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FACULTY OF ENGINEERING
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Project Report

CENG 408

Innovative System Design and Development II

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**An Educational Game Platform for Primary School
Children**

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Abstract

Nowadays, the role of educational games in learning is becoming serious. The proliferation of distance education with Covid-19 has shown how useful and effective educational games are during this period, in some cases mandatory. STEM subjects have an important role in the earlier education phase and more specifically at the elementary school level. In this report, we explored how we can reduce the subjects that children have the most experimental difficulties in lessons to an easier level to understand with the help of educational play.

Keywords: Serious games, Misconception in Education, Role of Educational Games in Math

Özet:

Günümüzde, eğitici oyunların eğitimdeki rolü daha ciddi bir rol almaktadır. Covid-19 ile uzaktan eğitimin yaygınlaşması, bu dönemde eğitim oyunlarının ne kadar yararlı ve etkili olduğunu ve bazı durumlarda zorunlu olduğunu göstermiştir. STEM konuları daha erken eğitim aşamasında ve daha spesifik olarak ilkokul düzeyinde önemli bir role sahiptir. Bu raporda; çocukların derslerin pratiğinde zorlandıkları konuların, eğitici oyun yardımıyla nasıl anlaşılır seviyeye gelebileceğini araştırdık.

Anahtar Kelimeler: Ciddi oyunlar, Eğitimde kavram yanılgısı, Eğitici oyunların Matematikteki Rolü

1. Introduction

1.1 Motivation

We are a group of senior students studying Computer Engineering. As a group, due to our interest and curiosity in the game industry, we decided to make an application that includes math games in accordance with the curriculum that children have difficulty in understanding in our graduation project. In this way, we believe that we will change the perspectives of parents towards today's technology. We also believe that our project will explain how education and technology come together in a beneficial way. We used Unity Game Engine to make our games better. We used various courses from Udemy to learn Unity Game Engine in more detail. The main motivation of this project is to enable children to use technology efficiently and have fun and learn.

1.2 Problem Statement

The main problem of this project is to help children understand the subjects by supporting them with games, in a way that children can learn while having fun, on mathematics topics that are suitable for the curriculum that children have difficulty in understanding.

Thus, when children understand the subjects they do not understand, their self-confidence will increase and they will participate in the mathematics lesson in a more motivating way.

1.3 Background or Related Work

The mathematic is the most challenging lesson for the many people and especially for some primary school children, which is a major problem. Nowadays the game industry has huge acceleration, so we want to make a game using popularity of this industry. Our game “Primath” takes advantages of technology such as Unity Game Engine to provide a solution for this problem; also with this solution, teachers have another tool for teaching the challenging lessons to students.

1.4 Solution Statement

We have developed this game application for our children to participate in math lessons more motivated. This application should not be called just a game, this application can be checked by the parents, and they will be able to follow what gains the student has gained. Our games are all about learning and having fun. One of our main goals is to make an application where students can have a pleasant time without getting bored.

2. Literature Review

2.1 Introduction

Children enjoy playing games and often equate games with fun. Teachers of primary mathematics can capitalize on this fact and design instructional games to motivate children to learn [1]. STEM is a curriculum based on the idea of educating students in four specific disciplines — science, technology, engineering, and mathematics — in an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications [2]. In this document, our goal is to prepare more effective and fun content for our game by looking at similar games that we plan to make to primary school students, examining the topics, and we will examine not only the games that have been made, but also the incomprehensible subjects in mathematics and the methods developed about these topics.

2.2 Importance of Math Games in Education

People of all ages love to play games that are fun and motivating. Games give students opportunities to explore fundamental number concepts, such as the counting sequence, one- to-one correspondence, and computation strategies. Engaging mathematical games can also encourage students to explore number combinations, place value, patterns, and other important mathematical concepts. Further, they afford opportunities for students to deepen their mathematical understanding and reasoning. Teachers should provide repeated opportunities for students to play games, then let the mathematical ideas emerge as students notice new patterns, relationships, and strategies. Games are an important tool for learning in elementary school mathematics classrooms:

- Playing games encourages strategic mathematical thinking as students find different strategies for solving problems and deepen their understanding of numbers.
- When played repeatedly, games support students' development of computational fluency.
- Games present opportunities for practice, often without the need for teachers to provide the problems. Teachers can then observe or assess students and work with individuals or small groups of students.
- Games have the potential to allow students to develop familiarity with the number system and with “benchmark numbers” (such as 10s, 100s, and 1000s) and engage in computation practice, building a deeper understanding of operations.
- Games support a school-to-home connection. Parents can learn about their children's mathematical thinking by playing games with them at home [3].

2.3 How Should The Educational Game Be

Invest in quality art and sound:

We all perceive the world through our senses, but children rely more on sensory experiences than adults. That's why you should pay extra attention to the art, animations, sounds and vibrations in your game.

For young children - young children and preschoolers - experts often recommend brighter and larger visual elements, since young children rarely focus on details. Older children, on the other hand, often enjoy games that require focus and attention to detail.

It goes without saying that the sound should be of high quality, compatible with the theme of the game and visuals. Catchy tunes are popular among android and iOS mobile devices and educational games for kids for the web.

Go for hyper-casual games:

One of the defining features of hyper-casual games is that the sessions are short. Children, especially younger ones, tend to lose their focus quickly, and long sessions with the same mechanics can squeeze them quickly. Short sessions combined with various tasks will direct children to play and learn in a more relevant way and for longer periods of time [4].

Educational Game Mechanics:

Exams	Exams are the first mechanism that comes to mind when it comes to educational games for children. In a game, quizzes must be included in the character journey so that they are best suited for an RPG or adventure game.
Puzzles	Puzzles can be incorporated into an adventure game along with other mechanics, or they can be single-core mechanics of a learning game that teaches something visual, such as the names and colors of objects, animals and plants.
Combination	Combining objects to get new objects is extremely fun for kids, and with merging you can teach them the basic science facts. Check out Little Alchemy to see how you can use merging to teach children how elements mix in the world around them.
Connecting	You can often see connection mechanics in hyper-everyday games. This mechanic asks users to connect two or more points efficiently while avoiding obstacles and traps. It encourages analytical skills and strategic thinking.
Timers	A timer is usually an additional mechanic, since its main purpose is to put some pressure on you to complete tasks faster. It is a good addition to

	educational games of the quiz genre, as it makes it difficult for young students to find the right answer somewhere.
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When planning educational games, it is also very important to be able to choose the most accurate game type, playgroup, venue and the right tool equipment to be used in the game according to the age, development level and interests of the participants. When choosing an educational game, we can list the considerations as follows.

1. The purpose of the game
2. Player level
3. Location of the game
4. Tools to use
5. Duration of the game

A: Purpose of the Game

It should be well known what is intended with the game being played and planning should be done for that purpose. Accordingly, the selected game must be fit for purpose. For example, in a situation where we aim to gain the importance of cooperation, it is necessary to have activities and games that can be done together rather than having activities where individual characteristics come to the fore.

B: Player Level

Players' gender, age, physical capacity, abilities and physical competence should be taken into account; players must be eligible for the game with these features. Having activities that are much more difficult than players can do can distract the game from its purpose or cause a variety of problems. Players with chronic conditions should not be included in overactive games, they should be given more passive roles. In addition, appropriate groups should be created for the game, children with leadership qualities should be given to different groups, each child should be given the opportunity to become a leader.

C: Location of the Game

The place where the game or event will take place must be safe, and materials that may be dangerous to players should be removed from the playing field. Games can be played in a large or narrow space, either in the hall or outside, according to their characteristics. It must be decided in advance where the game will be played. Where in the class the game will be played if it is to be played in the classroom; if it is to be

played outdoors, it should be determined in advance whether it will be played in grass, woodland or concrete area and game planning should be done accordingly.

D: Tools to Be Used in the Game

The tools to be used in the game should be taken into the game plan. In addition, game- specific tools must be sufficient for each child. Ensure that game tools do not harm players. The tools to be used must be in accordance with the purpose of the game and the characteristics of the player.

E: Duration of The Game

The warm-up game should be played for 5 minutes, the moving game should be played for 15 minutes, the relaxing game should be played for 10 minutes. In addition to these specified periods, 10 more minutes should be reserved for the repetition of the game, the introduction of the new game, the disclosure of its rules and the evaluation of the game. Some games must be played based on the number of replays instead of the duration. If the children's interest is dissipated at the end of the game, the game should not be repeated. In young children, time limits should be placed on strenuous games even if the attractiveness of the game is not lost. Because the player who is too immersed in the game may not be aware that he is struggling. Especially during this period, it should be noted that the game is not played until it is exhausted [5].

2.4 Similar Applications

Monster Math

The application called monster math is a mathematical application used by Makkajai Edu Tech Private Limited to help students with difficulties before kindergarten and up to 4th grade of primary school. Students practice their common core aligned math skills. Available free on iPad, iPhone, or Android, the app progresses through the main story to engage students and help them practice and learn basic four-operation calculations, multiplication tables, as well as more than 40 skills in multipliers, multiples, and primes. The app is fully customizable to suit your student's ability, and you can choose difficulty between basic and advanced skills with a simple toggle. With detailed reports and weekly emails, it gives you an in-depth view of how a student is progressing in math.[6] [7]

Math vs Zombies

Math vs Zombies is an application developed by ToptoLearn Software to help children between kindergarten and primary school 5th grade with difficulties in mathematics, with topics on basic 4 operations, price \$4.99 and published on December 12, 2013. One level (easy, medium, hard) and seven games are played in each world of addition, subtraction, multiplication, or division. In each world, children solve a series of math problems. When zombies appear (with chilling music), players solve each zombie's math problem by selecting a number on the touchscreen and then zapping that zombie with a lightning bolt. In the seventh game of each level, each of the zombies carries four math problems that must be solved to complete the game. Winning each level unlocks the next. You can repeat the levels as many times as you want. Creepy/cute characters and ominous music add charm to a game that is essentially a fun way to practice math.[8]

Monster Math Duel: Fun arithmetic math fight games

Developed by Makkajai Edu Tech Private Limited, Monster Math Duel is free to try, but you can pay later; Available on Apple Store and Play Store, It is a math application that you can do addition, division, fractions, geometry, multiplication, shapes, subtraction, was released on May 4, 2017, and helps students in grades 1 to 4.

Start by adding a name to the app and choosing a class level. At one grade level, children can switch to playing all skills or manually select the skills they want to practice. For all skills, children can choose one or all of the following: Equals, Not Equals, or Compare. This determines the type of challenge in the game. For example, if children select the "Subtract Within 10" skill and then choose "Equals", the game will start with something like "Equal to 8" and the children must select all the subtraction problems (within 10) displayed on the screen. . It is equal to 8. To start playing the game, children choose one of three game options. The Nearby option allows parents to add up to seven players on other devices via Wi-Fi, the Split Screen option lets kids play on one device against an opponent of any grade level, and the VS Computer option lets kids play against the computer. All games are timed and the one with the most points wins the round. Parents can view a simple progress report to find out what skills their child is practicing and how well they are doing.[9][10]

2.5 Conclusion

In summary, in our project, we have planned the developed an application where children can learn mathematics topics that are suitable for the curriculum that they have difficulty in understanding, but also having fun with it. Playing games especially games that have concern to teach something may get boring, but in our game we prevent that issue by making various and interesting games for all classes in primary school (1st, 2nd, 3rd, and, 4th grades).

3. Software Requirements Specification

3.1 Introduction

3.1.1 Purpose

The main purpose of making this educational platform is to make primary school (1-2-3 and 4. Classrooms) to make it easier for students to understand the subjects they are struggling with in math classes with the support of the game. The mathematics subjects we covered were found using the current curriculum of education. The emergence of the new generation in technology has been our main guide. In this sense, we decided that the most effective way to communicate with the new generation, which is very much in control of the technology and technology that is developing every day, is to gamify. We designed a different mini game making project to build this bridge and make the learning process fun. This document mainly introduces what are the general requirements of the project. It is possible to say that these requirements are spelling functions and performance requirements. In addition, this document; also describes how users interact with the user interface of the game.

3.1.2 Scope of Project

The importance of loving something to succeed in something is undeniable. However, while it's usually nice for kids to go to school and spend time with friends, it usually doesn't sound so good when it comes to classes. Doing homework for a course that has not been well listened to due to this apathy, is also exhausting for the child and as a result, the subject is not fully understood. In fact, although those lessons are important for the later years of their life, a child who grows up with a negative point of view due to these reasons may be unhappy in his/her later life, may have little productivity or his/her work may not be very successful. We want to change their perspective on mathematics in a positive way by enabling children to learn with fun through serious games. In addition to the verbal and visual expressions made by a teacher, we want to make his/her job even easier. Our games will be developed for the first 4 grades and will include images and methods to attract a child's attention. It will also aim to go after a concept known as "misconception" in education. This concept refers to the situation in which visual and verbal expression is inadequate, no matter how knowledgeable and skilled the teacher is, and in such cases the subject is better understood by the games [11]. The innovative side of our application is precisely aimed at solving this problem, so it is also useful for teachers. After clicking Play on menu, the student will choose which class they are in so that they can play their game at the level appropriate to their level. There will be an information option in the games to inform the teacher, and after clicking this button, a box will be opened with the student's achievements. By the time successfully completing the game, the student will have achieved the desired goals by ending the game after receiving his or her score.

3.1.3 Glossary

Player: A person who interact with the game and A player of a game is its playing participant.

Unity3D: Cross-platform game engine developed by Unity Technologies.

Unity: game engine for develop the game.

Serious Game: A serious game or applied game is a game designed for a primary purpose other than pure entertainment.

Game Mechanics: The rules that govern and guide the player's actions, as well as the game's response to them. A game's mechanics thus effectively specifies how the game will work for the people who play it.[12]

Standalone application: A standalone application is an application that runs locally on the device and doesn't require anything else to be functional [13].

Quest: Is a task in video games that a player-controlled character, party, or group of characters may complete in order to gain a reward [14].

Game Engine: A Game Engine is defined as being a set of software tools or APIs built to optimize the development of a video game [15].

Storyboard: Storyboarding your game involves creating a collection of cards that you can move around, representing all your scenes in a logical order [16].

3.1.4 Overview of Document

The second title of this document contains information about the functionalities of our project. But technical information about this project is in the Requirements Specification title. As a result, both titles explain important information, but the Requirements Specification part especially stands for software developers, while the Overall Description can be understandable for any person.

3.2 Overall Description

3.2.1 Product Perspective

Primath is a game platform with games suitable for all grades in order to prepare students for education in a positive way, where students in the 1st, 2nd, 3rd, and 4th grades of primary school have difficulty in understanding and including mathematics topics that are suitable for the curriculum. Our basic way in the game is class selection. According to the class selection, the player encounters games in the form of difficulties proportional to the class he chooses. The games will be played in order according to the selected class. The games have different achievements and playing styles according to each class, therefore

each game is aimed at gaining a certain outcome. The main subject of our games in mathematics.

3.2.2 Player Functions

3.2.2.1 Player

The player must be accessible to mobile devices (tablets, smartphones) or computers. The player should not look too close to the screen so that his eyes do not get tired. The player must not be sensitive to screen changes and sounds or have epilepsy. The player must have basic knowledge of reading and write in order to play the application prepared according to the primary school level. The player must be at least seven years old or older. The player can easily review and try the application together with the parent.

3.3 Requirement Specification

3.3.1 External Interface Requirements

3.3.1.1 User Interface

The user interface will be worked on the website we will have uploaded later.

3.3.1.2 Hardware Interface

A tablet or computer which have internet connection is enough for the project. There are no any other external requirements for hardware interface.

3.3.1.3 Software Interface

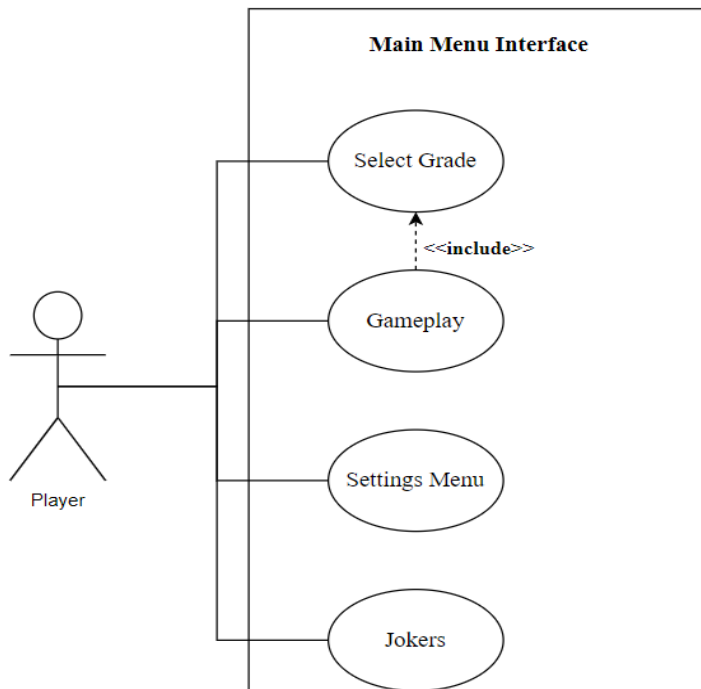
There are no external requirements for the software interface.

3.3.1.4 Communications Interface

There are no external requirements for communication interfaces.

3.3.2 Functional Requirements

3.3.2.1 Main Menu Interface Use Case



Use Case Number	1
Use Case Name	Main Menu Interface
Summary	Game engine prints the main menu interface and player can interact with main menu.
Actor	Player
Trigger	Player opens the game or returns the main menu.
Precondition	<ul style="list-style-type: none">• Player must be online.• Player must be entered the website where game embedded.• Player already plays the core game.
Scenario	<ol style="list-style-type: none">1. Player runs the game or return from core game to main menu.2. Game engine runs the code and print the interface.
Exceptional Situations & Alternative Flows	Game may not work. Restart the web page. Input device may not work. Check the additional input device. E.g., mouse, keyboard, or touchpad.
Postcondition	The main menu interface is ready to interact.

3.3.2.2 Settings Menu Interface Use Case

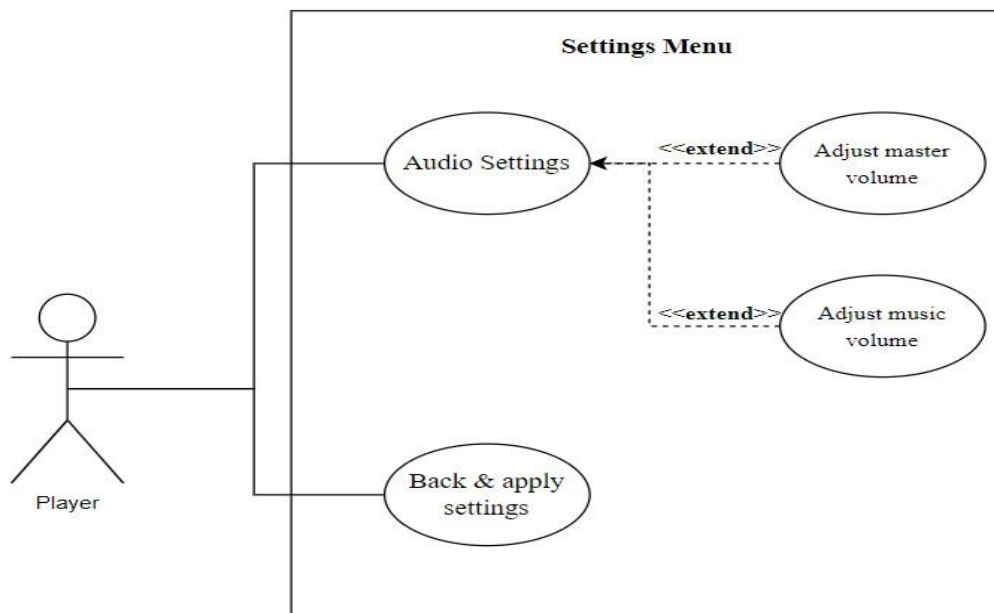


Figure 2 [Settings Menu Interface Use Case Diagram]

Use Case Number	2
Use Case Name	Settings Menu Interface
Summary	Game engine prints the settings menu interface and player can interact with settings menu.
Actor	Player
Trigger	Player opens the game or returns the main menu.
Precondition	<ul style="list-style-type: none"> • Player must be online and entered the website where game embedded. • Player already plays the core game and clicks or touches the pause game object. • Player opens the main menu.
Scenario	<ol style="list-style-type: none"> 1. Player runs the game, main menu prints, and player clicks or touches the settings button object. 2. Game engine runs the code and print the interface.
Exceptional Situations & Alternative Flows	<ul style="list-style-type: none"> • Game may not work. <ol style="list-style-type: none"> 1. Restart the web page. • Input device may not work. <ol style="list-style-type: none"> 1. Check the additional input device. E.g., mouse, keyboard, or touchpad. • The settings of master and music volumes may not be saved. <ol style="list-style-type: none"> 1. Check the game save file, if the is no save file restart the game.
Postcondition	The settings menu interface is ready to interact.

3.3.2.3 In-games Features Use Case

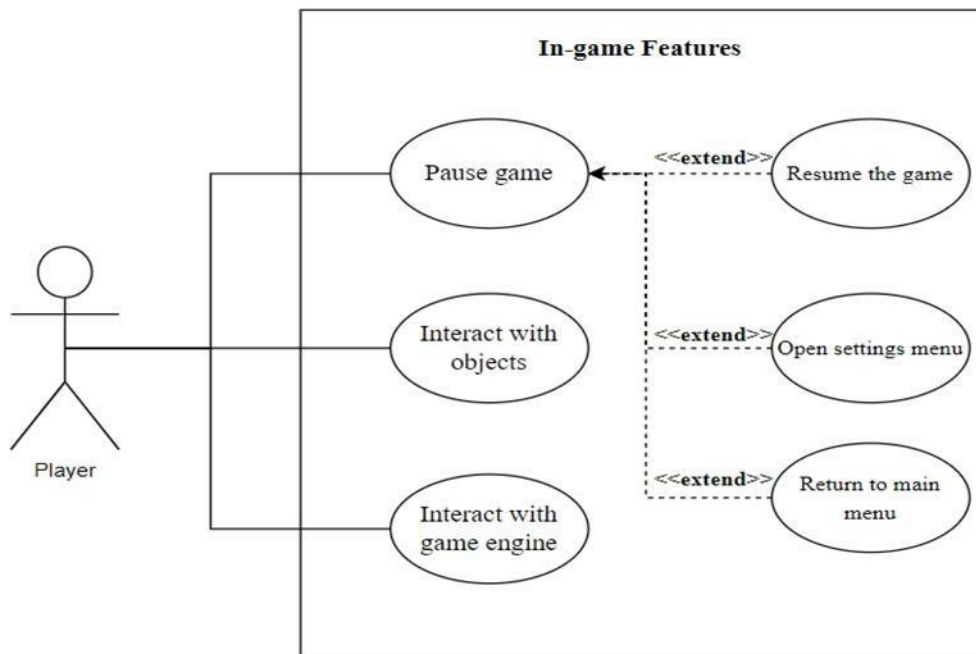


Figure 3 [In-games Features Use Case Diagram]

Use Case Number	3
Use Case Name	In-games Features
Summary	Game engine plays the selected grade game.
Actor	Player
Trigger	Player clicks/touches the play button and selects a grade to play.
Precondition	<ul style="list-style-type: none"> • Player must be online and entered the website where game embedded. • Game engine prints the main menu. • Player interact with the main menu.
Scenario	<ol style="list-style-type: none"> 1. Player runs the game, main menu prints, and player clicks or touches the play button object then selects the grade. 2. Game engine runs the game. 3. Player interact with the game user interface.
Exceptional Situations & Alternative Flows	<ul style="list-style-type: none"> • Game may not work. <ol style="list-style-type: none"> 1. Restart the web page. • Input device may not work.

	1. Check the additional input device. E.g., mouse, keyboard, or touchpad. <ul style="list-style-type: none"> Buttons may not work. Be sure player clicks/touches the right place, restart the game..
Postcondition	The in-game features are ready to interact.

3.3.3 Performance Requirements

Our game will be made by using Unity Game Engine. 2019.4 and higher versions of Unity will be supported by the application. The operating system does not matter since it will be played on web site we will have uploaded to.

3.3.4 Software System Attributes

Portability: The project does not require any additional technological devices rather than smartphones or tablets. That improves the portability of the project. The project developed using Unity 3D. The Unity 3D works on various platforms. Therefore, it provides advantages for portability to various platforms also, it can easily insert to other apps (modules).

Performance: The game is a game that is suitable for every platform in terms of performance and Performance relative to the number of resources used under stated conditions.

Usability: The project does not include complex hardware components. Thus, the installation and configuration of the project are fundamental as long as the required system requirements (mentioned in the documentation) are satisfied also, it has a user-friendly interface

Maintainability: New features, add-ons, and improvements made for the system with developing the technology. For this purpose, object-oriented programming will be applied to make modifications, reduce maintenance costs, and make improvements. in the feature, this game can easily adapt new technology

Safety Requirement: Since the project was developed for primary school children, the recommended duration of the game hour should not be exceeded and content that set a bad example for children should be avoided also, the game is suitable for ages 7 to 11.

Security: Since the game is made to help the education of young children, the game can only be played on educational game platforms.

4. Software Design Description

4.1 Introduction

4.1.1 Purpose

The purpose of this Software Design Document (SDD) is to detail the architectural and system design of the project titled as “Primath”. The scope of this project is the complete mathematics misconceptions and make entertainment a part of it. The concept of serious games allows using games for a primary purpose other than pure entertainment [17].

Primath is a serious game which runs on web site.

The target audience of this project is kids on primary education. This game will create an opportunity to learn and practice on the different mathematic miss concepts subjects.

Primath aims to combine this process with entertainment. To provide a better understanding, this SDD includes various diagrams such as UML class diagram, activity diagram, and use case realization diagram.

4.1.2 Scope

This document contains the whole definition of the design of Primath. To choose the games that are suitable for the purpose depending on the level of education, detailed research is going to be made.

Unity Game Engine will be used to make this game. Coding and designing parts of production will be made by using Unity. As an IDE, we will be working on Visual Studio and as an programming language C# will be used.

For the design part, we will use assets from Unity Asset Store. Also we might download free-to-use 2D pictures using any search engine.

The games will be held for the first 4 grades. Each game will be prepared in accordance with one of the achievements determined by the ministry of national education. There will also be an information box on the games that describes the achievement in writing so that the teacher can see that achievement.

4.1.3 Glossary

TERM	DEFINITION
SERIOUS GAMES	A serious game or applied game is a game designed for a primary purpose other than pure entertainment [18].
SDD	Software Design Document
UML DIAGRAM	The Unified Modeling Language (UML) is a general-purpose, developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system [19].
UNITY	Unity is a cross-platform game engine developed by Unity Technologies [20].
SPRITE	Sprites are simple 2D objects that have graphical images (called textures) on them [21].
UX	User Experience (UX) Design (UXD, UED, or XD) is the process of creating evidence-based, interaction designs between human users and products or websites [22].
UI	user interface (UI) is the space where interactions between humans and machines occur [23].
ASSET	A Unity asset is an item that you can use in your game or Project [24].
SCRIPT	Unity allows you to create your own Components using scripts. These allow you to trigger game events, modify Component properties over time and respond to user input in any way you like [25].
TEXTURES	Unity recognizes any image or movie file in a 3D project's <i>Assets</i> folder as a Texture (in 2D projects, they are saved as Sprites) [26].
MISCONCEPTIONS	Ideas that students hold about concepts which are inaccurate or false, especially in the scientific sense.

4.1.4 Overview of Document

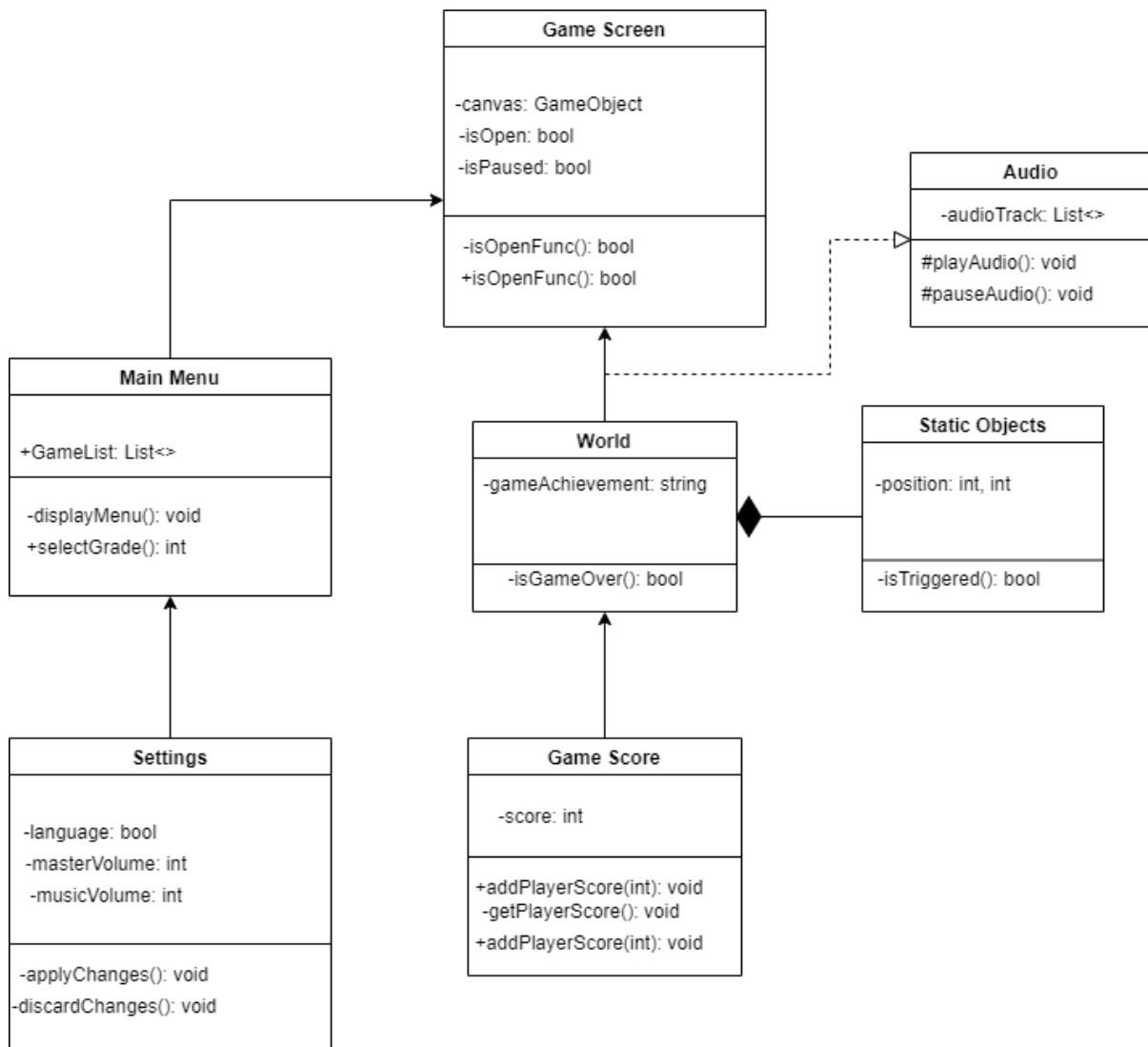
The second part of this document describes the Architectural Design of the project. There is also a UML class diagram of the game system and its architectural design. The third part is Use Case Realization. In this section, the block diagram of the system is drawn and briefly explained. The last part is about the Environment.

4.2 Architecture Design

4.2.1 System Design Approach

As a group, we meet every week at Discord to set weekly missions. Every weekend, we clarified our work not only by bringing it together, but by discussing the unclear parts of the work done together. When everyone is satisfied with each other's work, we subordinate the parts we do and complete the work in that way. That way, we meet two or three times a week.

4.2.1.1 Class Diagram



4.2.2 Architecture Design of the Application

4.2.2.1 Main Menu

Summary: This system is used by the player. Players can choose a game play, can go to the options menu, can go to the glossary, to choose or get jokers from it.

Actor: Player

Precondition: The player must have initial information and must be online on website which the Primath embedded.

Basic Sequence:

- Player must be online on website which the Primath embedded.
- The player must have initial information.
- The player can choose gameplay to choose class.
- The player can go to the options menu.
- The player can go to the glossary and choose or get jokers.
- The player can exit from the application.

Exception: None.

Post Conditions: None

Priority: High

4.2.2.2 Settings Menu

Summary: Player can adjust audio settings of the game.

Actor: Player

Precondition: Player must be on the main menu or in-game to open up settings menu.

Basic Sequence:

- The player can adjust the music volume.
- The player can adjust the master volume.
- The player can apply changes.

Exception: None.

Post Conditions: Any applied changes are saved.

Priority: Medium

4.2.2.3 Gameplay Mode

Summary: Player can select the class to play.

Actor: Player

Precondition: Player must be on the main menu.

Basic Sequence:

- The player can choose a class to play.
- After the player chose class to play, can interact with game objects.
- The player can pause the game.
- The player can adjust master volume through the options menu.
- The player can adjust music volume through the options menu.
- The player can exit from the application.

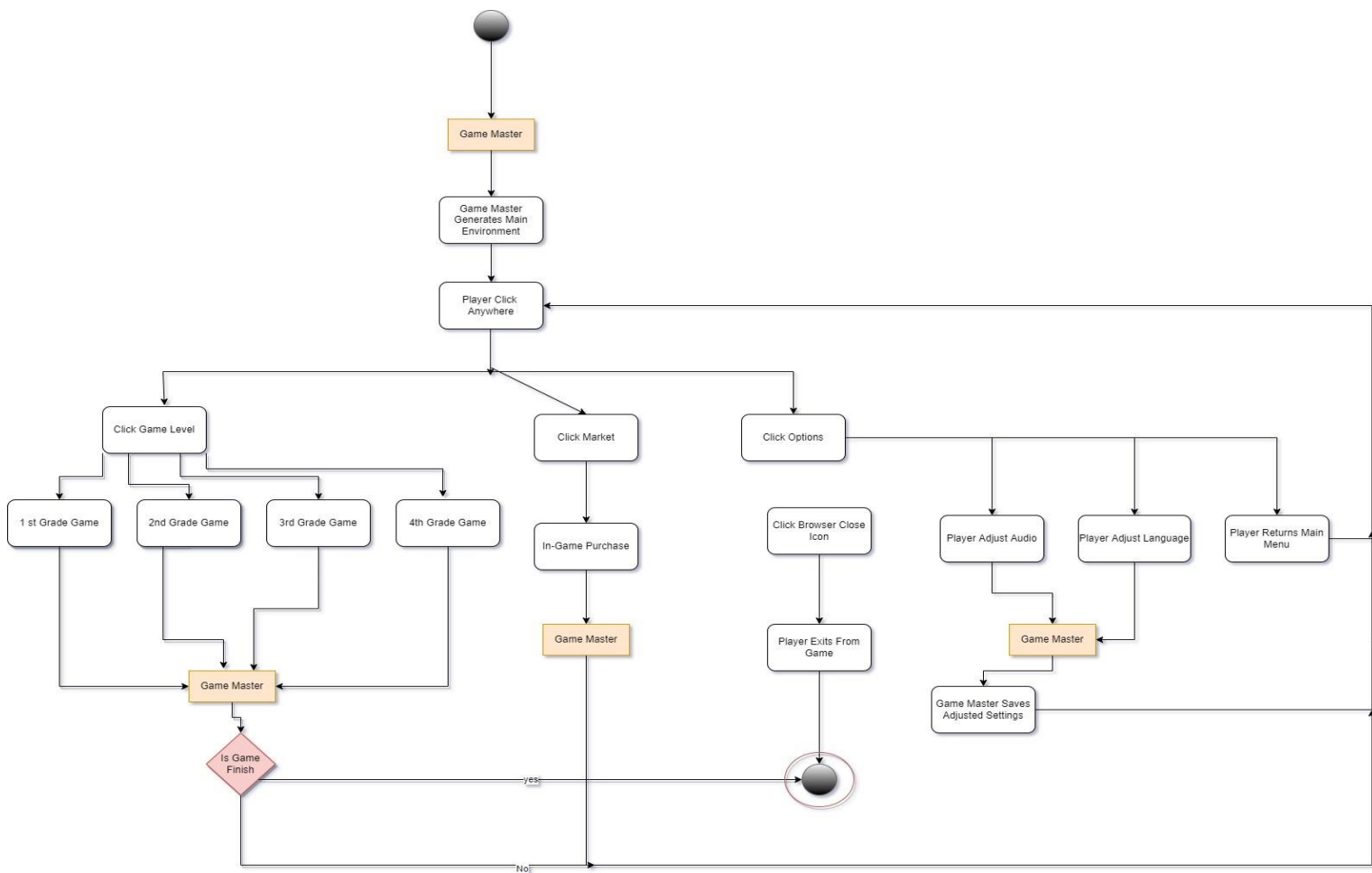
Exception: None.

Post Conditions: Player can play after any class mode when it finished the chosen class.

Priority: High

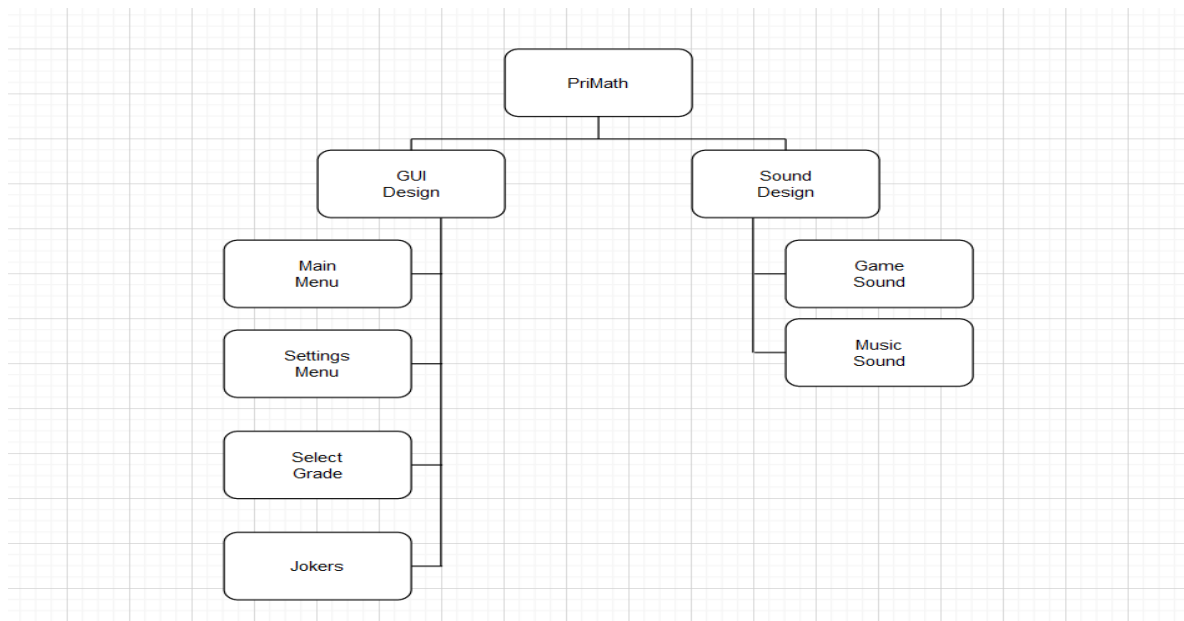


4.2.3 Activity Diagram



4.3 Use Case Realization

4.3.1 Brief Description of Figure-1



The components of the Primath Project are shown in Figure 1. All designed systems of the simulation are shown in the block diagram in the figure. The subsystems of the system are divided into two subcomponents.

4.3.1.1 Graphical User Interface (GUI)

The GUI design explains the relationship between the actors and the system. There are four subsystems in this design: Main Menu, Settings Menu, Select Grade, and Jokers. The Main Menu is a start page. The Settings Menu contains options for the game, you can change and show the settings. Select Grade, you advance by choosing the class you are a student of. As your class increases, your difficulty level increases as well. Jokers, he gives a hint to the children in the games where the children have difficulty and helps them to learn the games and finish them successfully.

4.3.1.2 Sound Design

We split the sound design into two. As Game Sound and Music Sound. Game Sounds are in- game sounds that change according to the game children are playing. Music Sound is the music we add to prevent children from getting bored while playing.

4.4 Environment

4.4.1 Modeling Environment

The Environment of the project will be developed using Unity3D and its tools. Additionally, the project will include some free assets from Unity Asset Store to develop the game quicker. To avoid boringness, the environment of the game will construct as much interactive as for primitive school students. For that purpose, the environmental design of the game should not contain violence and adult content. It must contain objects/games such that improve primitive school students to their mathematic skills of miss conceptions. To give the sense of progress and create a better competitive

environment, we're going to add items and wildcards to the game to help students move forward using these wildcards where they hang out and prevent them from getting cold up too quickly from the game, and we're not going to ask them to watch/receive advertising or in-game money to generate a financial income from that grocery portion.

5. Test Plan

5.1 Introduction

5.1.1 Overview

The features of the Primath game specified in the SRC document will be tested. The buttons on the menu and settings page of the game, buttons and objects for the game will be tested.

5.1.2 Scope

This document contains the test plan of the use cases, test cases, and test design features.

5.1.3 Terminology

Acronym	Definition
GUI	Graphical User Interface
ST	Settings
FGG	First Grade Games
SGG	Second Grade Games
TGG	Third Grade Games
FGS	Fourth Grade Game

5.2 Features to be Tested

Each section lists the main features to be checked and provides a brief overview of them all. At the end of this document there will be a Test Design Specification added for each major feature.

5.2.1 Graphical User Interface (GUI)

Graphical User Interface parts used in this project. We separated the GUI in 6 parts which are Main Menu, Settings, First Grade Game, Second Grade Game, Third Grade Game and Fourth Grade Game. These parts also have some common parts. GUI parts contain testing of GUI components such as objects, buttons and sliders.

5.2.2 Settings (ST)

5.2.2.1 Set Music Level (ST.SML)

Player interacts with the handle of music level.

5.2.2.2 Set Sound Level (ST.SSL)

Player interacts with the handle of music level.

TC ID	Requirements	Priority	Scenario Description
ST.SML	3.2.2	M	Music handler moved to right; music sound increased. Music handler moved to left, sound decreased.
ST.SSL	3.2.2	M	Music handler moved to right; music sound increased. Music handler moved to left, sound decreased.

5.2.3 First Grade Games (FGG)

5.2.3.1 First-Grade Button (GUI.FrstGradeButton)

The player enters first grade games by clicking the FrstGradeButton button.

5.2.3.2 First-Game Button (GUI.FirstGameButton)

The player enters first game of first grade games by clicking the First Game Button.

5.2.3.3 Second-Game Button (GUI.SecondGameButton)

The player enters Second game of first grade games by clicking the Second Game Button.

5.2.3.4 Third-Game Button (GUI.ThirdGameButton)

The player enters Third game of first grade games by clicking the Third Game Button.

5.2.3.5 Back Button (GUI. BackButton)

When the player clicks the BackButton button, it goes back to the previous page.

TCD ID	Priority	Date Run	Run By	Result	Explanation
GUI.FrstGradeButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "First Grade" button. After selecting, games displayed
GUI.FirstGameButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "First Game" button. After selecting, first game displayed
GUI.SecondGameButton	H	26.05.2022	Sinem	Pass	Select

			İlayda YÜCEL		"Second Game" button. After selecting, second game displayed
GUI.ThirdGameButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "Third Game" button. After selecting, third game displayed
GUI. BackButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "BackButton". After selecting, previous page displayed

TC ID	GUI.FrstGradeButton
Purpose	Select "1.Sınıf" button. Player can choose different games from first grade games.
Requirements	2.1
Priority	High
Estimated Time Needed	Under 1 Minutes.
Dependency	The game is executed.
Setup	The game need open from the browser.
Procedure	[A0] Select "Oyna" from main page.
---	[A1] Select "1. Sınıf" from second page.
---	[A2] 1st grade games will be listed.

TC ID	GUI.FrstGradeButton
Purpose	Select "1.Oyun" button. Player Can play the first game of the 1st grade
Requirements	2.1
Priority	High
Estimated	1 Minutes
Dependency	1st grade games must be selected
Setup	1st grade games must be selected.
Procedure	[A0] Select "Oyna" from main page
---	[A1] Select "1. Sınıf" from second page.
---	[A2] 1st grade games will be listed.
---	[A3] User select "1.Oyun" and game will be start.

TC ID	GUI.SecondGameButton
Purpose	Select "2.Oyun" button. Player Can play the second game of the 1st grade
Requirements	2.1
Priority	High
Estimated	1 Minutes
Dependency	1st grade games must be selected
Setup	Second game Button Started the Second game.
Procedure	[A0] Select “Oyna” from main page
---	[A1] Select “1. Sınıf” from second page.
---	[A2] 1st grade games will be listed.
---	[A3] User select “2.Oyun” and game will be start.

TC ID	GUI.ThirdGameButton
Purpose	Select "3.Oyun" button. Player Can play the third game of the 1st grade
Requirements	2.1
Priority	High
Estimated	1 Minutes
Dependency	Second game Button Started the Third game
Setup	1st grade games must be selected.
Procedure	[A0] Select “Oyna” from main page
---	[A1] Select “1. Sınıf” from second page.
---	[A2] 1st grade games will be listed.
---	[A3] User select “3.Oyun” and game will be start.

TC ID	GUI. BackButton
Purpose	Select "<--" button. Player Can goes back to the previous page
Requirements	2.1
Priority	High
Estimated	1 Minutes
Dependency	The state of being on a page other than the main page
Setup	“<-- “ Button return previous page
Procedure	[A0] Select “Oyna” from main page
---	[A1] Select “1. Sınıf” from second page.
---	[A2] 3st grade games will be listed.
---	[A3] When Player Select "<--" button,it will return previous page
Cleanup	Previous page

5.2.4 Second Grade Games (SGG)

5.2.4.1 - Second-Grade Button (GUI.ScndGradeButton)

The player enters second grade games by clicking the ScndGradeButton button.

5.2.4.2- First-Game Button (GUI.FirstGameButton)

The player enters first game of second grade games by clicking the First Game Button.

5.2.4.3- Second-Game Button (GUI.SecondGameButton)

The player enters Second game of second grade games by clicking the Second Game Button.

5.2.4.3- Third-Game Button(GUI.ThirdGameButton)

The player enters Third game of second grade games by clicking the Third Game Button.

5.2.4.4- Back Button (GUI.BackButton)

When the player clicks the BackButton button, it goes back to the previous page.

TC ID	Requirements	Priority	Scenario Description
GUI.ScndGradeButton	2.1	H	Select "Second Grade" button. After selecting, games will be displayed
GUI.FirstGameButton	2.1	H	select "First Game" button. After selecting, first game will be displayed
GUI.SecondGameButton	2.1	H	select "Second Game" button. After selecting, second game will be displayed
GUI.ThirdGameButton	2.1	H	select "Third Game" button. After selecting, third game will be displayed

GUI. BackButton	2.1	H	Select “BackButton”. After selecting, previous page will be displayed
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TC ID	GUI.ScndGradeButton
Purpose	Select "2.Sınıf" button. Player can choose different games from second grade games
Requirements	2.1
Priority	High
Estimated Time Needed	Under 1 Minutes
Dependency	The game is executed
Setup	The game need open from the browser
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “2. Sınıf” from second page
	[A3] 2nd grade games will be listed
Cleanup	Exit

TC ID	GUI.FirstGameButton
Purpose	Select "1.Oyun" button. Player Can play the first game of the 2nd grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	2nd grade games must be selected
Setup	First game Button Started the First game
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “2. Sınıf” from second page
	[A3] 2nd grade games will be listed
	[A4]User select “1.Oyun” and game will be start
Cleanup	Exit

TC ID	GUI.ThirdGameButton
Purpose	Select "3.Oyun" button. Player Can play the second game of the 2nd grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	2nd grade games must be selected
Setup	Second game Button Started the Third game
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “2. Sınıf” from second page
	[A3] 2nd grade games will be listed

	[A4]User select “3.Oyun” and game will be start
Cleanup	Exit

TC ID	GUI.SecondGameButton
Purpose	Select "2.Oyun" button. Player Can play the second game of the 2nd grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	2nd grade games must be selected
Setup	Second game Button Started the Second game
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “2. Sınıf” from second page
	[A3] 2nd grade games will be listed
	[A4]User select “2.Oyun” and game will be start
Cleanup	Exit

TC ID	GUI. BackButton
Purpose	Select "←" button. Player Can goes back to the previous page
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	The state of being on a page other than the main page
Setup	“← “ Button return previous page
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “2. Sınıf” from second page
	[A3] 2nd grade games will be listed
	[A4] When Player Select "←" button,it will return previous page
Cleanup	Previous page

5.2.5 Third Grade Games (TGG)

5.2.5.1 Game One (GO)

5.2.5.1.1 Left Button (TGG.GO.LB)

Player clicks the button to check the answer is true or not.

5.2.5.1.2 Middle Button (TGG.GO.MB)

Player clicks the button to check the answer is true or not.

5.2.5.1.3 Right Button (TGG.GO.RB)

Player clicks the button to check the answer is true or not.

TC ID	Requirements	Priority	Scenario Description
TGG.GO.LB.01	3.2.3	H	Player clicks the left button to answer the question.
TGG.GO.MB.02	3.2.3	H	Player clicks the middle button to answer the question.
TGG.GO.RB.03	3.2.3	H	Player clicks the right button to answer the question.

5.2.5.2 Game Two (GT)

5.2.5.2.1 Interact With Game Objects (TGG.GT.IO)

Player holds and drags the correct game object to pass the given question.

TC ID	Requirements	Priority	Scenario Description
TGG.GT.IO.01	3.2.3	H	Player selects and drags the one of the three-game object to the middle of the screen, answer point.

5.2.5.3 Game Three (GTH)

5.2.5.3.1 Interact With Game Objects (TGG.GTH.IO.01)

Player holds and drags the game objects to the mid-core game objects.

5.2.5.3.2 Interact With Game Objects (TGG.GTH.IO.02)

Player clicks the core objects in order.

TC ID	Requirements	Priority	Scenario Description
TGG.GTH.IO.01	3.2.3	H	Player selects and drags the one of the game objects to the top of core objects, fill the blanks.
TGG.GTH.IO.02	3.2.3	H	Player Clicks the one of the game objects, if it is in right order turns green otherwise red.

5.2.6 Fourth Grade Games (FGG)

5.2.6.1 - Fourth-Grade Button (GUI.FrthGradeButton)

The player enters fourth grade games by clicking the FrthGradeButton button.

5.2.6.2- First-Game Button (GUI.FirstGameButton)

The player enters first game of fourth grade games by clicking the First Game Button.

5.2.6.3- Second-Game Button (GUI.SecondGameButton)

The player enters Second game of fourth grade games by clicking the Second Game Button.

5.2.6.4- Third-Game Button(GUI.ThirdGameButton)

The player enters Third game of fourth grade games by clicking the Third Game Button.

5.2.6.4- Back Button (GUI. BackButton)

When the player clicks the BackButton button, it goes back to the previous page.

TC ID	Requirements	Priority	Scenario Description
GUI.FrthGradeButton	2.1	H	Select "Fourth Grade" button. After selecting, games will be displayed
GUI.FirstGameButton	2.1	H	select "First Game" button. After selecting, first game will be displayed
GUI.SecondGameButton	2.1	H	select "Second Game" button. After selecting, second game will be

			displayed
GUI.ThirdGameButton	2.1	H	select "Third Game" button. After selecting, third game will be displayed
GUI. BackButton	2.1	H	Select "BackButton". After selecting, previous page will be displayed

TC ID	GUI.FrthGradeButton
Purpose	Select "4.Sınıf" button. Player can choose different games from second grade games
Requirements	2.1
Priority	High
Estimated Time Needed	Under 1 Minutes
Dependency	The game is executed
Setup	The game need open from the browser
Procedure	[A0] Select "Oyna" from main page
	[A1] Select "4. Sınıf" from second page
	[A3] 4th grade games will be listed
Cleanup	Exit

TC ID	GUI.FirstGameButton
Purpose	Select "1.Oyun" button. Player Can play the first game of the 4th grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	4th grade games must be selected
Setup	First game Button Started the First game
Procedure	[A0] Select "Oyna" from main page
	[A1] Select "4. Sınıf" from second page
	[A3] 2nd grade games will be listed
	[A4]User select "1.Oyun" and game will be start
Cleanup	Exit

TC ID	GUI.ThirdGameButton
Purpose	Select "2.Oyun" button. Player Can play the second game of the 4th grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes

Dependency	4th grade games must be selected
Setup	Second game Button Started the Third game
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “4. Sınıf” from second page
	[A3] 2nd grade games will be listed
	[A4]User select “3.Oyun” and game will be start
Cleanup	Exit

TC ID	GUI.SecondGameButton
Purpose	Select "3.Oyun" button. Player Can play the second game of the 2nd grade
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	4th grade games must be selected
Setup	Second game Button Started the Second game
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “4. Sınıf” from second page
	[A3] 2nd grade games will be listed
	[A4]User select “2.Oyun” and game will be start
Cleanup	Exit

TC ID	GUI. BackButton
Purpose	Select "←" button. Player Can goes back to the previous page
Requirements	2.1
Priority	High
Estimated Time Needed	1 Minutes
Dependency	The state of being on a page other than the main page
Setup	“← “ Button return previous page
Procedure	[A0] Select “Oyna” from main page
	[A1] Select “4. Sınıf” from second page
	[A3] 4th grade games will be listed
	[A4] When Player Select "←" button,it will return previous page
Cleanup	Previous page

5.3 Test Results

5.3.1 Individual Test Results

Settings

TCD ID	Priority	Date Run	Run By	Result	Explanation
ST.SML	M	26.05.2022	Muhammed Emre KURT	Pass	Music handler moved to right; music sound increased. Music handler moved to left, sound decreased.
ST.SSL	M	26.05.2022	Muhammed Emre KURT	Pass	Music handler moved to right; music sound increased. Music handler moved to left, sound decreased.

First Grade

TCD ID	Priority	Date Run	Run By	Result	Explanation
GUI.FirstGradeButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "First Grade" button. After selecting, games displayed
GUI.FirstGameButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "First Game" button. After selecting, first game displayed
GUI.SecondGameButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "Second Game" button. After selecting, second game displayed
GUI.ThirdGameButton	H	26.05.2022	Sinem	Pass	Select "Third

			İlayda YÜCEL		Game" button. After selecting, third game displayed
GUI. BackButton	H	26.05.2022	Sinem İlayda YÜCEL	Pass	Select "BackButton". After selecting, previous page displayed

Second Grade

TCD ID	Priority	Date Run	Run By	Result	Explanation
GUI.ScndGradeButton	H	26.05.2022	Ziya Can Erandaç	Pass	Select "Second Grade" button. After selecting, games displayed
GUI.FirstGameButton	H	26.05.2022	Ziya Can Erandaç	Pass	Select "First Game" button. After selecting, first game displayed
GUI.SecondGameButton	H	26.05.2022	Ziya Can Erandaç	Pass	Select "Second Game" button. After selecting, second game displayed
GUI.ThirdGameButton	H	26.05.2022	Ziya Can Erandaç	Pass	Select "Third Game" button. After selecting, third game displayed
GUI. BackButton	H	26.05.2022	Ziya Can Erandaç	Pass	Select "BackButton". After selecting, previous page displayed

Third Grade

TCD ID	Priority	Date Run	Run By	Result	Explanation
TGG.GO.LB.01	H	25.05.2022	Muhammed Emre KURT	Pass	Clicked the left button, game played the animation.
TGG.GO.MB.02	H	25.05.2022	Muhammed Emre KURT	Pass	Clicked the left button, game played the animation.
TGG.GO.RB.03	H	25.05.2022	Muhammed Emre KURT	Pass	Clicked the left button, game played the animation.
TGG.GT.IO.01	H	25.05.2022	Muhammed Emre KURT	Pass	Selected item dragged to the answer point, game executed the answer.
TGG.GTH.IO.01	H	25.05.2022	Muhammed Emre KURT	Pass	Selected item dragged to the blank item; the blank items text changed.
TGG.GTH.IO.02	H	25.05.2022	Muhammed Emre KURT	Pass	Clicked the game object, game objects text color changed.

Fourth Grade

TCD ID	Priority	Date Run	Run By	Result	Explanation
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GUI.FrthGradeButton	H	26.05.2022	Oğuz Hazneci	Pass	Select "Fourth Grade" button. After selecting, games displayed
GUI.FirstGameButton	H	26.05.2022	Oğuz Hazneci	Pass	Select "First Game" button. After selecting, first game displayed
GUI.SecondGameButton	H	26.05.2022	Oğuz Hazneci	Pass	Select "Second Game" button. After selecting, second game displayed
GUI.ThirdGameButton	H	26.05.2022	Oğuz Hazneci	Pass	Select "Third Game" button. After selecting, third game displayed
GUI. BackButton	H	26.05.2022	Oğuz Hazneci	Pass	Select "BackButton". After selecting, previous page will be displayed

5.3.2 Summary of Test Results

Priority	Number of TC's	Executed	Passed
H	21	21	21
M	2	2	2
TOTAL	23	23	23

We have executed 23 test cases and all of them are passed.

5.3.3 Exit Criteria

We have executed all test cases and 100% of test cases are passed. All of the high and medium priority test cases are passed. Exit criteria is met.

6. Conclusion

"PRIMATH" is a digital platform which contains different type of serious games to improve children's math mindset.

There are many educational mini games for 4 different classes. Thanks to the question mark bubbles in the game, it allows the children to give more specific information about what the buttons do and more specific information about the game. Games are suitable for the mathematics misconception all the 4 classes, "PRIMATH" aims to help teachers to well teach these misconceptions of mathematics. There is also a time limit for each game to improve competition among the children so they will try their best to make a better score from their friends. The time limit decreases the learning time.

Some of the advantages of serious games are

- So that it is a digital platform application is effortless to Access
- Changing children's perspective on the concept of education
- Teaching the concept of time management
- Changes children's perspectives on harmful game.

Serious games will contribute to the personal, mental, and social development of young children and will provide a different perspective to solve the problems that children will encounter. Our Primath project will always be a project open to development. Thanks to this project, children will easily adapt to new generation technologies, and they will be able to develop these technologies. When human beings develop new training techniques and methods, they will be able to integrate all kinds of software projects related to it.

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