Systems Analysis and Design Report

Group 2
John Alabasinis - 22090614
Jana Nasrallah - 22079884
Salman Rashid - 22080099

Professional Experience

Table of Contents

Introduction 2
Executive Summary **3**
Risks and Issues Related to the System 4
Constraints Related to the System 5
Software Architecture Diagram 6
Network and Communication Diagram 7
User Story Acceptance Criteria 8
Sequence Diagram 14
Screen Designs 15
List of Messages 18
Feature/Function Test Plan 19
Candidate Tests 20
- Feature F001: Object Manipulation 20
- Feature F002: Trash Bin Functionality 20
- Feature F003: Score System 20
- Feature F004: Level Configuration 21
- Feature F005: User Interface Display 21
- Feature F006: Audio Feedback 21

Introduction

This Systems Analysis and Design (SAD) report defines the technical specifications, design models, and validation processes required to implement the PX Project. The system is an interactive learning game that applies Crime Prevention Through Environmental Design (CPTED) principles through object manipulation, scoring, and feedback mechanisms.

The purpose of this report is to translate the project's educational objectives into system-level requirements and design solutions. Key elements include risk assessment, system constraints, architectural design, user story acceptance criteria, and test planning. By documenting these components, the report establishes a structured foundation to guide development, mitigate technical risks, and ensure that the final system performs reliably across different environments.

Problem Statement

The primary challenge addressed in this Systems Analysis and Design (SAD) report is the absence of an interactive, technically robust platform for teaching Crime Prevention Through Environmental Design (CPTED) principles. While the project proposal defined the educational objectives, the key problem from a systems perspective lies in translating these objectives into a functional, scalable, and maintainable software solution.

The system must support real-time object manipulation, dynamic scoring, feedback mechanisms, and reporting features, all while maintaining usability across a range of devices. Technical risks include performance optimisation, accessibility compliance, integration of educational content, and ensuring that the software architecture remains adaptable within a fixed development timeline.

Without a clearly defined system design, there is a risk of scope creep, inconsistent functionality, and reduced educational value. Therefore, the problem to be solved is how to engineer a system that meets stakeholder requirements, adheres to constraints, and delivers reliable, measurable outcomes through structured analysis, design, and testing.

Executive Summary

The PX Project SAD report provides a comprehensive framework for the technical design and implementation of a CPTED-focused educational game. The system is designed around core features such as object placement, real-time scoring, visual and audio feedback, and structured reporting.

The report covers:

- **Risk and Issue Analysis**: Identification of internal and external risks including scope creep, technology stack suitability, performance optimisation, accessibility requirements, and data privacy. Each risk is paired with mitigation strategies to ensure system reliability.

- **System Constraints**: Acknowledgement of limitations such as asset creation, access to subject matter experts, device performance variance, and the fixed 12-week development timeline.

- **System Design Models**: Architecture and network diagrams outlining system components, interactions, and communication flows.

- **Functional Specifications**: User stories with acceptance criteria that define measurable outcomes for key features (e.g., object manipulation, scoring, tooltips, level configuration, reporting).

- **Testing Strategy**: Feature-level test plans and candidate tests that validate both functional behaviour and system performance.

This structured approach ensures alignment between project objectives, technical feasibility, and user experience.

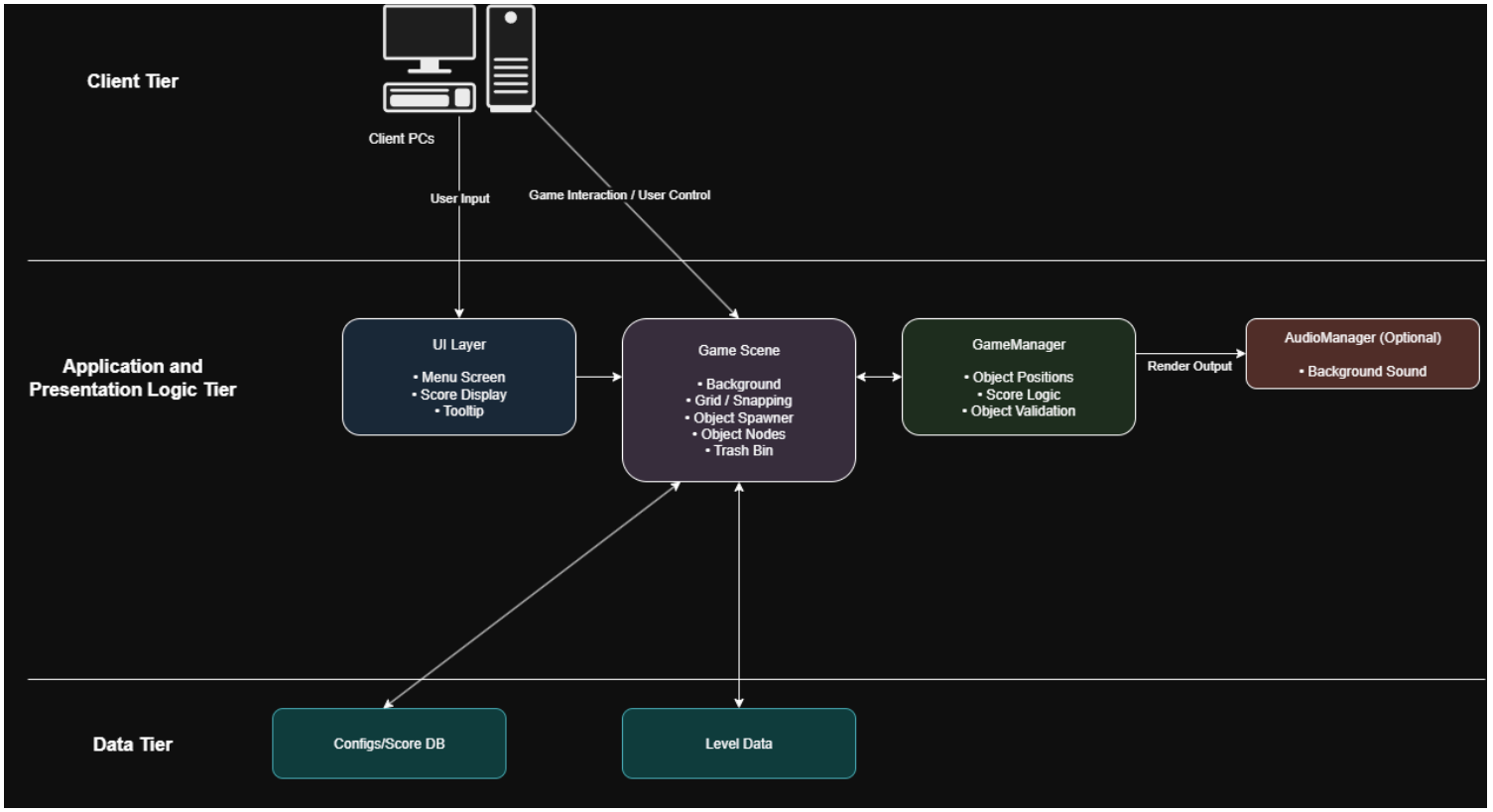
Risks and Issues Related to the System

	Risk	Mitigation Strategies	Impact Level	Type of Risk
1	Functional Scope Creep	Define a clear set of game features and learning objectives at project start. Get client approval on any changes before adding any new elements, and maintain a change log.	Medium	Internal
2	The chosen game engine/stack is incompatible with the team's skills or client's requirements.	Research and confirm the best-suited technology early. Create small prototypes to test compatibility. Provide training if required.	High	Internal
3	Game performance issues on target devices (e.g., lag, glitches, slow loading).	Optimise assets, test regularly on target devices, and adjust graphics/features to maintain smoother performance.	High	Internal
4	Accessibility limitations prevent some students from using the game.	Follow the best accessibility practices such as colour contrast, adjustable text size, keyboard navigation, etc, and test with diverse users.	Medium	External
5	Incomplete or inaccurate CPTED content reduces educational value.	Work closely with experts on this subject and the client to review and validate all content before release.	High	External
6	Data privacy concerns if user progress or feedback is collected.	Use anonymous tracking or comply with the relevant data protection regulations (e.g. GDPR), and clearly inform users about data usage.	Medium	External

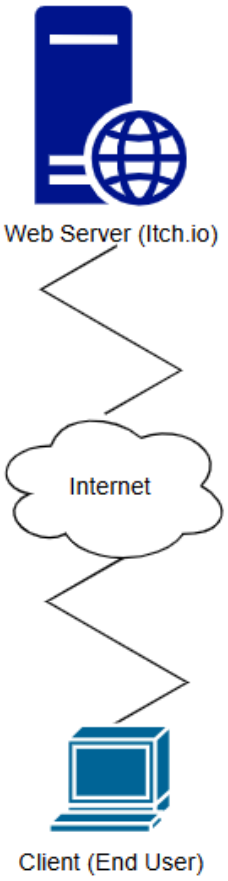
Constraints Related to the System

	Constraint	Mitigation Strategies
1	Lack of existing assets such as graphics, audio, and models specific to CPTED concepts.	Allocate time early in the project for asset creation or sourcing. Use open-license resources, and confirm visual style with the client to avoid rework.
2	Limited access to experts on CPTED validation.	Schedule SME review sessions in advance and prepare all questions and content for batch feedback to make best use of time.
3	The game must run smoothly on a variety of devices with different performance capabilities.	Set minimum performance requirements early. Optimise graphics, limit heavy animations, and test on a range of devices during development.
4	Educational accuracy must meet the client and curriculum requirements.	Obtain early agreement on learning objectives. Keep a version controlled content document so any updates can be tracked and approved.
5	Fixed 12-week development timeline.	Use an agile approach with prioritised features so that core gameplay and safety concepts are delivered first, with enhancements added if there is enough time left.

Software Architecture Diagram



Network and Communication Diagram



User Story Acceptance Criteria

ID: FR_1	**Feature:** Drag and drop objects	**Priority:** Essential
BF: Game Environment Management - BF1		**Estimate:** 6 hours

Story:
As a player, I want to click and drag safety-related objects into the environment so that I can make it safer.

Acceptance Criteria:

1. Object Dragging
    a. The player can click and hold an object from the sidebar to start dragging it.
    b. The object follows the cursor until released.
    c. The player can drag multiple objects during gameplay.

2. Object Placement
    a. The player can release the object onto valid areas in the environment.
    b. Invalid drop zones prevent object placement.

3. Snapping & Alignment
    a. Objects that are placed onto the scene snap to the nearest grid tile.

ID: FR_2	**Feature:** Dynamic feedback	**Priority:** Essential
BF: Feedback and Learning Support - BF6		**Estimate:** 8 hours

Story:
As a player, I want to see visual feedback when I place objects so that I can understand how they affect the safety of nearby areas.

Acceptance Criteria:

1. Visual Indicators
    a. When an object is placed, a visual animation (e.g. glow) indicates safety impact.
    b. Positive impacts display in green tones; negative impacts in red tones.

2. Real-time Updates
    a. Feedback is displayed immediately after object placement.

ID: FR_3	**Feature:** Points system	**Priority:** Essential
BF: Scoring System - BF3		**Estimate:** 6 hours

Story:
As a player, I want to gain or lose points as I am placing objects so that I know if I am making the area safer or not.

Acceptance Criteria:

1. Point Allocation
    a. Points are added or deducted immediately when an object is placed or removed.
    b. Point values are determined by the object's effect on safety.

ID: FR_4	**Feature:** Undo/Remove objects	**Priority:** Optional
BF: Game Environment Management - BF1		**Estimate:** 5 hours

Story:
As a player, I want to be able to reposition/remove objects so that I can correct any mistakes or so that I can earn more points.

Acceptance Criteria:

1. Repositioning
    a. The player can undo the position of a dragged object and place it in a new location.

2. Removing Objects
    b. The player can remove an object entirely from the environment.

3. Score Adjustment
    c. Points are recalculated immediately after an object is moved or removed.

ID: FR_5	**Feature:** Informative tooltips	**Priority:** Essential
BF: Feedback and Learning Support - BF6		**Estimate:** 4 hours
Story: As a player, I want to receive informative tooltips when I hover over an object so that I can learn how it relates to CPTED principles.		
Acceptance Criteria: 1. Tooltip Trigger a. Hovering over an object in the sidebar displays a tooltip. 2. Tooltip Content b. Tooltips include a description of how the object relates to CPTED principles. 3. Formatting c. Tooltips are readable and do not obstruct important gameplay elements.		

ID: FR_6	**Feature:** Multiple levels	**Priority:** Essential
BF: Tutorial/Onboarding Flow - BF7		**Estimate:** 20 hours
Story: As a player, I want to play through different levels so that I can apply CPTED concepts to various public spaces.		
Acceptance Criteria: 1. Level Variety a**.** The game contains at least three different environments - each with different challenges. 2. Progression b**.** Players unlock new levels after completing prior ones.		

ID: FR_7	**Feature:** Level selection	**Priority:** Optional
BF: User Progress Tracking - BF4		**Estimate:** 3 hours
Story: As a player, I want to select or replay levels from a menu so that I can improve my performance or explore different environments.		
Acceptance Criteria: 1. Level Menu a. The player can open a level selection screen from the main menu. 2. Replay Function b. Completed levels can be replayed. 3. Locked Levels c. Unlocked levels are clearly distinguishable from locked ones.		

ID: FR_8	**Feature:** Dynamic sounds	**Priority:** Essential
BF: User Progress Tracking - BF4		**Estimate:** 5 hours
Story: As a player, I want the background sound to change based on the safety level so that I receive audio cues about my performance.		
Acceptance Criteria: 1. Sound Variation a. Background music changes based on current safety level. b. Sound effects play when placing or removing objects.		

ID: FR_10	**Feature:** Post completion report	**Priority:** Essential
BF: Feedback and Learning Support - BF6		**Estimate:** 5 hours

Story:
As a player, I want to receive a detailed report after completing a level so that I can learn what I achieved and how to improve.

Acceptance Criteria:

1. Report Content
    a. The report includes final score, points breakdown, best object used, and safety improvements.

2. Formatting
    b. The report is presented clearly in a modal or separate screen.

3. Accessibility
    c. The player can access the report after completing a level

ID: FR_11	**Feature:** Safety final rating	**Priority:** Essential
BF: Feedback and Learning Support - BF6		**Estimate:** 3 hours

Story:
As a player, I want to get a final rating so that I have a clear measure of success.

Acceptance Criteria:

1. Rating Scale
    a. The player receives a safety rating at the end of the level.

2. Calculation
    b. Ratings are based on the final safety score.

ID: FR_13	**Feature:** Pause/Restart options	**Priority:** Optional
BF: Game Environment Management - BF1		**Estimate:** 2 hours

Story:
As a player, I want to pause or restart the level so that I can take breaks or try again if needed.

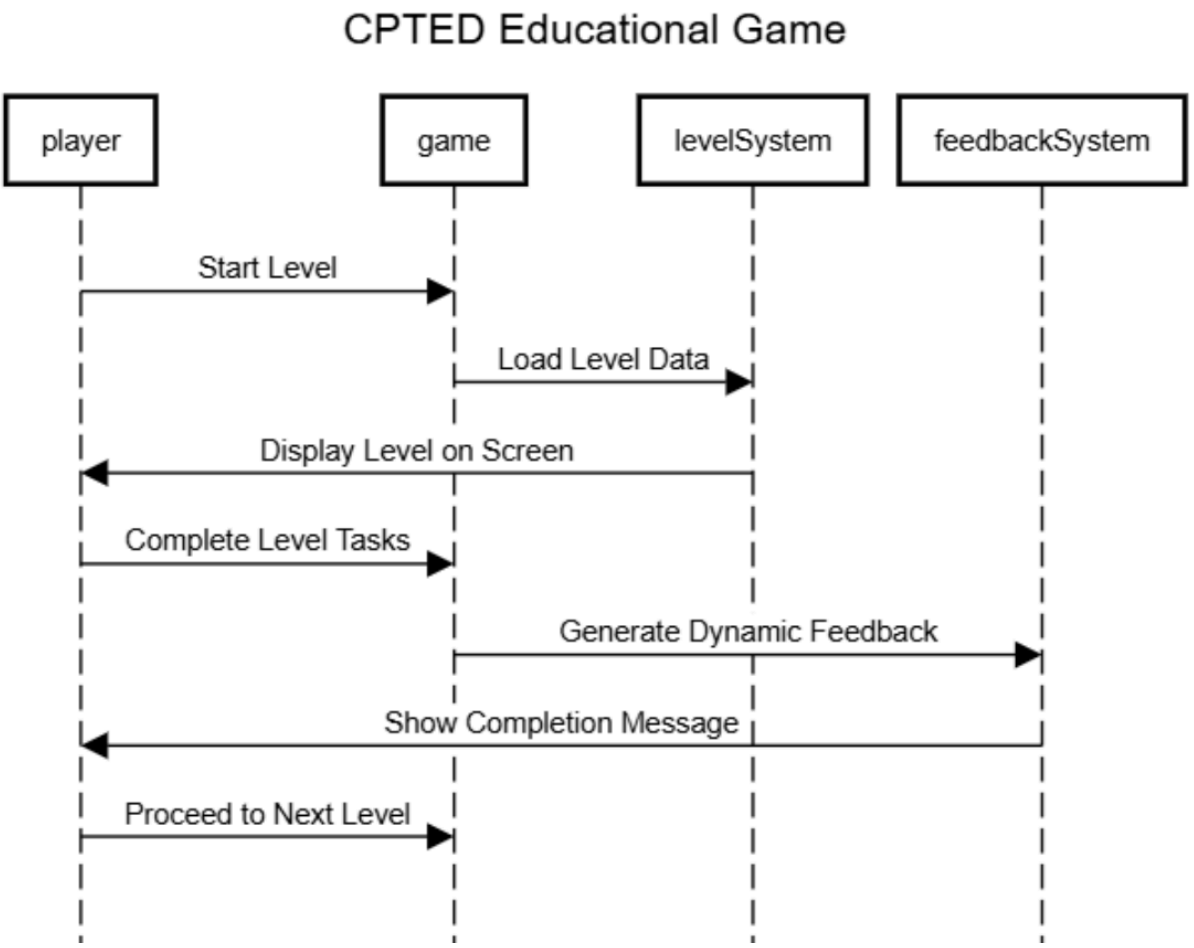
Acceptance Criteria:

1. Pause Functionality
   a. Pressing the pause button freezes game activity.

2. Restart Functionality
   b. Restarting a level resets all placed objects and scores.

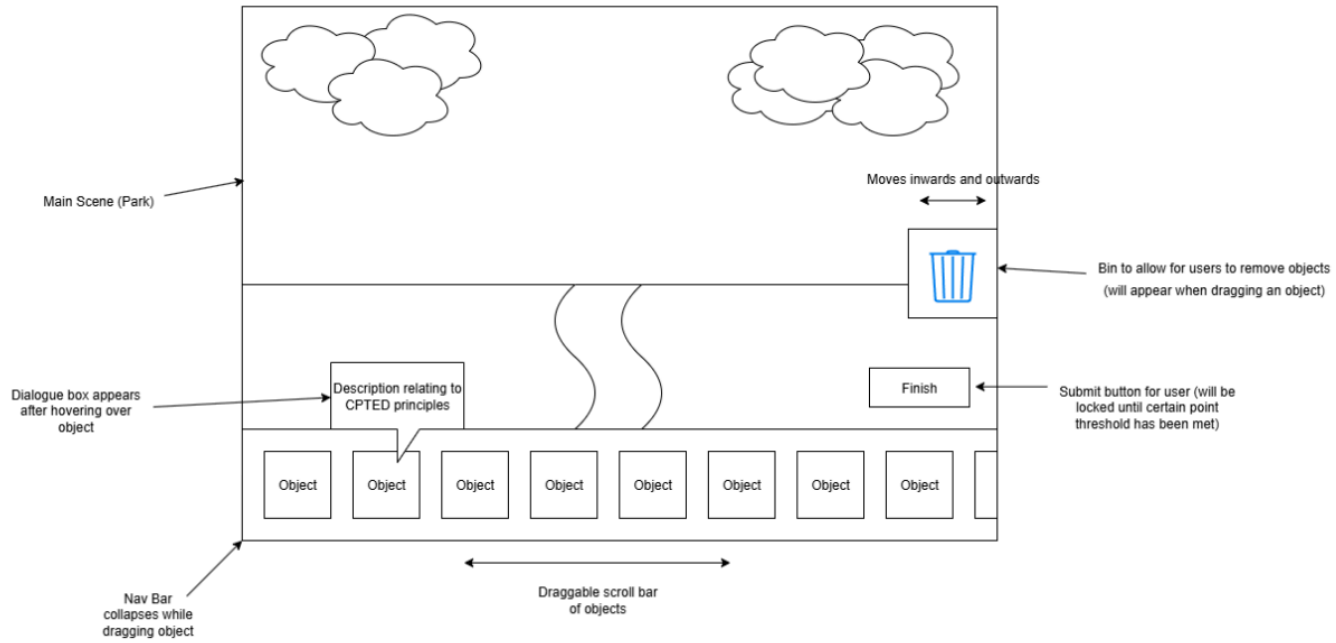
3. UI Indicators
   c. The game displays a clear “Paused” or “Restarting” screen.

Sequence Diagram

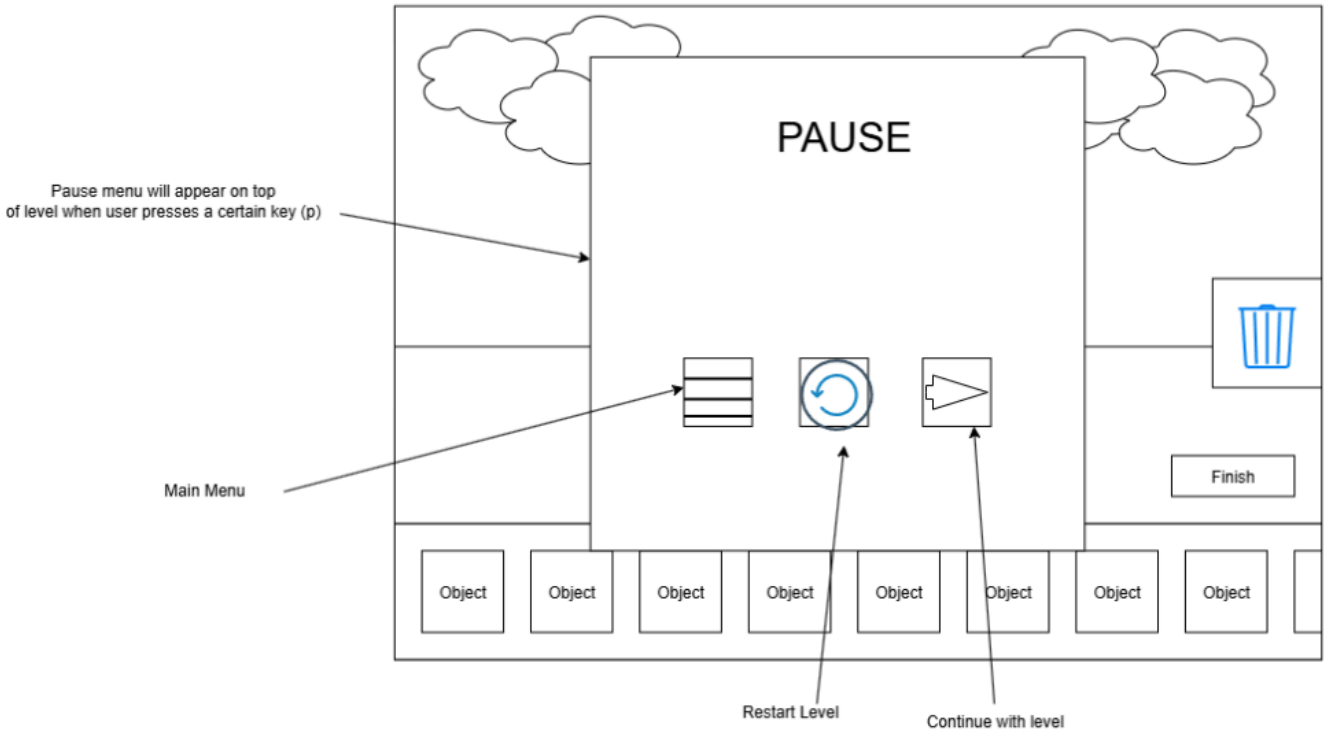


Screen Designs

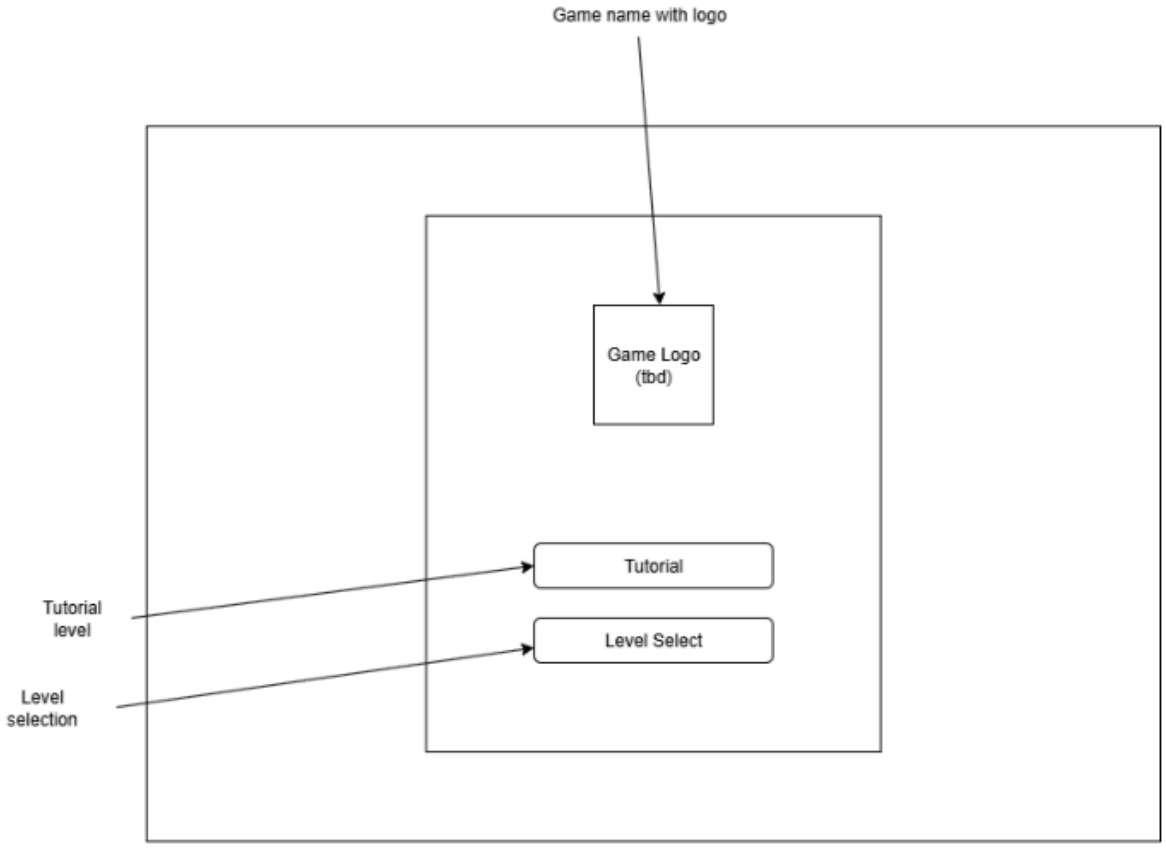
Screen #1. Main Game Screen



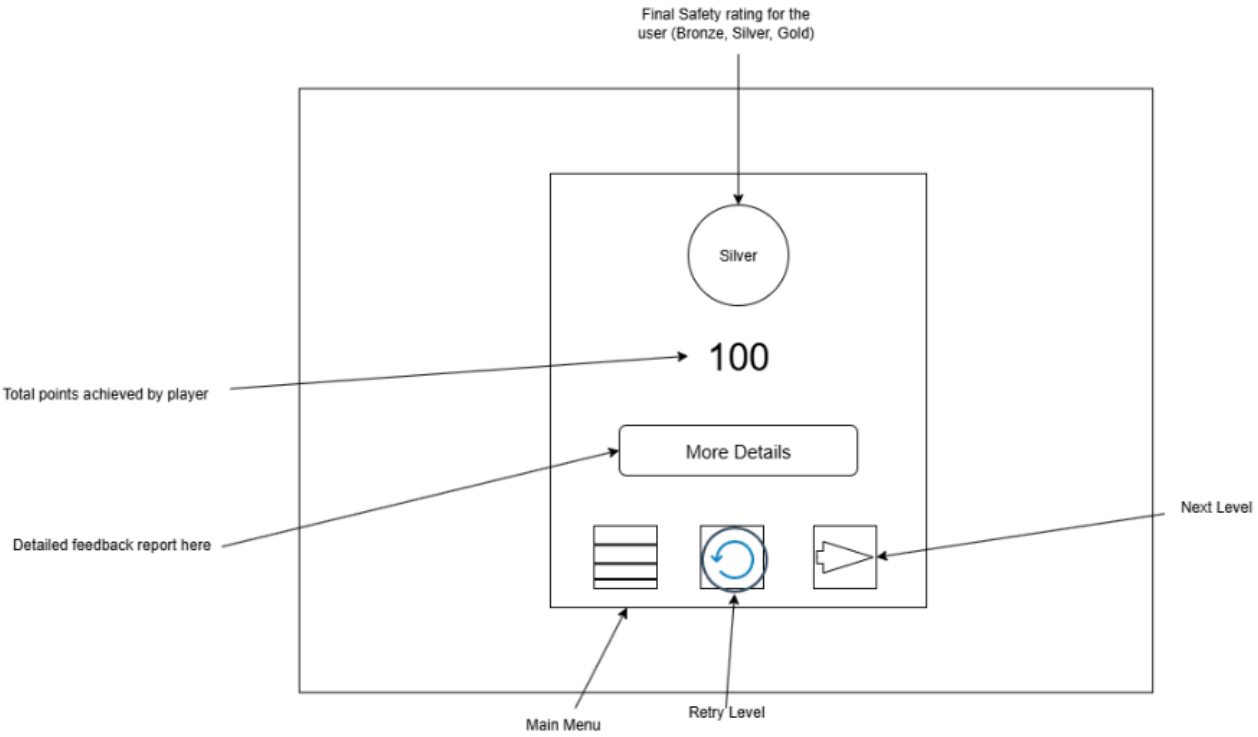
Screen #2. Pause Menu



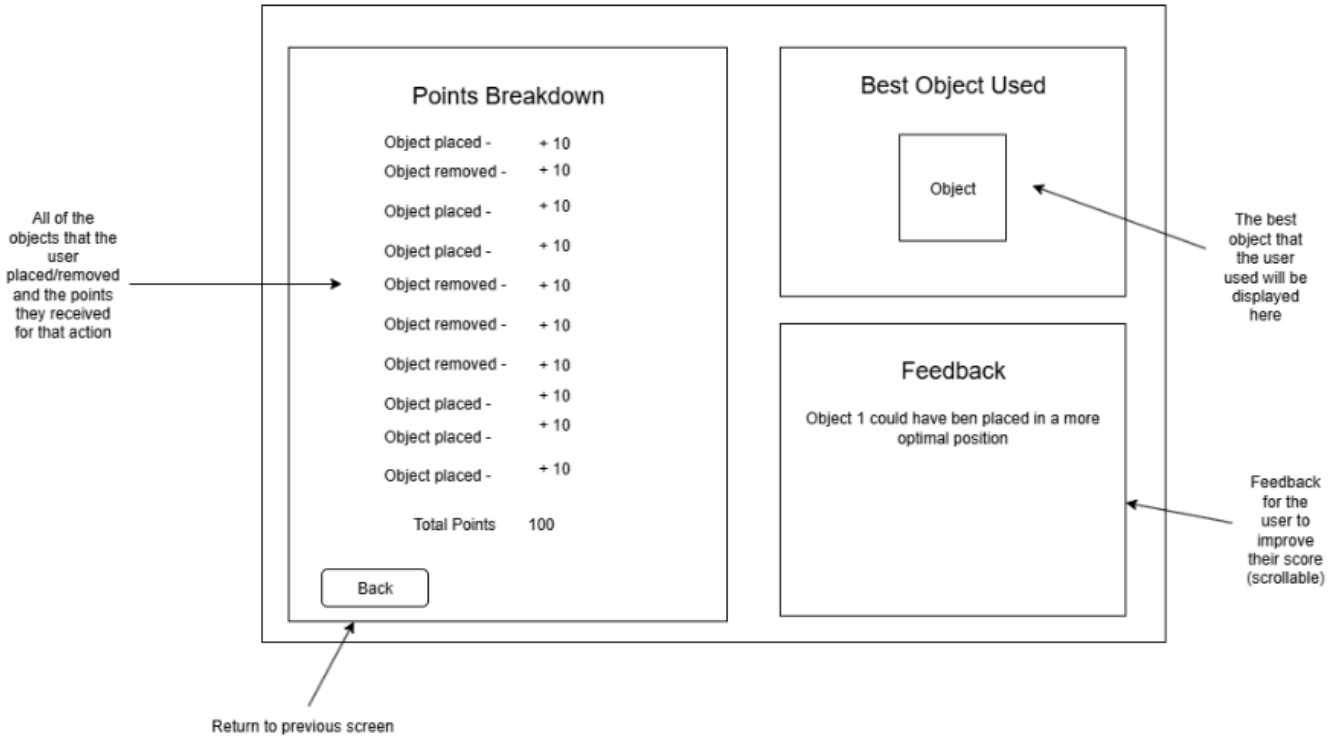
Screen #3. Main Homepage Screen



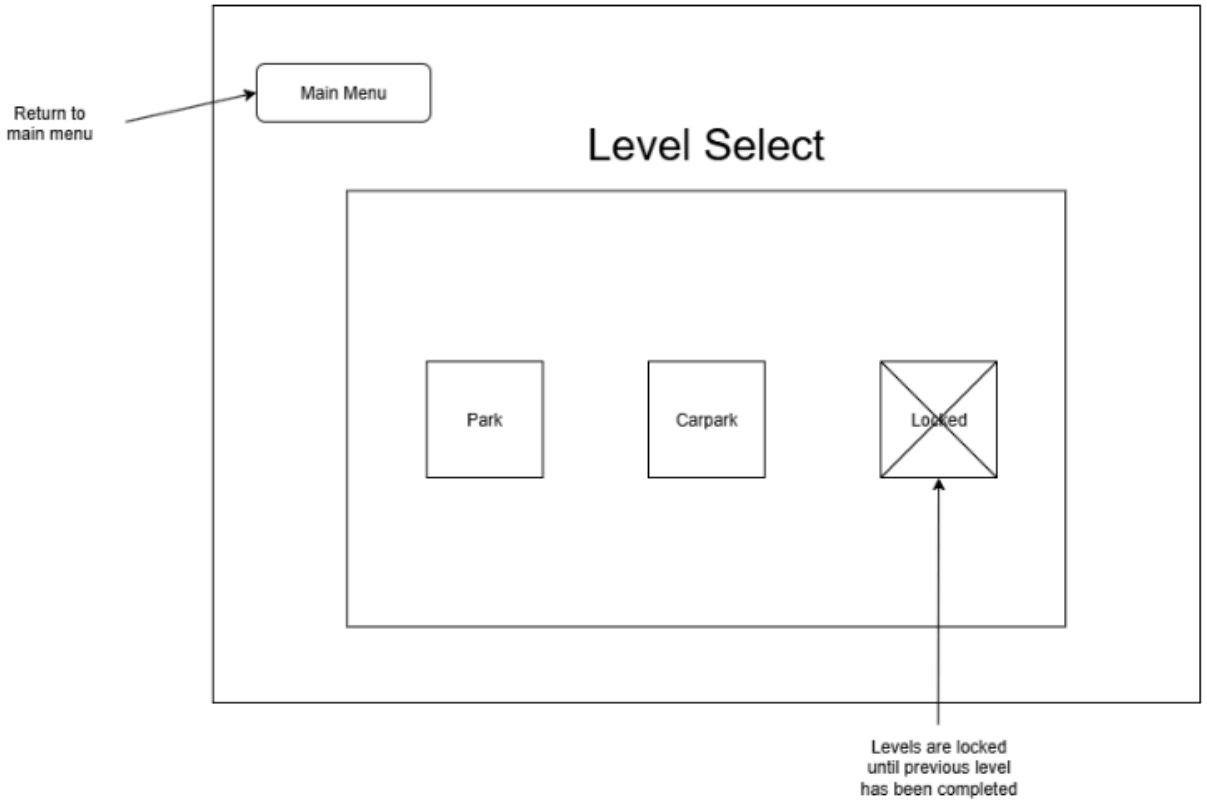
Screen #4. Level Complete Screen



Screen #5. Points Breakdown Screen



Screen #6. Level Select Screen



List of Messages

Msg No.	Message	Associated User Story (In order)	Associated Screen Design
MSG_1	Object successfully placed.	Drag and drop objects	Screen #1
MSG_2	The object makes a sound depending on the object, no message.	Dynamic feedback	Screen #4
MSG_3	Safety score increased!/Safety score decreased! Try another object.	Points system	Screen #5
MSG_4	Object removed!/Object undone!	Undo/Remove Objects	Screen #1
MSG_5	‘Object’ e.g. Lamps improve visibility, deter crime, and enhance natural surveillance.	Informative tooltips	Screen #1
MSG_6	Start improving safety! Select a level.	Multiple levels	Screen #6
MSG_7	Select a new level or select an old level to improve its safety score.	Level Selection	Screen #6
MSG_8	Click here for feedback report.	Post completion report	Screen #4
MSG_9	Your final safety rating is X!	Safety final rating	Screen #4
MSG_10	You are paused./The level has been restarted.	Pause/restart option	Screen #2

Feature/Function Test Plan

Feature ID	Feature	Test Case	Expected Result	Test Status
F001	Object Manipulation	Drag and Drop	1. User can drag and drop objects on the grid. 2. Fence objects snap to grid positions.	Pending
F002	Trash Bin Functionality	Object Deletion	1. Dropping an object into the trash bin deletes it.	Pending
F003	Score System	Score Updates	1. Score updates when objects are placed/validated correctly.	Pending
F004	Level Configuration	Level Loading	1. Level data loads correctly based on configuration file. 2. Nodes appear in correct state.	Pending
F005	User Interface	Display Elements	1. Menu, tooltip, and score display render correctly.	Pending
F006	Audio Feedback (Optional)	Sound Playback	1. Background music plays correctly.	Pending

Candidate Tests

Feature F001: Object Manipulation

Action	Expected Result	Pass Criteria	Status
Drag object to grid	Object follows cursor	Object moves smoothly	Pending
Release fence object on grid slot	Object snaps to position	Position is saved	Pending

Feature F002: Trash Bin Functionality

Object Type	Dropped On	Is Object Deleted?	Score Change	Feedback Message	Expected Result	Status
Broken Wire (unsafe)	Trash Bin	Yes	+10	Object removed	Pass	Pending
Lamp (safe)	Trash Bin	No	0	Cannot discard	Pass	Pending

Feature F003: Score System

Action	Score Change	Expected Result	Status
Place safe object correctly	+10	Score increases	Pending
Place unsafe object	-10	Score decreases	Pending
Place unsafe object in trash	+10	Score increases	Pending
Place safe object incorrectly	0	Score remains unchanged	Pending

Feature F004: Level Configuration

Scenario	Expected Result	Pass Criteria	Status
Load Level 1	Objects appear in correct slots	Match predefined layout	Pending
Load invalid level	Fails gracefully	Error handled	Pending

Feature F005: User Interface Display

UI Component	Expected Behavior	Status
Main Menu	Buttons respond to input	Pending
Tooltip Display	Tooltips appear near object	Pending

Feature F006: Audio Feedback

Audio Type	Trigger	Expected Output	Status
Background Music	Safety level	Music plays	Pending
Effect Sound	Trash object	Sound plays	Pending

Conclusion

The PX Project SAD report establishes a rigorous technical plan for delivering an educational system that is both functional and sustainable. Through systematic risk identification, defined constraints, and detailed design specifications, the report ensures that development proceeds with clarity and reduced uncertainty.

The inclusion of user story acceptance criteria and test plans provides measurable checkpoints for verifying that the system meets functional and non-functional requirements. Architecture and communication models support modularity and scalability, ensuring the system can adapt to future enhancements without compromising stability.

In conclusion, this SAD report confirms that the PX Project is technically viable within the given constraints and provides the analytical foundation required for structured development, testing, and deployment.