to the area below in the yellow marked area. The player has to press the following color button on the guitar controller in the Figure 2-8 and strum the bar to play the note on the screen as shown in Figure 2-7. There is also hold note the player has to strum and hold.



Figure 2-7 Guitar Hero Gameplay

[Source: <http://www.guitarhero3.com/>]



Figure 2-8 Guitar Hero Guitar Controller

IGGAMERS ©

[Source: <http://gaming.stackexchange.com/questions/227134/can-i-sync-a-guitar-hero-world-tour-controller-dongle-with-a-guitar-hero-3-guitar>]

2.4 Unity 5 Game Engine

Unity 5 Game Engine [7] is a tool for developing games. Unity 5 offers easy and quick way of implementing and developing game. The engine is capable of developing both 2D and 3D games. The subscription of Unity is free but there will be a fee for commercializing the game.

Unity Game Engine is capable of developing cross platform application means that developing one game can be ported to any desired platform. The list of Unity supported machine can be found in Figure 2-9.

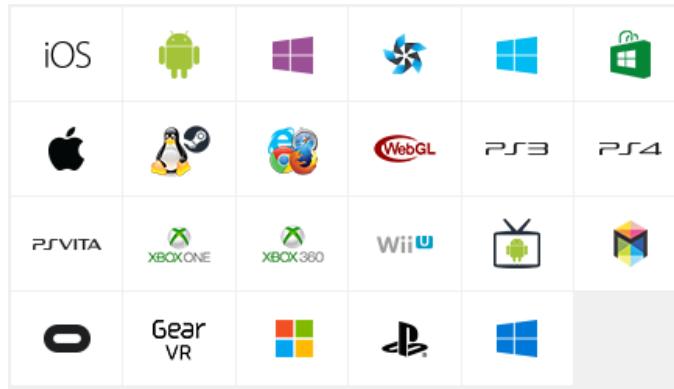


Figure 2-9 Unity Supported Multiplatform

[Source: <https://unity3d.com/unity>]

2.5 Arduino

Arduino is an open-source hardware and software which is easy to use. Arduino consists of Arduino board and Arduino Software. Arduino board is for making the game controller and controlled by the software.

2.6 BPM

BPM Stands for “Beats Per Minute”. BPM indicates the rhythm of the song whether it is slow or fast. According to the music theory, one minute consists of 60 seconds. 60 BPM means that there are 60 beats in one minute. In detail, there is a beat in every second. 120 BPM means that there are 120 beats in one minute. In detail, there are 2 beats in every second. Songs in this world commonly varies around 60 to 200 BPM.

2.7 Offset

In every song, there is a unique time before the first beat of the song starts. This is called “Offset”.

2.8 Isometric

Isometric [8] is a technique commonly used in computer and video game development to project a 2D-sprite (an image file asset in the game) in the game to be a 3D-like image. Using camera rotation technique to represent angles between x, y and z axis at strictly 120°, this will change an image that used to look like 2D image to 3D image. This technique is usually called 2.5D or pseudo-3D technique because it does not really represent 3D image.

Chapter 3

Design and Methodology

3.1 General Requirements

3.1.1 Platform

The game will be a stand-alone arcade platform. The game software will be running on Windows operating system.

3.1.2 System Requirements

- User can login to the game system.
- User can select the mode his/her desired.
 - o User can select the desired song if the mode selected is Arcade Mode.
 - o User can select the desired set of songs if the mode selected is Technical Mode.
 - User can arrange songs in desired order according to the selected set of songs.
- User can view details about each songs including song's name, artist, difficulty, levels and artwork.
- User can view profile that display Player's Level, Name, Icon.
- User can view Collections.
- User can customize profile item such as icon.
- User can customize play speed prior game start.
- User can access Shop to buy unlockable.

3.1.3 Gameplay Requirements

- System can play the song without struggle.
- System can display the music video corresponding to the selected song.
- System can load the note pattern correctly according to the song and difficulty.
- System can display the visualized the note marker in sync with the song beats and the pre-programmed timing of each note.
- User can press the corresponding key when notes come at the judgement line.
- System can update the score according to the accuracy of the pressed button.
- System can calculate the combo when notes are pressed without mistake consecutively.
- System can calculate combo bonus from the cumulative combo.
- System can calculate cumulative score from full score of notes and combo bonus.
- System can calculate grade (letters) from the cumulative score.
- System can display result screen.

3.1.4 Data Access Requirements

- User can register for the game.
- User can login to the system.
- User can view player's information such as name and play count.

3.1.5 Database Requirements

- System can store user's information including name, level and play record in the database.

- System can store log file that updates continuously in game within database.

3.2 Use Case Analysis

This parts provide use cases of game software. There are 2 main roles. The first is the player and second is the game developer.

3.2.1 Use Case Diagram

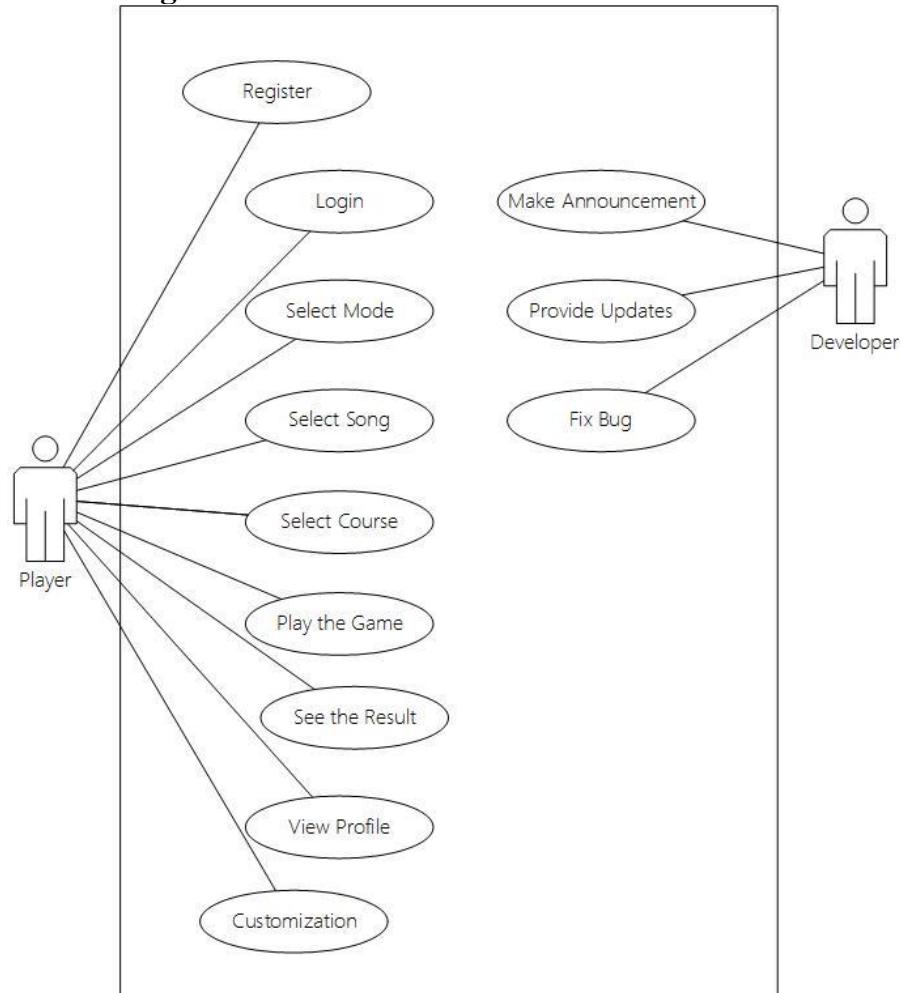


Figure 3-1 Use Case Diagram

Figure 3-1 shows Use Case Diagram. The player can register, login, select mode, select song, select course, play the game, see the result, view profile and customize. The developer can make announcement, provide updates and fix bug.

3.2.2 Use Case Narrative

1. Scenario 1: Register

Goal: To register to the game system for keeping profile and record.

Preconditions: User must have an ID card and the system is connected to internet. User enter the game for the first time.

Main Success Scenario:

1. User inserted coins or touch the cash card.
2. System accept the credits and display “Game Start”
3. User press start button.
4. System redirect to Login Screen.
5. User touch the ID card to the scan panel.
6. System checks the availability of the card and confirm the user that it is a new card.
7. System asks for the desired in game name.
8. User enter the desired name.
9. System check the availability of the given name and confirm to the user.
10. User confirm the name submission.
11. System record ID number and name to the database.

Alternative Scenario:

1. User cannot register because the card has already been registered.
 - 1.1. System display error message.
 - 1.2. User use another ID card.
 - 1.3. User enter name.
 - 1.4. System confirm the availability of name.
 - 1.5. User confirm the name.
 - 1.6. System record ID number and name to database.
2. User cannot register because the name is invalid.
 - 2.1. System display error message.
 - 2.2. User enter another name.
 - 2.3. System confirm the availability of name.
 - 2.4. User confirm the name.
 - 2.5. System record ID number and name to database.
3. User cannot register because there is no internet connectivity.
 - 3.1. System display error message.
 - 3.2. System wait for internet connectivity.
 - 3.3. User use an ID card.
 - 3.4. User enter name.
 - 3.5. System confirm the availability of name.
 - 3.6. User confirm the name.
 - 3.7. System record ID number and name to database.

2. Scenario 2: Login

Goal: To play the game with an account.

Preconditions: User must have registered with an ID card.

Main Success Scenario:

1. User use an ID card.
2. System check the registered ID card and display user's information.
3. System ask for confirmation of using the account.
4. User confirm an account.
5. System redirect to the game.

Alternative Scenario:

1. User cannot login because ID card has not been registered.
 - 1.1. System display error message.
 - 1.2. User register the ID card.
 - 1.3. System check the registered ID card.
 - 1.4. System ask for confirmation of using the account.
 - 1.5. User confirm an account.
 - 1.6. System redirect to the game.
2. User cannot login because user cancel the confirmation of account.
 - 2.1. System redirect to login screen.
 - 2.2. User use an ID card.
 - 2.3. System check the registered ID card and display user's information.
 - 2.4. System ask for confirmation of using the account.
 - 2.5. User confirm an account.
 - 2.6. System redirect to the game.

3. Scenario 3: Mode Select

Goal: To play the desired mode.

Preconditions: User must have been through login screen with or without an ID.

Main Success Scenario:

1. User go through the variety of mode.
2. User select the desired mode.
3. System redirect to the selected mode.

Alternative Scenario: -

4. Scenario 4: Arcade Mode – Select Song

Goal: To play the desired song.

Preconditions: User must have selected Arcade Mode.

Main Success Scenario:

1. User go through the songs.
2. User select the desired song.
3. User select the desired difficulty.
4. User confirm song selection and press start.
5. System load the song and difficulty pattern then redirect to gameplay screen.

Alternative Scenario: -

5. Scenario 5: Technical Mode – Select Course

Goal: To play the desired course.

Preconditions: User must have selected Technical Mode.

Main Success Scenario:

1. User go through the course.
2. User select the course.
3. System load songs provided in the course and ask the user to arrange 3 songs in any order.
4. User select and arrange the song as preferred.
5. User confirm the arrangement and press start.
6. System load the song and the arranged course then redirect to gameplay screen.

Alternative Scenario: -

6. Scenario 6: Gameplay

Goal: To play along and finish the song with no fail.

Preconditions: User must have selected song or course through Arcade Mode or Technical Mode.

Main Success Scenario:

1. User enter gameplay screen automatically redirected by the system.
2. User press the button according to the note marker/s that approach according to the beat of music.
3. System calculate score of each pressed note using the accuracy.
4. System update score and combo.
5. User finish the song.
6. System calculate accumulated score.

Alternative Scenario:

1. User fails the song.
 - 1.1. System check whether it is Arcade Mode or Technical Mode.
 - 1.1.1. If Arcade Mode, and it is the first song, user can continue to the next song.
 - 1.1.2. If Technical Mode, user cannot continue.
 - 1.2. System display Game Over message.
 - 1.3. System ask for Continue.

7. Scenario 7: Results

Goal: To see the result of the song.

Preconditions: User must have finished the song.

Main Success Scenario:

1. System retrieve cumulative score, combo and amount of pressed note respected to accuracy.
2. System display information in term of result.
3. User view result.
4. User press next.

Alternative Scenario:

1. User failed the song.
 - 1.1. System retrieve cumulative score, combo and amount of pressed note respected to accuracy.
 - 1.2. System display information in term of result.
 - 1.3. User view result.
 - 1.4. System display game over.

8. Scenario 8: View Profile

Goal: To view profile including name, icon and level.

Preconditions: User must have registered account.

Main Success Scenario:

1. System retrieve player information.
2. System display player profile.
3. User view profile on song selection screen.

Alternative Scenario: -

9. Scenario 9: Customization

Goal: To customize user profile including icon.

Preconditions: User must have registered account.

Main Success Scenario:

1. User select customization.
2. User select icon.
3. System ask for confirmation.
4. User confirm customization.
5. System record customization in database.

Alternative Scenario: -

3.3 High Level System Architecture Design

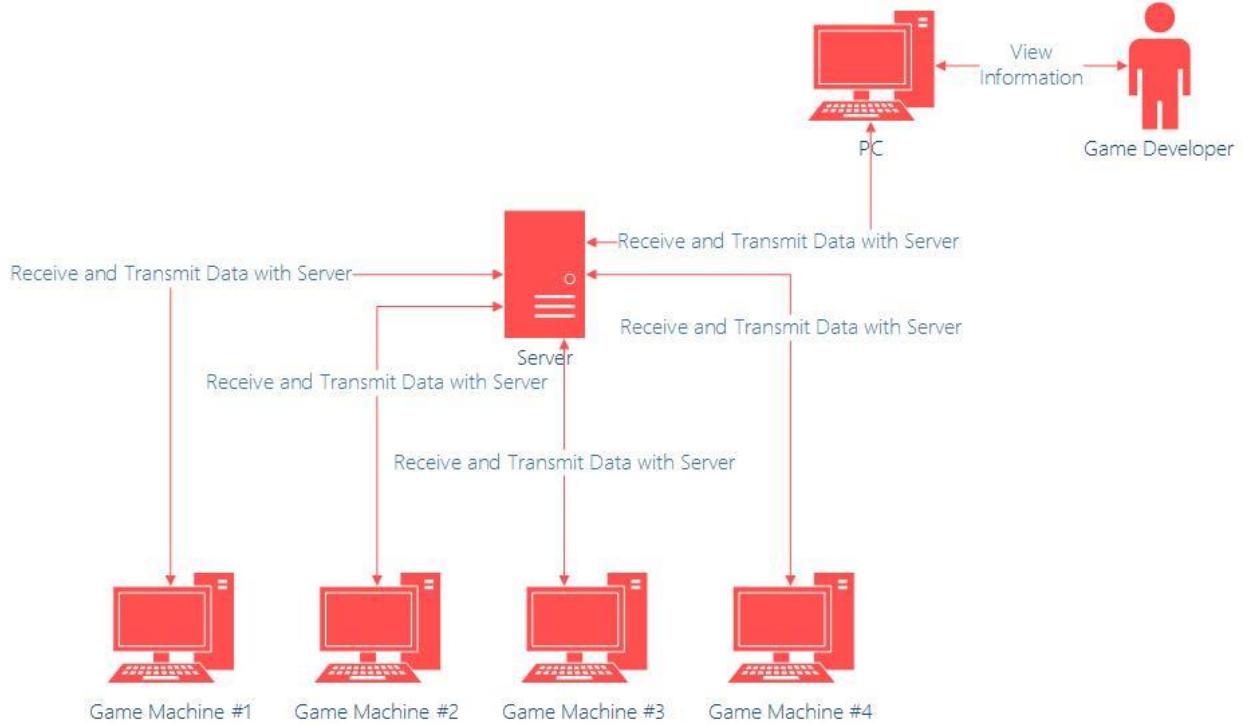


Figure 3-2 System Architecture Diagram

From figure 3-2, the system architecture in high level is designed to have the game machines exchanging data with the server in real time. The game developers can have data that game machines send to the server by using PC to access the information. Data that the machines will send to the server are such as the machine status, player information or player records. Server can send the server status to the machines. Game Developer can know machine status and server status by accessing data from PC and can provide patches or updates.

3.4 Game Design

3.4.1 Summary

Rhythm Action game that integrate isometric design to deliver new sensation of Music Game that have never existed before.

3.4.2 Gameplay

The gameplay of this game has been kept simple. The main gameplay is to press the button while looking at the note marker and listening to the song's beat. The goal is to hit the note as accurate as possible. The game will provide variety of songs and a set of difficulties. Difficulties vary from ones for beginner and ones for expert player. The game offers challenges as difficult note patterns and missions. The goal is that player will be able to play all the songs to get the best grade and to clear all missions provided in the game.



Figure 3-3 Sample Gameplay with Notes

From figure 3-3, this is how gameplay screen of this game looks like. The heart of this game is to press the button corresponding to the note markers (those in orange, green, red and blue) when those markers move to the white line. This line is called Judgement Line. If the markers perfectly fit with the judgement line means that the markers or notes are at their most accurate time with the beat of the song. The player need to press the button at that specific time. The score will be calculated based on the accuracy the note has been pressed. More accurate the player has pressed the note and more combo they can maintain, resulted in more score that will be granted to them. There is also penalty for missing the note. If player cannot press the note, the health point will decrease. When health point reach 0, the game is over. This is the ideal core of our game.

3.4.3 Mindset

The mindset of this game that has been triggered on the player is that the game designer wanted the player to feel that they are challenged by the difficulties of the song patterns and missions. It is designed that player will feel weak at first because of the brand new gameplay that they have to learn and develop their skills. When they have been playing for some amount of time, they will be capable for playing the game. At the end of the day, the player will accomplish achievements and satisfy with their skills.

3.4.4 Potential

1. Fun

This game is designed to satisfy the theory of fun of game design which have physical fun, mental fun and social fun.

1.1. Physical Fun

Physical Fun is the way to express fun in the way that the body has part in an activity that a person does for fun. For example, playing sports. When a man plays basketball, his mind feels fun because he can use his body to support that fun he has.

The same thing applied in this game. The game is design to require the player to use their hands, eyes, ears and sense. So, this will create physical fun for the player.

1.2. Mental Fun

Mental Fun is when a player can satisfy his or her need on esteem and actualization. For example, when a person can achieve some achievement like get an A grade or graduate, he or she will feel happy and proud.

So, in this game, it is designed to offer many challenges for players to take on and beat. When the players beat a challenge, they will get rewards. This will make them feel like they can do it and feel happy and proud.

1.3. Social Fun

Social Fun is when we got ourselves socialized. When a person feels that he or she is a part of the community, can talk or exchange ideas.

This game also addresses this issue by using the nature of arcade game that the player will play the game in public. When the game is in public, player can find the community of people that play the same game easier and they can talk and further expand the player community.

2. Maslow's Hierarchy of Needs

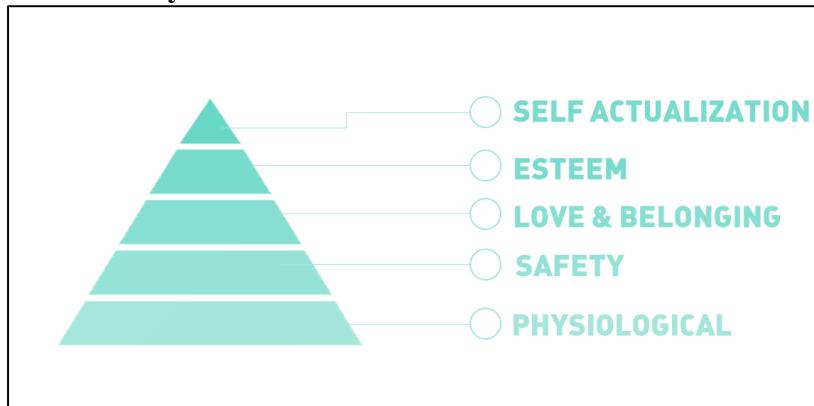


Figure 3-4 Maslow's Hierarchy of Needs

2.1. Physiological

The game has been designed to satisfy the first need of human in Maslow's Hierarchy of Needs which is physiological need. The game uses many parts of the body such as eyes, ears and hands. I which, physiological need is the need of usage or exercise of body parts, so using eyes to follow the note, using ears to listen to music and using hands to press button satisfy this need.

2.2. Safety

For safety, the game introduces life point system. Life point system is the system that when missing note, the life that is given will be decreased, and when life point runs out, the player will fail the stage. This satisfy safety need because this need is the need of being safe. So, trying to survive the stage will help exercise this need and satisfy it.

2.3. Love & Belongings

Love and belongings is the need of being acquired. This can be interpreted as acquiring unlockable. The game is designed to provide unlockable when player has completed some requirement after that, unlockable will be given. So, when the player has acquired unlockable, they must feel proud and try to protect what they have already acquired.

2.4. Esteem

For esteem, this can be easily explained as the feeling of pride that one can surpass the other. In the game, there will be a score system that players all around can play the song and get as high as possible to surpass other players. When player can surpass the other's, they will feel proud, the feeling that we called esteem. So, the game satisfies esteem need.

2.5. Self-Actualization

Self-Actualization is the other perspective of esteem but in form of surpassing the player himself. It is the need to develop the player potential to compete with himself and surpass the record that has been made. In the game, the score system and the record system are the one that satisfy this need, when player play the song repetitively to score perfect score with the past score that is not perfect. So, when player can score more than the one that he could do it in the past, he will feel proud of himself.

3. Game Equilibrium

To make the game run without struggle, there should be an equilibrium in the game. Note charts should be accurately giving level according to their difficulty. Also, when giving level, the chart designer should use the other song charts as references of difficulty to create equilibrium of the songs in the same level.

4. Challenges

This game offers many challenges to players to challenge themselves. A variety of song note chart difficulties that ranged from very easy for beginners to very hard for expert user. Also, there will be missions for players to clear and achievements for them to clear. In which missions and achievements will require the players to use their full potential to play, otherwise they cannot clear it.

3.5 Technical Design

3.5.1 Game Flow

The game flow including the first design of Arcade Mode. The charts show the work between player and system

1. Arcade Mode Game Flow

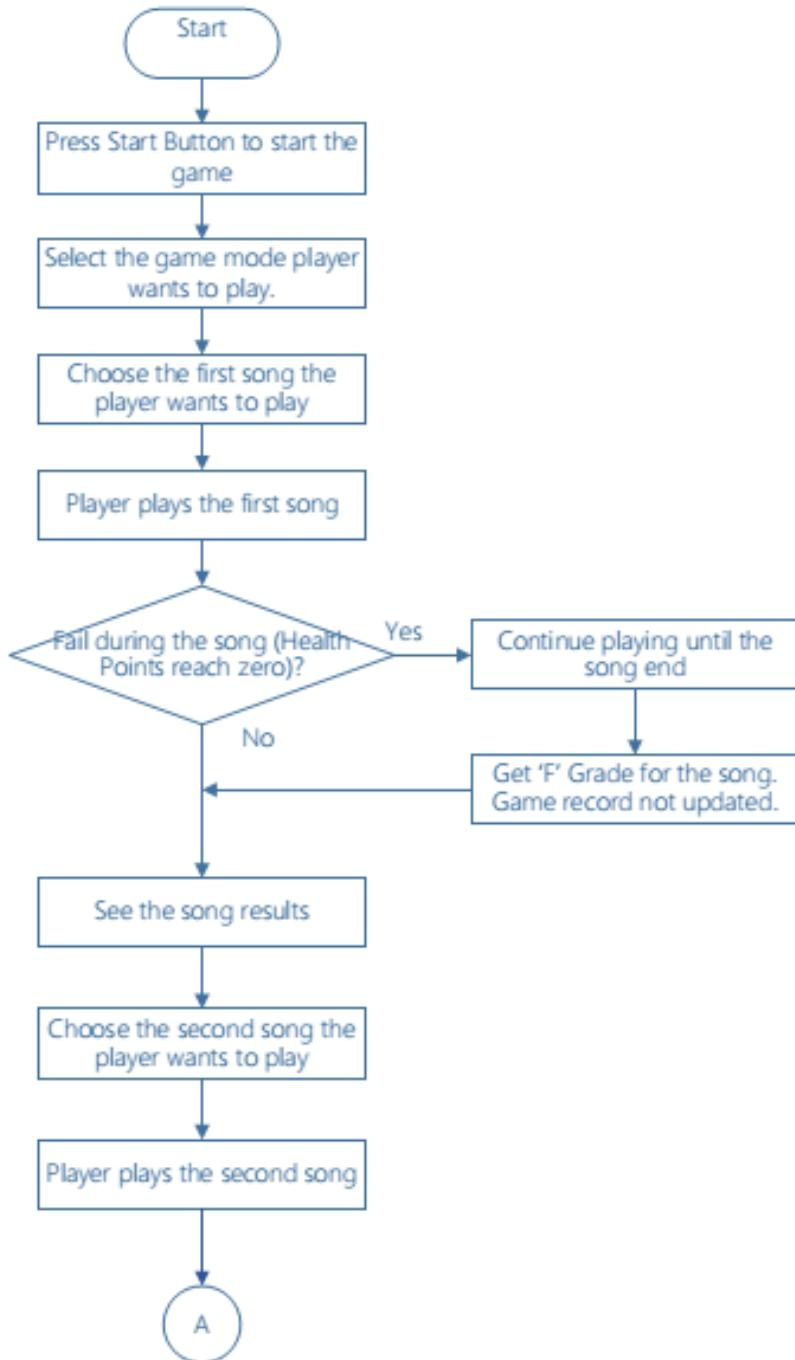


Figure 3-5 Arcade Mode User Flow (1)

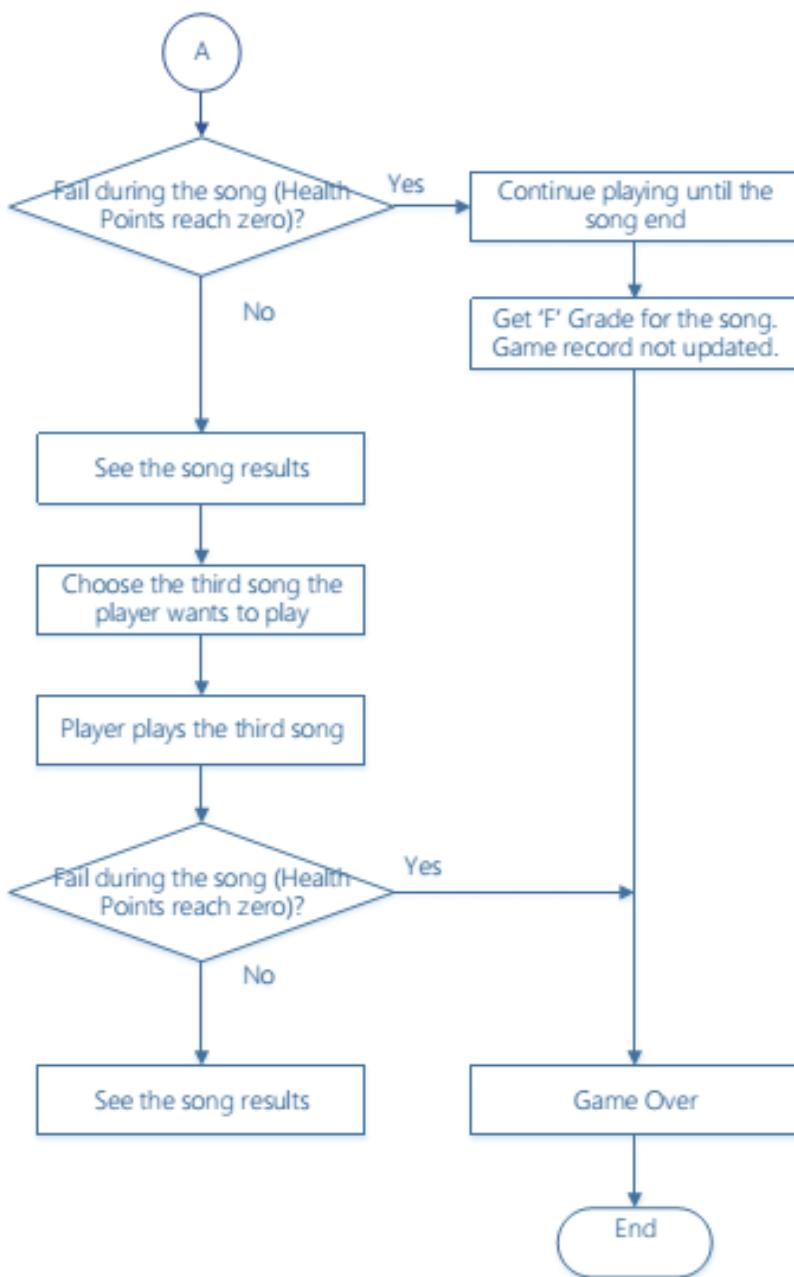


Figure 3-6 Arcade Mode User Flow (2)

2. Arcade Mode System Flow

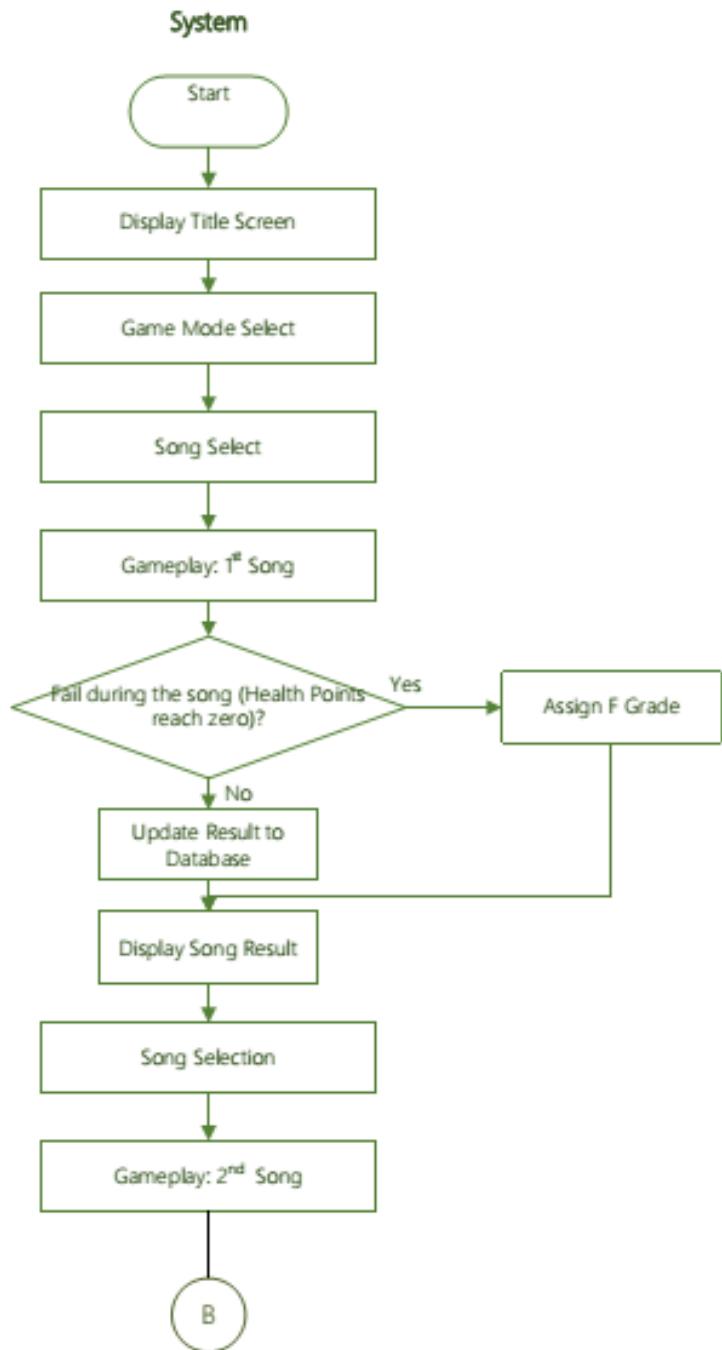


Figure 3-7 Arcade Mode System Flow (1)

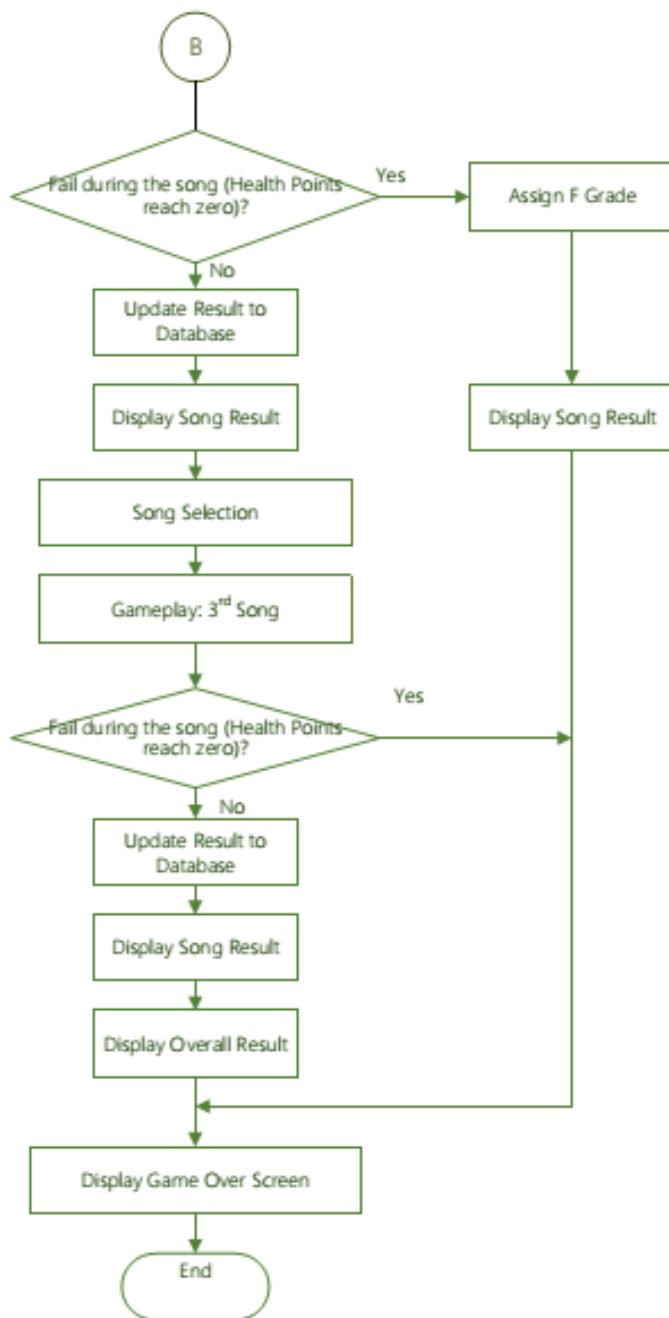


Figure 3-8 Arcade Mode System Flow (2)

3.5.2 Controls

There are 2 types of controls in the current design. The first one is controls in PC prototype version which is used to do gameplay test. The next one is controls on the real machine which will be used on the hardware controller that is going to be implemented.

3.5.2.1 Controls in PC Prototype Version

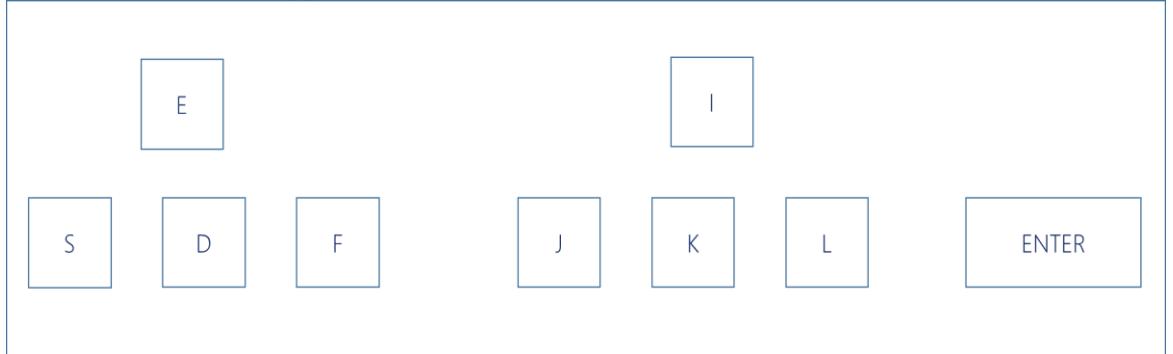


Figure 3-9 PC Prototype Keyboard Control

Figure 3-8 shows prototype keyboard control that will be used to explain the controls in the following section.

1. Interface Control

For the interface control of the prototype, it is planned that the button “ENTER” will be used as universal confirm button. This button can be used as a start button to start the game and to confirm the selection that user made.

For directional buttons in the prototype, the game will use the leftmost and rightmost button to be left and right direction button respectively. In this case, those buttons are “S” and “L”. These two buttons will be used to scroll left and right, to go over the mode or songs list. For “E” and “I” buttons, this two button will only be used to select the difficulty of the song.

2. Gameplay Control

For the gameplay, there will be 8 buttons that will be used to play the notes. Figure 3-9 shows the sample screen of the gameplay.

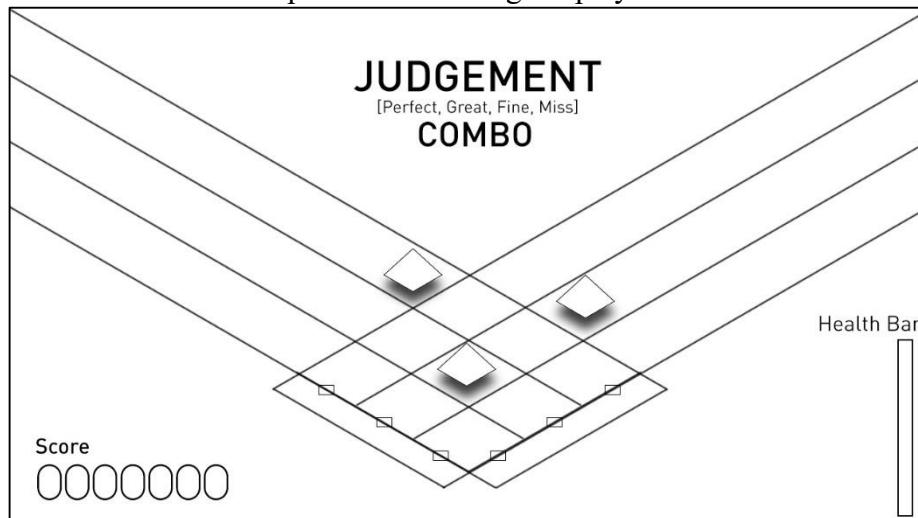


Figure 3-10 Sample Gameplay Screen

Buttons “S”, “D” and “F” will be used to press the note that comes along 3 lanes on the right side. Starting from the top lane, this lane will be controlled by “S” button. Then the middle lane will be controlled by “D” button. Last, the bottom lane will be controlled by “F” button. Furthermore, there will be another buttons that will control the entire 3 lanes together, as 1 lane. This special button and notes are called “FX” (abbreviated from Effect), and it will be controlled by “E” button.

The same thing applies to the opposite side lanes on the left. Buttons “L”, “J” and “K” will be used to press the note from the top, middle and bottom lane respectively. And the FX button will be controlled using “I” button.

3.5.2.2 *Controls on the Real Machine*

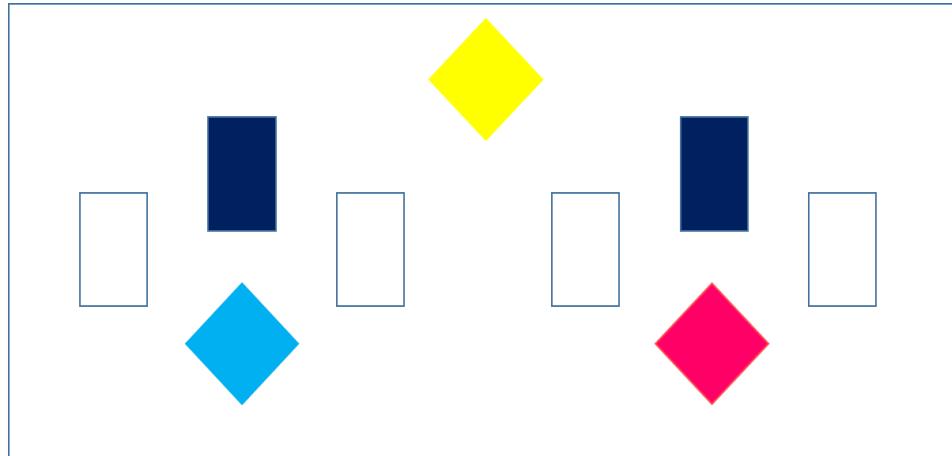


Figure 3-11 Real Machine Controller Button Planning

1. Interface Control

For interface control, the real controller will use “Yellow” Diamond button as shown in figure 3-10 as universal confirm button. This button will be used to start the game from title screen, confirm song selection and to proceed to the next screen.

Leftmost and rightmost white button will serve as left and right direction button respectively. These buttons will be used to scroll around mode selection and song selection.

Left black button and right black button serve as buttons for selecting difficulty of the song.

2. Gameplay Control

According to the gameplay in figure 3-9, this controller makes it easier to control the game. The left part of the controller including 3 rectangular buttons and 1 blue diamond button will control the lane bordered in blue. Leftmost rectangular button will control the top lane, middle button will control middle lane and rightmost button will control the bottom lane. The right part of the controller will work the same way. It will control the lanes bordered in red. Rightmost rectangular button will control the top lane, middle button will control middle lane and leftmost button will control the bottom lane.

3.5.3 User Interfaces, Screens Layout and Navigation

There are total of 8 screen layouts that has been planned at this moment. The sequence of the screen can be shown in screen sequence chart in Figure 3-11.

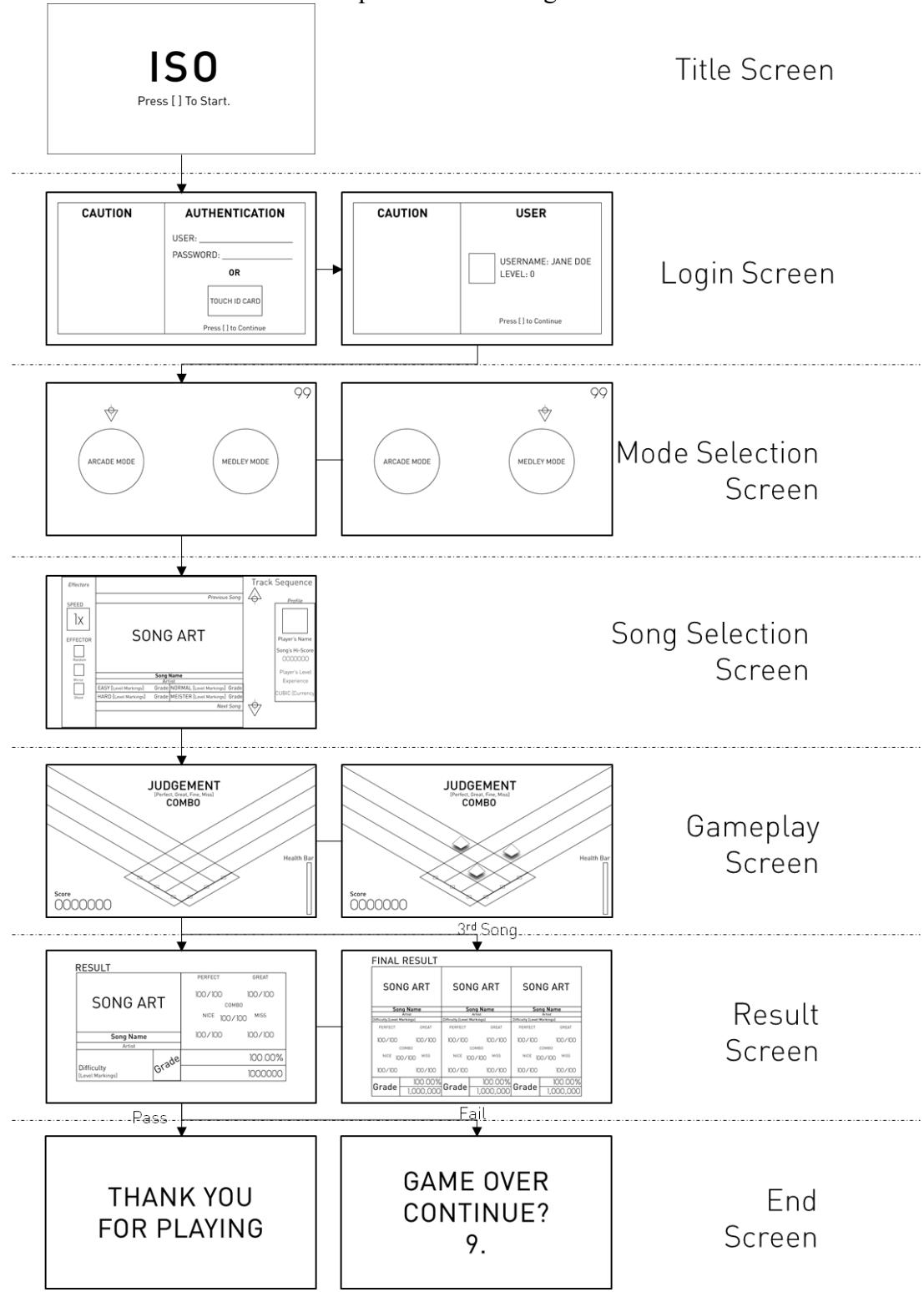


Figure 3-12 Screen Sequence Chart

1. Screen 1: Title Screen



Figure 3-13 Title Screen Layout

Goal: To start the game and to be navigated to Login Screen.

Next Screen: Login Screen

Navigation: On this page, there will be only one button that can be pressed. After the game has been activated with coins inserted, the confirm button can be pressed and navigate to Login Screen. The screen is shown in Figure 3-12.

2. Screen 2: Login Screen

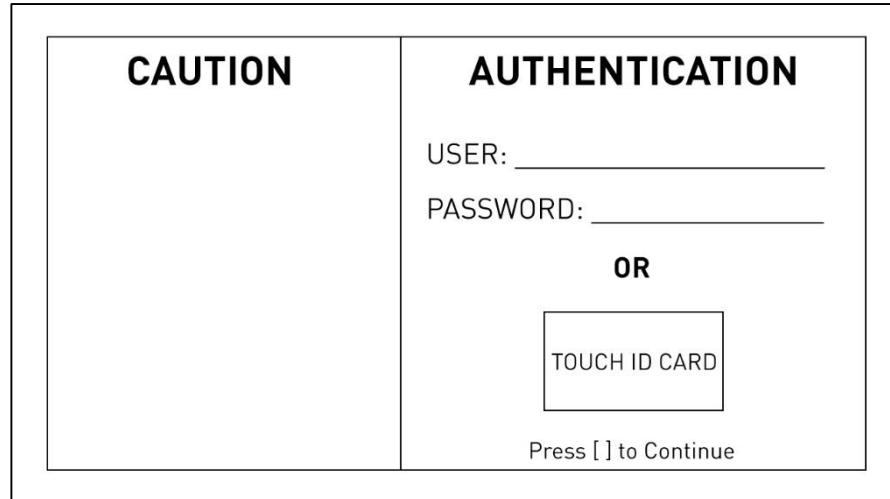


Figure 3-14 Login Screen - No ID Card Accessed

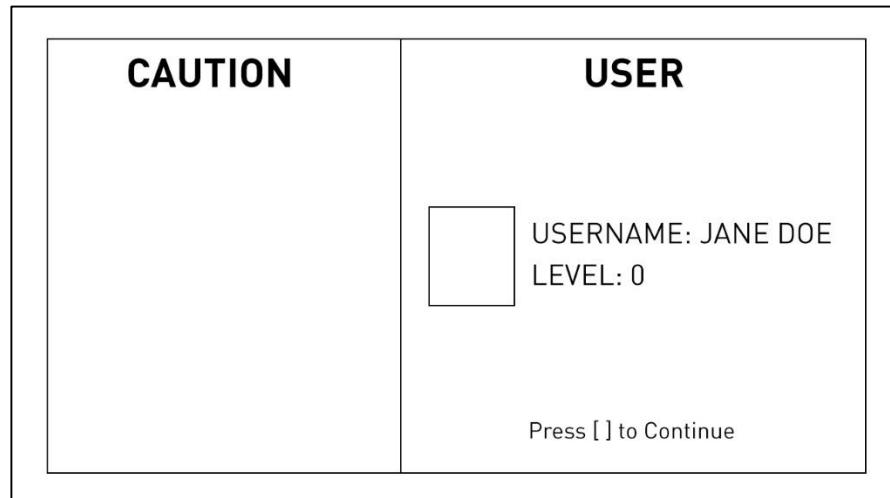


Figure 3-15 Login Screen - ID Card Accessed

Goal: To login into the system using ID card. Or play as guest without ID Card.

Next Screen: Mode Selection Screen

Navigation: After title screen redirect to this login screen. The screen will be as shown in figure 3-13. The system will ask for ID and Password or ID card or else user can press confirm button to skip this step and play as guest. If the card hasn't been registered, the system will ask the player to input the name and confirm by pressing the same button.

If the card has already been registered, the system will show this card owner information, including name, icon and level as shown in figure 3-14. Player then has the choice to confirm using this ID by pressing the confirm button.

3. Screen 3: Mode Selection Screen

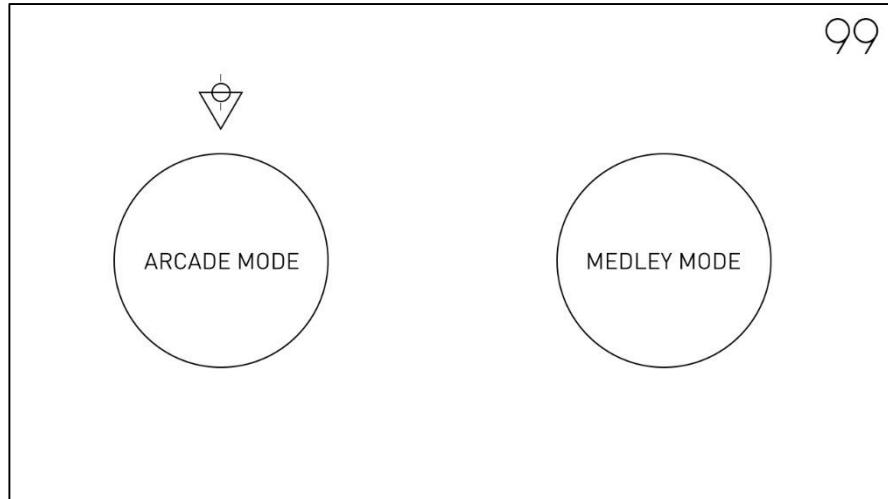


Figure 3-16 Mode Selection Screen - Arcade Mode

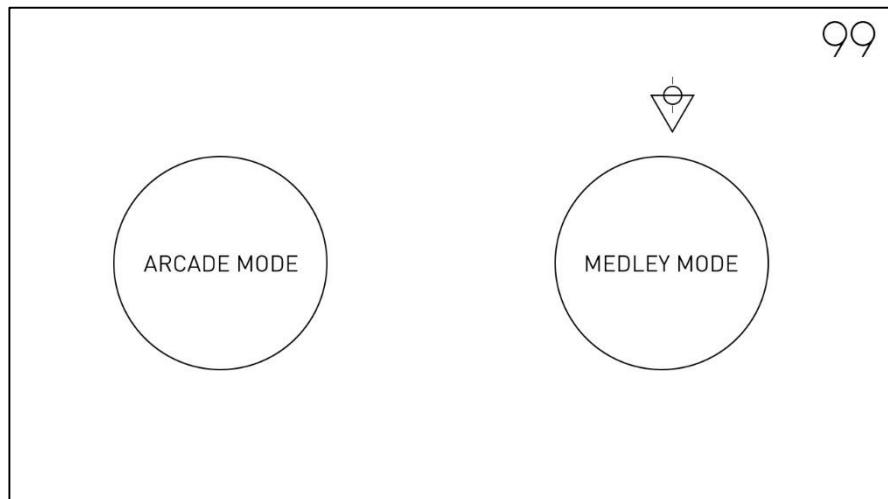


Figure 3-17 Mode Selection Screen - Medley (Technical) Mode

Goal: To select the desired mode and proceed to song selection.

Next Screen: Song Selection Screen

Navigation: After login screen. System will redirect to mode selection screen as shown in Figure 3-16. At this screen, player can use left and right direction button to scroll between provided modes. When, player has decided on the mode, they can press confirm button to proceed to song selection screen.

4. Screen 4: Song Selection Screen

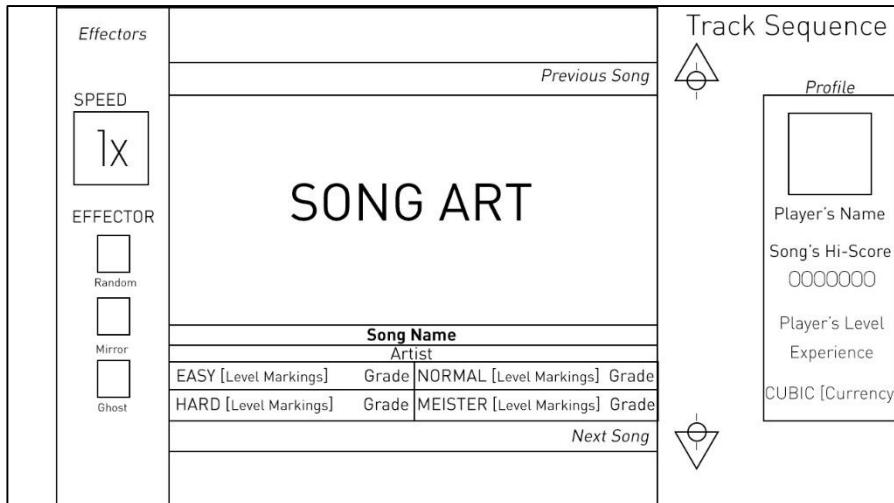


Figure 3-18 Song Selection Screen

Goal: To select the desired song and difficulty and proceed to gameplay screen.

Next Screen: Gameplay Screen.

Navigation: Figure 3-17 shows song selection screen. On this page, player be using up and down direction button on the right hand side to scroll up and down for the song. There will be information of the song including song name, genre and artist. Also, this screen shows play record including grade, high score, combo and percentage. At the bottom of the song, player can use difficulty changing button to scroll between difficulties and select the one that is desired. After the song and difficulty has been decided, player can select the effector that makes changes to gameplay including speed, random notes, mirror note and ghost mode. After everything is decided, player can press confirm button to start the song.

5. Screen 5: Gameplay Screen

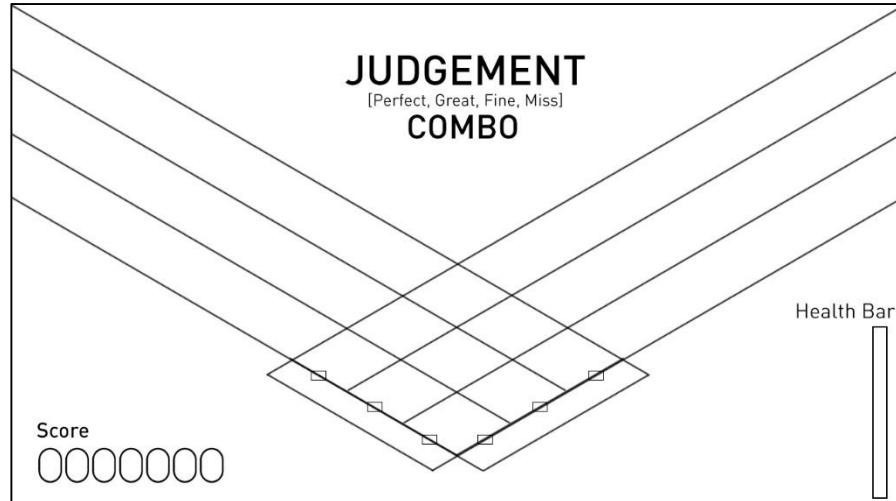


Figure 3-19 Gameplay Screen

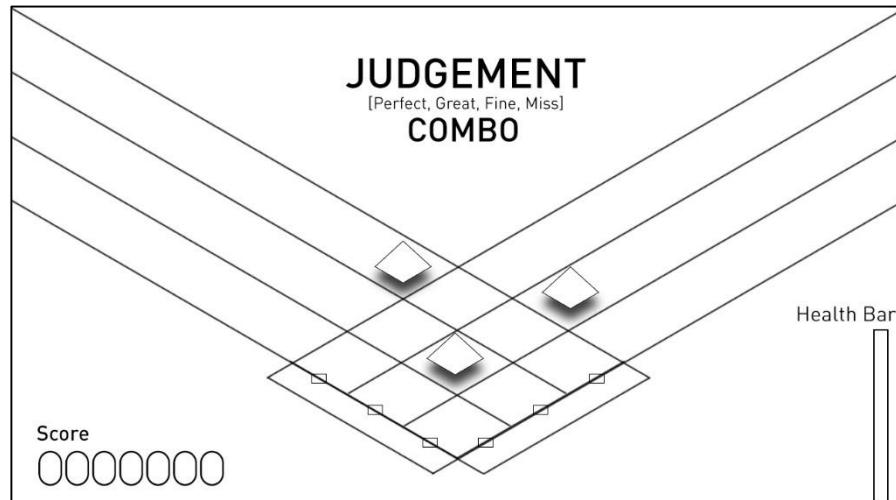


Figure 3-20 Gameplay Screen with Notes

Goal: To play the selected song. Finish it and see the result.

Next Screen: Result Screen.

Navigation: Figure 3-18 and 3-19 show the gameplay screens. Player can use buttons stated in Controls section to play the game. When player finish the song, no matter cleared or failed, player will be redirected to result screen.

6. Screen 6: Result Screen

RESULT		PERFECT	GREAT
SONG ART		100/100	100/100
		COMBO	
		NICE	100/100 MISS
		100/100	100/100
Difficulty [Level Markings]		Grade 100.00%	
		1000000	

Figure 3-21 Result Screen

FINAL RESULT			
SONG ART		SONG ART	
Song Name		Song Name	
Artist		Artist	
Difficulty [Level Markings]		Difficulty [Level Markings]	
PERFECT	GREAT	PERFECT	GREAT
100/100	100/100	100/100	100/100
COMBO		COMBO	
NICE	100/100	NICE	100/100
MISS		MISS	
100/100	100/100	100/100	100/100
Grade	100.00%	Grade	100.00%
	1,000,000		1,000,000
Grade	100.00%	Grade	100.00%
	1,000,000		1,000,000

Figure 3-22 Final Result Screen

Goal: To see the result and proceed to next song.

Next Screen: Song Selection Screen (2nd Song). Game Over Screen (if the current song is the third track.)

Navigation: After player finish the song, the screen will be redirected to result screen to see the performance of the finished song. After the player finished viewing result, he or she can press confirm button to proceed. Or if the time that is delayed for result viewing is out, the screen will automatically proceed.

If the song that has just finished is the last song, the game will redirect to Final Result Screen to see the accumulated result. The screen is shown in Figure 3-21.

7. Screen 7: Thank You for Playing Screen

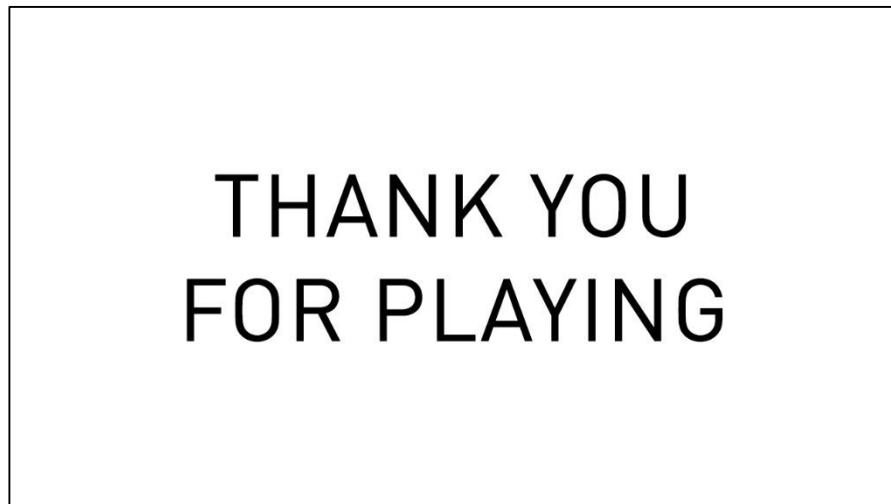


Figure 3-23 Thank You for Playing Screen

Goal: To let the player knows that the game round is over and thank the player for playing.

Next Screen: Title Screen

Navigation: After seeing result of the last (3rd) song, the screen will be redirected to this screen to show player gratitude. The game round ends here. Then, the screen will be redirected to title screen. The screen is shown in Figure 3-22.

8. Screen 8: Game Over Screen

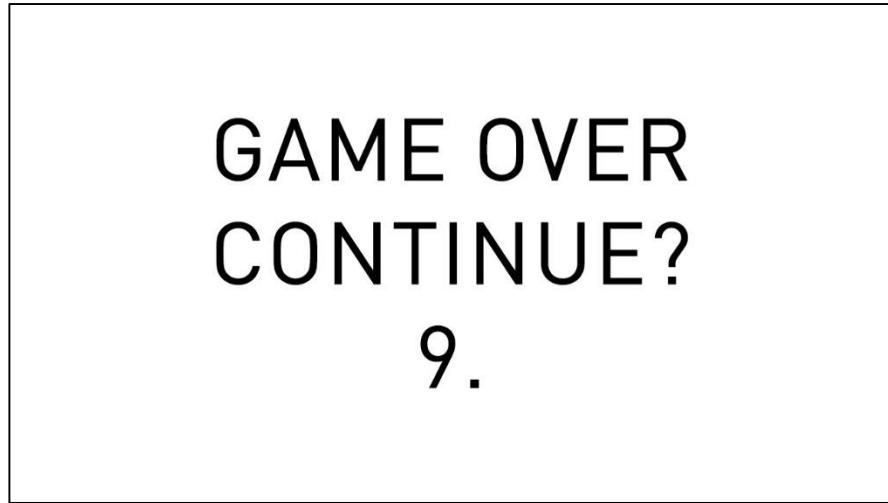


Figure 3-24 Game Over Screen

Goal: To notify the player that their game round is over because failure and ask whether to insert more credit and continue or not.

Next Screen: Gameplay Screen if player choose to continue. Thank you for playing Screen if the player ignores.

Navigation: This screen shows after the player failed the song. The system will ask the player whether to insert more coins and continue or not. If the player inserts the coin, then the confirm button should be pressed. Otherwise, the time will run out and the screen will be redirected to title screen. The screen is shown in Figure 3-23.

3.5.4 Mode Design

1. Arcade Mode

Arcade Mode is designed to have 3 stages. At each stage, the player can choose a song of their choice based on what the player wants to play. Then, player has to play the selected song, 1 song per stage. At the first stage, there is a rule that there will be no fail on this stage. This is because it will make the game friendlier to beginners. If beginners pay and play the first song, and then failed and cannot continue, those beginners will feel negative about the game. On the second stage, player can play the whole song even if the song failed because the health reduced to 0. But player cannot proceed to the last stage. On the last stage, if the health reduced to 0, the game will be over immediately.

2. Medley(Technical) Mode

Medley or Technical is another mode that has been planned to implement. This mode will be different from Arcade Mode because there are 4 stages to play. First, the player has to select 1 course that will contain specific set of songs. Second, the player will have freedom to choose 3 songs from that set and arrange them in any order as desired. The last stage or so-called boss stage will be selected from the songs that has been secretly put in the course using the performance and the choice of songs the player chose. This challenges players in the way that they wouldn't know what song they are going to face. It is all depends on them.

3.5.5 Mechanics

3.5.5.1 Player's Information Mechanics

1. Player's Name

Player's Name is the mechanic that uses to tell which player is which player. Player's name in this game cannot be changed after the first step of registration and cannot be duplicated. This makes it easier for developers to indicate the specific player and easier for players to remember the name of people in the game community.

2. Player's Icon

Players Icon mechanic is like an avatar or profile picture in social network system. Icons can be collected by clearing missions or achievements in the game. Player can customize icon in customization mode.

3. Player's Level and Experience

Player's Level mechanic is the mechanic that uses to tell how long the player has played the game. Players with low level can be interpreted as beginners. Players with high level can be called experts. Levels in this game can be raised by playing the song in any mode and the song will grant experience points (EXP). Experience Points given from playing will differs depending on song difficulty, accumulated score and grade as shown in equation below.

Equation 3.1

$$\text{Experience Gain} = 100 + \text{Round}\{(Difficulty) \times (\text{Grade} + \text{Score Ratio})\} \leq 120$$

In which “Difficulty” has value as in Figure 3-24.

Difficulty	Variable
Easy	0.7
Normal	0.8
Hard	0.9
Expert	1

Figure 3-25 Difficulty Multiplier

And the “Grade” contains fixed experience point as in Figure 3-25.

Grade	Accumulated Score	EXP
SSS	1,000,000	10
SS	950,000 ~	9
S	900,000 ~	8
AA	850,000 ~	7
A	800,000 ~	6
B	700,000 ~	5
C	600,000 ~	4
D	500,000 ~	1
F	0 ~	0

Figure 3-26 Experience Point in Associated with Grades

Score Ratio in the first equation can be calculated from Equation 3.2.

Equation 3.2

$$\text{Score Ratio} = \left[\frac{\text{Accumulated Score}}{100,000} \right]$$

Right now that the experience points have been calculated. The required experience points for each level to level up is needed. And this value can be calculated from Equation 3.3.

Equation 3.3

$$\text{EXP(Total)}_N = \text{EXP(Total)}_{N-1} + (150 * N)$$

, when $\text{EXP(Total)}_1 = 100$
And N = Current Level

3.5.5.2 Gameplay Mechanics

1. Visual and Sound Synchronization Mechanic

Visual and Sound Synchronization mechanic of this game uses help from Note Spawner. Note Spawner is the module that will read the pre-programmed song chart file. The file contains timing number and lane position for each note. When the spawner works, this module will read the timing and position, then spawn markers according to position and timing to fall along the lane to the judgement line. This will

automatically make the note visual and sound of the song synchronize with each other.

2. Life or Hit Point (HP) Mechanic

HP mechanic in this game is used in the gameplay to challenges player even more aside from hard note chart. Health Point will decrease whenever the player misses the note according to judgement mechanic. And when the health is decreased, there will be regeneration of health when the note is pressed without miss. Max health point in this game is set at 100 and each note judgement grants health point addition or reduction as in Figure 3-26.

Judgement	Health +/-
Perfect	+3
Great	+2
Fine	+1
Miss	-9

Figure 3-27 Note Judgement in Associated with Health Regeneration or Reduction

3. Notes Mechanic

There are 3 main types of notes in this game.

1. Single Note

Single Note is the note that is pressed in 1 single step. No holding.

2. Hold Note or Long Note

Hold Note is the note that represent long sound in the song. The player is intended to press and hold the note until the marker is gone.

3. FX (Effect) Note

FX Note is derived from Effect Note. It is the note that resembles special sound effect in the song. FX Note is represented as a big note that come as one in 3 lanes.

4. Song Level Design Mechanic

In this game, the song charts will be manually designed by the game designers. This will make the chart has most accuracy of the designed notes and the beat of the song. Unlike most of the game in the market that use algorithm to generate patterns using the waveform, manually designing this will grant a lot more accurate, fun and creative patterns. When the chart has been designed, we need to assign the “Level of Difficulty” to it. This level will tell how difficult the chart was. In this game, we have ranged song difficulty from Level 1(Easiest) to Level 12(Hardest). Using information such as song duration and number of notes to predict the level of the song. Equation 3.4 shows how level of song is predicted.

Equation 3.4

Let t = Song Duration in seconds

n = Number of Notes

Statistics Factor = 2.5

$$\text{Level} = \text{Round} \left(\frac{n}{t} \right) \times \text{Statistic Factor} + \text{Balancing Factor}$$

When $\text{Balancing Factor} \in \{-3, -2, -1, 0, 1, 2, 3\}$

Statistics Factor has been calculated from collected statistics of the number of notes and song duration and Balancing Factor is used by the designer when they want to adjust the level when they think that the predicted level is too low or too high

3.5.5.3 Scoring Mechanics

1. Score Updating

Score updating in this game is running in real time when the gameplay is running. Notes will be generated from Note Spawning module that generate visualized note markers following the note chart script. Then, whenever a note or notes are pressed, this will trigger an event to measure the accuracy of the pressed note. Using the exact timing from the chart script, this event will capture the mistimed hit the calculate the accuracy, then display as Judgement Word (Perfect, Great, Fine, Miss). The figure below shows the range of accuracy in milliseconds unit.

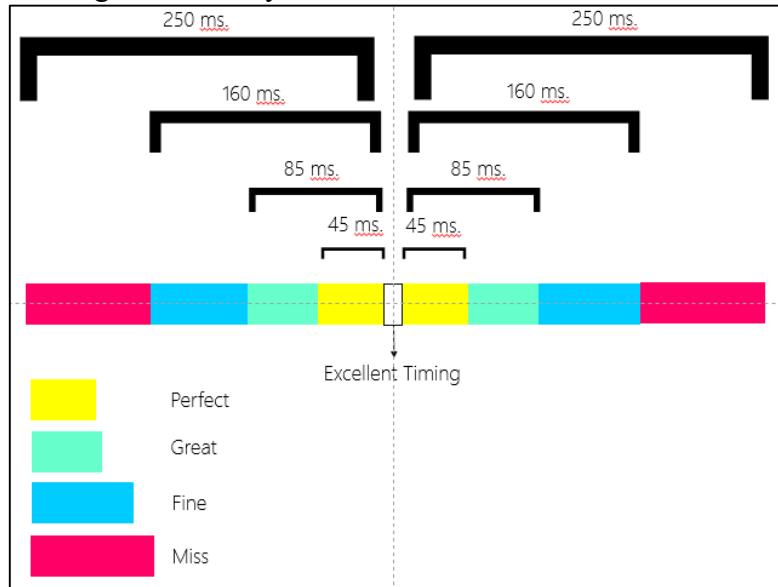


Figure 3-28 Mistimed Hit Range

From figure 3-27, excellent timing is colored in white narrow bar in the middle of the color bar. 4 colors bars that lies on the left and the right side of the excellent timing bar represent early mistimed hit and late mistimed hit. An example should be used to explain this situation. Assumed that the excellent timing is 0 milliseconds. When the note is hit at 25 milliseconds early or 25 milliseconds late will be graded as Perfect hit. Or if the note is hit at 70 milliseconds early or 70 milliseconds late will be graded as Great hit.

2. Cumulative Score Calculation and Scoring Criteria

2.1. Cumulative Score Calculation

In this game, the cumulative score is designed to be divided into 2 proportions. The first proportion is “Performance Score”, which contributes 95% to the whole cumulative score. The second part is “Combo Score” or “Combo Bonus” which contributes 5% to cumulative scores. The reason behind the division of the cumulative score into 2 parts is that, the designers concern the equilibrium between “A player who can achieve good performance by hitting the notes with high accuracy but has less concentration to maintain combos” and “A player who has average accuracy in hitting notes but can maintain the combos throughout the song”. By applying the stated cumulative score calculation, this will provide the game with equilibrium in scoring and skill of players. Also, this scoring system will help filling the gap between expert player and average player.

Continue with the cumulative score, the cumulative score of a single song of this game is designed to be 1,000,000. So, 95% of 1,000,000 is 950,000 and 5% is 50,000. As shown in Figure 3-28.

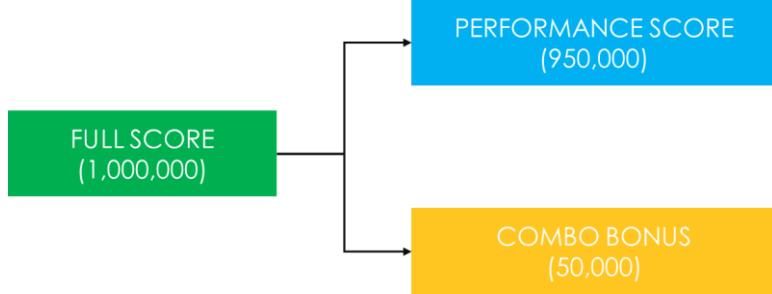


Figure 3-29 Cumulative Score Proportion

2.1.1. Performance Score

Performance Score is a major part of the whole cumulative score. It is designed to be earned by using the accuracy of the player in hitting each note. So, notes hit with high accuracy will grant high score, less accuracy will grant lower score and notes that are not hit by the player in the time that has been designed to calculate the score will grant no score at all. Now, each song in this game has a different amount of notes, so, the score of a note will not be fixed but differ throughout different song. The score for each note can be calculated from Equation 3.5.

Equation 3.5

Let x be Each note “Perfect” Score.

We can find x by:

$$x = \frac{950,000}{n}$$

When n = total notes in the song.

2.1.1.1. Performance Score and Accuracy

As stated in the previous part that the score will be calculated according to the accuracy of the player when they hit the notes, so a set constant is needed to weight between the note that has been hit with high accuracy and note that has been hit with less accuracy or has not been hit, following Figure 3-29 below.

Judgement	Score
Perfect	x
Great	$0.8*x$
Fine	$0.3*x$
Miss	0

Figure 3-30 Note Accuracy and Score Multiplier

From the table, “ x ” stands for the “Perfect” score of the note that has been calculated prior using the calculation stated in 2.1.1. Then, the perfect score will be weighed down for the lower accuracy. As in the table, “Great” accuracy score which is one level below perfect will be weighed

down by 0.8. “Fine” accuracy score which is one level below great will be weighed down by 0.3 and “Miss” accuracy which occurs when note has passed the score calculation time, the score will be automatically 0.

So, to calculate the whole Performance Score, we will use Equation 3.6.

Equation 3.6

$$\begin{aligned} \text{Performance Score} \\ = & x(\text{Number of Perfect}) \\ & + 0.8x(\text{Number or Great}) \\ & + 0.3x(\text{Number of Fine}) \end{aligned}$$

2.1.2. Combo Bonus

Combo Bonus is a minor part of the cumulative score, but yet has significance with the full score. This part of the score can help player who cannot hit notes with high accuracy has some compensation to their less accuracy by maintaining the combo throughout the song. Combo Bonus can be calculated by Equation 3.7.

Equation 3.7

$$\begin{aligned} \text{Combo Bonus} \\ = & \frac{\text{Max Combo (Long Note count as 2 combo)}}{\text{Total Note}} \\ & \times 50,000 \end{aligned}$$

From the equation above, it shown that difference in combo amount can cause significant gap between scores of 2 players. For example, a song has 500 combos. Player A achieved 500 or full combo through the song. Player B achieved only 250 combos throughout the song. So, Player A gets 50,000 combo bonus but Player B gets only 25,000 combo bonus, quite a significant gap. Furthermore, this part of the score is not only to maintain equilibrium in scoring system and player’s skill but also enthusiast and encourage the player to maintain the combo throughout the song, which is challenging.

3. Grading Criteria

Grading Criteria of this game has been designed to have a gap of 100,000 point between each letter of grade. The letters represent the grade in this game uses letters F, D, C, B, A and S. Furthermore, in grade A and S, there will be a division to make the variety of grading differ even more. As shown in Figure 3-30.

Grade	Accumulated Score
SSS	1,000,000
SS	950,000 ~
S	900,000 ~
AA	850,000 ~
A	800,000 ~
B	700,000 ~
C	600,000 ~
D	500,000 ~
F	0 ~

Figure 3-31 Grades associated with Accumulated Score

From the table above, the reason that the game has designed to have grading criteria this way is because it used psychology of esteem in the design. When achieving some grade like SS or SSS. This will make players proud in themselves, because those grades cannot be achieved easily due to the cumulative score calculation that takes combo bonus in account. So, achieving SS or SSS means that player must have played the song with high accuracy and can maintain a lot of combos along the course. This will make the one who achieve these grades feel proud and want to achieve something like this in every song and tell other people that they have these achievements in possession.

3.5.6 Database Design

Database in this game is used to store Player Information, Song Information, Login Log, Charts, Play History and Shop Information. The relationship of database can be shown as in Figure 3-31.

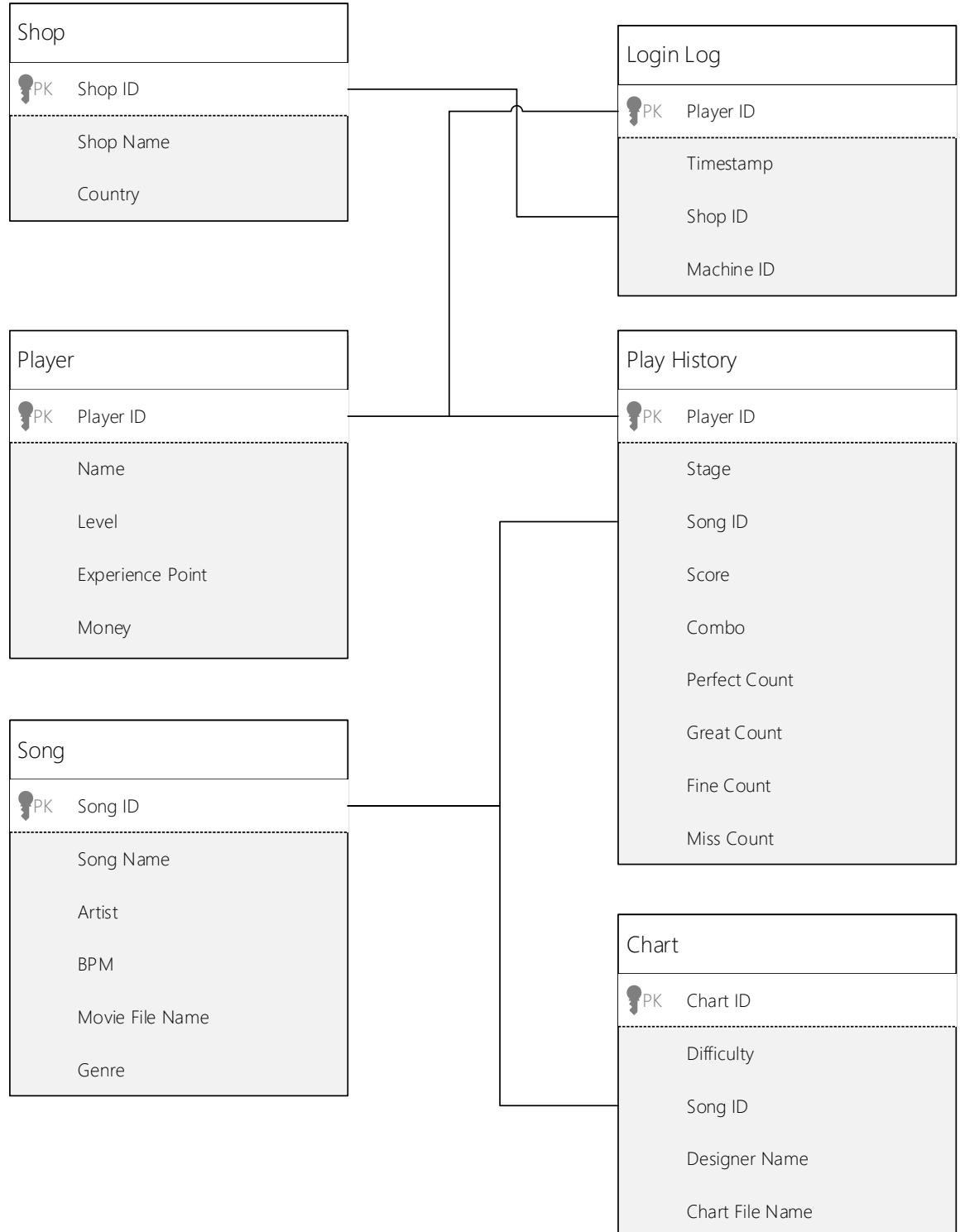


Figure 3-32 Database Design

3.6 Hardware Design

3.6.1 Controller

1. Draft Layout

For the design layout of the controller, first, there will be only one component on the controller which is buttons. On this machine, we are using 45 mm illuminating flat-panel rectangular push buttons for the note controlling buttons, all of them. The layout will be divided into 3 parts, left hand control, right hand control and central control. The layout of left hand and right hand control will be similar. The will consist of 4 buttons. 3 to control the single/normal notes. This will be arranged in zigzag way, means two on the lower levels, one on the higher level in triangular shape. Each button will be placed vertically and spaced for 0.5 inches from the other button. Another button will be used to control the FX note. For the left hand control, this button will be located on the right below the 3 note control buttons. The opposite way applies to the right hand control. There is reason behind this way of layout design. Imagine putting the hands on these buttons, it will suit the hand gesture perfectly. So, there won't be a problem of straining the hand muscle while playing the game. For the central control, there will be only one button in this area, the universal confirm button. For this button, we are using 33 mm illuminating flat-panel square push buttons. This will be located above the note control area.

The total length and width of the controller will be 31 x 8 inches, yielding 186 square inches' area. Figure 3-32 shows the layout of the controller.

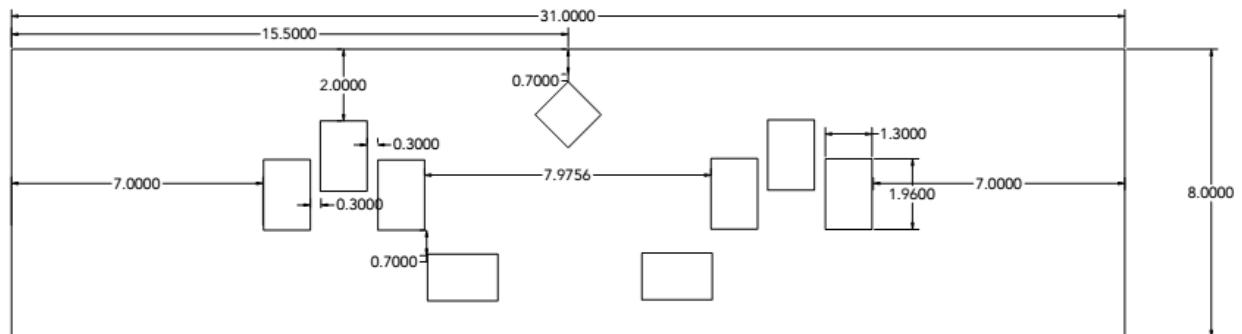


Figure 3-33 Controller Layout in Inches

2. Circuit Design

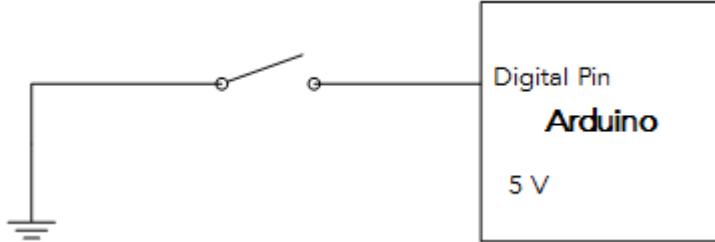


Figure 3-34 Controller Circuit (1)

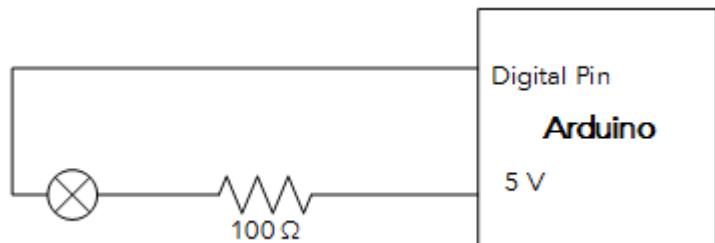


Figure 3-35 Controller Circuit (2)

The circuit of the controller utilizes the tools provided on Arduino MEGA board to connect with the lighted button switches. The switches will be connected to ground and the digital pin that will communicate between the game software and the hardware when an input and output is made, from pressing buttons. The lighting controller of the switches will be connected to a resistor of $100\ \Omega$ to the power source of Arduino MEGA that can provide 5 V power, and another leg will be connected to the digital pin to receive the signal that indicate lighting to be on or off. Lighting of the button will be on when the button is pressed and will be off when it is released.

For the detailed information about the input of the button that will be send to Arduino, the input that will be associated with programming for the software to receive the pressing will be in format of 0 and 1. It is kind of reverse logic because regularly, when the button or switch is activated, the input will be 1 and 0 when released. But in this case, the input will be 0 when the button is pressed and 1 when released, due to the nature of the switch buttons that are used.

The figure of Arduino DUE layout is provided in Figure 3-35 for more understanding.

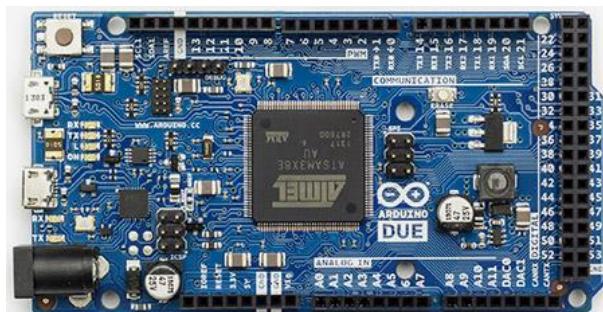


Figure 3-36 Arduino MEGA Layout

3. Key Materials

Below are key materials we planned to use in making the controller.

3.1. Planks

Planks will be used as a main structure of the box that contains the circuit. We chose to use 9 mm. thick planks to use in this work to provide durability.

3.2. Buttons

For the buttons, we used 45 mm illuminating rectangle push buttons for the controller. Because this specification of buttons has been widely used for a game like this and is proved to support the finger well. The example of buttons are shown in Figure 3-36.



Figure 3-37 45 mm Illuminating Flat-Panel Rectangular Push Buttons

3.2.1. LED

LEDs are used to illuminate the buttons when they are pressed to create more attraction to the game. The example of LED is shown in Figure 3-37.



Figure 3-38 LED

3.2.2. 100 g Pushbutton Spring

100 g Pushbutton Springs are used to provide rebound when pressing buttons. The 100 g number means that the rebound will give a soft and gentle pressure rather than hard and fierce. The example of push button springs are shown in Figure 3-38.



Figure 3-39 100g Pushbutton Spring

3.2.3. Omron Micro Switch – 25 g Pressing

Micro Switches are used as the main switch to provide a function like keyboard to play the game. The 25 g Pressing number shows that the switch requires only 25 g pressure to activate. The example of Omron Micro Switch is shown in Figure 3-39.



Figure 3-40 Omron Micro Switch - 25 g Pressing

3.3. Arduino MEGA

Refers to figure 3-34, Arduino MEGA is used to provide a programmable feature to the switch buttons and being power source for lighting LED light for the buttons.

3.6.2 Cabinet

1. Draft Architecture

The dimension of the cabinet will be of 53 inches in height by 31 inches' length and 31 inches' width. The cabinet will be divided into 3 major parts: the stand, the controller and the screen, plus the speakers and decorations.

1.1. Stand

The stand is the part in the bottom of the cabinet. It takes role in supporting the controller and screen. Also, this will be the place to store the CPU. For the dimension, the stand will be 86 cm high by 78 cm wide by 19 cm thick, that on top will be the controller and the bottom part will be cavities for CPU and coins. Next is the stand for the monitor that will be about 1-meter-high by 78 cm width by 30 cm thick. The monitor will be place on this stand. Also, there will be a space about 45 cm from the stand and the TV to create a vision distance and will also be used to stick the controller stand and TV stand together.

1.2. Controller

The controller stands beyond the stand. Using the same dimension of the controller in 3.6.1 the controller will be standing on the stand making around 15 degrees to make it support the hand of the player. This will make around 4 inches' distance in height from the stand.

1.3. Screen

For the screen, this part will be next to the controller, above it. We are using 32-inch LED monitor in this machine. Figure 3-40 is an example of a LED monitor with its measurements.



Figure 3-41 32-Inch LED Monitor with Measurements

For the figure of the draft of cabinet architecture can be found in Figure 3-41 on the next page.

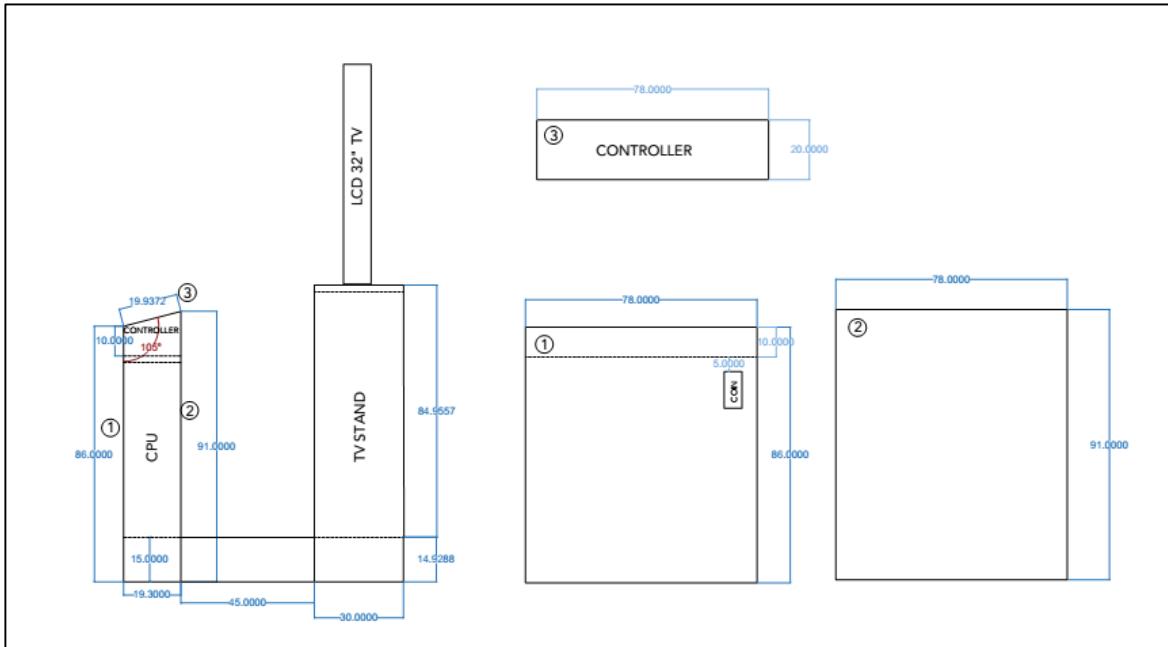


Figure 3-42 Draft Cabinet Architecture - Side View & Front View (Inches)

3.6.3 Software Integration

For the integration with the software. The hardware which consists of 9 buttons and 1 coin acceptor will be connected to Arduino DUE. Then, Arduino DUE, when connected can act as a controller and imitate the input from hardware as keyboard and mouse. So, the buttons and coin acceptor that is connected will be seen by the game software as a keyboard input. Next, the buttons will be assigned to specific buttons on keyboard by a keyboard input module and the game's interface and gameplay module can receive inputs as keyboard input. Figure 3-42 below shows the block diagram of software and hardware linkage.

The next section will show the linkage of hardware to each screen of the game.

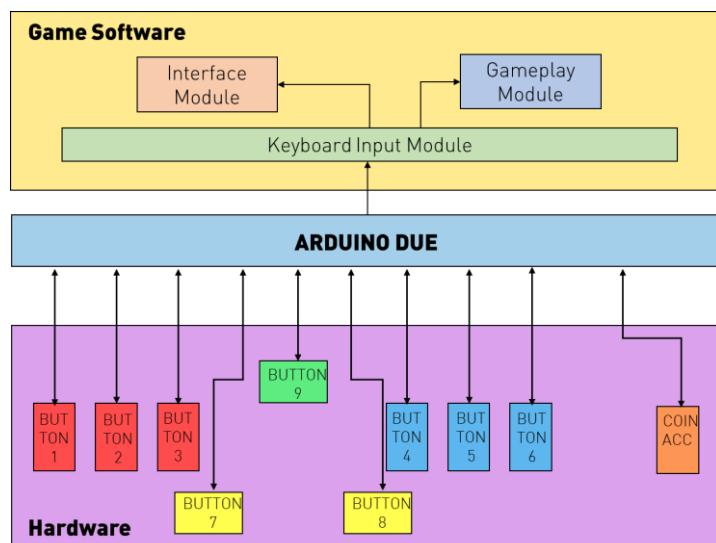


Figure 3-43 Block Diagram shows hardware and software linkage

1. Screen 1: Start Screen

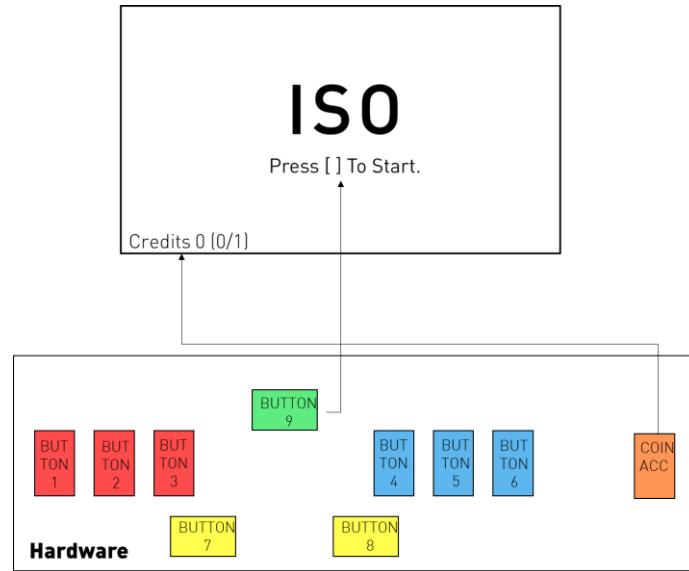


Figure 3-44 Linkage of hardware and Start Screen

For start screen, the signal of coin acceptor when the coin is accepted will activate the incrementing of the credit. Button 9 will be used to activate or start the game. The linkage is shown in Figure 3-43.

2. Screen 2: Mode Selection Screen

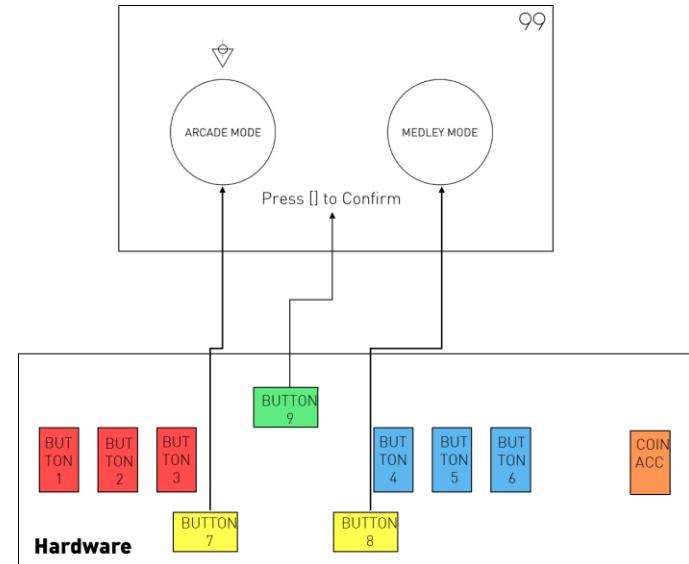


Figure 3-45 Linkage of hardware and Mode Selection Screen

For mode selection screen, button 7 and 8 are used to select between the 2 modes and button 9 is used to confirm and proceed to the next page. The linkage is shown in Figure 3-44.

3. Screen 3: Song Selection Screen

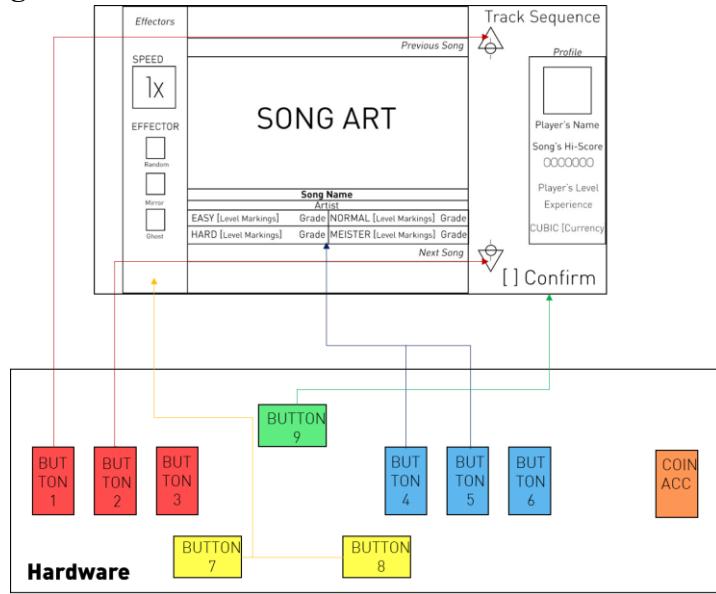


Figure 3-46 Linkage of hardware and Song Selection Screen

For song selection screen, button 1 and 2 are used to scroll up and down the song list. Button 4 and 5 are used to scroll the difficulty. Button 7 and 8 are used to call up the effector list and button 9 is used to confirm. The linkage is shown in Figure 3-45.

4. Screen 4: Gameplay Screen

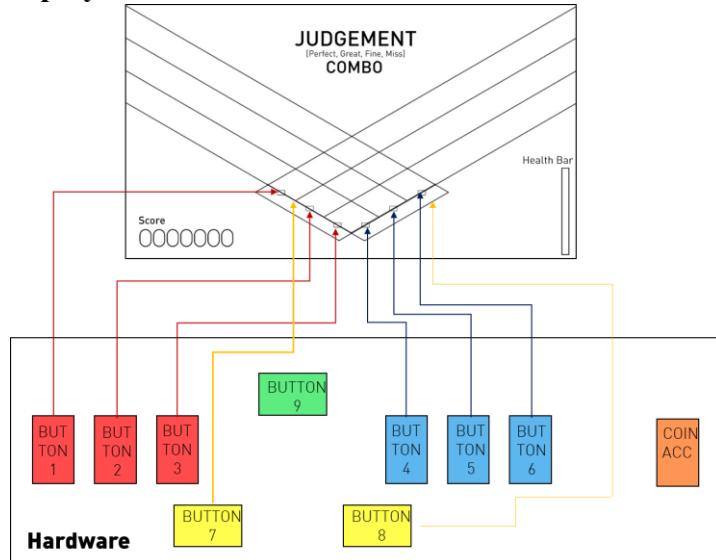


Figure 3-47 Linkage of hardware and Gameplay Screen

For gameplay screen, Button 1, 2 and 3 are used to control the lane coming from the right. Button 4,5 and 6 are used to control the lane coming from the left. Button 7 is used to control FX lane coming from the right and button 8 is used to control the FX lane coming from the left. The linkage is shown in Figure 3-46.

5. Screen 5: Result Screen

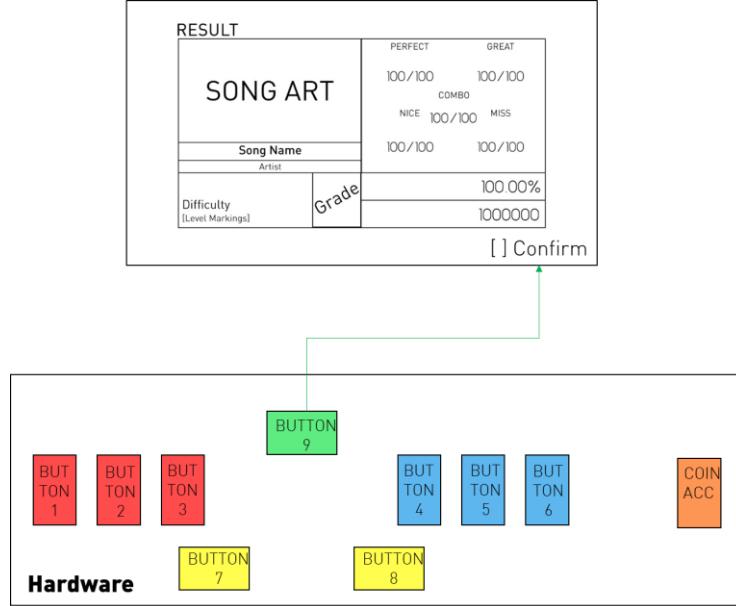


Figure 3-48 Linkage of hardware and Result Screen

For result screen, button 9 is used to proceed after the player finished looking at the result. The linkage is shown in Figure 3-47.

6. Screen 6: Total Result Screen

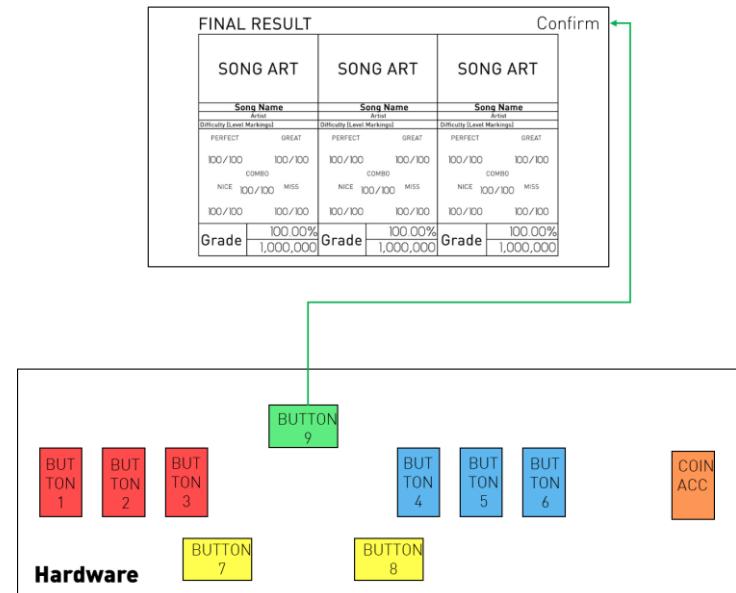


Figure 3-49 Linkage of hardware and Total Result Screen

For total result screen, button 9 is used to proceed after the player finished looking at the result. The linkage is shown in Figure 3-48.

3.7 Graphics

1. Notes

1.1. Single Note

Figure 3-49 below shows the single note design in the game.

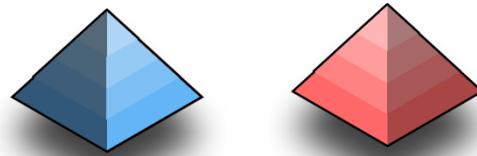


Figure 3-50 Single Notes

1.2. Long Note

Figure 3-50 below shows hold note design in the game.

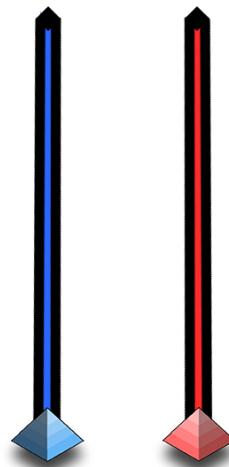


Figure 3-51 Hold Notes

1.3. FX Note

Figure 3-51 below shows FX note design in the game.



Figure 3-52 FX Notes

2. Gear or Stage

Figure 3-52 below shows gear design in the game.

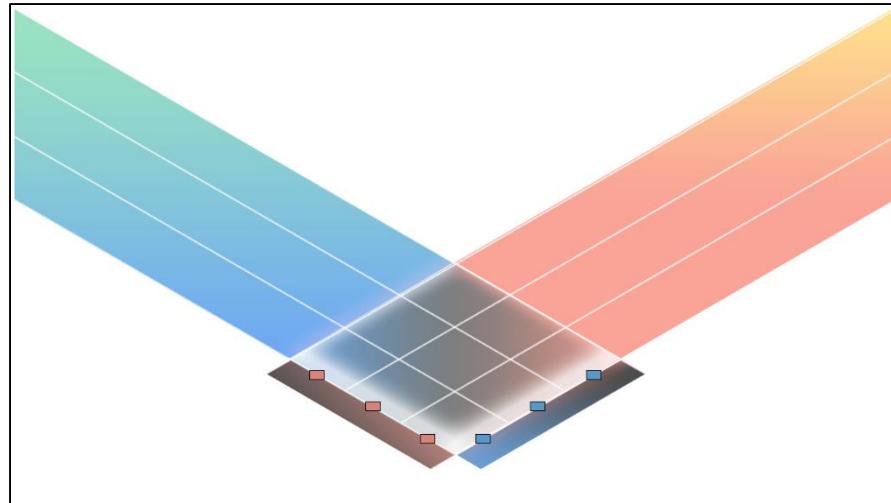


Figure 3-53 Gear

3. Note Hit Burst

Figure 3-53 below shows hit burst animation design in the game.

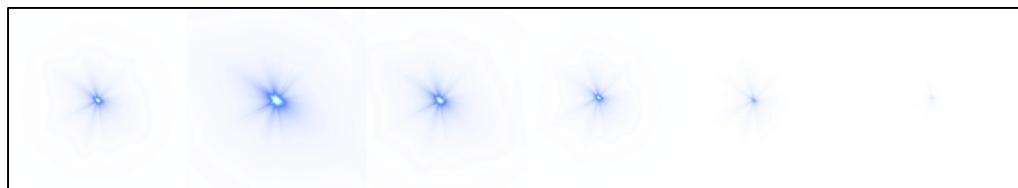


Figure 3-54 Hit Burst Animation

3.8 Sound and Music

1. Sound Effect

1.1. Interface Sound Effect

Interface Sound Effects are sound effect that will be triggered when pressing confirm, scrolling between menus or songs.

1.2. Gameplay Sound Effect

Gameplay Sound Effects are sound effects that will be triggered when pressing notes or missing notes.

2. Songs

Songs are the important part of this game, because they are considered as stages when comparing to RPG kind of game. In this game, there will be variety of songs from many genres. Ranged from Pop, Classical to Electronics. Creating diversity of choice of stages in game.

3.9 Software Prototype Evaluation

After the gameplay part of the software has been implemented as a prototype, we will distribute to inner circle people for example, our acquaintance or fellow student to test the gameplay. Then, we do evaluate the gameplay experience and collecting feedback to improve the game. The questionnaire and interview is the type or data collection we chose. The detailed questionnaire can be found in the appendix.

For the in-depth analysis of the software prototype, the questionnaire is designed to collect the player's experience after trying the game. The result of the questionnaire can be used to analyze the overall performance of the game including balance and understandability, the suitability of songs, graphics and sound effect in the game. In which, this information can be used to improve the game quality to satisfy the player's need.

3.10 Hardware Prototype Evaluation

In the same manner of software prototype design and implementation, after we have concluded the design of our hardware and implement the prototype of them, we planned to conduct an evaluation session for the said prototype. The session for controller prototype will be conducted with a group of volunteered people who want to test our prototype. These volunteers will be asked to play the game using the controller prototype and will be questioned for various issue about the prototype. These issues may range from gameplay suitability, appearance or health and gesture related issue. The design of the survey questions that will be conducted in the evaluation session can be found in the appendix.

The questionnaire is designed to collect experience and opinion on the hardware. For controller, the result of the questionnaire can be analyzed into the suitability of the layout that is designed, the quality and performance of the buttons and how much the controller create muscle stress. For the cabinet, the result of the questionnaire can be analyzed into how much the cabinet impressed the player, the usability of the cabinet components, the safety of the cabinet and how risk the cabinet can cause health problems.

Chapter 4

Results and Discussion

4.1 Results

4.1.1 Game Software Prototype

So far in the first semester, we were able to develop the prototype of the core gameplay of this game. This prototype can be played to evaluate the suitability and fun of the gameplay that we have designed.

The finished prototype has an ability to sync well between the visual and sound. The visual note markers come in the right time corresponding to the beat of the song.

Figure 4-1 to 4-5 are screenshots of the prototype that we have been developed.



Figure 4-1 Game Software Prototype - Start Screen

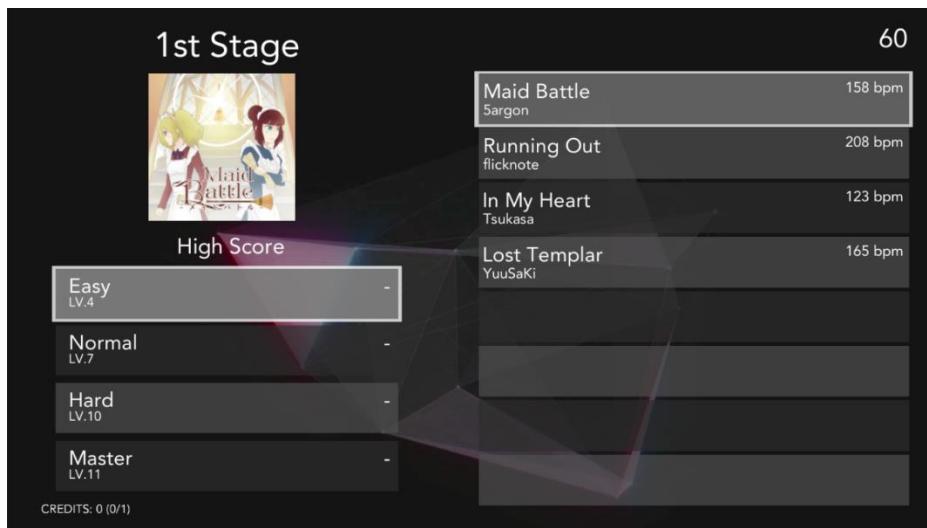


Figure 4-2 Game Software Prototype - Song Selection Screen



Figure 4-3 Game Software Prototype – Gameplay Screen (1)



Figure 4-4 Game Software Prototype – Gameplay Screen (2)

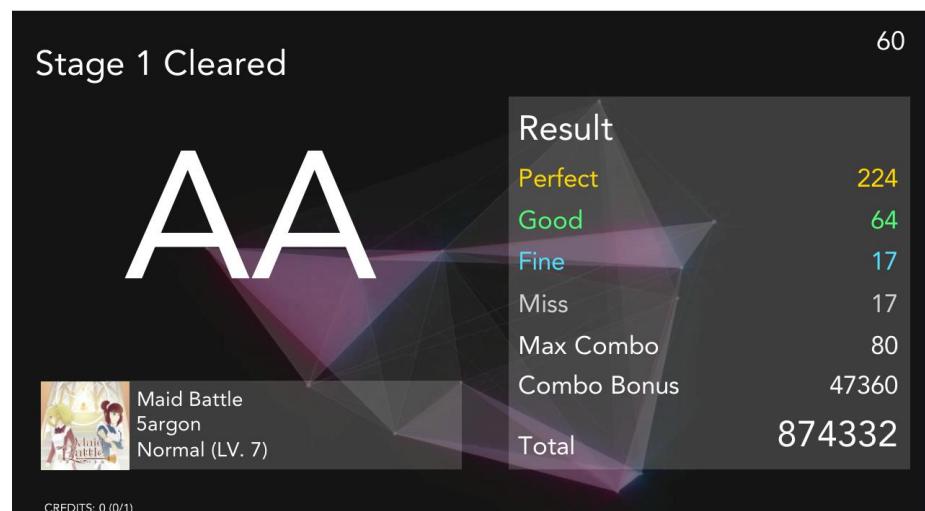


Figure 4-5 Game Software Prototype - Result Screen

4.1.2 Controller Prototype

As in the first half of the second semester. After we have been working on analyzing feedback from the gameplay prototype evaluation and conclude the result, we decided to start working on the hardware part starting from the controller. Starting from drafting the design of the controller and selecting the materials, then we put those things together.

The figure below shows rough sneak peek on the details of the controller prototype. For this prototype, it must be noticed that, some part of it is still incomplete. For example, the confirm button which is planned to be on the top of the controller is still missing because of lacking in the material, which has been solved for the future by ordering some more of them. And more of incomplete issue on working with details of the appearance, like the edge and the margin of the plank which is used to make up the controller has yet to be trim to create a tidy work, the buttons' colors are still unorganized and we will fix this when the new lot of materials comes and also decoration work.

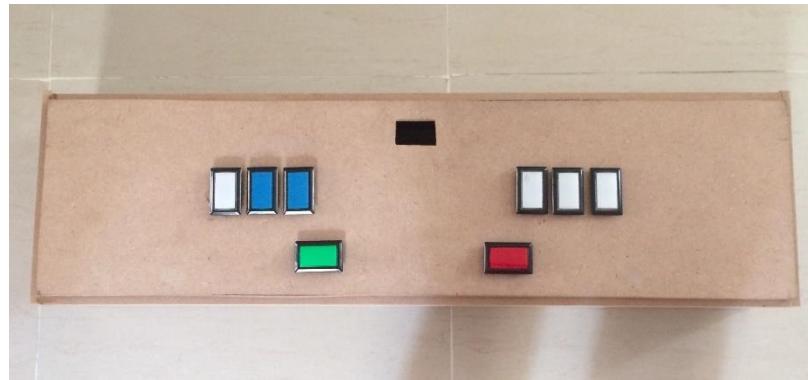


Figure 4-6 Controller Prototype (1)

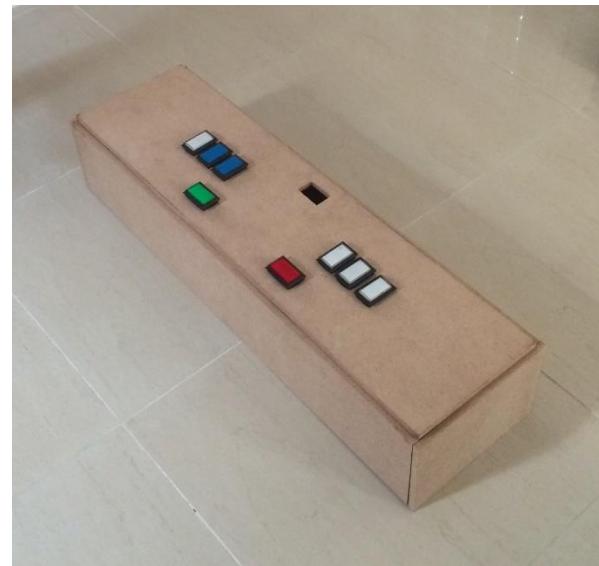


Figure 4-7 Controller Prototype (2)

Anyway, in midst of the said problems, we are able to create a prototype that can be used to do test play and gesture test and we are planning on having volunteers to test on the prototype in the near future.

Lastly, we must state that the reason that makes the works seem to progress slower than

expected is because we have some issues on finding materials like planks which are specifically hard to order because we are using the size that is not a standard plank size. And we do not want to cut it ourselves because we believe that using industrial tools can provide more accurate work but at last we ended up cutting the planks ourselves. Another problem belongs to shipping issues because most of the materials must be ordered from outside the country, so it takes time.

4.1.3 Official Software

1. Title Screen

The title screen is shown in Figure 4-8. The screen will show the game name big in the center and there will be a message that ask the player to insert coin. When a coin is inserted, the credit number at the bottom left of the screen will be increment. In this case it is “CREDITS 0 (0/1)” means that it needs one coin to activate one credit/play of the game. And when the credit is activated, player can press confirm button to proceed to the game.



Figure 4-8 Official Software - Title Screen

2. Mode Selection Screen

The second screen after title screen is mode selection screen as shown in Figure 4-9. The concept of this screen is very simple. The player can scroll left and right to select the desired mode. The Arcade mode on the left provide 3 stages with song of player's own choice. The Medley mode, which hasn't been implemented provide 4 stages with 3 selected songs and 1 random song with shared HP gauge. After the player finally decided on the mode, the confirm button can be pressed to proceed to song selection screen.

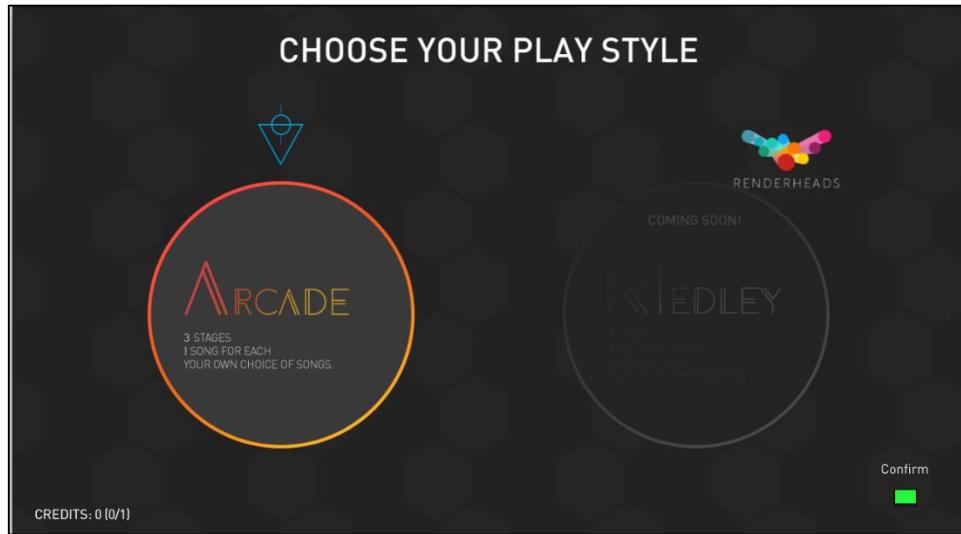


Figure 4-9 Official Software - Mode Selection Screen

3. Song Selection Screen

Figure 4-10 and 4-11 is song selection screens. The screen mainly consists of the list of songs and its difficulty, the player information, the effector list, the song sequence and the countdown. Firstly, the user will be using 2 leftmost blue buttons on the controller to scroll up and down for the song. The 2 leftmost red buttons will be used to scroll for difficulty. After the song and difficulty is decided, player can press confirm button (green) to proceed to effector selection.

For effector selection, the player can use 2 leftmost red buttons to change the speed of approaching note and blue buttons to turn on or off the effector which, from the left, the first one is used to turn on random effector, the second is used to turn on mirror effector and the last one is used to turn on the ghost effector. And when everything is decided, the player can press confirm button to start the song.

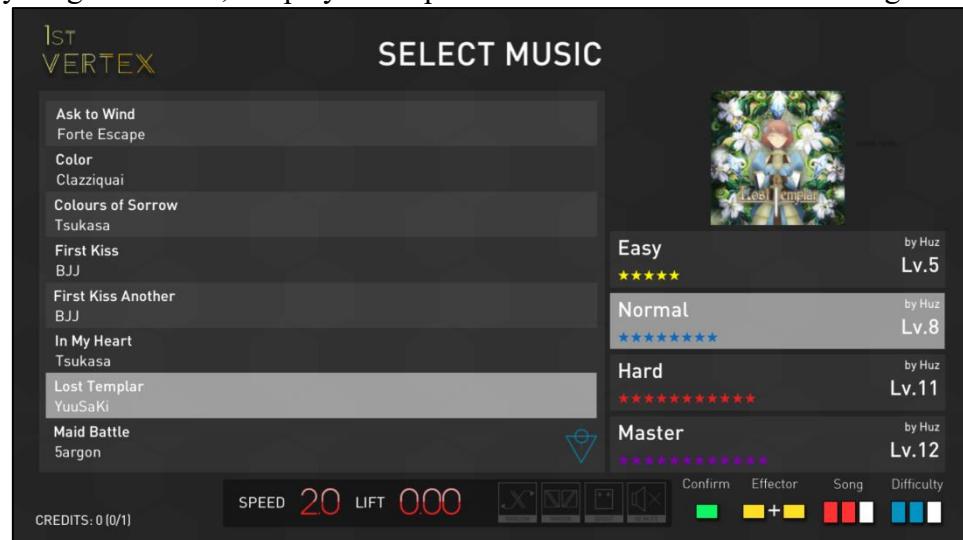


Figure 4-10 Official Software - Song Selection Screen (1)

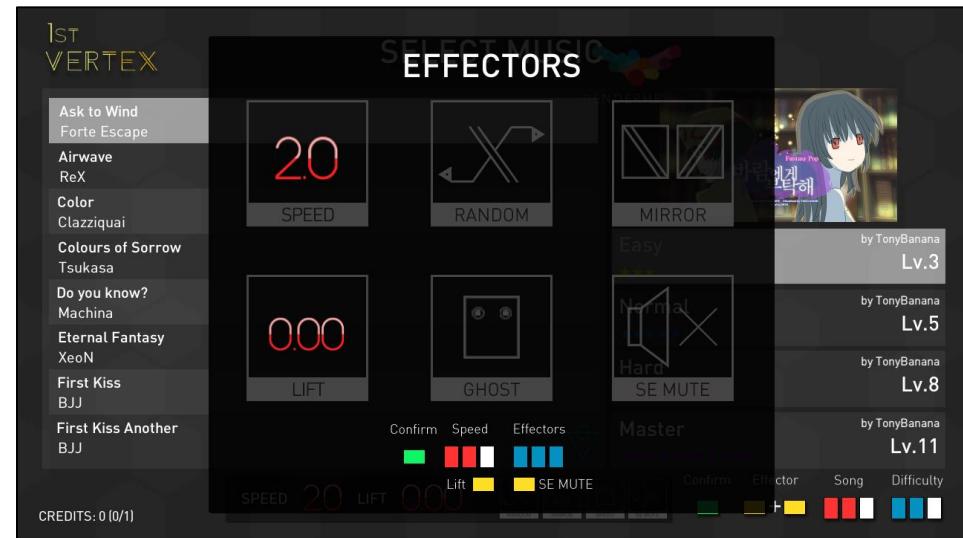


Figure 4-11 Official Software - Song Selection Screen (2)

4. Gameplay Screen

After song selection screen, the next is gameplay screen as shown in figure 4-12. The majority of the area of the screen is occupied with the game's gear which the note will approach and player has to press the corresponding button. Next, the upmost part of the screen will show the judgement of the just pressed note. It indicates how accurate the note is pressed. Another thing that is shown is combo, indicates the amount of note that have been pressed consecutively without missing. Then, at the bottom left of the screen will be the score that will keep updating as the note is pressed. At the bottom right is the health gauge, that will be decreased if the note is missed and will be regenerated after an amount of perfectly accurate notes are pressed.



Figure 4-12 Official Software - Gameplay Screen

5. Result Screen

Figure 4-13 below is the result screen. This screen will come after the song is finished. On this screen, there will be the song's album art on the left, and the song name artist and difficulty. Then, on the right, there will be the panel that show the information about the notes that were pressed during the song, categorized in how accurate they are pressed. There will be the total combo shown in the middle of the panel and the percentage ratio of accuracy shown at the bottom along with the total accumulated score. When the player finished looking at the result, the confirm button can be pressed to proceed.



Figure 4-13 Official Software - Result Screen

6. Total Result Screen

The total result screen in Figure 4-14 is a collection of all result screens that are shown in the session, arranged in sequence order. The player can see the whole performance that he or she played on this screen. The screen will proceed after a short period of time.

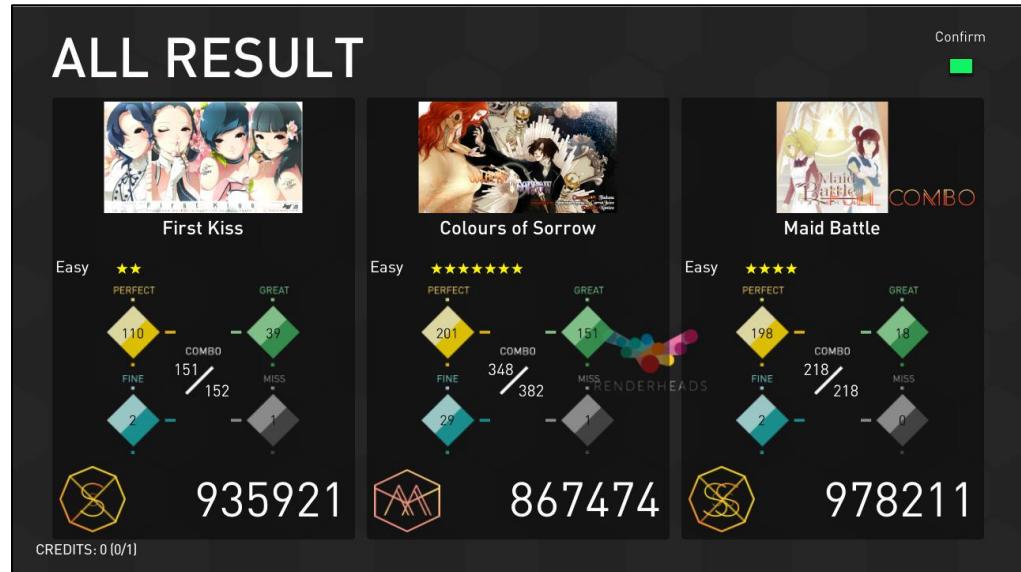


Figure 4-14 Official Software - Total Result Screen

7. Game Over Screen

The last screen, the game over screen is shown in Figure 4-15. This screen purpose is to appreciate the player that he or she play this game. If the player inserts a coin and activate the credit, the game will be ready for playing again.

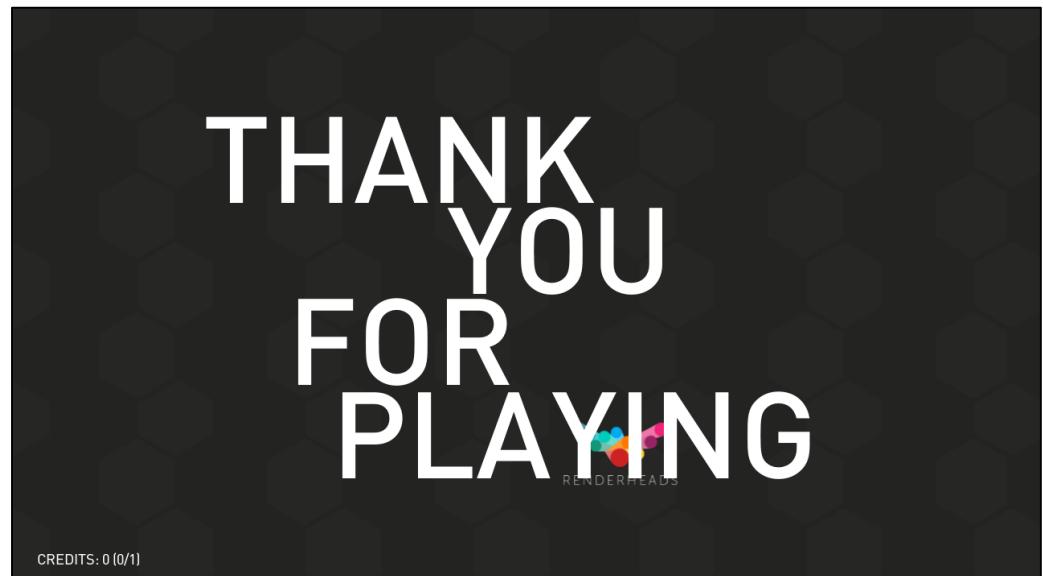


Figure 4-15 Official Software - Game Over Screen

4.1.4 Final Machine

Figure 4-16 shows the finished final machine. The machine consisted of the controller panel, coin acceptor and the stand for TV and speakers. The TV and speakers will be separated. The machine can be activated by, first, put the TV and the speakers on the stand. Then, connect the HDMI cable of the TV and sound cables of the speakers to the PC. Next, connect the USB cable of the Arduino to one of the USB port of the PC. Then launch the software and the machine is ready.



Figure 4-16 Final Machine

4.2 Functionality

While developing the gameplay prototype, the developers frequently conduct testing with the software prototype to make sure that the game functions well and find the bugs that we should fix and improve the software.

4.2.1 Software Functionality

1. Visual and Sound Synchronization Mechanic

- The gameplay can spawn notes according to the beat of song.
- The gameplay can maintain stability of the note spawned and the timing of the beat of song.

2. Life or Hit Point Mechanic

- The gameplay can reduce the life point when the note is missed.
- The gameplay can regenerate life point when the note is hit when the life point is not full.
- The gameplay can change state to game over when the life point is zero.

3. Note Mechanic

- The gameplay can display single note and FX note along with handling its function.

4. Score Updating Mechanic

- The gameplay can recognize the time the note is hit and compare the mistimed hit with the pre-generated timing.
- The gameplay can calculate the score of each note according to the accuracy calculated from comparing the mistimed hit and the pre-generated timing.

5. Cumulative Score Calculation

- The gameplay can calculate the score from total note score and combo bonus.

4.2.2 Software Prototype

So far in this semester, we have been able to develop the prototype of the core gameplay of this game. This prototype can be played to evaluate the suitability and fun of the gameplay that we have designed.

The finished prototype has an ability to sync well between the visual and sound. The visual note markers come in the right time corresponding to the beat of the song.

Figure 4-1 and 4-2 are screenshots of the prototype that we have been developed.

4.2.3 Software Prototype Evaluation

After finishing the software prototype, we conduct a test play with our acquaintance and the community of music game player that is interested in testing this game to find out how satisfying the gameplay was and detect any flaw. There are 11 participants in this test play and evaluation. The reason that the number of the participants is quite few is because we selected a specific group of people to do the evaluation, not everyone, and the time we have to conduct this activity is quite limited because we need to follow up with our schedule.

The results of the evaluation are stated below, categorized in category, which are General Information, Overall, Fun and Benefits and Usability.

1. General Information

In this part, we collected the data about general information of the participants. The information is such as name or alias, age and gender.

1.1. Gender

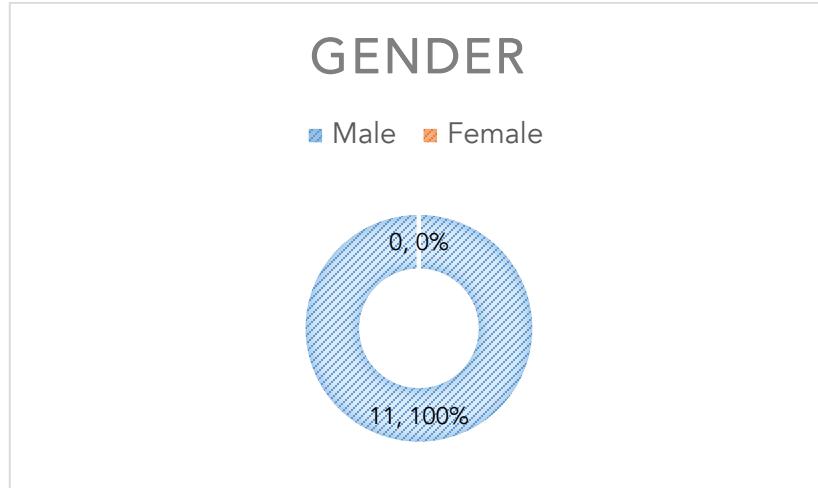


Figure 4-17 Doughnut Chart shows the gender of participants.

All the participants in this evaluation are all male. Because the purpose of this evaluation is to find out how satisfying the gameplay is and finding the flaws of the game. So, from the statistics, this game category or music game is more familiar to male player. So, all of the participants are male. The portion of the gender of the participants is shown in Figure 4-17.

1.2. Age Range

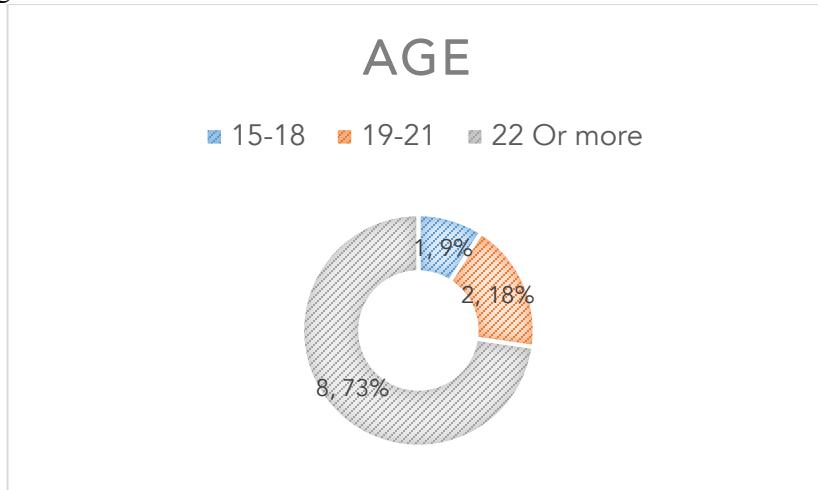


Figure 4-18 Doughnut Chart shows age range of participants.

Majority of people who participated in this evaluation are in the age range of 22 years old or more. This makes the evaluation results and suggestion more technical. Because the people with higher age tend to have more experiences in this kind of game and also in programming. So, we can get many useful suggestions to help with our design and development. The portion of the gender of the participants is shown in Figure 4-18.

2. Overall

In this part, we collected data about overall gameplay, the songs, scoring, graphics and sound effect. Simply put, it's all about the gameplay.

2.1. Overall

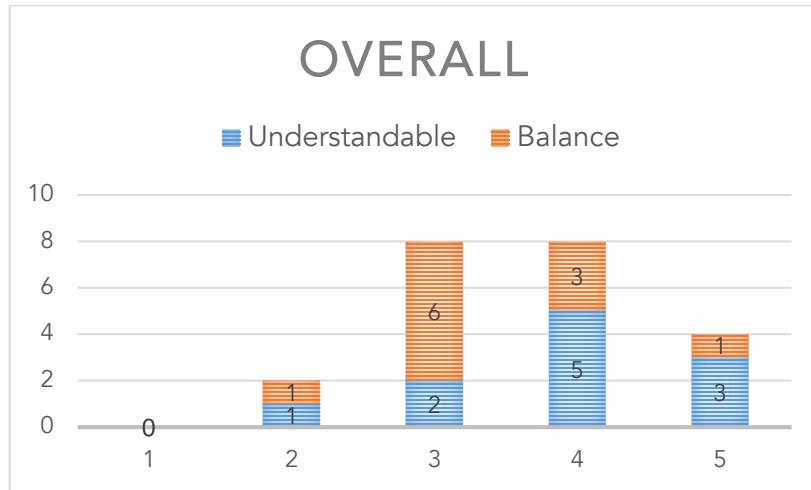


Figure 4-19 Bar Chart shows Overall Satisfaction

For Overall part, we are asking participants about how understandable the game is and about the balance of the game. The result implies that the overall gameplay is quite satisfying, the scores are mostly in 3 or 4. So, the game is quite easy to understand and quite balance, means it's not too easy or too hard. What we can improve from this part is that, we may consider adding a tutorial to teach how to play the game. The detailed score portion is shown in Figure 4-19.

2.2. Songs

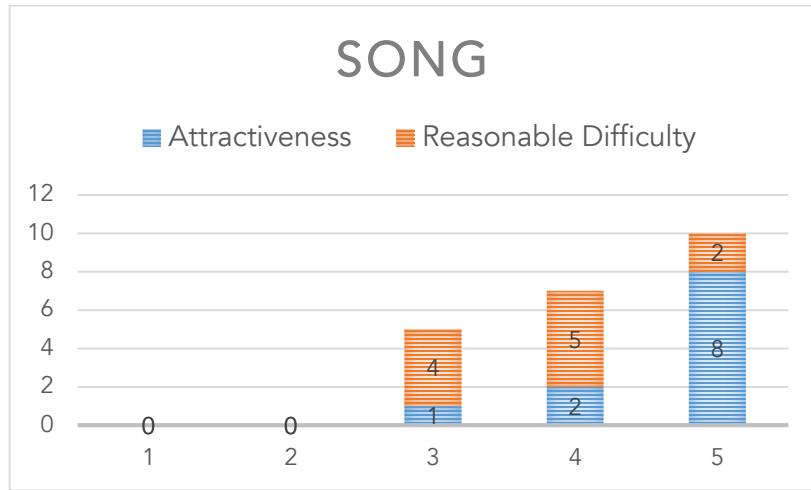


Figure 4-20 Bar Chart shows Songs Satisfaction

In this part, we asked the participants about the attractiveness of the song offered in the game and the difficulty of each difficulty chart. The result implies that the song is really attractive but the chart difficulty can be more balanced. So, we are going to add catchier and interesting song and nerve some over difficult chart. The detailed score portion is shown in Figure 4-20.

2.3. Scoring

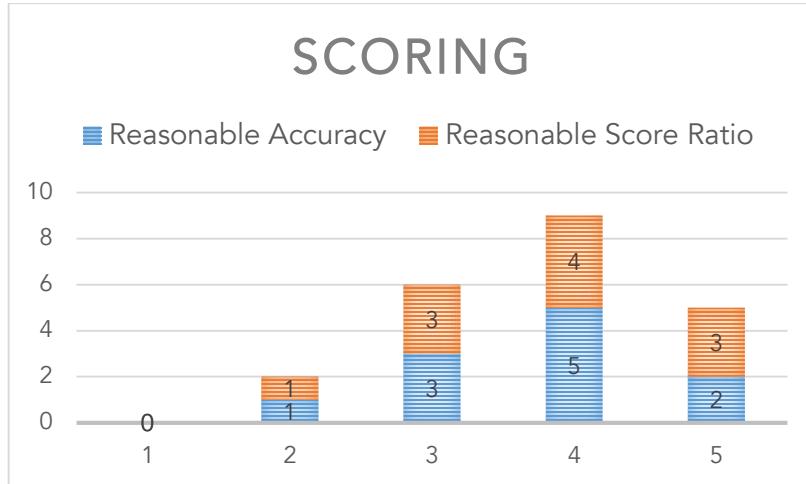


Figure 4-21 Bar Chart Shows Scoring Satisfaction

In this part, we asked the participants about the scoring in this game. The score given to the accuracy in pressing note reasonability and the score ratio reasonability. The result implies that the players are quite satisfy about the score given to the player according to the accuracy they pressed. But some gives suggestions that the total score ratio is not very reasonable and make the score inflate. So, we will reconsider the ratio of total score to be more reasonable. The detailed score portion is shown in Figure 4-21.

2.4. Graphics

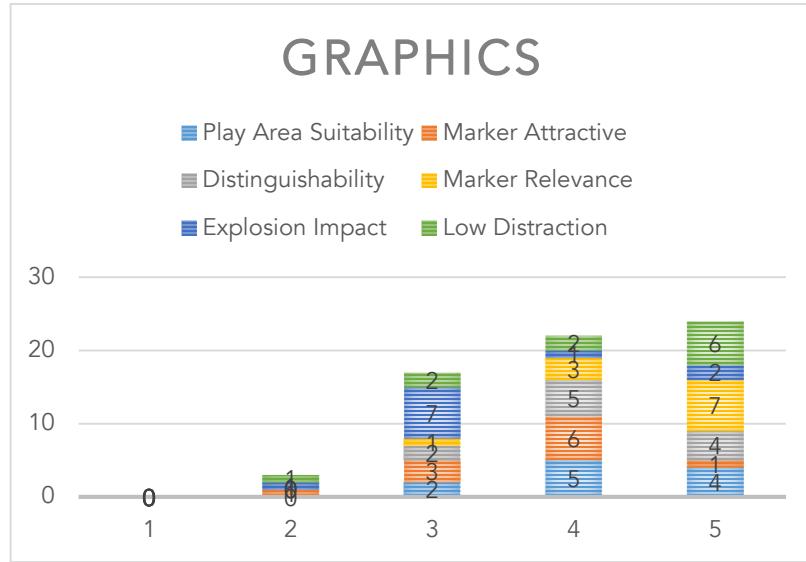


Figure 4-22 Bar Chart shows Graphics Satisfaction

In this part, we asked the participants about the graphics in game, including the play area, the note marker and the explosion. Most of the people are quite satisfy with the play area and the explosion but the note marker is quite plain and similar to other game. So, we will improve this by redesign the note marker and maybe the explosion too. The detailed score portion is shown in Figure 4-22.

2.5. Sound Effect

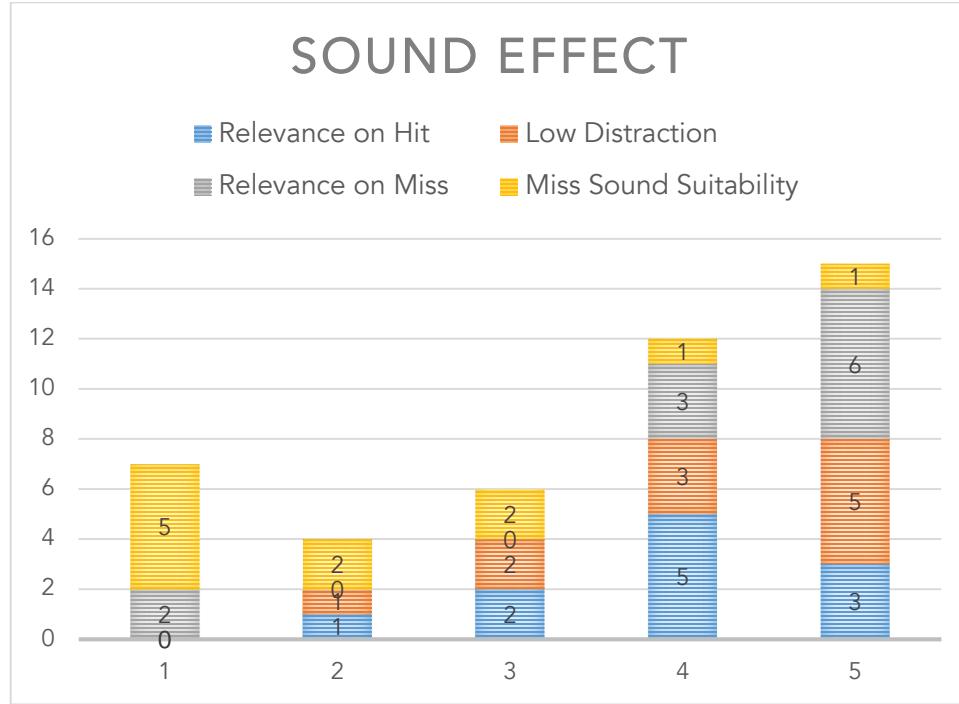


Figure 4-23 Bar Chart shows Sound Effect Satisfaction

In this part, we asked the participants about the sound effect, the one that is played when the player hit or miss the note. We focused on the relevance of the sound effect and how it can distract player during the play. The result implies that the sound effect is quite relevance but not very satisfying and the miss note sound is not suitable to the game. So, we are going to replace both hit and miss sound with more appropriate sound effect. The detailed score portion is shown in Figure 4-23.

3. Fun

In this part, we collected the data about fun of the game. The information is divided into physical, mental and social fun.

3.1. Physical

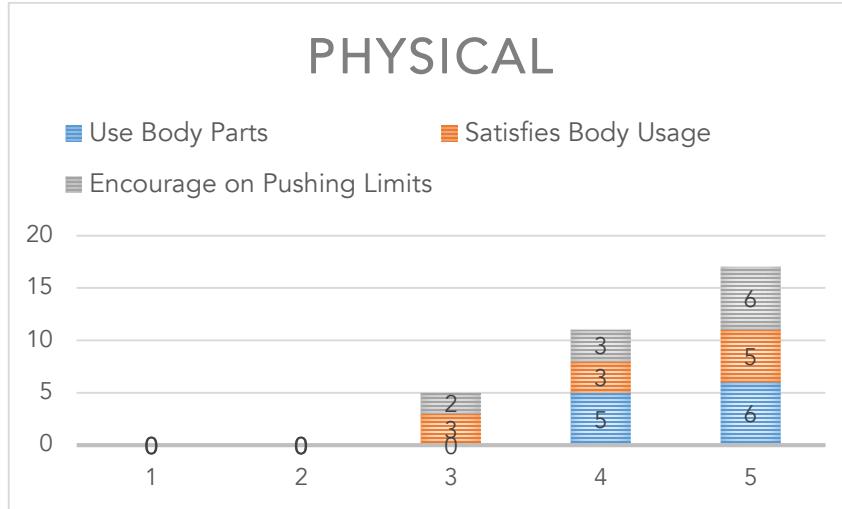


Figure 4-24 Bar Chart shows Physical Fun Satisfaction

For Physical Fun, we asked the participants about how the game satisfies their body needs. We asked questions on how much the game use the body parts and does it satisfies the need of body exercise. The result implies that the game can satisfy the physical need of the player very well. So, we are going to keep this quality in the final launch. The detailed score portion is shown in Figure 4-24.

3.2. Mental

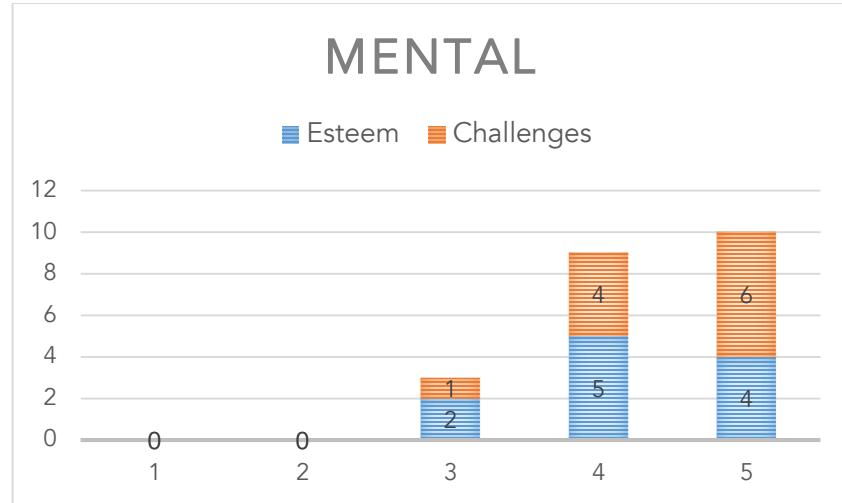


Figure 4-25 Bar Chart shows Mental Fun Satisfaction

For Mental Fun, we asked the participants on how the game gives the feel of esteems and challenges to the player. The result implies that the game is successful in this part. The game make participants feel proud when they clear the stage and challenges their potential. We can add more challenges in this game to make it more interesting and challenging in the future. The detailed score portion is shown in Figure 4-25.

3.3. Social

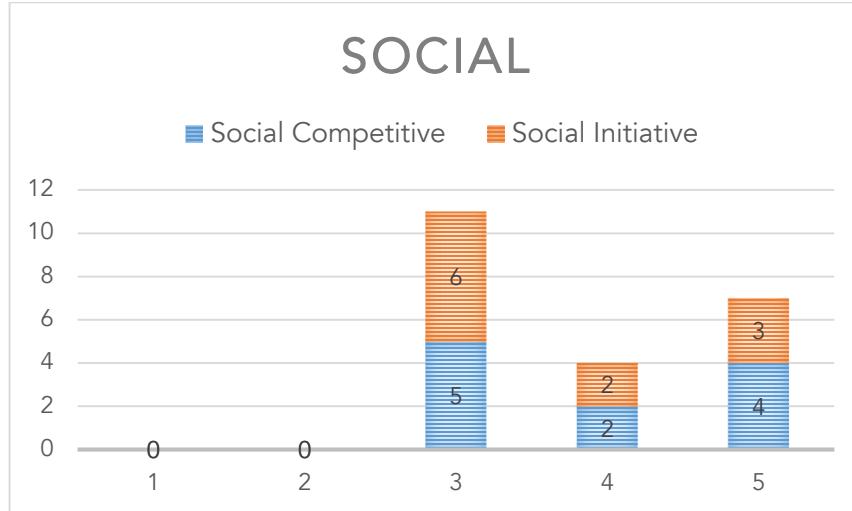


Figure 4-26 Bar Chart shows Social Fun Satisfaction

In this part, we asked the participants on how this game satisfies their social needs. The result implies that this game moderately satisfies social needs. Maybe because this game is quite new so there are not many people know about this and it can't be considered as a big community. So, we will try to make the game interesting and promote to more people, so there can be a community that players can talk and compete on their performance. The detailed score portion is shown in Figure 4-26.

4. Benefits and Usability

In this part, we collected the data about benefits and usability of the game.

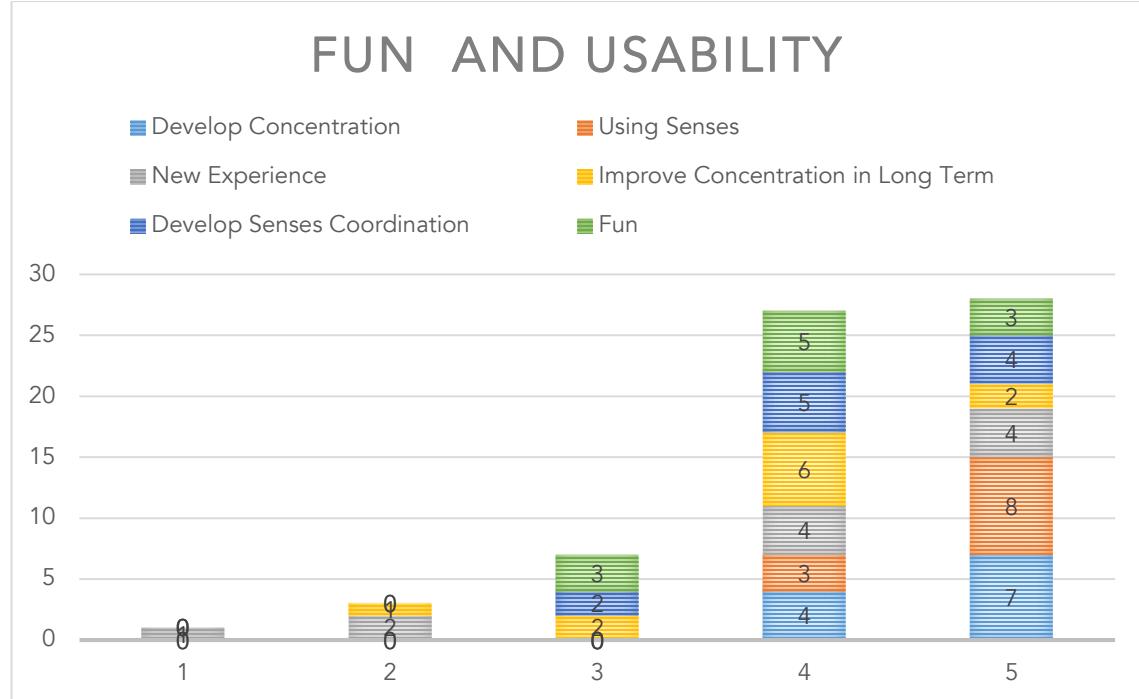


Figure 4-27 Bar Chart shows Fun and Usability Satisfaction

In this part we asked about overall fun and benefits of this game. How much the game develop concentration, sense coordination, giving fun and offer new experience to the participants. The result is that the game really satisfies in this point. It helps developing concentration and sense coordination and also gives fun and new experience in music game. The detailed score portion is shown in Figure 4-27.

4.2.4 Hardware Functionality

4.2.4.1 Controller

1. Buttons Usability

- The buttons are able to be used to give input to the game instead of using keyboard like in the prototype stage.

2. Lightings

- Buttons have lights when pressing and remain dim when they haven't been pressed.
- Buttons' light blink in rhythm while in "Customer Attraction Mode" when the game hasn't been activated.

4.2.4.2 Cabinet

1. Integration with Controllers

- The cabinet is able to support the controller that is attached to it without collapsing.

2. Display Screen

- The cabinet is able to hold the display screen that will be used to display the game status.

3. Coin Acceptor

- The cabinet has a working coin acceptor attached to it. This will be used to accept coins and activate the machine.

4. Lightings

- The cabinet has lightings attached to it to attract people who pass by.

4.2.5 Hardware Prototype Evaluation

This part is the part that we will analyze the result from doing the evaluation on the hardware and plan to response on feedback from the volunteers.

4.2.5.1 Controller

1. General Information

In this part, we collected the data about general information of the participants. The information is such as name or alias, age and gender.

1.1. Gender

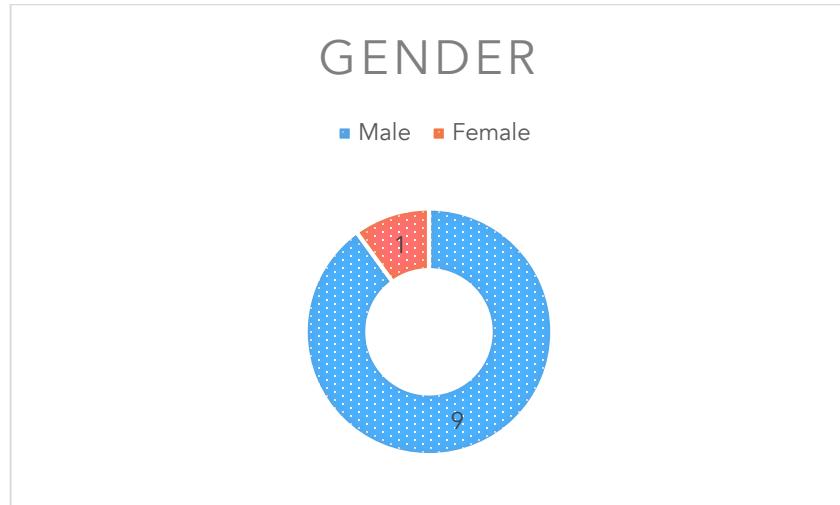


Figure 4-28 Doughnut Chart shows the gender of participants.

In this evaluation of controllers, there are total of 10 participants, in which 9 of them are men and 1 of them are woman. The portion of the gender of the participants is shown in Figure 4-28.

1.2. Age

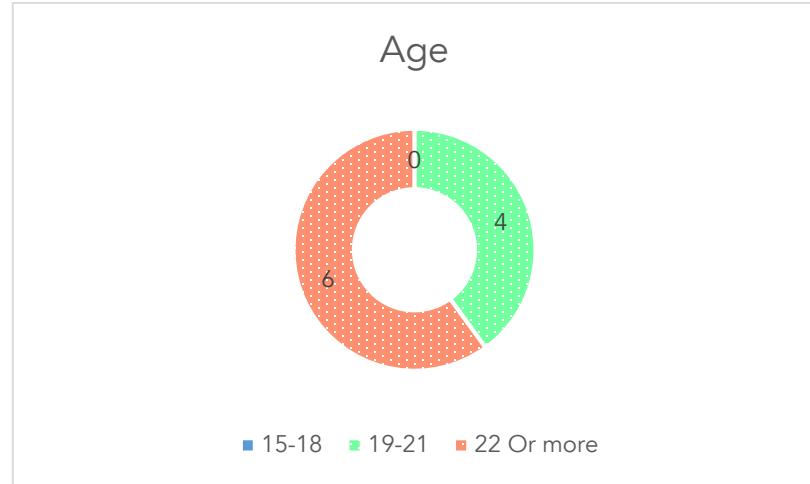


Figure 4-29 Doughnut Chart shows the age of participants.

Before starting the survey, we asked for the participants' age. We got the information that 4 of them are in range of 19-21 years old and 6 of them are in range of 22 years old or more. The portion of the gender of the participants is shown in Figure 4-29.

2. Hardware Properties

In this part, we collected data about hardware properties including controller base and buttons.

2.1. Controller Base

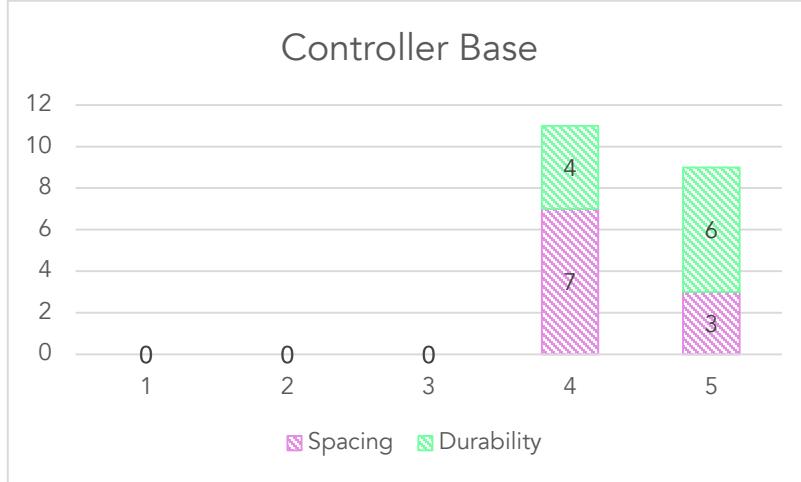


Figure 4-30 Bar Chart shows Controller Base Evaluation

In this part, we asked the participants about of well-designed and how durable the supporting base of the controller is. We are quite satisfied with the feedback from the participants the mostly give 4 and 5 on both spacing and durability of the controller. So, we concluded that the prototype has good area spacing and durability. But there are suggestions that we should provide more space for resting hands and make the controller a little inclined. The detailed score portion is shown in Figure 4-30.

2.2. Buttons

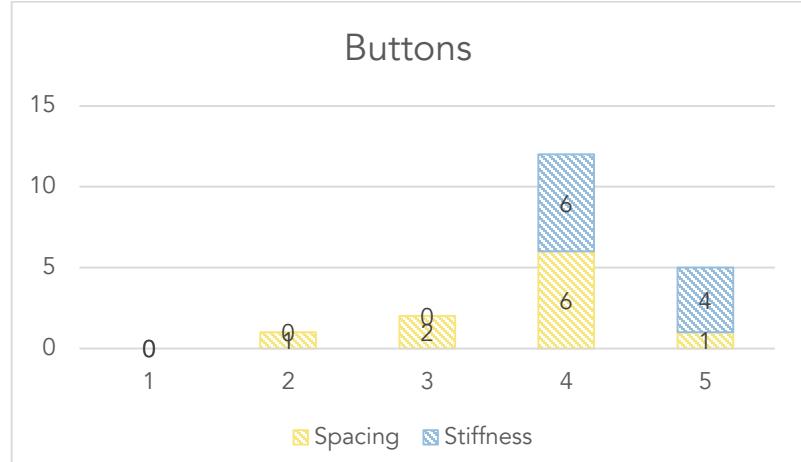


Figure 4-31 Bar Chart shows Buttons Evaluation

For buttons, we asked the participants about how the buttons layout and stiffness of the buttons was. And the result is quite satisfying. The participants stated that the buttons are quite well-spaced and the stiffness is just right. Some suggestions are to move the buttons a little bit more close to each other. The detailed score portion is shown in Figure 4-31.

3. Gameplay Suitability

In this part, we collected data about gameplay support of the controller.

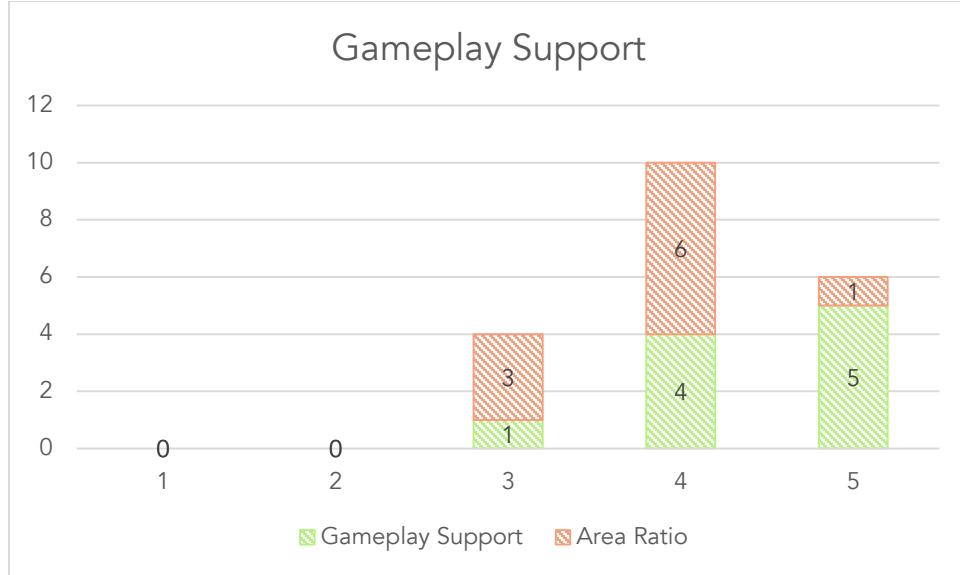


Figure 4-32 Bar Chart shows Gameplay Support Evaluation

For gameplay support, we asked the participants about how the buttons layout support the type of gameplay and the area to rest hands during gameplay. The result show that most of the participants are quite satisfied with the controller in the aspect of gameplay support. The detailed score portion is shown in Figure 4-32.

4. Health Issue

In this part, we collected data about the health issue that the controller can cause.

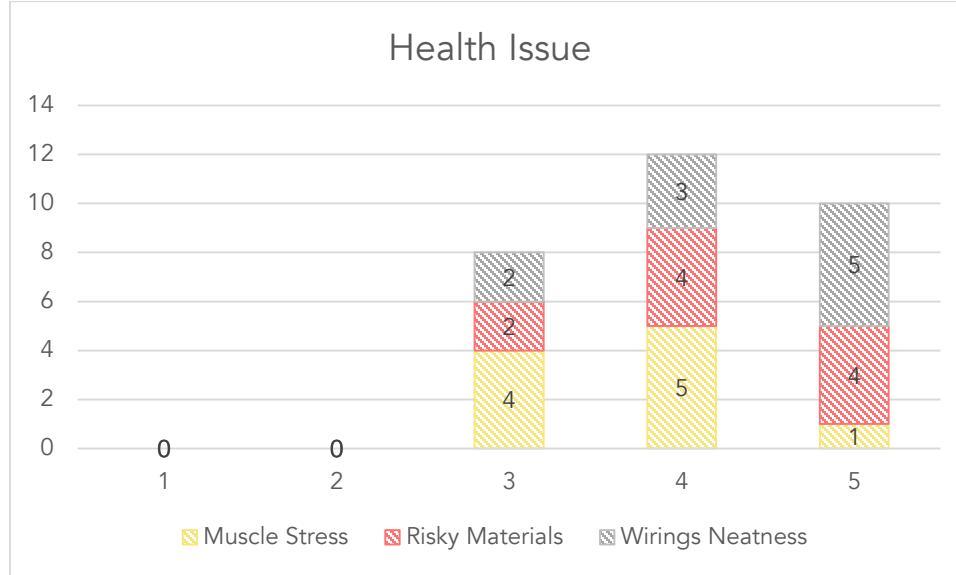


Figure 4-33 Bar Chart shows Health Issue Evaluation

About health issue we asked about how controller created muscle stress from playing the game, the safeness of the materials and tidiness of wiring. The result stated that the materials are suitable and are not risk to cause accident and the wiring are neat. But there are suggestions stated that if using the controller consecutively for a long time, it can create a little muscle stress. So, in this point we need to work on to fix this. The detailed score portion is shown in Figure 4-33.

4.2.6 Cabinet Evaluation (Integrated Prototype)

This part is the part that we will analyze the result from conducting a survey by having the testers that have already played the game fill the questionnaire, containing questions on the satisfaction on the game cabinet. The result of the survey will reflect the satisfaction and will suggest the improvements that can be made to the game cabinet. The questionnaire is divided in to 3 sections including general information, cabinet and game software.

1. General Information

In this part, we collected the data about general information of the participants. The information is such as name or alias, age and gender.

1.1. Gender

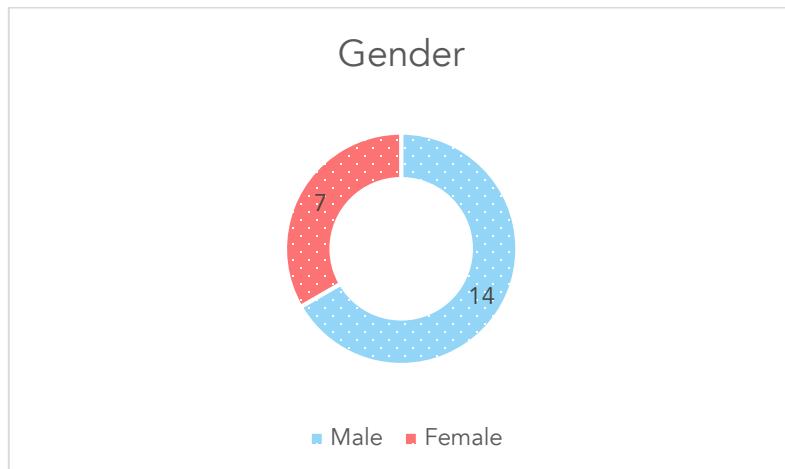


Figure 4-34 Doughnut Chart shows the gender of the participants.

In this evaluation session, we have a total of 21 participants. 14 of the participants were male and 7 of the participants were female. The portion of the gender of the participants is shown in Figure 4-34.

1.2. Age

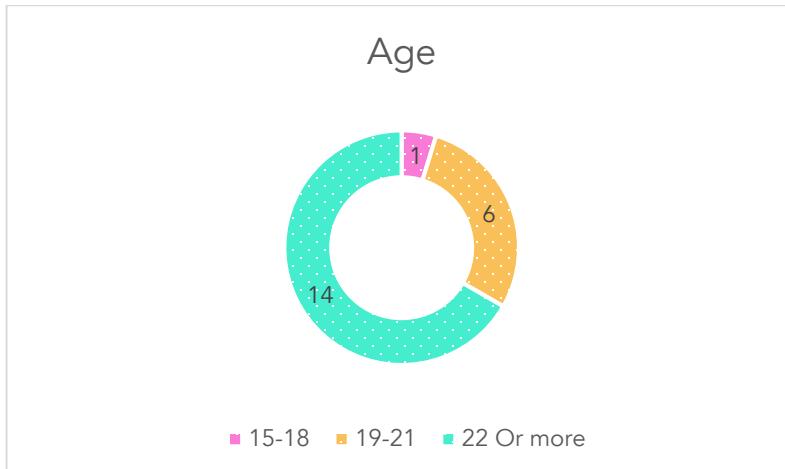


Figure 4-35 Doughnut Chart shows the age range of the participants.

In this evaluation session, we have a total of 21 participants. 1 of the participants was the age of 15-18 years old, 6 of the participants were the age of 19-21 years old and 14 of the participants were the age of 22 or more. The portion of the age range of the participants is shown in Figure 4-35.

2. Cabinet

In this part, we collected the data about the satisfaction of the participants toward the cabinet. The questionnaire in this part has been divided into 4 aspects including impression, usability, security and health issue.

2.1. Impression

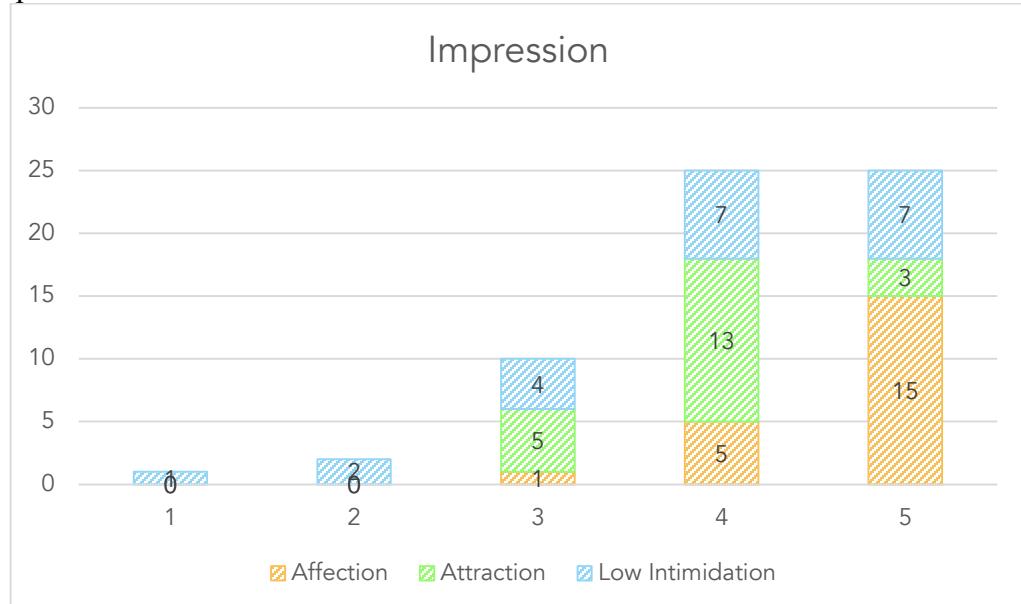


Figure 4-36 Bar chart shows the satisfaction towards the impression of the cabinet.

For impression toward the cabinet, we asked the participants in 3 aspects including the affection of the machine to the participants, attraction and low intimidation. The result shows that the cabinet could impress the participants in an average amount. With the average score of 4.1, this implies that the cabinet can attract a good amount of the people that pass by and do not intimidate those people to approach and give it a try. Some suggestion from one of the participant suggests that the cabinet should have color or patterns to make it more colorful. The detailed score portion is shown in Figure 4-36.

2.2. Usability

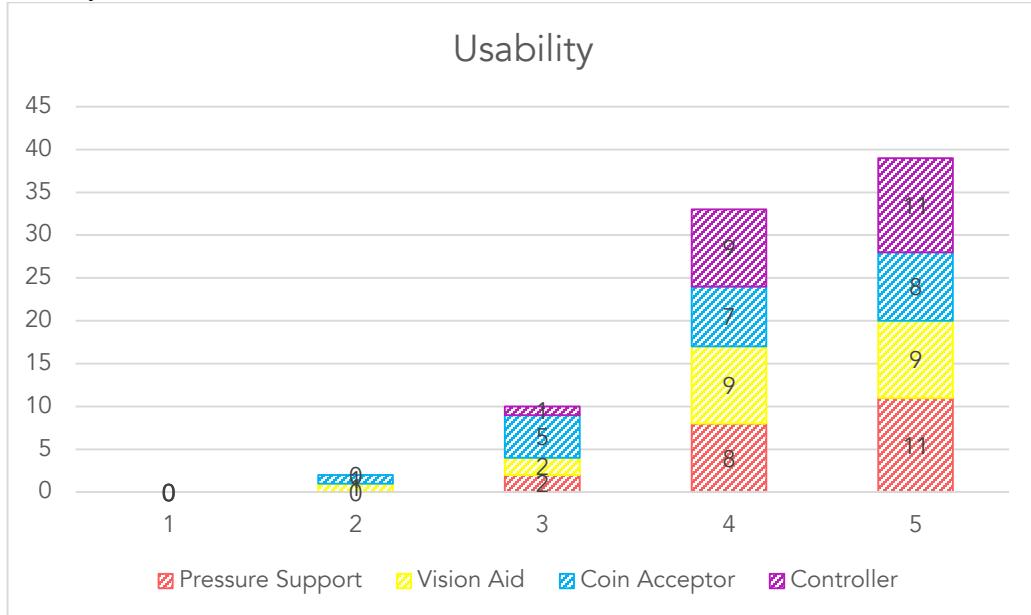


Figure 4-37 Bar chart shows the satisfaction toward the usability of the cabinet.

In this part we asked the participants for their satisfaction toward the usability of the cabinet, which the questions have been divided into 4 aspects including pressure support, vision aid, coin acceptor usability and controller usability. The result shows that the participants has high satisfaction toward the usability of the cabinet. Scoring for average point of 4.3, this implies that the components of the cabinet are usable, including coin acceptor and controller. Moreover, the cabinet has good support for pressure from pressing buttons on the controller and the height of the cabinet aids the vision of the participants when looking to the monitor. Suggestions from some of the participants are that the buttons are too far from each other that people with small hands cannot spread their hands to conveniently press the button and maybe the controller needs some label to tell the function of the buttons. The detailed score portion is shown in Figure 4-37.

2.3. Security

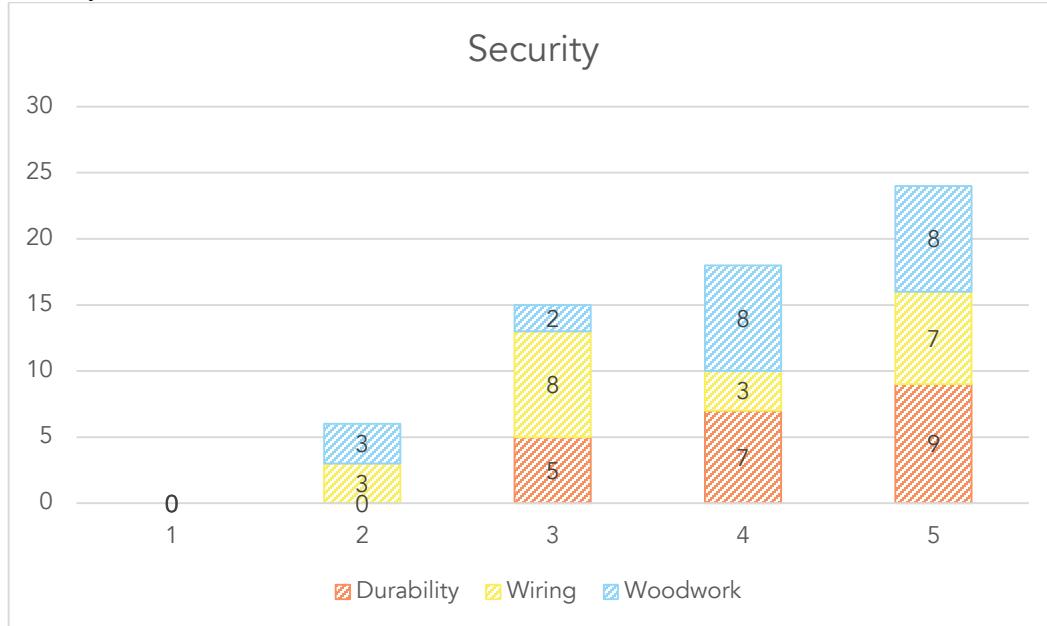


Figure 4-38 Bar chart shows the satisfaction toward the security of the cabinet.

For the security of the cabinet, we asked the participants in 3 aspects including the durability of the cabinet, tidiness of wiring and tidiness of woodwork. The result shows that the participants have an average satisfaction toward the security of the cabinet. Scoring at 3.9, this implies that the cabinet has quite good amount of security. The cabinet has good durability that can sustain high amount of pressure and wiring and woodwork is quite neat. Some suggestion from the participant is that there should be a board or wood plank to cover the cavity that the wires of the controller lie. The detailed score portion is shown in Figure 4-38.

2.4. Health Issue

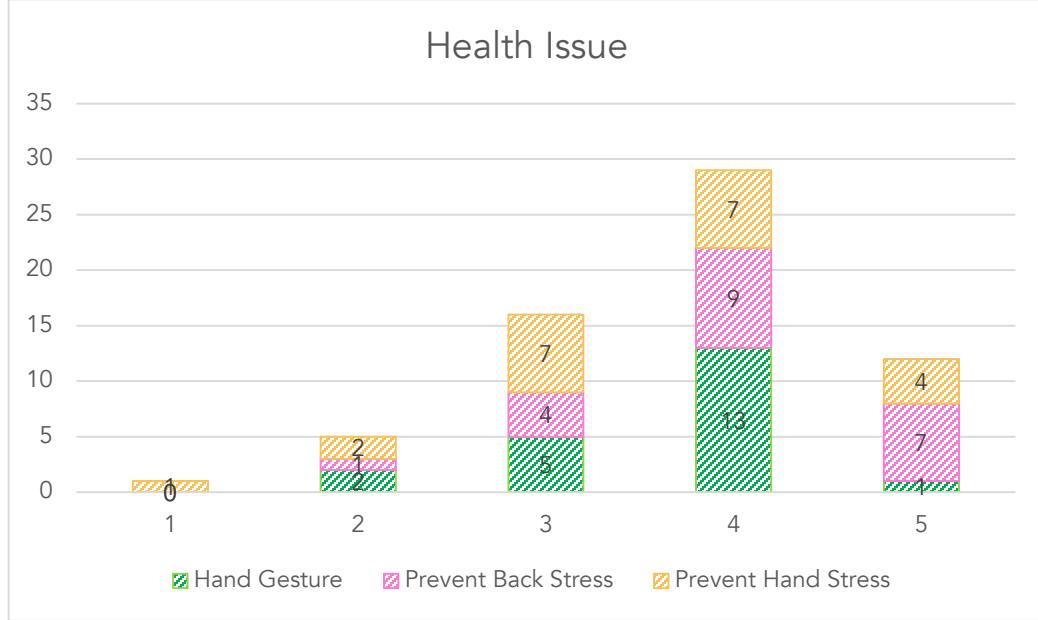


Figure 4-39 Bar chart shows the satisfaction toward the health issue of the cabinet.

For health issue, we asked the participants about how the cabinet is risky to cause health issues. The questions are divided in to 3 aspects including hand gesture support, back stress prevention and hand stress prevention. The result shows that the participants have fair amount of satisfaction toward health issue of the cabinet. The score shows that the participants have an average of 3.7 point for their satisfaction in this aspect. This implies that the cabinet has mild amount of possibility to cause the health problems to the participants. The majority of the participants complained about the hand stress when play the game for a long time and suggested that the buttons should be more narrow together and the inclined angle should be adjusted. The detailed score portion is shown in Figure 4-39.

3. Game Software

In this part, we collected the data about the satisfaction of the participants toward the game software. The questionnaire in this part has been divided into 4 aspects including overall satisfaction, song, scoring and graphics.

3.1. Overall

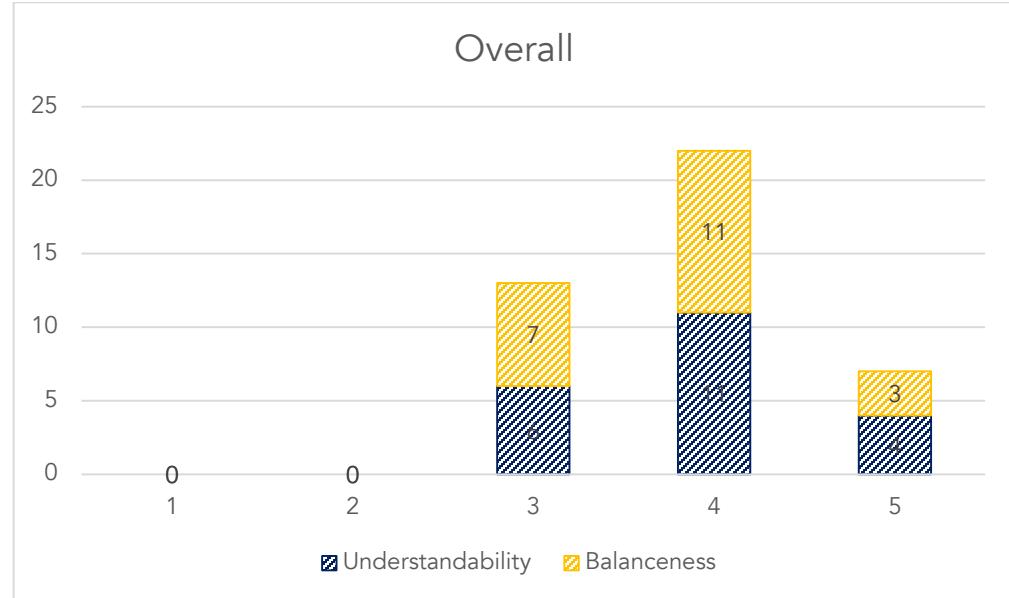


Figure 4-40 Bar chart shows the satisfaction toward the overall of the game.

For the overall of the game software, we asked the participants about the overview of the game software including the understandability and game balance. The result shows that the game scores averagely high for its overview. Scoring for 3.9, this implies that the game can be easily understand without the guide of the developer, because the game has navigation on every screen and also has tutorial for the gameplay as well. Moreover, the game is quite balance, having both easy and hard songs for the player to play. The detailed score portion is shown in Figure 4-40.

3.2. Song

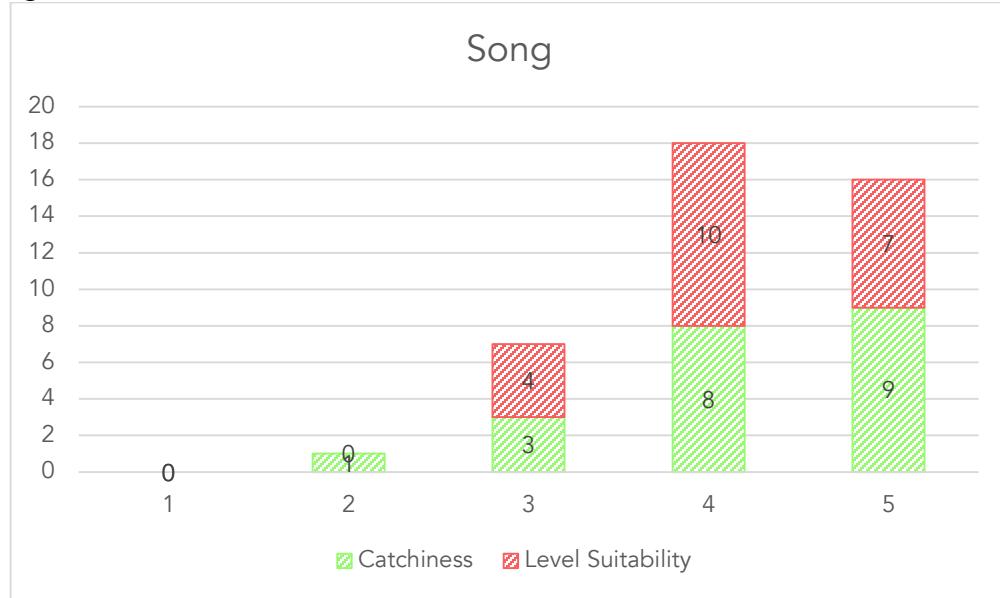


Figure 4-41 Bar chart shows the satisfaction toward the song in the game.

For songs in the game, we asked the participants about the catchiness of the songs and whether the difficulty that is assigned to the pattern (easy, normal, hard and master) is suitable to the real difficulty. The result shows that the song in the game is catchy and the level assigned is suitable. Scoring at 4.2, this implies that the game has a good set of songs and the difficulties are also suitable. The detailed score portion is shown in Figure 4-41.

3.3. Scoring

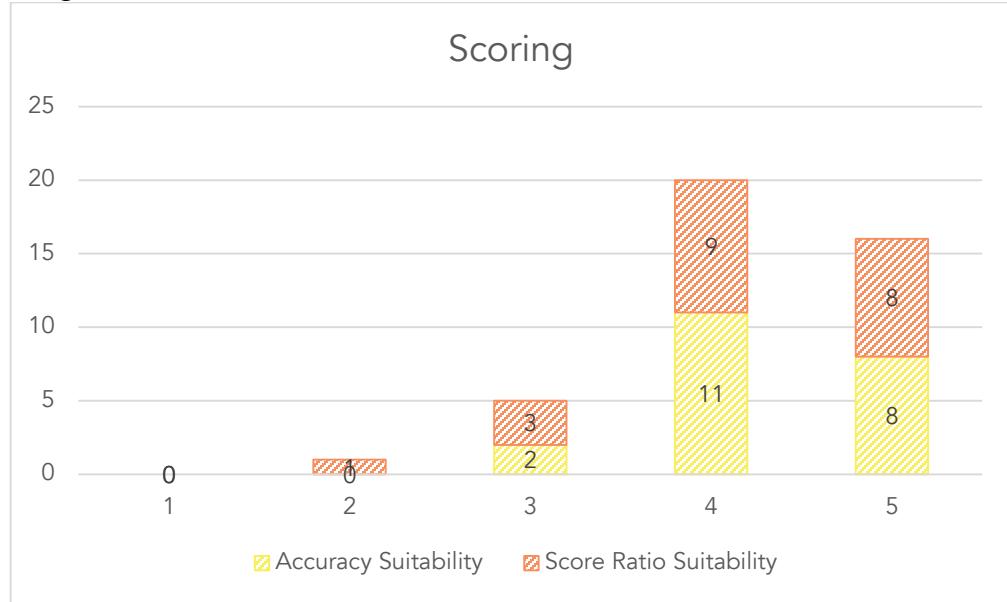


Figure 4-42 Bar chart shows the satisfaction toward the scoring mechanic in the game.

For the scoring aspect, we asked the participants in 2 aspects including accuracy suitability and the suitability of the scoring mechanic. The result shows that the player has quite high satisfaction toward the both aspects. Scoring at 4.2, this implies that the game has good scoring mechanic, not too easy or too hard. The detailed score portion is shown in Figure 4-42.

3.4. Graphics

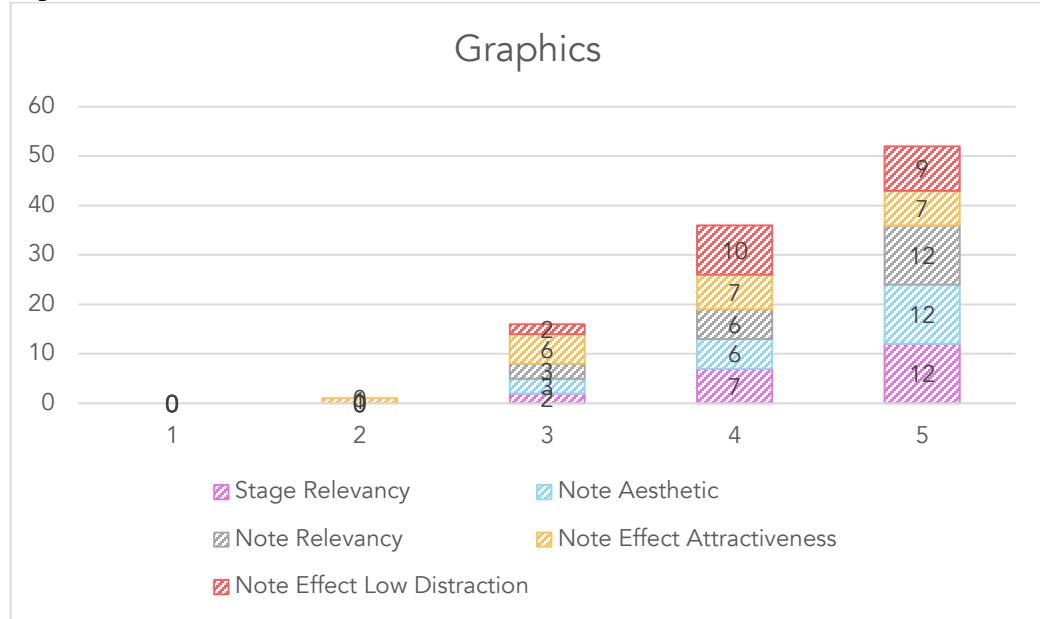


Figure 4-43 Bar chart shows the satisfaction toward the graphics in the game.

For graphics, we asked the participants in 5 aspects including the stage relevancy, the note relevancy, the note aesthetic, the note effect distraction and note effect attractiveness. The result in this aspect is quite high, scoring at 4.3. This implies that the stage in the game or so called the gear is relevant, the notes are beautiful and relevant and the note effect is attractive and has low distraction while playing. The comments from the participants are in the same way that the graphics in the game really catch their eyes from the first sight. The detailed score portion is shown in Figure 4-43.

Chapter 5

Conclusion

5.1 Project Conclusion

This project has been done with success according to the proposed purpose of the researchers in developing this game, which is to create a game that is different and interesting. That makes us chose music game as a genre of game to create because this kind of game cannot be seen much in the game market. And as this project has come to the conclusion point, we can feel that we have created a game that we would like to play and it's also interesting. But it does not mean that this is the final point of this project, we always have concerns and willing to implement more and more interesting features to this project that cannot be done in the time of this project year. This will keep this game update and interesting in the future.

Other than that, we learned many things from doing this project, the most important thing would be how this project teach us to work as a team. Without this point, this project will not ever be a success. Also, we learned a lot of knowledges throughout the process of researching the way of design and developing a game that will be useful in our future career.

5.2 Project Evaluation

So far, the researchers are satisfied with the result of this project. The project has been gradually developed, from the very first to the current state and tends to be better in the future. We keep developing new ideas that can be implemented to make it more interesting. This can be caused by the experience that we have gained while developing this game.

For the satisfaction of the people that have played our game, most of the participants have mildly to very satisfied with this game. But it must be kept in mind that, there's no game in this world that is perfect. So, we will always collect feedback to improve our game for better player's experience.

5.3 Problems Encountered and Resolves

In the process of developing this project, there are uncountable problems that we have encountered. So, we decided to break down types of problems in to 3 types below and will suggest ways that are used to resolve the problems.

5.3.1 Technical Problem

For Technical Problems, these are problems about software implementation and hardware implementation. For software, we encountered problems associated to rendering the asset files, mistimed display and delays and constraint of game engine. These are caused by the lack of experience of the developers in the field of game developing. So, we overcome these problems by asking the expert, make an appointment for consulting session and do more research on the encountered issues. For hardware problem, we faced the issue that the wire which we worked on the board using lead got loose and cause the circuit an error. In this issue, we planned to resolve by ordering printed plate from the professional using our circuit design.

5.3.2 Cooperation Problem

In every team project, miscommunication is the problem that is unavoidable. In our case is the same. There are times that the designers and programmers' thoughts on the same matter are different and make the result gone wrong. So, we fixed this problem by having frequent meeting and make clear on concepts before starting implementation.

5.3.3 External Problem

External problems are problems dealing with external resource. For example, buying materials for building hardware. In this project, we used wood for the case of hardware, so we contact the store to cut woods for us because we need a very precise cut. But when the time passed, the store kept postpone our orders. So, we decided to buy raw woods and cut them ourselves. It might not be as precise as using accurate tools or laser cut but it is as good as we can put the cut parts together.

Another problem is when we order buttons from Hong Kong and it takes around a month for them to be shipped to Thailand. So, we resolved this delay by making circuits in advance, so that when the buttons arrived, it can be immediately attached.

5.4 Project Expectations

For the expectations of this project, we have set it as 3 steps milestone. The first step is for us, the developers to get ideas and experiences in game development and teamwork skills that can be necessary for the future career.

The second step is that we want to successfully develop this game and let our acquaintances test and play this game and give us feedback for improvements that are needed to be made to the game.

The last step is that we want to make this game big. Means that we want it to be known, starting just from a group of people that play this kind of game and in the future, almost every gamer.

5.5 Future Plan

1. Songs Update

In the future, we planned to keep updating on songs that are in the game. New songs will be updated in the future. Doing it this way will keep the game interesting. Because, if we left the game with the current number of songs we have, the player will get bored easily.

2. New System

New System are things that will keep the game fresh and up to date. As planned, new system that will be added to this game will be new modes, more interesting profile system that allows changing of avatars and name, challenge system, and much more. These things will be added after we finalize the concept of each system.

3. Commercialize

We are trying to make this game known by a group of gamers. We are considering making announcement or promotional video, then publish to social network. Doing this will get this game from unknown to be known, then we can do commercialization on this game.

5.6 Project's Benefits

1. We have learned how to work as a team, to carry out the project that is too big and complicated for a person to handle.
2. We have learned about time management. How to manage to do a lot of things with time limited.
3. We have honed our skills for problem solving. When things didn't go as we expected and something went wrong, we need to come up with solutions to fix it. And sometime, the number of solutions are limited, so we need to be creative to come up with good resolve.
4. We have honed our skills in project management. As in this project we have a lot of tasks but limited human resource, so we need to manage people by putting the right man in the right job to optimize workloads.
5. We have developed our skill in social skill. When we need to ask favors from external people or resource, sometimes we need to make it formal. So, we learned how to contact with different type of people to ask them favors that help with this project.
6. We have developed our skills in user interface design because we need to design the user interface to be favorable and user - friendly at the same time not just the interface that is just usable.
7. We have learned about game design, how to design a game that is fun and interesting.
8. We have developed our skill in artistic design. We integrated artistic design in to both user interface and in-game design, so this make us more proficient in this field.
9. We have learned how to use Unity Game Engine to create a game. This game engine made it easier to develop and manage our codes and assets.
10. We have developed our skill in dealing with Arduino. Because we used Arduino as an important part of this project, we became more familiar with this tool as we used it.
11. We have developed our skill in handiwork. We did handiworks on creating circuits and the case for our hardware, which are controller and cabinet.
12. We have developed our English skill while using it to write reports and doing presentation.

5.7 Project's Status

Tasks	Not Started	In Progress	Completed
Research knowledge about game design and development.			/
Design system design			/
Design gameplay			/
Design hardware design			/
Implement gameplay prototype			/
Test prototype			/
Test prototype with outsiders			/
Implement software prototype			/
Test software prototype			/
Test software evaluation			/
Implement hardware prototype			/
Test hardware prototype			/
Songs Update		/ (Indefinite Task with constant updates.)	
Implement official software			/
Implement official hardware			/
Integrate software and hardware			/
Test the integrated machine			/
Machine evaluation			/
Machine maintenance and decoration.			/

References

- [1] Rhythm game. (n.d.). Retrieved November 19, 2015, from https://en.wikipedia.org/wiki/Rhythm_game
- [2] Arcade game. (n.d.). Retrieved November 19, 2015, from https://en.wikipedia.org/wiki/Arcade_game
- [3] Dance Dance Revolution. (n.d.). Retrieved November 19, 2015, from https://en.wikipedia.org/wiki/Dance_Dance_Revolution
- [4] Konami Digital Entertainment, Inc.| DDR. (n.d.). Retrieved November 19, 2015, from <https://www.konami.com/ddr/>
- [5] Guitar Hero. (n.d.). Retrieved November 19, 2015, from https://en.wikipedia.org/wiki/Guitar_Hero
- [6] Guitar Hero Live Home | Official Site of Guitar Hero. (n.d.). Retrieved November 19, 2015, from <https://www.guitarhero.com/>
- [7] Game engine, tools and multiplatform. (n.d.). Retrieved November 19, 2015, from <https://unity3d.com/unity>
- [8] Isometric graphics in video games and pixel art. (n.d.). Retrieved November 19, 2015, from https://en.wikipedia.org/wiki/Isometric_graphics_in_video_games_and_pixel_art

Appendix A

User's Experience Evaluation

Software Prototype Evaluation

Section 1. General Information

Name (Alias)								
Sex	<input type="checkbox"/> Male				<input type="checkbox"/> Female			
Age	<input type="checkbox"/> 15 - 18		<input type="checkbox"/> 19-21			<input type="checkbox"/> 22 or more		

Section 2. Overall

2.1 Overall

Gameplay is easy to understand.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Gameplay is balanced. Not too hard or too easy.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

2.2 Songs

Songs in gameplay prototype is attractive and catchy.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Level of Difficulty of songs in the gameplay prototype is reasonable to its difficulty.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

2.3 Scoring

Scoring of each note and the accuracy of hitting is reasonable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Total score ratio between "Play Score" (95%) and "Combo Bonus" (5%) is reasonable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

2.4 Graphics

The gear (play area) is clear and suits the type of the game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The note marker is attractive.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The note marker can be easily distinguished from the gear.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The note marker is relevant for its purpose. (Ex: Make it feel like you have to press it.)	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The explosion when hitting note has impact.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The explosion when hitting note not distract the concentration of the player.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

2.5 Sound Effect

Sound Effect when hitting note is relevant, that it tells the player that the note has already been hit.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Sound Effect when hitting note is not too distracting.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Sound Effect when missing note is relevant, that it tells the player that the note has already missed.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Sound Effect when missing note suits the game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

Section 3. Fun

3.1 Physical

The gameplay uses variety parts of body, including eyes, ears, hands and senses.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay satisfies the needs of usage of the body parts.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay encourages the player to push the ability of his body surpass its potential.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

3.2 Mental

The gameplay makes the player feel proud after achieving promising achievements.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay offers challenges that challenge player to beat it. (Ex: Song's Difficulty, Brand New Gameplay)	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

3.3 Social										
The gameplay allows you to brag the achievement or score with the fellow player.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay allows you to pick up the conversation about the game with fellow player.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Section 4. Benefit										
Playing this game help me develop my concentration.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay encourages me in using my senses including sight, hearing, focus and reaction.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The gameplay gives new experience aside from the other game in the same category.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
I feel that I can improve my concentration after playing this game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
I feel that I can coordinate between my senses (sight, hearing and reaction) better after playing this game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
I feel that I can have fun after playing this game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

Controller Prototype Evaluation

Section 1. General Information										
Name (Alias)										
Sex	<input type="checkbox"/> Male				<input type="checkbox"/> Female					
Age	<input type="checkbox"/> 15 - 18		<input type="checkbox"/> 19-21		<input type="checkbox"/> 22 or more					
Section 2. Hardware Properties										
2.1 Controller Base										
Controller Base provides suitable space to place hands when playing the game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Controller Base is strong enough to sustain the force of player when pressing buttons.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Controller Base:										
2.2 Buttons										
Buttons spacing is well-organized.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Buttons have suitable stiffness and rebounding force.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Buttons are too stiff.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Buttons are too soft.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Buttons:										
Section 3. Gameplay Suitability										
Buttons are placed to support the style of gameplay.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The ratio of area on the controller is suitable for the game. When playing, it provides enough freedom to move hands. And when idle, it provides enough space to rest.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Gameplay Suitability:										
Section 4. Health Issue										
Location of the buttons does not create muscle stress while playing.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The materials used in creating the controller is safe from creating any risky accident.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Wirings are neatly done that ensure they will not be causing any accident.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Health Issue:										

Cabinet Evaluation

Section 1. General Information										
Name (Alias)										
Sex	<input type="checkbox"/> Male				<input type="checkbox"/> Female					
Age	<input type="checkbox"/> 15 - 18		<input type="checkbox"/> 19-21		<input type="checkbox"/> 22 or more					
Section 2. Cabinet										
2.1 Impression										
The machine can attract the people who pass by to give it some attention.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The machine appearance is appealing.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The machine does not intimidate people to give it a try.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Impression:										
2.2 Usability										
The machine can sustain the controller and support the player while playing well.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The monitor's height from ground makes a good vision during the play.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The coin acceptor is in the appropriate position and usable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The controller is usable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Usability:										
2.3 Security										
The machine is sturdy and not risk to collapse.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The wiring is neatly done.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The woodwork is neatly done.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Safety:										
2.4 Health Issue										
The machine is comfortable; the controller supports the hand gesture.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The height from ground to controller does not create back muscle stress.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The controller does not create muscle stress.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Suggestion on Health Issue:										
Section 3. Gameplay										
3.1 Overall										
Gameplay is easy to understand.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Gameplay is balanced. Not too hard or too easy.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
3.2 Songs										
Songs in the game is attractive and catchy.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Level of Difficulty of songs in the game is reasonable to its difficulty.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
3.3 Scoring										
Scoring of each note and the accuracy of hitting is reasonable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
Total score ratio between "Play Score" (95%) and "Combo Bonus" (5%) is reasonable.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
3.4 Graphics										
The gear (play area) is clear and suits the type of the game.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The note marker is attractive.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5
The note marker can be easily distinguished from the gear.	<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input type="checkbox"/>	5

