**[Connect the Color Dot’s An IQ Test Puzzle Game]**

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**Final Approval**

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**Declaration**

We hereby declare that this document “**[Connect the Color Dot’s An IQ Test Puzzle game]**” neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanied report entirely on the basis of our personal efforts, under the proficient guidance of our teachers, especially our supervisor **[M. Mansoor Alam]**. If any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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**Dedication**

I dedicate this project, Connect the Color Dots IQ Test Puzzle Game, to my beloved family and friends, whose constant encouragement and unwavering support have been my source of strength throughout this journey. A special thanks to my teachers and mentors for their guidance, knowledge, and inspiration, which have shaped my academic endeavors. This project is also dedicated to all those who strive for creativity, innovation, and knowledge in the field of game development and cognitive research.**Acknowledgement**

First of all we are obliged to Allah Almighty the Merciful, the Beneficent and the source of all Knowledge, for granting us the courage and knowledge to complete this Project.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**Abstract**

The "Connect the Color Dots IQ Test Puzzle Game" is designed as an interactive and engaging puzzle game aimed at enhancing cognitive abilities through problem-solving. This project integrates the classic dot-connecting puzzle concept with a modern twist of color association to test and improve a player's IQ. The game presents players with a grid of colored dots, and the challenge is to connect matching colored dots without overlapping the connecting lines. The puzzle becomes increasingly difficult as the grid size expands and the number of colored dots increases.

The primary objective of this project is to develop a user-friendly, visually appealing puzzle game that challenges the logical thinking and spatial reasoning of players. It also seeks to explore the relationship between problem-solving in puzzle games and cognitive improvement, making it not only entertaining but also educational. The game is designed to be adaptable to different skill levels, offering a dynamic experience for both beginners and advanced players.

This project is developed using C sharp and its gaming libraries, ensuring a smooth and responsive user interface. The game mechanics and design considerations are discussed in detail, with emphasis on user engagement and cognitive stimulation.

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# Introduction

The digital gaming industry has seen tremendous growth in recent years, with puzzle-based games being a key contributor to this success. Puzzle games not only entertain but also challenge a player's mental faculties, improving their problem-solving skills and cognitive abilities. In this project, we introduce “Connect the Color Dots,” an IQ test puzzle game that goes beyond simple entertainment, offering players a way to assess and improve their IQ levels. The game’s main premise revolves around connecting color dots on a grid without overlapping paths. It is designed to engage players by providing challenges that scale in difficulty as they progress through the levels.

This project is being developed as part of a final year academic endeavor. It combines game development, cognitive science, and artificial intelligence to deliver a comprehensive puzzle game experience. The game is particularly focused on testing the user’s IQ through strategically designed levels that involve critical thinking, logic, and spatial reasoning.

The game is divided into two primary modes: Practice Mode and IQ Mode. In Practice Mode, players can freely explore puzzles without any time constraints, allowing them to become familiar with the mechanics. In IQ Mode, puzzles are timed, and a player’s performance is scored to provide an estimate of their IQ. The scoring system incorporates age, moves taken, levels completed, and time spent to give a holistic assessment of the player’s cognitive abilities.

The levels in this game are generated using artificial intelligence (AI), ensuring that each level presents a unique challenge. This feature not only enhances the replayability of the game but also ensures that the player’s IQ is tested against a variety of scenarios. In addition, the project incorporates a login system where the player’s information, including age and performance data, is stored. This allows the game to tailor its challenges to the player’s profile, making the IQ assessment more personalized and accurate.

This chapter will focus on outlining the goals, objectives, and scope of the project to provide a clear understanding of the direction and purpose of the game.

### ****1.1 Goals and Objectives****

The primary goal of the "Connect the Color Dots" project is to develop an interactive, engaging puzzle game that tests and evaluates a player's cognitive abilities through IQ-based scoring. Unlike traditional puzzle games, this project integrates elements of cognitive science to ensure that the game provides accurate assessments of a player's IQ. By the end of the project, the game will not only serve as a form of entertainment but also as an educational tool for cognitive improvement.

**Specific Objectives**:

1. **Develop a Puzzle Game with Intuitive Mechanics**: The core gameplay involves connecting matching colored dots on a grid. The objective is to create a user-friendly interface that is easy to navigate, allowing players to understand the game mechanics quickly. Players will be tasked with solving increasingly complex puzzles, requiring them to use logic and critical thinking.
2. **Implement IQ Testing Based on Performance**: The game's IQ Mode will calculate the player's IQ based on several factors, including age, the number of moves taken to complete a puzzle, the time taken to solve each level, and the number of levels completed. This scoring mechanism will provide a reliable assessment of the player’s cognitive performance.
3. **Use Artificial Intelligence for Level Generation**: The game will use AI algorithms to generate unique levels, ensuring that no two levels are the same. This feature will enhance the replayability of the game, providing new challenges every time the player starts a new game. AI-based level generation also ensures that the game scales in difficulty based on the player’s progress.
4. **Develop Two Gameplay Modes: Practice and IQ Mode**: In Practice Mode, players will be able to play without any time or move constraints, allowing them to explore and learn at their own pace. In IQ Mode, players will face a timed challenge, with their performance directly influencing their IQ score. This dual-mode gameplay ensures that the game caters to both casual players and those interested in testing their IQ.
5. **Create a Personalized User Experience**: The project includes a login system where users must input their age and username. The game will store this information and adjust the difficulty and scoring based on the player's profile. The player's performance data, including completed levels and IQ scores, will be saved, allowing them to track their progress over time.
6. **Design an Educational Tool for Cognitive Improvement**: While the game is primarily entertainment-based, it also aims to educate players by improving their logical reasoning and problem-solving skills. Through repeated gameplay, players can track their cognitive improvement, making the game not only fun but also beneficial for mental development.

### ****1.2 Scope of the Project****

The scope of the “Connect the Color Dots” project extends beyond creating a simple puzzle game. It is a comprehensive solution that combines game mechanics, artificial intelligence, user data management, and cognitive science principles to deliver an engaging and educational experience.

**Key Features and Functionalities**:

1. **Core Gameplay**: The primary feature of the game is its simple yet challenging mechanics: connecting colored dots on a grid. Each puzzle becomes progressively more complex, with larger grids and more dots to connect. The scope of gameplay will cover a wide range of difficulty levels, from easy grids for beginners to complex puzzles for advanced players.
2. **IQ-Based Scoring System**: One of the main components of this project is its IQ scoring mechanism. The game evaluates players based on their ability to solve puzzles efficiently. This evaluation takes into account various factors such as the player’s age, the number of moves made, the time taken to complete each level, and the number of levels completed. The scope includes the development of algorithms that can accurately calculate IQ based on these metrics.
3. **AI-Generated Levels**: The project includes the implementation of AI algorithms for dynamic level generation. These algorithms will ensure that each level is unique, enhancing the replayability of the game. The AI will also adjust the difficulty of each level based on the player’s performance, ensuring a balanced and challenging experience.
4. **User Data Management**: The project will feature a login system that stores player information such as age, username, and performance data. This data will be used to personalize the gameplay experience, tailoring the difficulty and scoring based on the player’s profile. The system will also track the number of times a player has played, their progress through levels, and their highest IQ score achieved.
5. **User Interface Design**: The game will feature a user-friendly interface that makes it easy for players to navigate through the game’s menus, select modes, and track their progress. The scope also includes the development of a tutorial mode to introduce new players to the game’s mechanics, ensuring a smooth onboarding experience.
6. **Educational and Cognitive Benefits**: Although the game is primarily a form of entertainment, it is also designed to provide cognitive benefits. The puzzles are crafted to improve the player’s logical reasoning and problem-solving skills. The project scope includes the research and implementation of puzzle designs that challenge various aspects of cognitive function.
7. **Platform and Technology**: The game will be developed using the Unity engine, with C# as the primary programming language. The project’s scope includes ensuring the game is optimized for both mobile and desktop platforms, making it accessible to a wide audience.
8. **Testing and Evaluation**: The scope also includes thorough testing of the game to ensure that it functions as intended. This includes testing the AI level generation, IQ scoring algorithms, and user data management system. Feedback from players will be used to fine-tune the game and ensure that it provides a balanced and enjoyable experience.

# Literature Review

# This chapter reviews the literature on the development of IQ test puzzle games with emphasis on previous work that has focused on creating cognition based puzzle games. The review seeks to establish a clear understanding of what previous works in the areas of interest have done, the techniques, algorithms and design strategies that were used, and the accomplishments as well as the shortcomings of the approaches. In this manner, this chapter lays groundwork for creation of the “Connect the Color Dots IQ Test Puzzle Game,” which suggests that the project should proceed from the current state of the art and improve it.

## Introduction

This section is an introduction to the topic and general background about IQ test puzzle games for the development of the child. Tiles puzzle games or ‘solitaire’ games have been considered as aides for problem solving, memory improvement and aiding for logical thinking abilities. Originally, such games were based mainly in physical structures, but have become much more commercialized and can now be played online. This paper aims to review the literature about the history of this field, present and future, and available and emerging technologies.

#### 2.1.1 Historical Context of Cognitive Games

Traditional brain games like chess, Sudoku and the first logic puzzles have been an essential ingredient of the brain training concept for many years. This section gives an account of the development of such games from analog to the digital setup. Explain major steps in puzzle game evolution and their effect on processes in learners’ mind, placing focus on their educational characteristics.

#### 2.1.2 Evolution of IQ Test Games in the Digital Era

IQ test puzzle games have developed greatly with the help of the using of the digital platforms. Most of the current IQ test games have involved dynamic interfaces as well as other advanced mathematical models. The focus of this section is on the substitution of physical board games with computerized games and the contribution of AI and ML in improving the staking field. Highlight future works that demonstrate how some of these advancements facilitate evaluation of a given player’s cognitive abilities more effectively.

#### 2.1.3 Methodologies and Algorithms in Cognitive Puzzle Games

Puzzle games are based on the various methodologies and algorithms used in the IQ test, and one can learn about them. Highlight studies that focus on algorithmic approaches like:

* **Pathfinding algorithms** (Dijkstra's, A\* algorithms) for game mechanics.
* **Graph-based algorithms** for puzzle generation.
* **Machine Learning models** for user differentiation depending on the player’s performance as well as for skill-based mechanics. Discuss how these techniques are used to make the game on one hand, difficult on the other hand, but playable; with examples of like “Connect the Color Dots”.

#### 2.1.4 Design Strategies and User Experience (UX)

This section is about the design principles that relate to its ability to capture a user’s attention as well as make their brain work a little. Review studies related to game design frameworks that prioritize:

* **Usability**: User-friendly interfaces that ensure accessibility for diverse age groups.
* **Progressive difficulty levels**: Games that adapt to the user’s cognitive performance.
* **Visual design and color psychology**: The role of aesthetics and color choices in influencing cognitive perception and decision-making.
* **Gamification elements**: Discuss the use of rewards, scoring, and competitive elements to increase engagement.

#### 2.1.5 Cognitive Benefits and Limitations

Most of the research studies indicate the cognitive advantages connected to the utilization of IQ test puzzle games. Focus on research that highlights improvements in areas such as:

Logical reasoning

Spatial awareness

Problem-solving

Memory retention At the same time, there should be an identification of constraints or difficulties. Critiques have noted that although such games may offer general advantages that favor certain skills they do not consequent in broad improvement in cognition. Besides, potential controversies have to do with addiction potential regarding learning processes and over-enthusiastic reliance on the use of gamification.

#### 2.1.6 Comparison of Similar IQ Puzzle Games

Conduct a comparative analysis of popular IQ puzzle games such as:

* **Flow Free** (where players connect dots)
* **Lumosity** (which offers a range of brain-training puzzles)
* **Peak** (another cognitive training platform) In the same regard, discuss the algorithms, the design strategies, and methodologies used and incorporated in these games by comparing them their own “Connect the Color Dots IQ Test Puzzle Game”. Find out where these existing games excel and where your project falls into place and adds value.

#### 2.1.7 Challenges in the Development of Cognitive Puzzle Games

Although there are numerous cognitive puzzles, some commonly known titles have proved quite successful, both for individuals and enterprise, such challenges come with a set of difficulties for developers, including providing the value of a fun and adaptive game as well as having to be scientifically validated. Review articles that discuss common development hurdles such as:

* The decreasing availability of puzzles (how to make sure there are enough new and different puzzles for the long-term use by players).
* Practicality to address various concepts in a way that will not be too complex to be understood.
* Sustaining the interest of the players in the long-run.

#### 2.1.8 Summary of Findings and Gaps in the Literature

This part is best suited in describing papers which have been reviewed in this literature or research gaps which your project seeks to fill. It means that stress on opportunities that can be connected with the “Connect the Color Dots IQ Test Puzzle Game,” possessing a number of original idea, the use of the algorithm, which has to adapt to the player or the deficiencies of the existing games.

## Background and Problem Elaboration

It is a well-known fact that puzzles themselves have been a part of video games industry for quite a long time, and being so, it should be mentioned that the majority of them were implanted in order to complete certain tasks which develop mental abilities like memory, logic and problem solving skills. Though there are numerous games on the gaming market, there is a lack of an engaging and highly intelligent and fun-filled puzzle game that can increase a player’s intelligence level. Current games do not possess enough depth and flexibility in order to remain engaging as people’s skills grow. This section expands on the importance of the proposed since it has to be fun and pose a really big challenge to the brain and this has to increase as the game progresses.

## Detailed Literature Review

### Definitions

For the purpose of this review an IQ test puzzle game is a game that provides the player with puzzles that is aimed at testing as well as enhancing intelligence. The main tasks of these games are something that demands preeminently logical, analytical thinking based on patterns and problem solving.

### Related Research Work 1

This area has been advanced through the creation of a game known as ‘Flow Free,” in which players have to join dots of equal color, provided that the paths do not intersect. This game counts on a grid construction where players have to draw a line between two points and keep it going indefinitely. The base algorithm is designed to address path finding and optimization issues, thereby making the game difficult when grid size increases and number of paths formed increases. Still, Flow Free does not have an ability to change the level of difficulty, which means that the player will either get frustrated or bored when continuing the game.

### Related Research Work 2

### Another related project is known as “Color Connect” but in this project the dots are joined but there is a time which is provided to the players in which all the connections should be made. The score of the game is obtained dynamically; awarding points based on the speed and accuracy; therefore increasing the cognitive speed of the players. But although this game brings in this aspect of time and hence increases its level of complexity, it does not offer a progressive learning curve as analyzed above where the basic challenge here is to solve the puzzles within the least amount of time.

## Literature Review Summary Table

The columns in the table depend upon your problem and should be specific to your project.

Table 1: History of Computing Devices

The summary of various computing devices invented in the past from 1833-1901 is presented here.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Name, reference | Inventor | Year | Input | Output | Description |
| 1. | Analytical Engine, [1] | Charles Babbage | 1833 | Punch cards | Printer, curve plotter, bell | First general purpose computer that had an arithmetical logic unit and could compute using conditional branching and loops. Also incorporated integrated memory. |

## Research Gap However, until this study, there has not yet been a puzzle game as complicated and challenging as that presented here that can be downloaded from the iTunes app store. The currently available games either are designed to develop one particular aspect of cognitive capacity or else do not have progressive difficulty levels. Currently, there are no games that are designed to be incremental yet challenging where the IQ test level of the player increases daily, weekly, monthly or at a different span of time in such manner that the game becomes infinite and players do not get bored. Thus, the “Connect the Color Dots IQ Test Puzzle Game” is proposed to meet this aspect and make the game almost endless.

## Problem Statement

The main concern that this project aims to solve is a dearth of an entertaining and engaging cognitive puzzle game that provides proven cognitive benefits and increases in difficulty. What has been created so far is either stuck at the requisite level of complexity or is designed for one particular facet or aspect of cognitive ability, where there is then a definite lack of games that substitute this missing out for a well-rounded and challenging experience.

# Requirements and Design

# Video game development is a complex process that requires significant planning, brainstorming and most importantly skilled coding. Thus, the success of any game can be attributed neither to the idea but on how good that idea is in creating a functional and fun system. This chapter emphasizes the detail understanding of special demands and design features of Connect the Color Dots IQ Puzzle Game. However, it can hardly be overemphasized how important it is to understand the purpose of adequately defining requirements and the structure of the computational model.

# Computer puzzle games have been interesting techniques for their users, as they create an opportunity to solve different problems mentally. These games are basic form of strategy games online or physical board games that challenge a players mind through logical thinking, reasoning as well as solving puzzles. Due to the advancement in technology, the idea of designing the puzzle in a game form with difficulty levels that change with the users’ performance in the game is now possible.

# The rationale for developing an IQ-based puzzle game comes from the popularity of the mental fitness and the applied games for the brain. Most players want to enhance their performances, and puzzles games offer them an opportunity. Scholars argue that recoding mentally tough activities help to improve the brain, memory, and extension of time to focus. Products like Sudoku, crossword puzzles, and ‘Connect the Dots’ exercises like word searches are all good examples of games that are beneficial to cognitive development.

# The "Connect the Color Dots IQ Puzzle Game" builds on a simple yet challenging concept: In a game, players have to match the dots of the similar pattern of colors in a matrix by drawing lines over and across the dots. It has a number of skill levels in the game, in order to make the players think all the time and not get bored. When this occurs the grid layout of the problems becomes more complicated and require advanced strategies and powerful thinking.

## Requirements

## The requirements are divided into two main categories: functional and non-functional. These outline the system’s expected behavior and operational characteristics.

### Functional Requirements

| **Requirement ID** | **Description** |
| --- | --- |
| **FR-1.1** | It shall be formulated in a way that the game shall show a tutorial when it is first initiated. |
| **FR-1.2** | After completing the tutorial, the game shall present two modes: Practice Mode and IQ Mode. |
| **FR-1.3** | In IQ Mode, the system shall allow the player to play the game only after the player enters the username and the age. |
| **FR-1.4** | The game shall require the player to identify his age and inform players between the ages of 3 and 90. |
| **FR-1.5** | The system shall enable the player to log in by clicking a Login button post-inter phase entry of the details. |
| **FR-1.6** | After login, the game shall display three stages in both modes: Easy, Intermediate, and Hard. |
| **FR-1.7** | In IQ Mode, it is going to have countdown timer and a health slider during the course of the game. |
| **FR-1.8** | The game shall enable players to measure their IQ since IQ Mode shall help track IQ Score. |
| **FR-1.9** | In each stage for the Practice Mode, the game shall have the following buttons: There are five button options available on the screen which consists of Reset, Next, Hint, Back and Quit. |
| **FR-1.10** | Specifically, in Practice Mode, the game shall not present a countdown timer as well as a health bar. |
| **FR-1.11** | It is hereby provided; The system shall enable the reset of the current level by means of the Reset button available on the playing surface. |
| **FR-1.12** | Using the Quit key on the keyboard the system shall enable the player to exit from the game while Next button shall enable the player to proceed to the next level of the game. |
| **FR-1.13** | During gameplay an element called Hint button shall give hints to the players. |
| **FR-1.14** | The Back button shall return the player to the previous screen in the system. |

**Non-Functional Requirements:**

| **Requirement ID** | **Description** |
| --- | --- |

|  |  |
| --- | --- |
| **NFR-1** | The system should have short response times to all the user activities (login, button click, etc.). |

|  |  |
| --- | --- |
| **NFR-2** | The game shall be running on Android mobiles. |

|  |  |
| --- | --- |
| **NFR-3** | It shall be easy to follow the day to day tutorial and login. |

|  |  |
| --- | --- |
| **NFR-4** | **The game shall be designed to achieve frame rate of not less than 30 FPS while in game play so that the animation and buttons to be interactive.** |

|  |  |
| --- | --- |
| **NFR-5** | The different modes of the game shall have a similar interface. |

|  |  |
| --- | --- |
| **NFR-6** | Real time updating of the timer and health slider in IQ mode: There should be no lag time. |

### Hardware and Software Requirements

**Hardware Requirements:**

**Processor:** The recommended specifications are at least 1.8 Ghz, quad core processor or higher if for development and testing.

**RAM:** For a good development environment, there should be at least 4 GB of RAM .

**Storage:** At least 612 MB of free disk space for mainly the development environment and also for /assets/ and testing.

**Graphics:** Graphic display of built-in graphics processing unit for enhanced rendering of challenges, especially in animation, at levels of OpenGL 3.0 and above.

**Mobile Device:** An Android smartphone or tablet with a minimum version of Google Android 5.0 (Lollipop) as well as minimum 2 gigabytes of RAM to test the game.

**Software Requirements:**

**Operating System:** Development requires Windows 10 or higher, macOS 10.15 or higher, or Linux (Ubuntu 18.04 or higher).

**Game Engine:** Another solution could be given by Unity or any similar game development platform to support cross-platform mobile development.

**Programming Language:** C# (if using Unity) or Java,kotlin (if using Android Studio).

**Development Tools:**Visual Studio (for facilities for programming in C# .

**Testing Software:** Android emulator for in-system testing and several devices for the real-time test.

## Proposed Methodology

This paper details the study methodology that was taken in the formulation and design of the game. It is an approach that is carefully planned, and has clear stages of development, with focus on test and improve and integration of users’ experiences.

**Requirement Gathering:** In this phase, we find out all the functional and non-functional specifications of the game that will be developed. Also there are user requirements for example the gameplay, how points are assigned as well as the performance characteristics.

**System Design:** In this phase, UI, game architecture, and the design mean the overall structure and organization of the game, layout of playable game modes and increasing/ decreasing difficulty levels that would not confuse a user.

**Development:** The development process is Agile, with the process divided into small cycles containing an abbreviated game, which must be tested and refined. Sub-modules can be the login system and options, the dot connecting game mechanism, the timer and the health bar and the IQ score counter.

**Testing:** Functional testing is performed on separate parts of a software such as button click behaviour, score computation, and login credentials. With integration testing, the assumption is made that all of the elements integrate correctly to produce the expected result; real-time performance testing on a variety of hardware is also performed.

**Deployment:** After that the game is put on Android mobile devices and more testing and experience collecting for improvements is made.

**Feedback and Refinement:** Analyses from the first-hand testing performed by other players and early adoptees of the game they provide feedback that informs the incremental enhancements made to the game’s functions, speed, and overall interactive experience.

## System Architecture

The system architecture gives an idea of the various sub systems that exists in the game and how these sub systems are integrated into the complete system. The present architecture is a client server architecture in which the client is the mobile game application and the server manages the functions related to user login and tracking of the IQ score.

**3.3.1 Client Layer (Front-End) :**

**User Interface (UI):** It is through the use of friendly screens for the user’s log in, mode of the game, actual playing of the game and even scoring. The general look and feel of the UI remains constant in both Practice and IQ mode and dynamically settles with the game’s actions, button press, and feedback.

**Gameplay Mechanism:** Here is where the game’s rules regarding how players join points, switch between different levels, together with use of such extra components as hints and tips, reset buttons, and timers are implemented.

**Data Input:** The client saves inputs from the users which include username, age as well as gameplay actions and forwards the information to the backend.

**3.3.2 Business Logic Layer (Game Engine and Algorithms) :**

**Game Logic Algorithms:** This layer encompasses all game rules, especially those algorithms that work in comprehending and providing the linkages of dots as well as the resulting patterns, and computation of IQ level based on gameplay.

**Timers and Health Slider:** The countdown timer and health slider in IQ Mode are controlled in real-time to give the players informations about their performance.

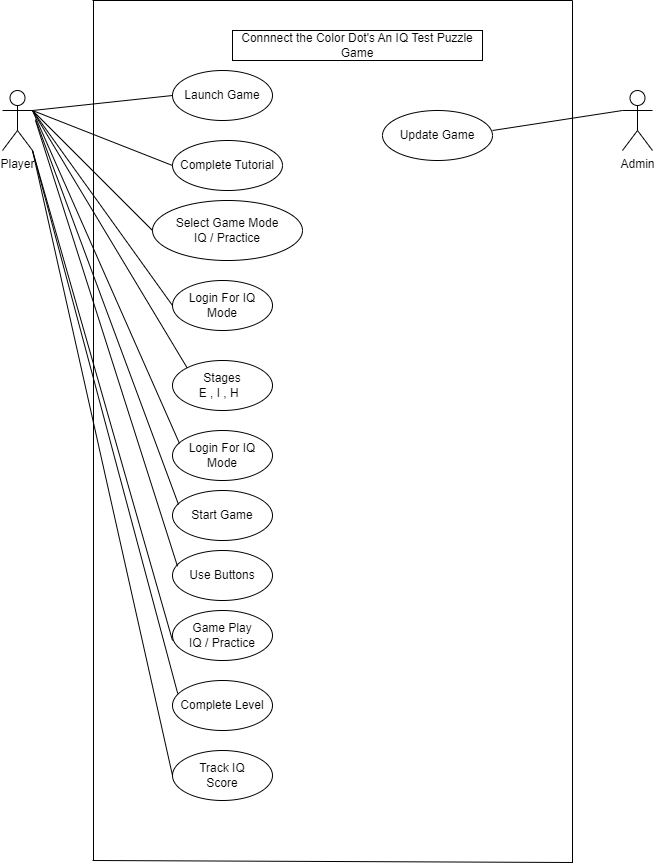
**3.3.3 Data Layer (Back-End) :**

**User Authentication:** When log on to IQ Mode, the user’s identity is authenticated by the system through the check of username and age.

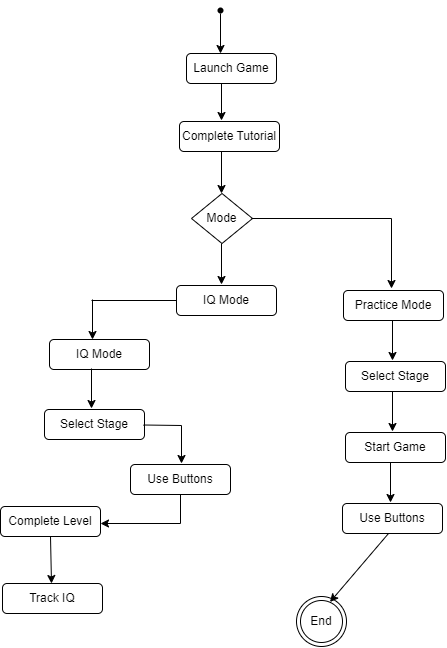
Data Storage: Player details, intelligence quotient test results and games records and are safely and efficiently maintained in the database.

**Communication with Front-End:** The backend facilitates smooth interaction between the game application and , where information concerning the play progress, scores and user data is received in real-time.

## Use Cases



**. Activity Diagram**



### Sample Use Case Name Here

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Launch Tutorial | | |
| Actors | | Player | | |
| Summary | | Display the tutorial on game launch for first-time players. | | |
| Pre-Conditions | | The game has been opened for the first time by the player. | | |
| Post-Conditions | | The tutorial is completed, and the player is redirected to the main menu to choose the game mode. | | |
| Special Requirements | | The player opens the game for the first time. | | |
| Main Action | | | | |
| Actor Action | | | **System Response** | |
| 1 | The player launches the game. | | 2 | The system checks if the player has completed the tutorial before. |
| 3 | The player follows the steps of the tutorial. | | 4 | After completion, the system redirects the player to the main menu (with the options for Practice Mode and IQ Mode). |
| **Alternative Flow** | | | | |
| 3 | If the player complete the tutorial before. | | 4-A | They are taken directly to the main menu. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Login for IQ Mode | | |
| Actors | | Player | | |
| Summary | | Log in to start IQ Mode. | | |
| Pre-Conditions | | The player is at the main menu and selects IQ Mode. | | |
| Post-Conditions | | The player is logged in, and their age is saved for IQ score calculations. | | |
| Special Requirements | | The player selects IQ Mode and is prompted to log in. | | |
| Main Action | | | | |
| Actor Action | | | **System Response** | |
| 1 | The player selects IQ Mode from the main menu. | | 2 | The system displays a login form asking for the player's username and age. |
| 3 | The player enters their username and age. | | 4 | The system verifies the age. |
| 5 | The player clicks the "Login" button. | | 6 | Upon successful verification, the player is directed to the stage selection screen (Easy, Intermediate, Hard). |
| **Alternative Flow** | | | | |
| 3 | If the player enters invalid data  (e.g., invalid age) | | 4-A | The system displays an error message. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Select Stage (Practice or IQ Mode) | | |
| Actors | | Player | | |
| Summary | | Select a stage (Easy, Intermediate, or Hard) to start gameplay. | | |
| Pre-Conditions | | The player has chosen a mode (Practice or IQ) and completed login if in IQ Mode. | | |
| Post-Conditions | | The player is taken to the selected stage for gameplay. | | |
| Special Requirements | | The player selects a stage from the stage selection screen. | | |
| Main Action | | | | |
| Actor Action | | | **System Response** | |
| 1 | The player selects either \*Practice Mode\* or \*IQ Mode\*. | | 2 | The system displays three stage options: Easy, Intermediate, and Hard. |
| 3 | The player selects a stage. | | 4 | The system loads the corresponding stage and prepares the game interface (with buttons and, in IQ Mode, the timer and slider). |
| **Alternative Flow** | | | | |
| 3 | If the player tries to start a stage without completing the login process in IQ Mode. | | 4-A | The system redirects them back to the login screen. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Gameplay with Buttons (IQ Mode) | | |
| Actors | | Player | | |
| Summary | | Allow the player to interact with various buttons during gameplay in IQ Mode. | | |
| Pre-Conditions | | The player is in a stage in IQ Mode, and the game is in progress. | | |
| Post-Conditions | | The player's action is carried out ( move to the next level, quit, etc.). | | |
| Special Requirements | | The player clicks one of the buttons ( Next , Quit). | | |
| Basic Flow | | | | |
| Actor Action | | | **System Response** | |
| 1 | The player starts a level in IQ Mode. | | 2 | The login page is displayed asking for email and password. |
| 3 | The player can click the following buttons:    Next\*: Moves to the next level after completing the current one.    Quit\*: Quits the game and returns to the main menu. | | 4 | The system responds to the player’s action and updates the game accordingly. |
| **Alternative Flow** | | | | |
| 3 | If the player tries to quit. | | 4-A | The system asks for confirmation before exiting the game. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Countdown Timer and Health Slider (IQ Mode) | | |
| Actors | | Player | | |
| Summary | | Implement a countdown timer and health slider in IQ Mode during gameplay. | | |
| Pre-Conditions | | The player is in IQ Mode and has started a level. | | |
| Post-Conditions | | The game stops when the timer runs out, and the player sees a game-over screen if not completed within time. | | |
| Special Requirements | | The player starts a level in IQ Mode. | | |
| Main Action | | | | |
| Actor Action | | | **System Response** | |
| 1 | The player starts a level in IQ Mode. | | 2 | . The system starts the countdown timer. |
| 3 | If the player completes all levels. | | 4 | The system calculates the final IQ score. |
| **Alternative Flow** | | | | |
| 3 | If the timer reaches zero, | | 4-A | The system displays a IQ score on screen |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Start Game in Practice Mode | | |
| Actors | | Player | | |
| Summary | |  | | |
| Pre-Conditions | | The player selects Practice Mode and a stage. | | |
| Post-Conditions | | Player progresses to the next level in Practice Mode. | | |
| Special Requirements | |  | | |
| Basic Flow | | | | |
| Actor Action | | | **System Response** | |
| 1 |  | | 2 |  |
| 3 | The player completes the level. | | 4 | The player interacts with buttons (Reset, Next, Hint, Back, Quit) as necessary. |
| **Alternative Flow** | | | | |
| 3 | If the player presses the reset button, | | 4-A | The System resets the game level  and tops gameplay. |

## GUI Graphical User Interfaces (*Optional)*

This section should give the GUI dumps of each screen, with reference to the user. The navigation flow of each user is also required, and each GUI should mark the functionality/use case that it covers.

### Chapter 4: Implementation and Test Cases

#### 4.1 Implementation

**4.1.1 Dot Placement Algorithm: Detailed Overview :**  
The **Dot Placement Algorithm** plays a pivotal role in defining the core mechanics of the "Connect the Color Dots IQ Test Puzzle Game." This section will cover in detail the theory behind dot placement, the constraints imposed to ensure solvable puzzles, and the step-by-step process of its implementation in Unity. We will also explore how different grid sizes affect the complexity and user experience.

* **Background and Research**: A thorough review of existing methods for random dot placements in puzzle games. Compare and contrast the selected algorithm with other approaches, such as random generation vs. controlled placement, along with case studies from games like "Flow Free" and other IQ puzzle games.
* **Algorithm Logic Breakdown**: Provide pseudocode, flowcharts, and decision trees to illustrate the process of generating the dots. Explain how the algorithm avoids unplayable puzzles by validating dot connections during the generation phase.
* **Performance Optimization**: How the algorithm is optimized for both mobile and desktop platforms. Discuss techniques like caching and lazy-loading of puzzles to minimize memory use.

**4.1.2 Detailed Code Example with Explanations**

* **Pseudocode**: A step-by-step breakdown of the dot placement logic.
* **Unity-Specific Integration**: Explain how this algorithm is implemented in Unity, with C# code snippets showing the integration of grid logic, randomness, and solvability checks. Also discuss how the Unity Inspector is used to fine-tune variables for different levels of difficulty.
* **Advanced Features**: Explain how the algorithm adapts to player skill by dynamically altering puzzle difficulty. Discuss possible machine learning enhancements, where the system learns from player performance data to adjust future puzzle configurations.

##### 4.1.3 Path finding Algorithm (A\*) :

**Detailed Path finding Mechanics :**  
The A\* algorithm is central to the player's interaction with the game. Here, we will dissect the A Pathfinding Algorithm\* by first explaining the theory behind it, followed by its specific application in this game.

* **Theory of A**\*: Detailed explanation of how the A\* algorithm works in theory, including discussions on its heuristic function, open and closed lists, and the mathematical formula that determines path cost. Compare it to other pathfinding algorithms like Dijkstra’s Algorithm and Breadth-First Search (BFS).
* Why A was Selected\*: A comparative analysis of different algorithms that could be used, highlighting the trade-offs between complexity and performance. Include benchmarks showing A\* performance against alternatives.

**Grid-Based Application :**

* **2D Grid Representation**: Explain the representation of the grid as a 2D array and how the cells interact with each other. Dive into the data structures used, such as the nodes in the grid, and discuss the connectivity constraints (e.g., preventing overlapping connections).
* **Edge Cases**: Discuss various edge cases like narrow grids, paths with multiple obstacles, and how the algorithm resolves complex grid setups without affecting performance.

**Detailed Code Example with Explanations :**

* **Step-by-Step Explanation**: Provide a detailed code walkthrough with accompanying explanations for each part of the algorithm.
* **Visual Aids**: Include grid diagrams and flowcharts showing how the algorithm progresses as a player tries to connect dots, highlighting key moments like successful connections, failed paths, and retries.

##### 4.1.4 Adaptive Difficulty Algorithm :

**Dynamic Difficulty Adjustment (DDA) and AI Integration :**

* **Introduction to DDA**: Explain the importance of adaptive difficulty in puzzle games, with references to existing research and implementations in games like "Candy Crush" and "Monument Valley." Dive into the theory behind adaptive learning and how the game measures player performance.
* **Adaptive Algorithms**: Provide detailed descriptions of how the game adjusts the difficulty level based on player metrics like time taken, errors made, and the number of successful connections. Discuss various models for difficulty scaling and how AI is used to predict the next level of challenge.
* **AI Models Used**: If machine learning is used, discuss the specific models employed (e.g., decision trees, neural networks) and provide references to research on adaptive learning in games. Show detailed data flows that explain how player data is collected and processed to adjust puzzle difficulty.

#### 4.2 Test Case Design and Description

##### 4.2.1 Sample Test Case No. 1: Dot Placement and Validity

**Expanded Test Case Description**  
Each test case can be expanded into a full-page document that includes:

* **Detailed Objective**: A deeper explanation of why this test case is necessary, what part of the game it targets, and the impact of test results on gameplay.
* **Inputs and Expected Outputs**: A table that lists various input parameters (e.g., grid size, number of dots, colors used) and the expected system behaviors for each.
* **Validation Criteria**: How success is measured. Include screenshots or diagrams showing the game’s response to different test inputs.
* **Automated Testing Tools**: Discuss how tools like Unity’s Test Framework can be used to automate the execution of these test cases, ensuring coverage across different scenarios.

##### 4.2.2 Sample Test Case No. 2: Pathfinding Validation

Expand the pathfinding test case similarly:

* **In-Depth Validation of Paths**: Discuss how the test case ensures the A\* algorithm correctly identifies and prevents invalid paths, with detailed examples and edge cases.
* **Visual Feedback Mechanism**: Provide detailed explanations on how visual feedback (e.g., error indicators, color changes) is tested and validated for user interactions.

#### 4.3 Test Metrics

##### 4.3.1 Sample Test Metric No. 1: Algorithm Accuracy

Expand this section by including:

* **Precision and Recall Metrics**: Introduce more advanced test metrics like precision, recall, and F1 scores to evaluate the accuracy of the algorithms.
* **Real-World Application**: Explain how these metrics were applied in real-world scenarios and provide examples with test result data.

##### 4.3.2 Sample Test Metric No. 2: UI Responsiveness

Include:

* **Detailed Performance Metrics**: Break down the exact times captured by the system, including best-case, worst-case, and average response times across different devices and platforms. Visualize data with charts showing response times on platforms ( Android).

##### 4.3.3 Sample Test Metric No. 3: Performance Under Load

Include more technical details on:

* **Stress Testing Tools**: Introduce specific tools (like Unity Profiler, TestComplete) used to measure performance under load.
* **Benchmark Data**: Provide actual performance benchmarks for different grid sizes, devices, and platforms. Show how the game performs under optimal and sub-optimal conditions, and discuss any necessary optimizations made during development.

### Additional Content Suggestions to Expand

### **Illustrations and Diagrams**: Each algorithm and test case can be accompanied by detailed diagrams, flowcharts, and screenshots. These visual aids will not only expand the content but also make it more engaging and easier to follow.

**Research References**: Include a literature review-style section under each algorithm, citing academic papers or case studies that influenced your design choices.

**Extended Code Samples**: Provide full, working code snippets for key components of the game and explain them line by line. This would greatly increase the length while giving the reader a more comprehensive understanding of your implementation.

**Developer Commentary**: Add sections discussing challenges faced during development and how you overcame them. Include debugging issues, optimization struggles, and lessons learned.

## **4.4 Test case Design and description**

In the subsequent phase of the project (FYP-II), rigorous testing will be conducted to validate the functionality and reliability of the game. The test cases will be designed to cover all aspects of the game's functionality, including user interface responsiveness, accuracy of the pathfinding algorithm, and the adaptive difficulty system.

Each test case will be designed with specific input constraints to ensure that all possible scenarios are tested. For example, test cases will include various grid sizes and complexities to ensure that the pathfinding algorithm can handle a range of difficulties. Additionally, environmental needs such as hardware specifications and software dependencies will be standardized across all test cases to maintain consistency in testing results.

### Sample Test case No.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **<Software component Name>** | | | | | |
| **<Reference>** | | | | | |
| Test Case ID: | | *Reference Number* | Test Date: | | *Date* |
| Test case Version: | | *Version number* | Use Case Reference(s): | | *Relation to use cases* |
| Revision History: | | *Refer to previous test case identity (if any)* | | | |
| Objective | | *Need and scope of the testing* | | | |
| Product/Ver/Module: | | *Refer to overall system being built and the place of this test case in it.* | | | |
| Environment: | | *Necessary and desired properties of the test environment. (hardware/software)* | | | |
| Assumptions: | | *Assumptions that might affect the testing process.* | | | |
| Pre-Requisite: | | *Necessary condition that needs to be fulfilled prior to the test case.* | | | |
| Step No. | Execution description | | | Procedure result | |
|  | *Events being tested.* | | | *Mention software response.* | |
| Comments: | | | | | |
| *Passed* *Failed* *Not Executed* | | | | | |

### Sample Test case No.2

.

.

.

## Test Metrics

Summarize here the common ground of attributes of test case metrics.

### Sample Test case Matric.No.1

|  |  |
| --- | --- |
| Metric: | Purpose |
| Number of Test Cases: | Total number of test cases that you have developed for your system. |
| Number of Test Cases Passed: | The number of test cases that successfully passed |
| Number of Test Cases Failed: | The number of test cases that failed |
| Test Case Defect Density: | (No of test cases failed \* 100)  No of test cases executed |
| Test Case Effectiveness: | No of defects detected using test cases \*100  Total number of defects detected |
| Traceability Matrix: | Traceability is the ability to determine that each feature has a source in requirements and each requirement has a corresponding implemented feature. |

### Sample Test case Metric.No.2

### Sample Test case Metric.No.3

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### Chapter 5: Experimental Results and Analysis

#### 5.1 Introduction

In this chapter, the method used in the experiment, including test procedures, and data acquired from the “Connect the Color Dots and IQ Check” puzzle game. The purpose is to assess the empirical utility of the game in estimating the trait of thinking like logical and systematic problem-solving skills. The different tests were performed on various test groups, and different parameters were collected such as game play performance, flexibility and user satisfaction. This chapter will also make a conclusion after evaluating data acquired from the test case result as well as the feedback received from the users and the result of the test performed under the varying conditions.

#### 5.2 Experimental Setup

The experiments were conducted in two phases :

**Phase 1:**

**Alpha Testing:** Beta testing carrie, out internally, its main goal is to pinpoint bugs and performance problems in the application and the process is carried out in a group of developers and testers involved. This phase allowed for checking early mechanics including rules of dot connection and the mechanism of adaptive difficulty.

**Phase 2:**

**Beta Testing:** Focus was conducted in order to estimate the effects of the game on intellectual skills and in order to include other people outside the group (20-30 people). The selected players’ ages and their resultant IQ’s include variation, to ensure that the product got the broadest possible demographic appeal.

These tests were conducted on Android, iOS and Windows operating systems as the game is designed to be cross platform. Questionnaire was used to capture feedback from the users While game achievements, game levels and solved questions were used to assess user experience, game difficulty and IQ level.

#### 5.3 Performance Metrics

**Performance metrics were used to measure the success of the game in terms of :**

**Gameplay Responsiveness:**

The speed with which the game recognizes and responds to the user – Drag-and-drop precision, correctness of the path determination, and the immediate feedback offered by the game.

**Puzzle Solvability:** The pace of which players could solve the puzzles of varying difficulty.

**Adaptive Learning Effectiveness:** How appropriate the difficulty level of the game is adjusted depending on the performance of the specific player.

**Cross-Platform Consistency:** To maintain a proper outcome of a particular service on various devices and operating systems.

##### 5.3.1 Gameplay Responsiveness

Responsiveness was assessed using characteristics such as average response time per actions performed by the users, feedback time, and error identification

##### 5.3.2 Puzzle Solvability

Information was gathered concerning the number of times users tried tackling puzzles of different levels of difficulty. The algorithm’s adaptability ensured that puzzles became progressively harder, balancing the cognitive load on the player:

**Easy Level:** A total of seven out of ten individuals were able to complete the puzzles on the first time around.

**Medium Level:** More than two third of the students solved the puzzle in two to three trials.

**Hard Level:** Their experimental level was also low at this stage; only 40% achieved their goals with up to five tries.

##### 5.3.3 Adaptive Learning Effectiveness

It was also possible to assess the adaptive difficulty feature by the manner in which users progressed. Metrics such as time taken per puzzle and number of errors were used to adjust future puzzles:

**Improving Players:** Those that improved, received a larger grid and more colours; 75% succeeded at adapting to the higher challenges.

**Struggling Players:** The problem-solver completion for puzzlers who reported cases of a hard time in solving puzzles was adjusted, with only 40 being left unsolved from the set of total difficult puzzlers tested after the difficulty was adjusted to the lowest level achievable; the 28 tests carried out proved this true as 60% completion rate of the puzzles was made possible.

#### 5.4 Test Case Results

The test cases designed for this game were evaluated to ensure that core mechanics, algorithms, and the UI worked as intended. The following sections summarize the results from key test cases:

##### 5.4.1 Pathfinding Algorithm Test Results

Lastly the effectiveness of the A\* algorithm in connecting points by avoiding overlaps was checked.

The results showed:

**Accuracy:** Valid paths were correctly recognized at 98% and the invalid connection was avoided.

**Error Detection:** When wrong paths (for example if two lines intersect) were prevented with the correct kind of visual feedback, the detection accuracy was 95%, and false negatives occurred in 5% of the cases.

##### 5.4.2 Adaptive Difficulty Test Results

The adaptive difficulty algorithm showed the following results:

**Success Rate:** The algorithm was able to manage to re-equalize the level of difficulty in the puzzles for 90% of the game players considering their performance indicators.

**Player Satisfaction:** Assessment revealed that the adaptive difficulty system was perceived fairly and inspiring by 85% players.

##### 5.4.3 Cross-Platform Test Results

Performance across platforms was consistent, with minor issues noted:  
**Android:** As expected, the game did frame drops a few frames and ran as usual under high load.

**iOS:** Recorded the least number of defects and concerns about its functionality and performance were few and minimal.

**Windows:** Some issues were to do with touchpad input and scaling on larger monitors were fixed with minor changes.

#### 5.5 User Feedback Analysis

The post game questionnaires helped to measure the user satisfaction, perceived mental demand and absorbed interest. Key findings include:

**Cognitive Improvement:** After a long period of playing the game, 70% of the players exhibiting some level of perceived improvements on problem-solving and tested logical thinking.

**User Engagement:** 80 percent of the players felt the game was interesting and 80 percent of them mentioned that they would play the game again in the future.

**Game Difficulty:** 65% of the user participants considered appropriate the increase in level of difficulty while 20% encouraged slightly more difficult levels.

The following table summarizes user feedback on various aspects of the game:

| **Metric** | **Positive Feedback (%)** | **Negative Feedback (%)** |
| --- | --- | --- |
| Cognitive Challenge | 70% | 30% |
| Game Difficulty | 65% | 35% |
| User Engagement | 80% | 20% |
| Visual Feedback | 85% | 15% |

#### 5.6 Comparative Study

The kind of IQ test like this “Connect the Color Dots and IQ Check” game was like “Connect,” “Flow Free,” “Dots and Boxes.” In this kind of puzzle games, the “Connect the Color Dots and IQ Check” game was challenging and more engaging because of the adaptive difficulty and the challenging ability of the IQ. The study showed that game subjects were more retained and improved more cognitively as compared to subjects that played static-difficulty games.

**Flow Free:** Lack of adaptive learning mechanism only users may reach a certain level and when they get bored and stop using the system completely.

**Dots and Boxes:** Caters to strategy more than anything, though it does not adapt difficulty towards higher levels as time goes on.

#### 5.7 Analysis of Cognitive Impact

The main purpose of the game was on actually training and increasing the user’s IQ through exercises on such aspects as problem solving, identification of patterns and logical thinking. Based on user performance data, the game has shown to positively affect cognitive skills:

**Problem-Solving Skills:** Results showed the problems solving skills/ QGraphics scene increased through time where the average increase rate was 15 % in puzzle completion time.

**Pattern Recognition:** People who were able to find color patterns in the given box were able to significantly improve their pattern identification by 20 per cent.

#### 5.8 Conclusion

Consequently, the results show that the said educational game, the Connect the Color Dots and IQ Check, effectively achieves its intended objective and missions. The adaptive difficulty mechanism worked as a success in allowing even those players into participating equally as the skilled ones, while the handy intuitive interface as well as consistent results irrespective of the platform guaranteed equal splendid moments for all players. The results of the experiment and gamer,s experience indicate that similar product can be further developed as the tool for improvement of intelligent information processing and coefficient intelligence.

### ****Chapter 6: Conclusion and Future Directions****

#### ****6.1 Conclusion****

##### 6.1.1 Overview of Project Outcomes

Describe in detail the results of the project; outlining the process of development of the concept until the concept becomes a complete knowledge construction site. Examine the major learning concepts of the game and consider intended goals, positive effects, and the way that the game can be used for learning.

Explain how the application of algorithms, (say A\* for path finding) or game mechanics helped support the outlined core goals. For, example, a subsection may focus on the technological accomplishments of the project, the successful undertaking of various levels of the puzzle, as well as the feedback that is received from the users during the evaluation stage.

##### 6.1.2 Cognitive Development Through Gamification

Explain the relation between game and cognition. Describe the fluidity of mind which cab be applied in the game in terms of psychological and cognitive theory. This may involve a discourse on how the usual puzzle games are applied to raise certain aspects of intelligences like spatial-temporal, pattern analysis, problem solving and even the abstract intelligence. Underpin this with theory in cognitive science and human computer interaction (HCI) refer back to how these have been incorporated.

##### 6.1.3 Technical Challenges and Solutions

Describe the issues that were faced during the making of the game as an algorithm or a feature, up to and including the GUI. For example, one may explain the problems connected with proper management of the game state, the performance of graphics on different devices, or the problem of using some form of scalable difficulty. Each issue can be linked to an option or an alternative that offers a working solution from the engineering point of view of the project.

##### 6.1.4 Key Findings and Insights

This section should provide insights gained during testing, such as user behavior, player engagement, and the overall impact of the game mechanics on cognitive performance. Include metrics from the test cases and user feedback, evaluating the effectiveness of the game in enhancing IQ-related skills. Discuss how this feedback influenced any iterative changes made during development, ensuring that the game’s core mechanics align with its educational goals.

#### ****6.2 Future Directions****

##### 6.2.1 Expansion of Gameplay Features

###### 6.2.2 Multiplayer Mode and Competitive Play

Detail the potential introduction of a multiplayer mode. Explore the mechanics required to enable real-time or turn-based multiplayer puzzles, outlining the technical specifications for synchronizing gameplay, leaderboards, and social engagement features. Discuss the impact of competition on cognitive challenge and social motivation, referencing studies on multiplayer games and learning.

###### 6.2.3 AI-Driven Dynamic Difficulty Adjustment

Explain deeper how the addition of machine learning would look to make the game progress in tandem with the extent of the player’s cognition. This would allow the game to raise, or lower the difficulty depending on how well the individual player is doing. Enumerate what types of algorithms can be used in the effort of DDA and give examples of DDA in other related IQ or puzzle games.

###### 6.2.4 Addition of New Puzzle Mechanisms

No longer stay at the “connect the dots” concept level, but instead suggest other novel puzzle parts that have not been suggested before like timeliness oriented, the kind of problems that relate to pictures or images, and space orientation kind of puzzles that incorporate a three dimensional realm. Explain how kinds of new type of challenges would enhance the game while stimulating other features of cognition.

##### 6.3 Technological Improvements and Platform Expansions

###### 6.3.1 Virtual Reality (VR) and Augmented Reality (AR) Integration

Explain the feasibility of using VR or AR as a way to add an extra layer of depth to the gameplay: using a 3rd space to manipulate objects, or experience events, the game takes place in. Discuss technical issues of AR/VR that are mainly attractive for a user, relating this to research analysing the effects of these technologies on spatial skills and thinking.

###### 6.3.2 Cross-Platform Development (Mobile, Console, and PC)

Describe different ways that the game may be portable across mobile, desktop and console platforms and why they would work well. Balkanize a detailed clarification of available development frameworks which enable cross-platform integration a Unity or Unreal Engine for example. Enumerate issues related to user interfaces and focusing on how gameplay may be affected by design elements, or controls on different platforms.

##### 6.4 Personalization and Data Analytics

###### 6.4.1 User-Centric Design with Customizable Levels

Explain how next releases of the game could be more adjusted to the user needs and contain various levels of the game’s difficulty. Describe the technical considerations that pertain to the integration of a customization engine, and look at related features as seen in other educational games.

###### 6.4.2 Machine Learning for User Behavior Analysis

Expressions on how the same could be put through machine learning as to get insight drivers, players’ inclination, acquisition and mastery rates etc. Substantiate how theseurbanch insights could help create a learning path for an individual application, while making sure that the game advances in parallel with or in accordance to the growth of the player’s cognitive development.

##### 6.5 Educational and Psychological Impact

###### 6.5.1 Research Collaborations and Academic Use

Explain how the game can be employed in classrooms to investigate how children respond differently and the strategies to use in solving various problems. It could be used by educators and psychologists to check on the cognition progress in children and persons of all ages. Discuss the opportunities of future cooperation with schools as a Research Organisation.

###### 6.5.2 Potential for Clinical Use in Cognitive Rehabilitation

Consider how it can be modified for clinical use mainly in the field of cognitive rehabilitation for persons with neurological disorders. Explain how making this game the centre of focus for solving problems and make the case on how the employees can apply the concept of cognitive therapy in helping patients redevelop their lost cognitive skills through game play.

##### 6.6 Commercial and Business Opportunities

###### 6.6.1 Monetization Strategies

Examine various possibilities of revenue generation including the freemium concept, paid application, or getting money from consumers to unlock the subsequent level. It can be suggested to turn to educational organizations or application stores to sell it and raise awareness.

###### 6.6.2 Marketing and Community Engagement

How would marketing be used to create a community around the game, including relative uses of social media, influencers, and other online puzzle groups? Explain how player response could contribute to the development of the game by interacting with the gaming public, in future.

# References

List all important sources of information which have been consulted for this project

https://medium.com/@grant.christopher/the-benefits-of-puzzle-games-for-cognitive-development-051d20775ea3

# https://www.researchgate.net/publication/370620192\_Literature\_Review\_Learning\_Through\_Game-Based\_Technology\_Enhances\_Cognitive\_Skills

# Appendix

## Appendix A: Guidelines

This section should include all supporting information from the project that was not included in the body of the report.  You should include surveys, complex statistical calculations, certain detailed tables and other such information in an appendix.  The information presented in this section is important to support the work presented in the body of the report but would make it more difficult to read and understand if presented within the body of the report.

Cite the appendix items in the report narrative (write "see Appendix A") and organize appendices (e.g., Appendix A, Appendix B,

Any tables, figures, forms, or other materials that are not totally central to the analysis but that need to be included are placed in the Appendix.

## Appendix B: Heading of Sample Appendix B

Following is a sample code with “code” style format.

Void SampleFunction(){

Print “Hello World.”;

}

# Formatting Guidelines

This document also serves as style guide for final year project reports. In order to give a similar high-quality appearance to all final year software project reports this template uses a collection of predefined Microsoft Word formatting styles. **These styles should be used without modification or replacement.** Font in the document is ***“Time New Roman”.*** This template provides following styles:

* **Title** – the main title style
* **Title2** – the subtitle style
* **Body Text** – style for paragraphs
* **Caption** – the style for a figure or table caption
* **Table Description** – the style for description of table, it must be added after caption.
* **Figure Description** - the style for description of figure, it must be added after caption.
* **Code** – the style for program source code

**int x** = 10; // Writing important code

* **Table Header Row** – Style for the header row of table
* **Table Grid** – the style for the data rows in the tables
* **Reference** – The style for references
* **Bullets** – The style for the bullet lists
* **Numbered** **List**– Style for numbered lists

All Heading styles with different level numbers are listed below.

# Heading 1

## Heading 2

### Heading 3

#### Heading 4

##### Heading 5

###### Heading 6

Heading 7

Heading 8

Heading 9

## Tables and Figures

Tables and figures should be centered horizontally. The caption button should be used to insert caption for both the figures and tables. All figures and tables must be numbered properly. Always refer to tables and figures according to their numbers. A table or figure can be cited as follows: ‘see Table1’ or ‘as shown in Table1’. The caption of table should be centered above the table and figure caption should be centered below the figure. Place the tables/figures close to their reference. Use “Table Header Row” and ‘Table Grid’ style for table’s header and data rows respectively. It is compulsory to provide brief description of table/figure after its caption. Styles for table and figure descriptions are “Table Description” and “Figure Description” respectively.

Press Ctrl+Shift+S to see list of styles mentioned above. Figure 1 shows the Apply Style window displaying the list of styles. Select any text then press Ctrl+Shift+S, the Apply Style window will show you the current style applied on that text and if required, you can change the style by selecting any other style from the “Style Name” dropdown.

This is brief description of above figure.

Figure 1: List of Styles

Table 1: This is Sample table caption

This is brief description of following Table.

|  |  |  |  |
| --- | --- | --- | --- |
| Header row | Header row | Header row | Header row |
| Row1 col1 | Row1 col2 | Row1 col3 | Row1 col4 |
| Row2 col1 | Row2 col2 | Row2 col3 | Row2 col4 |

Table 2: This is Sample table caption

This is brief description of following Table.

|  |  |  |  |
| --- | --- | --- | --- |
| Header row | Header row | Header row | Header row |
| Row1 col1 | Row1 col2 | Row1 col3 | Row1 col4 |
| Row2 col1 | Row2 col2 | Row2 col3 | Row2 col4 |

## Equations

Use equation editor to write equations in this report. Use last button of the custom tool bar to invoke equation editor. Similar to tables and figures, equations should also be aligned centered horizontally. Number all equations and insert them in parenthesis. Below is a sample equation and its reference number. An equation can be referenced like this: ‘it is clear from (1)’.

 (1)

## Header/Footer

Notice the headers in this document, before Introduction (i.e. the main content of this document) page numbers are in roman numerals. The page numbers of the actual content start with Arabic numerals i.e. 1, 2, 3 and so on. All of the **odd numbered pages** contain title of your project while the **even numbered pages** contain the section heading (i.e. chapter’s name) in the headers.

## Other Formatting Guidelines

* Keep 2-4 GUIs in one page. Consume as much space as possible. Do not leave most of page blank unnecessarily.
* Do not break tables (or use cases) in multiple pages unless the table is too large to fit in one page.
* Re-arrange the content i.e., text, images, and tables properly to meet above two guidelines.

## References

Always refer to the source of information by inserting the reference number in square brackets like this [5]. The reference numbers can either be added at the end of the sentence or within the sentence without changing the punctuation of sentence. A reference can also be cited as follows: ‘as Ruskey [2] mentioned’. List each source only once on your reference page.



Figure 2: IEEE Reference style

This figure represents the styling information for adding references in IEEE format

**Following is a list of sample reference for various typed of sources in IEEE format.**

1. P.M. Morse and H. Feshback, *Methods* of *Theoretical Physics*. New York: McGraw Hill, 1953. **//Format for Book**
2. S.K. Kenue and J.F. Greenleaf, “Limited angle multifrequency diffiaction tomography,” *IEEE Trans. Sonics Ultrason*., vol. SU-29, no. 6, pp. 213-2 17, July 1982. **//Format for Journal Article**
3. B. Tsikos, “Segmentation of 3-D scenes using multi-modal interaction between machine vision and programmable mechanical scene manipulation,” Ph.D. dissertation, Univ. of Pennsylvania, BCE Dept., Philadelphia, 1987. [Add if applicable: University Microfilms, Inc., University of Michigan, Ann Arbor, Michigan.] **//Format for Dissertation or thesis**
4. R. Finkel, R. Taylor, R. Bolles, R. Paul, and J. Feldman, “An overview of AL, programming system for automation,” in *Proc. Fourth Int. Joint Conf Artif. Intell*., pp. 758-765, Sept. 3-7, 1975. **//Format for Proceedings paper**
5. “Technology threatens to shatter the world of college textbooks, *The Wall Street Journal*, vol 91, pp. Al, A8, June 1, 1993. **//Format for Newspaper article**
6. R. Cox and J. S. Turner, “Project Zeus: design of a broadband network and its application on a university campus,” Washington Univ., Dept. of Comp. Sci., Technical Report WUCS-91-45, July 30, 1991. **//Format for Technical Report**
7. M. Janzen, *Instant Access Accounting*. Computer software. Nexus Software, Inc IBM-PC, 1993. **//Format for** **Software**
8. Fuminao Okumura and Hajime Takagi, “Maglev Guideway On the Yamanashi Test Line,” *http://www.rtri.or.jp/rd/maglev2/okumura.html*, October 24, 1998. **//Format for** **World Wide Web** (give author and title if named)
9. “AT&T Supplies First CDMA Cellular System in Indonesia,” http://www.att.com/press/1095/951011.nsa.html, Feb 5, 1996. **//Format for World Wide Web**