POLITECNICO
MILANO 1863

Project Report

Magic Osmo Tangram

Ghazal Sepehrirad
Hedieh Raeisi

Supervise by

Prof.
GARZOTTO FRANCA

January 25, 2026

The Team

- **Ghazal Sepehrirad**

- **Hedieh Raeisi**

Members' Contribution

Members' Contribution

Task	Hedieh Raeisi	Ghazal Sepehrirad
Initial data preparation	Responsible	Responsible
Design and UX	Contributer	Responsible
Documentation and Media	Contributer	Responsible
Unity implementation	Responsible	Contributor
System testing	Responsible	Contributor

Table 1: Members' contributions by task

Abstract

This project presents the design of an Advanced User Interface aimed at supporting attention regulation and cognitive development in children aged 6–8 diagnosed with ADHD. Magic Room: Tangram Osmo Edition combines embodied and spatial interaction through physical movement, gesture-based control, and large-scale floor and wall projection to create an engaging, story-driven learning experience. The interaction environment is specifically designed for the cognitive, behavioral, and sensory characteristics of children with ADHD, carefully managing sensory load to support focus and reduce cognitive overload. Children interact with Tangram puzzles using their body and hands, selecting, rotating, and positioning pieces through natural gestures without traditional input devices. Grounded in the Planning-Attention-Simultaneous-Successive (PASS) cognitive model and mediated learning theory, the system addresses challenges such as sustained attention, impulse control, and planning while enhancing spatial reasoning and problem-solving skills.

Contents

List of Figures

List of Tables

Chapter 1

Executive Summary

Executive Summary

Children aged 6–8 with Attention Deficit Hyperactivity Disorder (ADHD) commonly experience difficulties in maintaining attention, organizing tasks, controlling impulses, and regulating behavior during structured activities. Traditional digital learning tools and puzzle games, which typically rely on screen-based interaction and extended periods of sitting, are often poorly aligned with the sensory, motor, and cognitive characteristics of neurodiverse children, leading to disengagement and limited skill transfer. Prior research on embodied interaction and multisensory learning environments suggests that room-scale, movement-based systems can foster higher engagement, sustained attention, and active participation in children with neurodevelopmental disorders [1, 2, 3].

Magic Room: Tangram Edition reimagines Tangram learning through full-body spatial interaction within a projection-based therapeutic environment. The system creates a controlled sensory space in which children solve puzzles using natural body movements—standing to select pieces, gesturing to rotate them, and physically navigating to position them correctly—thereby replacing conventional screen-based input methods. Therapists configure session parameters such as difficulty progression and narrative themes, enabling real-time adaptation to each child's therapeutic needs while maintaining structured guidance.

The system integrates floor and wall projections with depth-based body tracking to support gesture recognition and dwell-time mechanisms that help distinguish intentional actions from impulsive ones. Floor projections present manipulable Tangram pieces, while wall projections display target silhouettes, orientation controls, and contextual feedback, ensuring a clear spatial separation of interaction roles. Puzzle-solving

activities are embedded within narrative-driven modules across therapist-selectable difficulty levels to promote sustained motivation and structured skill progression.

This approach transforms traditional Tangram activities into embodied cognitive training tools specifically designed for ADHD-focused intervention. By leveraging physical space and bodily movement as primary interaction modalities rather than peripheral input mechanisms, *Magic Room: Tangram Edition* exemplifies an advanced user interface paradigm for neurodiversity-inclusive learning and therapeutic environments, building upon prior work on multisensory smart spaces while contributing a structured, task-oriented interaction model tailored to executive function training [1, 2].

Chapter 2

Requirements

2.1 Problem

Children aged 6–8 diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) frequently exhibit difficulties in sustained attention, planning, impulse control, and self-regulation during structured tasks such as puzzle solving [5, 4]. These challenges are not adequately addressed by most existing educational tools and digital Tangram games, which are predominantly screen-based, require prolonged sitting, and offer limited sensory adaptation or therapist-guided personalization [6]. As a result, current interaction models are misaligned with the cognitive, behavioral, and sensory profiles of neurodiverse children and often lead to reduced engagement, shallow learning, and limited transfer beyond the game context [7].

2.2 Main Target Groups / Stakeholders

- **Primary users**

  Children between 6 and 8 years old with a formal ADHD diagnosis who participate in therapeutic or educational interventions focusing on attention and executive functioning [5].

- **Professional stakeholders**

  Clinical psychologists, occupational therapists, technicians, and other clinicians who design and monitor interventions and require structured activities to support attention regulation, planning, and impulse control training [5, 7].

- **Secondary stakeholders**

  Parents and institutions (clinical centers, therapy clinics, special education units,

and inclusive schools) that adopt the system as part of broader care and educational programs.

2.3 Needs of the Stakeholders

Children with ADHD need:

- Activities that externalize and scaffold planning and sequencing [11].
- Embodied, spatial interaction that allows movement [3].
- Immediate, predictable, and controlled multimodal feedback [12].
- Clear task structure and success criteria [9].

Therapists and clinicians need:

- Real-time control over task parameters [5].
- Embedded therapeutic objectives within the interaction [11].
- Transparent and interpretable system behavior [7].
- Longitudinal behavioral data for monitoring [4].

2.4 Cognitive Model Alignment (PASS)

The design of the proposed Tangram-based activity is informed by the *Planning-Attention-Simultaneous-Successive (PASS)* cognitive model [11, 13]. This model provides a structured framework for analyzing how different cognitive processes are engaged during task execution and is particularly relevant for understanding attention and executive functioning in children with ADHD [17].

Planning is involved when the child decides which Tangram piece to select, determines its orientation, and plans its placement within the target silhouette [11]. The system does not automate these decisions, requiring the child to actively organize actions and anticipate outcomes [13].

Attention is engaged through interaction mechanisms that require sustained focus, such as dwell-time selection and sequential task progression [4, 12]. The interaction

structure limits simultaneous choices and uses predictable feedback to support continued engagement [5].

Simultaneous processing is required to integrate individual Tangram pieces into a coherent global shape [11]. The child must continuously relate local elements to the overall silhouette, supporting spatial integration and visual-spatial reasoning [8].

Successive processing is exercised through the ordered interaction flow, which requires completing discrete steps—selection, orientation, grabbing, movement, and placement—in sequence [11]. Each action builds upon the previous one, reinforcing cause-effect relationships and procedural structure [17].

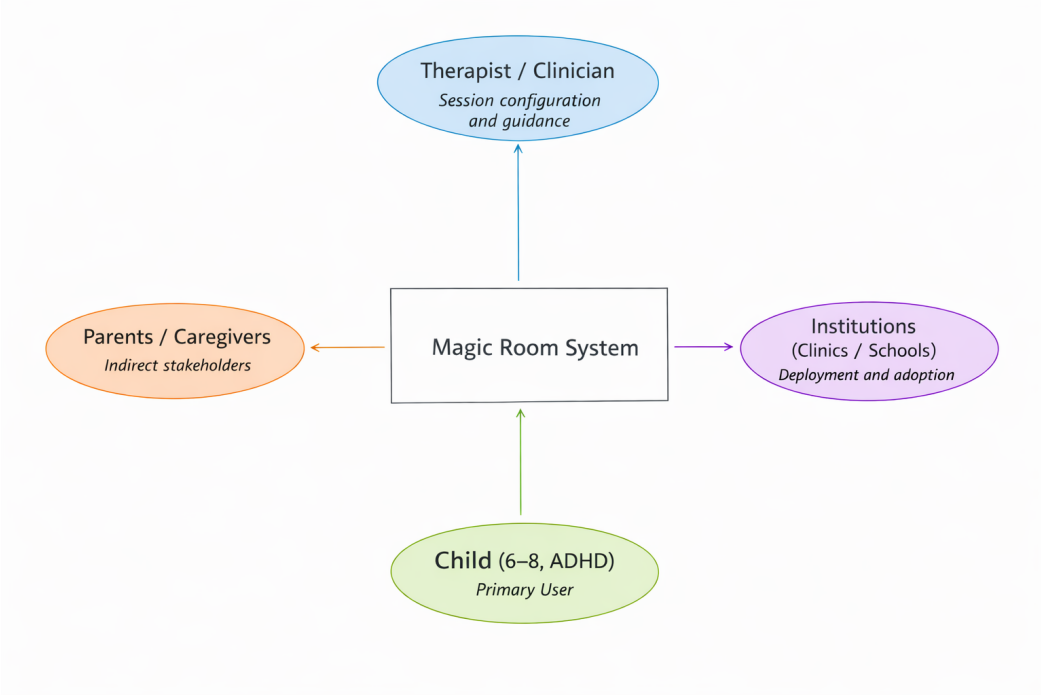


Figure 2.1: Stakeholder diagram

2.5 Context

The system is designed for controlled indoor environments such as therapy rooms or specialized school spaces equipped with projection and motion tracking. Sessions are therapist-guided and embedded in repeated intervention cycles [5].

2.6 Constraints

- Tolerance for impulsive and imprecise interaction [12].

- Robustness to noise and partial disengagement.
- Deployability in standard therapy rooms.
- Adjustable sensory load.

2.7 Goals

User goals:

- Practice sustained attention and planning.
- Train impulse control through dwell-time interaction.
- Build competence through adaptive difficulty [9].
- Support reflection via therapist mediation [5].

System goals:

- Treat physical space as the primary interface.
- Provide adaptive scaffolding and difficulty control.
- Distinguish deliberate from impulsive actions.
- Offer therapist-facing configuration and extensibility [7].

Chapter 3

State-of-the-art

3.1 State of the Art

Research on educational and therapeutic technologies for children with Attention Deficit Hyperactivity Disorder (ADHD) has developed across multiple parallel research streams, including tangram-based learning systems, embodied and gesture-based interaction, serious games for attention training, immersive projection environments, and evidence-based cognitive and pedagogical frameworks. While each stream contributes valuable insights, existing systems typically address these dimensions in isolation. This section reviews the most relevant prior work and positions the Magic Room as a novel synthesis that integrates these approaches into a coherent, ADHD-oriented interactive environment.

3.2 Tangram-Based Digital and Tangible Systems

Tangram-based learning tools are widely used to support spatial reasoning, problem-solving, and visual–spatial integration[8]. Commercial systems such as tablet-based tangible tangram platforms combine physical manipulatives with digital feedback, enabling hybrid physical–digital interaction. Empirical studies demonstrate improvements in spatial skills and increased engagement compared to traditional paper-based tangram activities.

Despite these benefits, most digital and tangible tangram systems remain screen-centered and require sustained seated attention, fine motor control, and prolonged visual focus. Such interaction profiles conflict with the attentional regulation and motor restlessness characteristic of children with ADHD. Furthermore, these systems typi-

cally provide fixed difficulty progressions, lack therapist-mediated control, and do not include explicit impulse-control mechanisms, limiting their suitability as ADHD-focused interventions.

3.3 Gesture-Based and Embodied Interaction for ADHD

Research on embodied and gesture-based interaction highlights the advantages of physical engagement, reduced abstraction, and predictable feedback for children with ADHD. Systems employing mid-air hand gestures, often combined with dwell-time confirmation, have demonstrated effectiveness in distinguishing intentional actions from impulsive responses and supporting spatial reasoning and motor coordination.

However, most gesture-based systems are limited to hand-level interaction within constrained spaces. They do not extend to full-body or room-scale embodiment and typically lack narrative framing, therapist-mediated adaptation, and grounding in ADHD-specific cognitive models. While these systems validate the benefits of embodied interaction, their limited scope constrains their therapeutic impact.

3.4 Serious Games and Screen-Based ADHD Interventions

Serious games designed for ADHD intervention have shown promising results in improving sustained attention and executive function[15]. Clinically validated systems demonstrate measurable reductions in symptom severity and improvements in cognitive performance.

Nevertheless, the majority of serious games remain abstract and screen-based, relying on touch, mouse, or controller input. These interaction paradigms do not leverage physical space or whole-body movement, limiting ecological validity and the transfer of learned skills to real-world contexts where attention and planning challenges manifest.

3.5 Immersive Projection Environments and Interactive Floors

Immersive projection-based environments transform physical spaces into interactive surfaces using ceiling-mounted projectors and motion-tracking technologies [16]. Re-

search indicates that such environments can enhance attention, memory, imagination, and engagement while reducing passive screen time through full-body interaction.

Despite these advantages, most interactive floors are designed for entertainment or general cognitive stimulation rather than targeted therapeutic intervention. They often rely on open-ended play and lack structured task sequencing, impulse-control scaffolding, therapist-mediated adaptation, and grounding in ADHD-specific cognitive theory. As a result, their potential for supporting planning and attention regulation remains underexploited.

3.6 Cognitive, Pedagogical, and Technological Foundations

Evidence-based cognitive and pedagogical frameworks provide essential grounding for ADHD-focused interactive systems. The PASS cognitive model identifies primary deficits in planning and attention in children with ADHD, highlighting the need for structured tasks that explicitly support these processes[13, 17]. Mediated Learning Theory further emphasizes the role of skilled adult mediation and adaptive scaffolding in fostering self-regulation and cognitive development.

Advances in motion tracking and gesture recognition technologies enable robust real-time body-based interaction across diverse users and environments. These technological developments confirm the feasibility of room-scale embodied systems capable of capturing ADHD-relevant behavioral patterns and supporting adaptive intervention.

3.7 Positioning of the Magic Room within the State of the Art

Within the reviewed landscape, the Magic Room uniquely integrates tangram-based problem solving, full-body embodied interaction at room scale, ADHD-specific design principles, therapist-mediated real-time adaptation, narrative engagement, and evidence-based cognitive theory. Unlike tablet-based tangram tools, it replaces screen-centered interaction with spatial movement. Unlike generic interactive floors, it employs structured, cognitively informed task sequencing. Unlike gesture-based systems, it extends interaction from hand-level gestures to full-body navigation while embedding impulse-control mechanisms directly into the interaction mechanics.

As summarized in Table 3.1, the Magic Room is the only system that simultaneously combines full-body embodiment, room-scale deployment, ADHD-specific design, therapist control, narrative framing, and structured cognitive tasks within a single coherent platform. This integration positions the Magic Room as a novel advanced user interface specifically designed for ADHD-focused therapeutic intervention.

System	Interaction Type	Embodied	ADHD-Specific	Therapist Control	Narrative/Story	Room-Scale	Structured Tasks	PASS Model
Magic Room	**Full-body projection**	✓	✓	✓	✓	✓	✓	✓
Osmo Tangram	Physical+tablet	✗	✗	✗	✗	✗	✓	✗
Digital Tangram	Touch/mouse	✗	✗	✗	✗	✗	✓	✗
HOPE Gesture	Mid-air hand	✗	✓	✗	✗	✗	✓	✗
Interactive Floors	Floor projection	✓	✗	✗	✗	✓	✗	✗
NAO Robot Tangram	Tablet+robot	✗	✗	✗	✗	✗	✓	✗

Figure 3.1: Magic Room vs. Related Systems

Chapter 4

Solution

4.1 General Approach

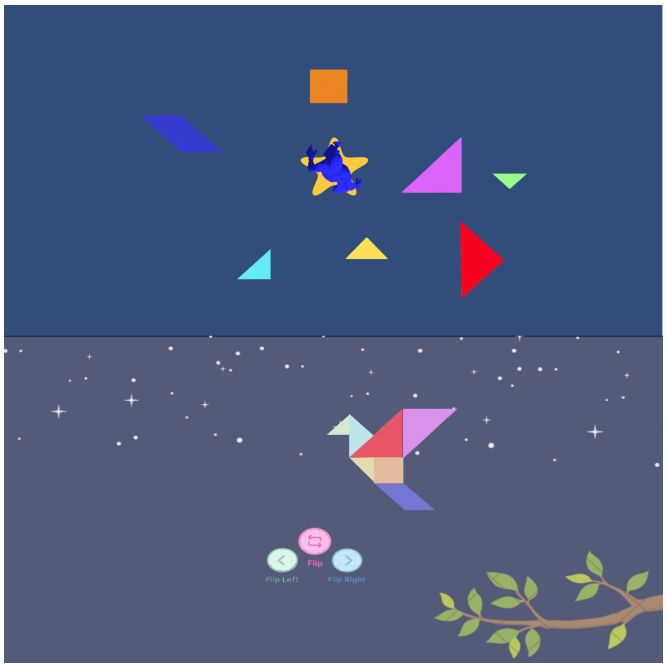
The UX design of Magic Room follows a user-centered and embodied interaction approach, specifically tailored to children aged 6-8 diagnosed with ADHD . Instead of relying on conventional screen-based interfaces that demand prolonged stillness and fine motor control, the system shifts interaction to a room-scale, spatial environment where movement and physical presence act as primary interaction resources.

The design philosophy adapts the environment to the user rather than forcing adaptation to the interface. Interaction rules are intentionally simple, predictable, and consistent, supporting attention regulation and impulse control through design rather than explicit instruction. Sensory elements such as color, animation, and sound are carefully moderated to create a calm, structured environment that minimizes cognitive and sensory overload.

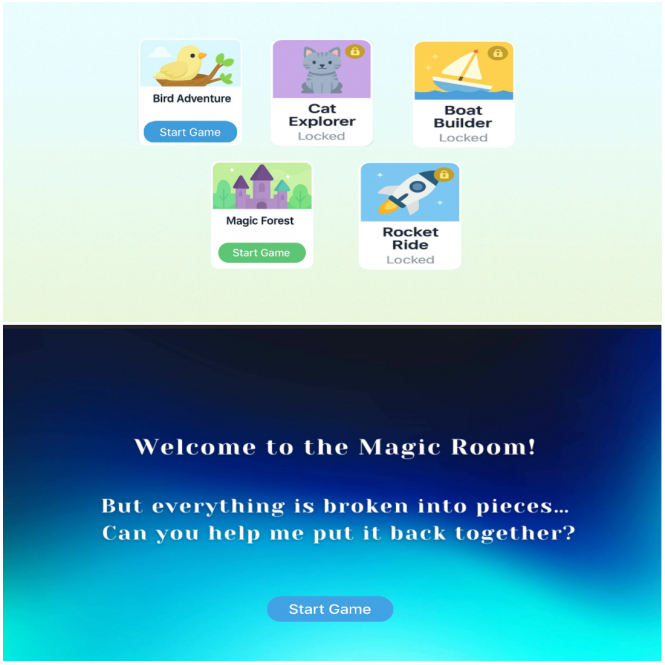
4.2 UX Description (Projection-Based AUI)

As a projection-based advanced user interface, Magic Room integrates floor and wall projections with gesture-based full-body interaction (Figure 4.1). The floor serves as the space for piece selection and exploration, while the wall displays task goals, orientation controls, feedback, and narrative context. This spatial separation reduces visual clutter and clarifies interaction roles.

Interaction employs natural bodily metaphors: standing still to confirm selection, holding a hand steady for commands, and closing the hand to grab or move objects. These interaction patterns reduce the learning curve and support intuitive use without



(a) Floor and ceiling projections supporting embodied Tangram manipulation.



(b) Wall projection presenting narrative context, story selection, and game progression.

Figure 4.1: Spatial distribution of interaction in the Magic Room system.

User Action	System Response
Standing on a Tangram piece for 5 seconds	The corresponding piece is selected and displayed on the wall.
Holding the hand steady over a control	The selected control action (rotate or flip) is executed.
Closing the hand point tothe location of the shape on the wall	The piece is grabbed and follows the child's movement.
Opening the hand	The piece is released and stops moving.
Placing the piece within the correct area	The piece snaps into position, the floor projection fades out, and a confirmation sound is played.

Table 4.1: Mapping between user actions and system responses

verbal explanation.

4.3 User Workflows

Main Child Workflow:

1. **Session Initiation:** Child enters room; short visual/audio intro plays.
2. **Puzzle Presentation:** Target silhouette on wall; pieces on floor.
3. **Intentional Selection:** Stand on the floor piece for dwell time (3–5s) .
4. **Orientation Adjustment:** The selected piece appears on the wall; rotate/flip.
5. **Grab and Movement:** Close hand to grab; bodily motion to target.
6. **Placement and Confirmation:** Snap-to-fit; locks with feedback.
7. **Feedback and Progression:** Multimodal reward; advance next piece.

Therapist Workflow:

1. Select scenario/world (Cat Explorer, Magic Forest) .
2. Set difficulty and hints.
3. Monitor live; adjust parameters.
4. Review progress/logs.

4.4 User Scenarios

Before the session begins, the therapist configures the system by selecting the *game difficulty*, and *game stage*. Once the configuration is completed, the session starts and the child enters the Magic Room.

The game begins with a menu interface, where the child selects a story under the guidance of the therapist. A voice narrator then introduces the story, fostering engagement and narrative continuity. A Tangram puzzle silhouette is displayed on the wall, while the individual Tangram pieces are projected onto the floor. To select a piece, the child stands on it for **five seconds**. Once the dwell-time threshold is reached, the system confirms the selection and displays the corresponding piece on the wall for manipulation, while the piece remains visible on the floor until correct placement is achieved.

The selected piece can be adjusted using three virtual controls displayed on the wall: *rotate 45° clockwise*, *rotate 45° counterclockwise*, and *flip*. To activate a control, the child raises a hand and holds it steady for a brief duration. The system interprets this sustained gesture as a click and applies the corresponding transformation, with the rotation advancing every **three seconds**.

Once the orientation is set, the child closes the hand to grab the piece. While the hand remains closed, the piece follows the child's movement and can be repositioned. Opening the hand releases the piece.

The child moves the piece toward the target silhouette on the wall. The system allows a placement tolerance, meaning exact precision is not required. When the piece enters the correct position within the Tangram silhouette, it snaps into place and the corresponding piece projected on the floor **fades out**, indicating successful placement. A confirmation sound is played, and the placed piece becomes fixed and cannot be moved again.

This interaction sequence is repeated until all pieces required for the selected stage have been placed and the Tangram puzzle is completed. If a Tangram piece is moved toward an incorrect position, the system does not snap the piece into place. Instead, the piece remains movable, allowing the child to explore alternative placements until the correct location is found. This design choice avoids explicit failure states and encourages trial-and-error exploration within a safe and supportive interaction space.

Upon successful placement of all Tangram pieces, a celebratory clap sound is played and a story-related video is displayed, signaling the completion of the level.

During these moments, the therapist remains present and actively accompanies the child, providing verbal guidance, encouragement, or hints as needed.

4.5 Narrative Design and Story Modules

To support narrative engagement, the system provides multiple story modules, each defined by a curated set of Tangram target shapes (Table 4.2). Each module couples progressive puzzle tasks with a short storyline to sustain attention and provide contextual motivation.

Table 4.2: Story modules

Story module	**Tangram shapes included**
Magic Forest	Bird, Butterfly, Duck, Fish,Sun;
The Sleeping Princess	Sun; Bridge, Castle, Princess, Teapot
Cat Explorer	Cat; Rabbit, Bear, Turtle, Kangaroo
My Adventure with Shapes	Crab; Boat, Fox, Lighthouse, Horse
Inventors of the Sky	Rocket; Helicopter; Plane; House, and Tree

Although the system supports multiple difficulty levels, these levels are not explicitly presented to the child during gameplay. From a psychological perspective, making difficulty labels such as “easy” or “hard” visible may negatively affect the child’s self-perception, particularly if the child becomes aware that they are playing at a lower level. Such awareness may reduce motivation, increase anxiety, or reinforce feelings of inadequacy.

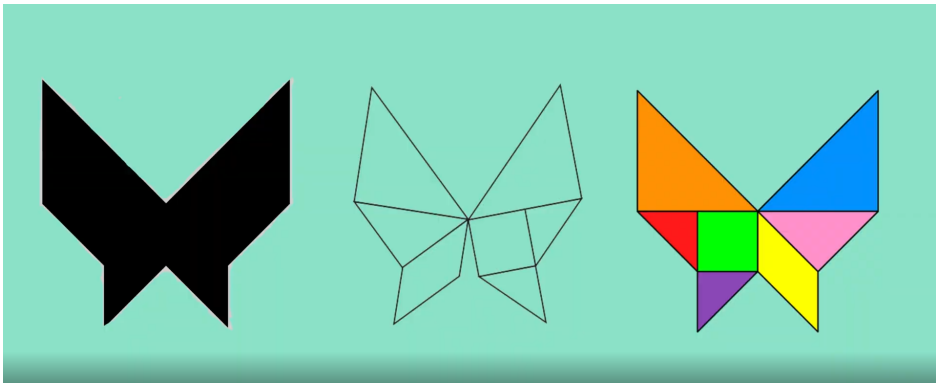


Figure 4.2: Difficulty levels

4.6 Conversational Interaction

The system includes audio-based feedback and prerecorded narrative content that support the interaction flow and the story selected for each session (see Figure 4.3). At the beginning of the experience, an introductory audio sequence is played to present the narrative context. During gameplay, sound cues are triggered by specific events, such as when a Tangram piece appears on the wall, when a piece is correctly placed, and when the puzzle is completed. Upon completion, a short celebratory sound and a concluding narrative segment are played.

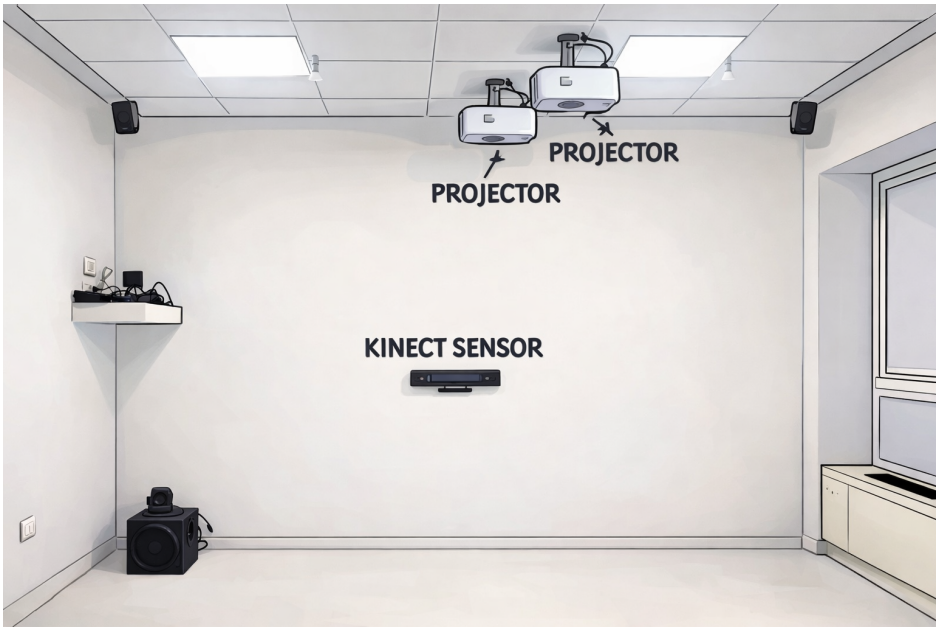


Figure 4.3: System setup of the Magic Room

All audio behavior is event-based and predefined. Sounds are triggered by interaction states such as session start, piece placement, and task completion, following a deterministic interaction logic.

In addition to system-generated audio, the therapist may verbally interact with the child at any time during the session. The therapist can explain the game mechanics, describe the story, provide guidance, or respond to the child's questions. This verbal interaction takes place independently of the system and is not processed or interpreted by the software.

Spoken interaction in the system is limited to prerecorded narration and live human speech. No system-generated conversational exchanges or dialogue flows are employed, and therefore no conversational prompts are reported in the Appendix.

Chapter 5

Solution - Implementation

5.1 Hardware Architecture

The Magic Room system provides a room-scale interactive environment that supports the proposed activity through coordinated floor and wall projections combined with body-based interaction. The activity is implemented within a Unity-based application and deployed in a physical room, where spatial parameters such as room dimensions are manually configured during installation and made available to the running activity.

The projected floor defines the primary interaction zone and displays selectable and manipulable elements, while the wall projection is used to present task goals, manipulation controls, and contextual system feedback. This spatial separation supports a clear distinction between action and guidance within the interaction. Body movements are captured using the sensing infrastructure available in the installed Magic Room environment, with newer installations relying on RGB camera–based tracking. The Magic Room software framework ensures consistent mapping between tracked body movements and the projected interaction space across different room configurations.

Audio output is provided through external speakers and complements the visual projections by supporting narration, confirmation sounds, and task completion cues. Together, these hardware components enable reliable execution of the interaction activity while maintaining spatial consistency and multimodal feedback across installations.

5.2 Functional Architecture

The system is composed of the following functional modules:

- **Puzzle Management Module**: manages tangram shapes, target configurations,

and puzzle validation logic.

- **Interaction Module**: handles user interaction with tangram pieces and supports intuitive manipulation.
- **Visual Feedback Module**: provides visual cues and highlights to support spatial perception and visuo-spatial reasoning.
- **Audio Feedback Module**: delivers multisensory audio feedback to reinforce learning and user engagement.
- **Learning Progress Module**: tracks task completion and supports gradual skill development.
- **Scene Management Module**: controls transitions between learning activities and difficulty levels.

These modules work together to promote autonomy, spatial perception, and learning skills in children with Specific Learning and Communication Disorders.

5.3 Implementation Architecture

The application is developed using **Unity** as the main game engine. All core functionalities are implemented using **C# scripts**, following Unity's component-based architecture.

Each tangram piece is represented as a game object with attached scripts to manage interaction, movement, and collision detection. Unity scenes are used to represent different learning activities and puzzle levels.

Visual feedback is implemented through animations, color changes, and visual highlights, while audio feedback is managed using Unity's `AudioSource` components. The modular design allows for easy extension of the system by adding new puzzles and learning activities without modifying the core architecture.

Chapter 6

Empirical Evaluation

6.1 Evaluation Goal

The purpose of this empirical evaluation was to conduct a system-level pilot demonstration of the Magic Room in a real physical setup. The evaluation focused on validating the core interaction concept of the system and assessing whether the intended spatial interaction model—particularly the functional separation between floor-based and wall-based projections—was understandable and usable in practice.

Rather than measuring learning outcomes or performance metrics, the goal of this evaluation was to verify the coherence of the interaction flow, the clarity of visual and narrative cues, and the feasibility of the proposed interaction paradigm in a real environment. The session was also intended as a demonstrative validation for the course instructor.

6.2 Participants

The evaluation was conducted with the project designers themselves acting as users. No child participants were involved at this stage. This decision was intentional, as the evaluation was designed as an early-stage feasibility and concept validation study, aimed at verifying the interaction logic and spatial coordination of the system before involving the target user group.

6.3 Experimental Setup

The evaluation took place in the University of Biccoca laboratory environment with controlled lighting conditions. The system was implemented as a projection-based in-

teractive space designed to support embodied and spatial interaction.

The setup included:

- Wall projection presenting narrative context, task goals, and interaction feedback
- Floor projection enabling Tangram piece selection and spatial exploration
- A spatial interaction mechanism allowing users to interact with projected elements through body movement and gestures
- Audio output providing feedback during interaction

The system configuration emphasized the coordination between floor-based interaction and wall-based feedback, intentionally abstracting from implementation-specific sensing technologies in order to focus on the interaction concept and spatial design principles of the Magic Room.

Figure 6.1 illustrates the interaction flow observed during the empirical evaluation, including story selection, floor-based Tangram interaction, and gesture-driven manipulation reflected on the wall projection.

Figure 6.1: Empirical evaluation of the Magic Room system

6.4 Tasks

During the demonstration session, the user performed a sequence of representative interaction tasks designed to reflect the intended user experience:

- Selecting a story from a wall-projected menu
- Selecting Tangram pieces through the floor projection
- Manipulating pieces using gesture-based interaction, including rotation and flipping
- Completing a Tangram figure as part of the interactive narrative

These tasks were selected to cover the full interaction flow of the system and to validate the clarity and consistency of the interaction concept.

6.5 Data Collection

Data was collected using qualitative and observational methods appropriate for an exploratory, concept-driven evaluation:

- Photographic documentation of the setup and interaction
- Video recordings capturing interaction sequences
- Observational notes recorded during and immediately after the session

No quantitative metrics were collected, as the purpose of the evaluation was not to assess performance or efficiency, but to examine the interpretability and coherence of the interaction design.

6.6 Results and Observations

Based on qualitative observation during the demonstration session, the proposed Magic Room interaction concept appeared clear, stable, and understandable. Participants were able to comprehend the intended relationship between floor-based selection and wall-based feedback, indicating that the spatial division of interaction roles was conceptually coherent.

However, the evaluation was affected by practical limitations of the demonstration setup. System performance issues, including slow response times of the computing hardware, negatively impacted the fluidity of interaction and made real-time play in the Magic Room challenging. In addition, body-based interaction could not be fully evaluated, as the Kinect sensor was unavailable during the session due to insufficient opportunity for prior testing. As a result, interaction was demonstrated using a mouse-based input as a fallback mechanism.

Despite these constraints, the overall interaction flow remained intelligible, and the core design logic of the activity could be communicated effectively. The narrative structure and visual cues supported a clear progression through the task, even though the embodied aspects of the interaction could not be experienced as intended.

These observations suggest that while the interaction concept is sound at a design level, a full evaluation of its usability and therapeutic relevance requires a stable hardware setup and proper deployment of body-tracking input. Future work should include testing with the complete Magic Room infrastructure and formal user studies involving children from the target population.

Table 6.1: Summary of the empirical evaluation

Aspect	**Description**
Evaluation type	Concept-driven system demonstration
Participants	Project designers (no child participants)
Environment	University laboratory
Interaction modalities	Wall projection, floor projection, embodied spatial interaction
Tasks performed	Story selection, Tangram selection, manipulation, puzzle completion
Data collected	Photographs, video recordings, observational notes
Main outcome	The interaction flow and conceptual structure were generally understandable; evaluation of full body-based interaction was limited due to technical constraints.

Chapter 7

Value proposition

7.1 Value Proposition

The Magic Room system offers a structured yet flexible interaction environment designed for children aged 6–8 with ADHD and the therapists who support them [5, 7]. For children, it provides a clear and predictable interaction flow grounded in movement, spatial exploration, and puzzle solving, reducing reliance on prolonged, sedentary screen use . For therapists, it enables advance configuration of difficulty levels, narrative worlds, and session length so that each session can be aligned with specific therapeutic or educational objectives while remaining adaptable in real time . Room-scale interaction, prerecorded narration, and error-tolerant placement support engagement within a controlled environment, while allowing the therapist to remain actively involved throughout the session . The system is intended for short, focused sessions and integrates naturally into existing therapeutic or classroom routines .

7.2 Why It Is a Good Solution

The solution is effective because it builds on prior research on multisensory interactive environments designed for children with neurodevelopmental disorders, where full-body interaction, spatial engagement, and controlled multisensory stimulation have been shown to support attention, engagement, and participation [2, 1]. Rather than relying on sedentary, screen-centered interaction, Magic Room leverages room-scale interaction through body movement, gestures, and spatial exploration, allowing children to interact with digital content as part of a larger physical environment. This approach aligns with findings from previous Magic Room studies indicating that immersive, space-based

interaction can reduce disengagement and support sustained involvement during activities.

In addition, the solution adopts a therapist-in-the-loop design paradigm that has been identified as a key strength of the Magic Room across different applications [2]. Therapists retain control over activity configuration, difficulty progression, and session pacing, enabling real-time adaptation to each child's needs while maintaining a structured interaction flow. By combining structured task progression with multisensory feedback and professional mediation, the system integrates the engagement benefits of Magic Room environments with goal-oriented cognitive activities, positioning it as an effective and adaptable solution for therapeutic and educational contexts.

7.3 Competitors and Comparison

Existing Tangram-based systems, including tabletop tangible products and standard digital applications, primarily rely on screen-centered, sedentary interaction . These tools support spatial reasoning and problem solving but provide limited bodily engagement and do not extend interaction to the scale of the room . General-purpose interactive floors and immersive projection environments promote movement but typically lack tightly structured puzzle tasks, therapeutic framing, or therapist-controlled progression. In contrast, Magic Room combines Tangram-based problem solving, room-scale embodied interaction, predefined narrative audio, and therapist-configurable parameters within a single, coherent system . Unlike screen-based games or open-ended interactive floors, it offers a clear task structure, predictable interaction rules, and configurable difficulty while remaining adaptable to different session goals, positioning it as a distinctive Advanced User Interface for educational and therapeutic contexts .

Chapter 8

Discussion and Future work

8.1 Discussion

The *Magic Room* project demonstrates how room-scale interaction and tangible problem solving can be integrated into a structured learning experience for children aged 6–8 with ADHD. While the system successfully implements an embodied and rule-based interaction model, several limitations should be acknowledged.

First, the system is designed for controlled indoor environments with sufficient space for floor and wall projection. This limits its applicability in contexts where space, lighting conditions, or hardware availability are constrained. In addition, the interaction relies on gesture recognition and dwell-time mechanisms, which may require calibration and adaptation for children with varying motor abilities.

Second, the project is based on a predefined set of Tangram puzzles, story themes, and game stages selected by the therapist prior to the session. While this supports structure and predictability, it limits spontaneous variation and content diversity within individual sessions. At present, adaptation during gameplay depends primarily on therapist intervention rather than automated system behavior.

Finally, the system has been developed as a prototype and has not undergone extensive longitudinal evaluation with children. As a result, conclusions regarding long-term effectiveness and generalizability should be interpreted with caution.

8.2 Future Work

Several directions for future development can be identified. One immediate extension involves expanding the available Tangram content, storylines, and difficulty levels to

support repeated and long-term use. Additional configuration options for therapists could provide finer control over pacing, placement tolerance, and feedback timing.

From a technological perspective, future work could explore the integration of **AI-based components** to support adaptive system behavior. For example, machine learning techniques could be used to analyze interaction patterns such as dwell-time, movement trajectories, and placement attempts in order to automatically adjust difficulty levels, suggest appropriate next stages, or personalize pacing across sessions. Such AI-driven adaptation would be designed to complement therapist mediation rather than replace it.

Further developments may include improving tracking robustness, supporting collaborative or multi-user interaction scenarios, and enhancing calibration tools. Finally, future research should include systematic user studies involving children and therapists to evaluate usability, engagement, and learning outcomes over extended periods, providing empirical evidence to guide iterative refinement of the system.

Chapter 9

Business perspectives

9.1 Business Perspectives

Although the *Magic Room* project has been developed primarily as an academic prototype, it presents several potential business and deployment opportunities in educational and therapeutic contexts.

One possible application domain is child therapy and rehabilitation centers, where the system could be offered as an interactive support tool for therapists working with children diagnosed with ADHD. Schools, learning laboratories, and special education institutions also represent potential contexts for adoption, particularly as part of inclusive and experiential learning programs.

From a business perspective, the system could be distributed as a modular solution, combining software licenses with projection and sensing hardware. Content packs (e.g., Tangram sets, story themes, and difficulty levels) could be expanded over time to support long-term use. Additionally, service-based models could be considered, including setup, maintenance, and training for educators and therapists.

Given the need for controlled physical space and specialized equipment, large-scale consumer deployment is less likely. Instead, a business-to-business(B2B) model focused on educational and clinical partners would be the most realistic path for future commercialization.

Bibliography

[1] F. Garzotto and M. Gelsomini, "Magic Room: A smart space for children with neurodevelopmental disorder," *IEEE Pervasive Computing*, vol. 17, no. 1, pp. 38–48, 2018.

[2] F. Garzotto, M. Gelsomini, M. Gianotti, and F. Riccardi, "Engaging children with neurodevelopmental disorder through multisensory interactive experiences in a smart space," in *Social Internet of Things*, A. Soro *et al.*, Eds. Cham, Switzerland: Springer, pp. 167–184, 2019.

[3] A. N. Antle, "Designing and studying digital interactive technology for physical therapy," *Personal and Ubiquitous Computing*, vol. 17, no. 2, pp. 321–328, 2013.

[4] C. Li *et al.*, "Assessment of ADHD subtypes using motion tracking," *Nature Mental Health*, vol. 4, no. 1, pp. 45–58, 2024.

[5] S. Goldstein, "The school neuropsychology of ADHD: Theory, research, and clinical practice," *Psychol. Schools*, vol. 45, no. 10, pp. 859–874, 2008.

[6] S. Schroth, "An exploratory study of Osmo Tangram and manipulatives in the elementary classroom," *M.S. thesis*, Univ. Southern Mississippi, 2019.

[7] World Health Organization, "ADHD guidelines for therapeutic interventions," WHO Press, 2024.

[8] O. Lahav *et al.*, "Enhancing spatial skills of young children with special needs using the Osmo Tangram," *Virtual Reality*, vol. 27, pp. 123–136, 2023.

[9] R. Feuerstein, *The Dynamic Assessment of Retarded Performers: The Learning Potential Assessment Device*. Baltimore, MD, USA: Univ. Park Press, 1979.

[10] *Magic Room Project Report*, Dept. Comput. Eng., Univ. Sri Jayewardenepura, Sri Lanka, 2026.

[11] J. P. Das, J. A. Naglieri, and J. R. Kirby, *Assessment of Cognitive Processes: The PASS Theory*. Boston, MA, USA: Allyn & Bacon, 1994.

[12] A. Freitag *et al.*, "Exploring mid-air gestural interfaces for children with ADHD," in *Proc. ACM Interact. Mobile Wearable Ubiquitous Technol.*, 2023, Art. no. 3624449.

[13] L. Qin *et al.*, "Evaluation of the diagnostic implications of Das-Naglieri cognitive assessment system in children with attention deficit hyperactivity disorder," *BMC Psychiatry*, vol. 18, no. 1, p. 399, 2018.

[14] S. Sharma and T. Heimonen *et al.*, "Designing gesture-based applications for individuals with developmental disabilities," in *Proc. CHI*, 2010, pp. 1811–1820.

[15] FDA, "EndeavorRx: FDA Breakthrough Therapy Designation," FDA Approval Documentation, 2021. [Online]. Available: https://www.fda.gov/media/144647/download

[16] Sensotec Australia, "Learning through play: How a mobile projector can do both," Sensotec Australia, 2025.

[17] Z. Zhang *et al.*, "Planning processing in ADHD with comorbid reading disorder," *Frontiers Pediatrics*, vol. 10, p. 898348, 2022.

[18] "Wearables in ADHD: Monitoring and intervention," *J. Develop. Psychol.*, vol. 45, no. 2, pp. 112–128, 2025.

[19] S. Inagaki *et al.*, "Interactive floor system makes tracks in encouraging playful learning," Kobe Univ. Res. Rep., 2021.

[20] Mantong Digital, "Interactive floor projection in education: Enhancing learning outcomes," Mantong Digital, 2025.

[21] JammaPark Solutions, "Projector setup solutions for floor & wall in immersive rooms," JammaPark Solutions, 2025.

[22] EyeClick, "How interactive floor games stimulate cognitive abilities," EyeClick, 2021.

Appendix A

Annexes

This annex presents the interaction scenarios and corresponding scripts used to demonstrate the Magic Room system. Each scenario illustrates a distinct interaction pattern and highlights the role of the therapist in guiding the activity.

A.1 Scenario 1 — Magic Forest: Narration & Visual Script

Overview. This scenario introduces the Magic Room through a sequence of short narrative scenes. Each scene combines a simple story prompt with tangram-based interactions and multisensory feedback (visual effects and sound cues).

Scene 1 — Welcome to the Magic Room

Suggested visual. Soft glowing blue background with text fading in: *"Welcome to the Magic Room! But everything is broken into pieces... Can you help me put it back together?"*
A completed bird tangram perched on a branch under a night sky with stars.
Narration (voice-over). *"Great job! You fixed the bird! Now she can flap her wings and fly high again."*
Animation / visual effects. Bird tangram flaps its wings and lifts into the sky.
Sound & music. Gentle flapping sound; uplifting short melody.

Scene 2—The Butterfly Awakens

Suggested visual. Tangram puzzle of a butterfly forming among flowers and sunlight.
Narration (voice-over). *"Look — the flowers are blooming! But something's miss-*

ing... who visits the flowers? Let's bring back the butterfly!"

Animation / visual effects. Tangram pieces appear one by one; butterfly flaps once complete.

Sound & music. Gentle *"ding"* sounds for each piece; happy fluttering sound at the end.

Scene 3—The Little Duck by the River

Suggested visual. Tangram puzzle of a duck forming near a bright blue river.

Narration (voice-over). *"By the river, a lonely duck waits. She wants to swim and splash again! Can you put her back together?"*

Animation / visual effects. Tangram pieces slide smoothly into place; duck quacks happily.

Sound & music. Soft water ripple sounds; playful music when finished.

Scene 4—The Little Fish in the River

Suggested visual. A small fish swims near the river water under shining sunlight; gentle ripples move across the surface.

Narration (voice-over). *"Down by the river, the water sparkles. But look — a little fish is missing! She wants to swim and play beneath the sun. Can you help her come back?"*

Animation / visual effects. Tangram pieces glide smoothly into the fish shape; when completed, the fish wiggles her tail and swims in circles.

Sound & music. Soft water bubbling and flowing sound; gentle harp tones; cheerful *"splash"* when finished.

Scene 5—The Bridge Across the River

Suggested visual. Pieces of a wooden bridge appear above the river, connecting two grassy sides; the fish swims underneath.

Narration (voice-over). *"The fish is happy now — but how will friends cross the river to visit her? Let's build a bridge to bring everyone together!"*

Animation / visual effects. Tangram pieces slide and lock to form a bridge; sparkles travel across as it completes; the fish passes beneath while a bird lands on top.

Sound & music. Wooden clacking sounds for each piece; warm ambient melody when the bridge is complete; flowing water and a soft *"connection"* chime.

A.2 Scenario 2 — The Sleeping Princess

Overview. This scenario follows a short narrative arc in which the child restores magic to a forest by completing a sequence of tangram puzzles. Each step unlocks the next part of the story through visual and sound feedback.

Scene 1 — The Gate of the Forest (Key)

Suggested visual. At the entrance of the castle, a golden gate is locked by a spell. A glowing outline indicates where the tangram key should be assembled.

Narration (voice-over). *"The gate is locked by a powerful spell. To enter the castle, we need to form the magic key to break the seal."*

Puzzle. Key tangram.

Animation / visual effects. Golden light gathers around the gate as pieces are placed; a brief unlocking animation plays on completion.

Sound & music. Soft magical hum during placement; a clear unlocking sound when completed.

Result. The gate opens, revealing a shining path into the castle.

Scene 2 — The Sleeping Spell (Bed)

Suggested visual. Inside the castle, the princess lies on a glowing bed, fast asleep. The bed tangram outline appears with a warm halo.

Narration (voice-over). *"Inside the castle, the princess is sleeping under a spell. Let's complete the bed so its light can help wake her up."*

Puzzle. Bed tangram.

Animation / visual effects. A warm glow intensifies with each correct placement; the bed softly pulses once complete.

Sound & music. Gentle lullaby in the background; subtle confirmation sound for each piece.

Result. The princess begins to stir as her magic slowly awakens.

Scene 3 — The Princess Awakens (Woman)

Suggested visual. The princess opens her eyes but cannot speak. A hopeful expression and a soft light emphasize she needs help.

Narration (voice-over). *"She's awake... but her voice is still lost. She looks at us with hope. Let's help her stand up."*

Puzzle. Woman (princess) tangram.

Animation / visual effects. The character silhouette becomes brighter and more defined as pieces are placed; a gentle rising motion appears when completed.

Sound & music. Gentle awakening chime upon completion.

Result. The princess stands and smiles silently—her voice is still missing.

Scene 4 — The Voice Tea (Teapot)

Suggested visual. A forest fairy appears and gestures toward a glowing teapot outline. Sparkles trail from the fairy to the puzzle area.

Narration (voice-over). *"A forest fairy whispers: 'Brew the magic tea... it will bring her voice back.' Let's build the teapot!"*

Puzzle. Teapot tangram.

Animation / visual effects. Soft sparkles appear with each piece; on completion, steam rises and a warm glow surrounds the teapot.

Sound & music. Bubbling tea sound; light sparkle tones; a soft "success" chime at the end.

Result. The princess drinks the tea and her voice returns. She thanks the player with a bright smile.

Scene 5 — The Return of the Light (Castle)

Suggested visual. The castle towers are dim under a shadowy spell. A large castle tangram outline appears, with the towers highlighted as the source of light.

Narration (voice-over). *"Now she remembers — the castle is still under the shadow of the spell. The towers can bring the light back to the forest. Let's rebuild the castle, piece by piece."*

Puzzle. Castle tangram.

Animation / visual effects. Golden light spreads gradually from the towers as the

puzzle is assembled; on completion, the entire scene brightens.

Sound & music. Warm, rising ambient melody; gentle "lock-in" sounds per piece; bright completion tone.

Result. The princess touches the glowing walls—the castle awakens, the forest shines, and the magic is restored.

Ending

Suggested visual. Sunlight fills the forest. The princess looks around with relief and joy.

Narration (voice-over). *"You brought the magic back to the forest!"*

Animation / visual effects. Soft sun rays and a final sparkle sweep across the scene.

Sound & music. Gentle celebratory flourish fading into calm ambient tones.

A.3 Scenario 3 — Luna the Cat Explorer

Overview. This scenario introduces a narrative-driven exploration experience in which the child accompanies Luna, a curious cat, across a set of animal-themed islands. Each island presents a tangram-based challenge that unlocks progression and reinforces engagement through positive multisensory feedback.

Introduction

Narration (voice-over). *"Meet Luna, the curious little cat who loves exploring new lands. One sunny morning, she finds a glowing map hidden under her bed. It leads to the Animal Islands, where every new friend has a puzzle to solve!"*

Suggested visual. Luna discovers a softly glowing map that reveals multiple small islands shaped like animals.

—

Scene 1 — The Cat's Discovery (Cat)

Suggested visual. Luna finds a mirror-shaped stone that reflects her silhouette. A tangram outline of a cat appears.

Narration (voice-over). *"Build your own shape — the Cat Explorer!"*

Puzzle. Cat tangram.

Animation / visual effects. The reflection aligns with the completed tangram; a soft glow surrounds Luna.

Sound & music. Gentle magical tone with a short confirmation chime.

Result. Luna becomes ready to begin her journey across the islands.

—

Scene 2 — The Rabbit's Race (Rabbit)

Suggested visual. A grassy island filled with carrots; a cheerful rabbit hops energetically nearby.

Narration (voice-over). *"If you can build me with your tangram pieces, I'll show you the way forward!"*

Puzzle. Rabbit tangram.

Animation / visual effects. The rabbit jumps playfully once the shape is completed.

Sound & music. Light hopping sounds; joyful laugh on completion.

Result. Luna receives her first clue—a shiny carrot-shaped key.

—

Scene 3 — The Bear's Cave (Bear)

Suggested visual. A dim cave interior where a large, friendly bear is sleeping.

Narration (voice-over). *"If you make my shape right, I'll wake up and share my honey!"*

Puzzle. Bear tangram.

Animation / visual effects. The bear stretches and yawns as the puzzle completes; warm light fills the cave.

Sound & music. Soft snoring fades into a gentle chuckle.

Result. The bear gifts Luna a pot of honey to support her journey.

—

Scene 4 — The Turtle's Bridge (Turtle)

Suggested visual. A wide river blocks the path; a wise turtle floats calmly near the water's surface.

Narration (voice-over). *"If you can build my tangram, I'll become your bridge!"*

Puzzle. Turtle tangram.

Animation / visual effects. The turtle glows softly and stretches across the river, forming a bridge.

Sound & music. Gentle water ripples; calm ambient tones.

Result. Luna crosses safely to the next island.

—

Scene 5 — The Kangaroo's Leap (Kangaroo)

Suggested visual. A bright island with cliffs; a cheerful kangaroo jumps high into the air.

Narration (voice-over). *"Can you build my tangram? I'll teach you how to jump across the cliffs!"*

Puzzle. Kangaroo tangram.

Animation / visual effects. The kangaroo demonstrates a high leap once completed.

Sound & music. Energetic bounce sound followed by a success chime.

Result. Luna learns how to leap forward and continue her adventure.

—

Ending

Suggested visual. All five animal friends gather together under a starry sky, sharing tea and honey.

Narration (voice-over). *"Adventure is more fun with friends!"*

Animation / visual effects. Soft star sparkles fade in as the scene settles.

Sound & music. Warm, calming melody fading gently to silence.

A.4 Scenario 4 — My Adventure with Shapes

Overview. This scenario places the child in a calm seaside environment where a sequence of animal-guided tangram challenges supports exploration, confidence-building, and emotional regulation. Each completed shape helps the player progress toward finding their way home.

Introduction

Narration (voice-over). *"You wake up on a quiet beach. The wind is soft, the sand is warm... but your boat is gone. To find your way home, you'll need help from the friends of the sea."*

Suggested visual. A peaceful beach scene with gentle waves, warm sand, and an empty shoreline where a boat should be.

—

Scene 1 — The Helpful Crab (Crab)

Suggested visual. A small crab moves in circles near the player's feet, waving its claws playfully.

Narration (voice-over). *"Can you build me with your tangram pieces?"*

Puzzle. Crab tangram.

Animation / visual effects. The crab claps happily once completed and points toward the shore.

Sound & music. Light clicking sounds; cheerful confirmation chime.

Result. The crab shows the player where the missing boat can be found.

—

Scene 2 — The Boat on the Shore (Boat)

Suggested visual. A broken boat rests on the sand, missing several pieces; a glowing tangram outline highlights the structure.

Narration (voice-over). *"If I fix the boat, maybe I can explore the sea!"*

Puzzle. Boat tangram.

Animation / visual effects. As pieces are placed, gentle waves begin to glow blue; the boat settles firmly into shape when completed.

Sound & music. Soft wave sounds; subtle build-up tone; clear completion sound.

Result. The repaired boat is ready to sail.

—

Scene 3 — The Clever Fox (Fox)

Suggested visual. A rocky island at sunset, with golden and pink tones in the sky; a fox watches curiously from the shore.

Narration (voice-over). *"You'll need a map to reach the lighthouse. Build me, and I'll show you the way."*

Puzzle. Fox tangram.

Animation / visual effects. The fox's tail glows as the puzzle completes, leaving luminous footprints across the waves.

Sound & music. Soft mystical tone; gentle guidance chime.

Result. A glowing path appears across the sea, indicating the correct direction.

—

Scene 4 — The Lighthouse of Light (Lighthouse)

Suggested visual. Night falls over the sea; a distant lighthouse stands dark and broken.

Narration (voice-over). *"It's hard to see in the dark... but I can fix the lighthouse and make the light shine again."*

Puzzle. Lighthouse tangram.

Animation / visual effects. A warm yellow light spreads outward from the lighthouse as the shape is completed, illuminating the surrounding water.

Sound & music. Low ambient hum rising into a calm, reassuring tone.

Result. The sea becomes visible again, creating a sense of safety and calm.

—

Scene 5 — The Horse of Return (Horse)

Suggested visual. A glowing path appears along the beach toward the horizon; a gentle horse waits nearby.

Narration (voice-over). *"You've done so well. Build me, and I'll take you home."*

Puzzle. Horse tangram.

Animation / visual effects. The horse neighs softly and begins to walk toward the sunrise once completed.

Sound & music. Gentle hoofbeats; warm farewell melody.

Result. The player rides safely toward home along the golden shore.

—

Ending

Suggested visual. The sea sparkles under the restored lighthouse light; the fox rests by the shore while the crab claps near the waves.

Narration (voice-over). *"You did it! You found your courage and your way home."*

Animation / visual effects. Soft reflections shimmer across the water as the scene fades.

Sound & music. Calm ocean ambience fading gently into silence.

A.5 Scenario 5—Inventors of the Sky

Overview. This scenario presents a thematic journey through key human inventions, highlighting how curiosity and imagination have driven scientific and technological progress. Each tangram puzzle represents a milestone in human development and is accompanied by a simple scientific concept and reflective message.

Introduction

Narration (voice-over). *"A long time ago, people dreamed of reaching the stars, seeing tiny worlds, and sharing music with one another. In this journey, you will discover great inventions that changed the world—and you will build them, piece by piece."*

Suggested visual. A calm, abstract background where silhouettes of different inventions slowly fade in and out, connected by a glowing path.

—

Scene 1—Rocket: The Dream of Space (Rocket)

Suggested visual. A rocket stands against a deep blue sky filled with stars and distant planets.

Narration (voice-over). *"People have always looked up at the sky and wondered what lies beyond the stars. The rocket helped us explore space, travel to the Moon, and learn more about our universe."*

Puzzle. Rocket tangram.

Scientific idea. Space exploration, planets, gravity.

Message. *"Curiosity takes us beyond limits."*

Animation / visual effects. A soft glow surrounds the rocket; stars shimmer gently once completed.

Sound & music. Low ambient space tone with a subtle lift-off chime.

—

Scene 2—Helicopter: The Power to Hover (Helicopter)

Suggested visual. A helicopter silhouette hovers above a landscape, slowly rotating its blades.

Narration (voice-over). *"After learning to fly forward with airplanes, humans imagined a new way to move — upward, and even staying still in the air. That dream became the helicopter."*

Puzzle. Helicopter tangram.

Scientific idea. Rotor lift, control, and aerodynamics.

Message. *"Every new invention begins when we imagine a new way to move."*

Animation / visual effects. Rotor blades begin to spin smoothly after completion.

Sound & music. Gentle rotor sound fading into a calm ambient tone.

—

Scene 3 — Plane: The Power of Flight (Plane)

Suggested visual. An airplane glides through a bright sky, connecting distant cities below.

Narration (voice-over). *"For thousands of years, humans dreamed of flying like birds. With the airplane, cities, countries, and families became connected."*

Puzzle. Plane tangram.

Scientific idea. Aerodynamics and engineering.

Message. *"Dreams give us wings."*

Animation / visual effects. The plane moves steadily across the sky once assembled.

Sound & music. Soft wind sound; gentle success chime.

—

Scene 4—House: Building Our World (House)

Suggested visual. A house appears in a peaceful environment, gradually evolving from a simple shelter to a modern structure.

Narration (voice-over). *"Shelter was one of the first human inventions—a way to feel safe and build a home. From caves to cities, we learned how to create places to live together."*

Puzzle. House tangram.

Scientific idea. Architecture, design, and sustainability.

Message. *"Every invention starts with the need to feel safe."*

Animation / visual effects. Warm light appears in the windows of the house.

Sound & music. Soft, comforting ambient tones.

—

Scene 5—Tree: The Breath of Life (Tree)

Suggested visual. A large tree stands at the center of the scene, its leaves gently moving in the wind.

Narration (voice-over). *"Before rockets and machines, there were trees—giving us air, shelter, and life. They remind us that every creation must live in balance with nature."*

Puzzle. Tree tangram.

Scientific idea. Photosynthesis, ecology, and environmental balance.

Message. *"Every creation must live in harmony with nature."*

Animation / visual effects. Leaves softly sway; light filters through the branches.

Sound & music. Gentle wind and nature ambience.

—

Ending

Suggested visual. All inventions fade into a single glowing path leading forward.

Narration (voice-over). *"From rockets to homes, every invention began with one thing—curiosity."*

Animation / visual effects. The path slowly fades into light.

Sound & music. A soft inspirational melody fading gently to silence.

Appendix B

Therapist Application Mockups

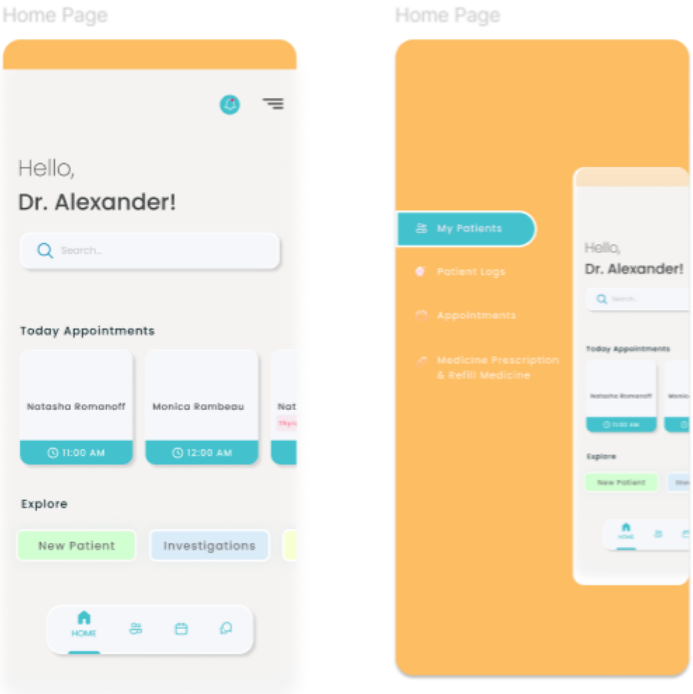


Figure B.1: Authentication and home dashboard screens of the therapist application.

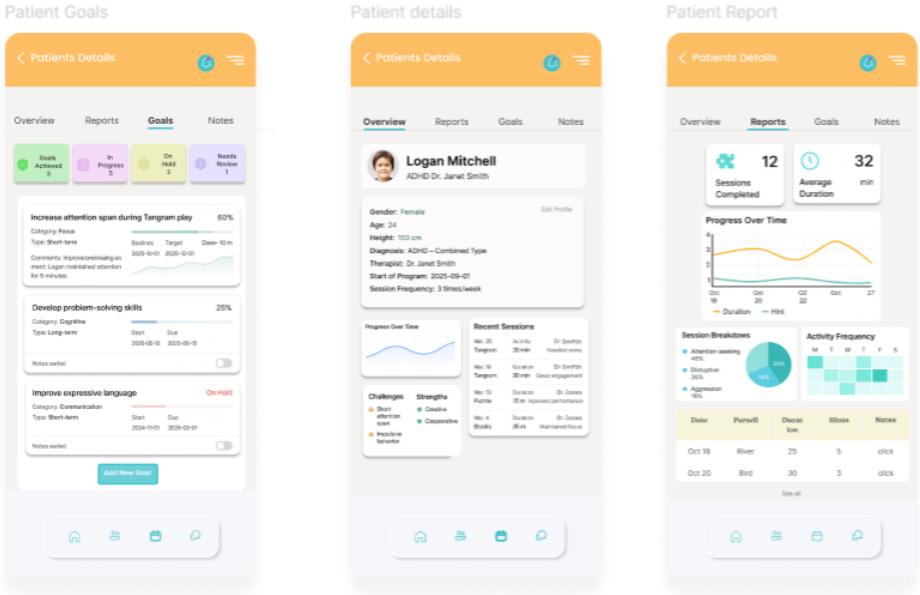


Figure B.2: Patient overview, goals, and reports screens used for monitoring therapy progress.

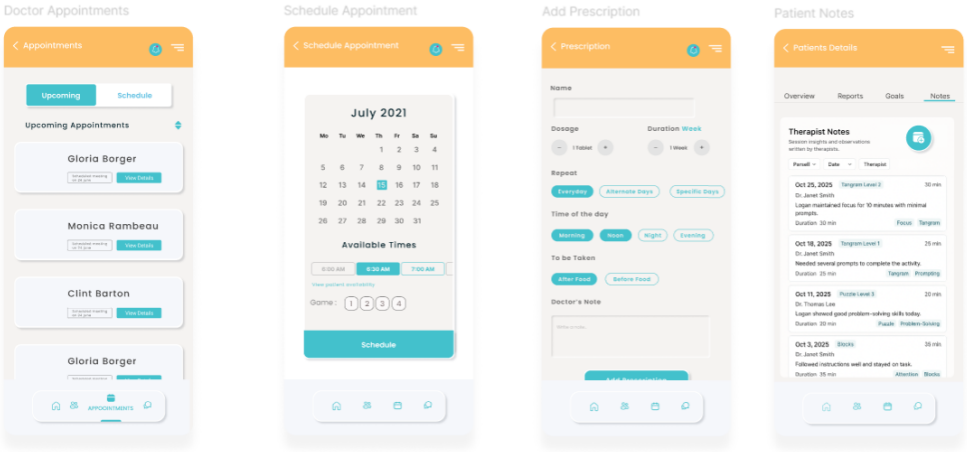


Figure B.3: Appointment scheduling, prescription management, and therapist notes interfaces.