המכללה האקדמית להנדסה בכרמיאל
בראודה

MATH LEARNING QUEST

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INTRODUCTION

This project aims to enhance math education for students aged 12-15 using Augmented Reality (AR) and gamification. The goal is to create an interactive and engaging environment where students can solve math problems through AR-based games.

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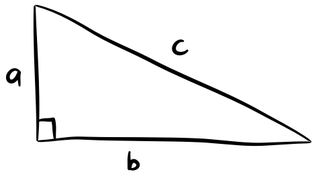
PROBLEM DEFINITION

- Many students find abstract mathematical concepts hard to grasp.
- Traditional teaching methods do not provide enough interaction or practical visualization.
- Students often lack motivation in subjects like math, leading to disengagement.



$a^2 + b^2 = c^2$

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GAMIFICATION

- Gamification is the application of game-like elements in non-game contexts to increase engagement and motivation.

- Key Gamification Elements in Our Project:
  - Points: Earned by solving math problems.
  - Badges: Awarded for completing stages or achieving milestones.
  - Leaderboards: Allow students to compare their progress with peers.

- Increases student motivation.
- Enhances learning outcomes by making learning interactive and fun.
- Promotes active participation.

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EXISTING SOLUTIONS

	Online	Free	AR	Visoualiztaion	Gamification
Khan Academy	V	V	X	V	X
AXIS LEARNING	V	X	X	V	X
AXIS COMMUNICATIONS	X	X	X	V	X

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OUR SOLUTION

- An AR-based math game where students interact with their physical environment. The user will scan a surface (table, wall, or sheet of paper), and buildings will appear as holograms. This makes the game feel like part of the real world.
- Gamification elements such as levels, rewards, and progress tracking to keep students motivated.
- Real-time feedback to help students improve and build confidence in their math skills.

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AUGMENTED REALITY

How We Use AR in Math Learning Quest?

✅ Real-World Interaction

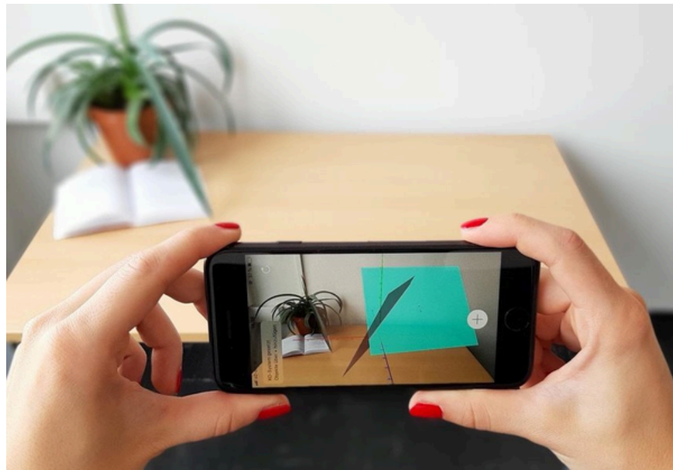
- Permanent anchoring of the buildings on the scanned surface
- Each building represents a different math operation (addition, subtraction, etc.)

✅ Gamified Learning Experience

- Players solve math problems to move elevators between floors.
- Hand gestures control interactions instead of buttons.

✅ Real-Time Feedback & Engagement

- Immediate visual and interactive responses to answers.



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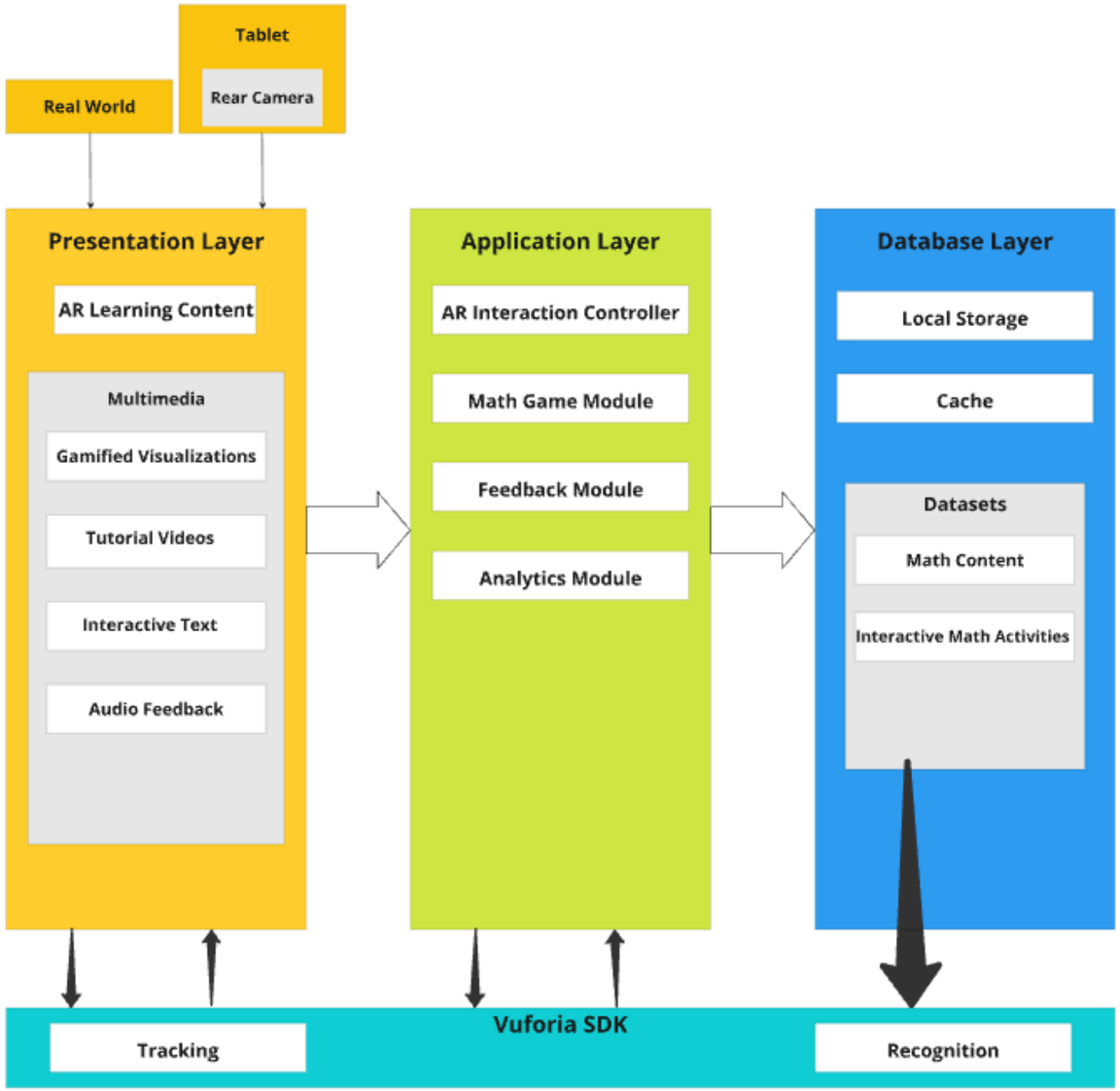
ARCHITECTURE OF THE SYSTEM



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FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

Functional Requirements:

- Scanning and displaying the game area: The user scans a physical surface, and the buildings appear as holograms.
- Elevator control using hand gestures or objects: Instead of clicking buttons, players can move their hands to control the elevator.
- Interactive feedback to solved exercises: When a student solves a math problem correctly, the elevator moves within the real-world AR environment.

Non-Functional Requirements:

- Performance: Response time should be under 50ms for smooth interactions.
- Usability: Interface should be intuitive with multilingual support.
- Security: User data must be encrypted and stored securely.

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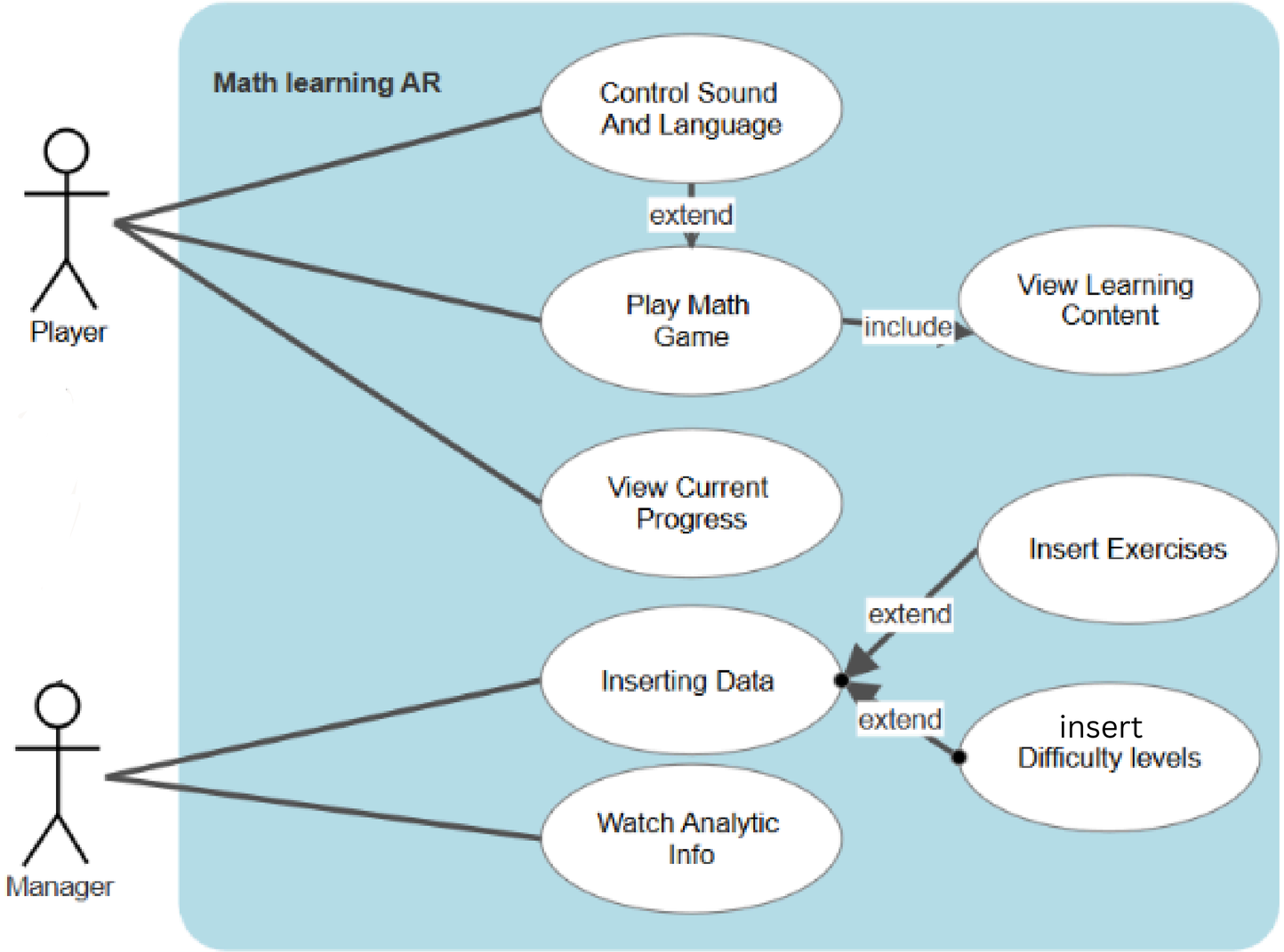
USE CASE DIAGRAM



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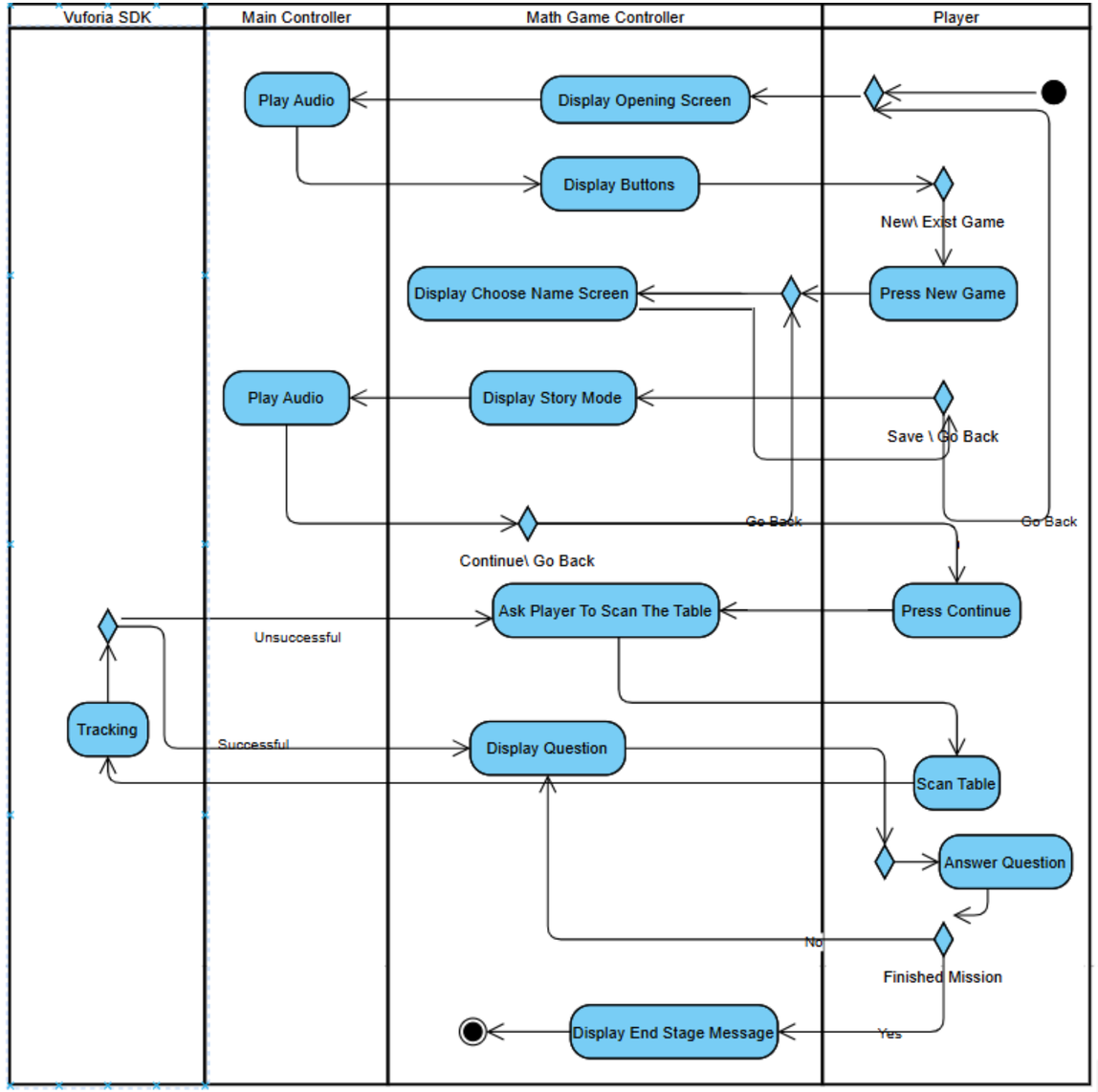
ACTIVITY DIAGRAM



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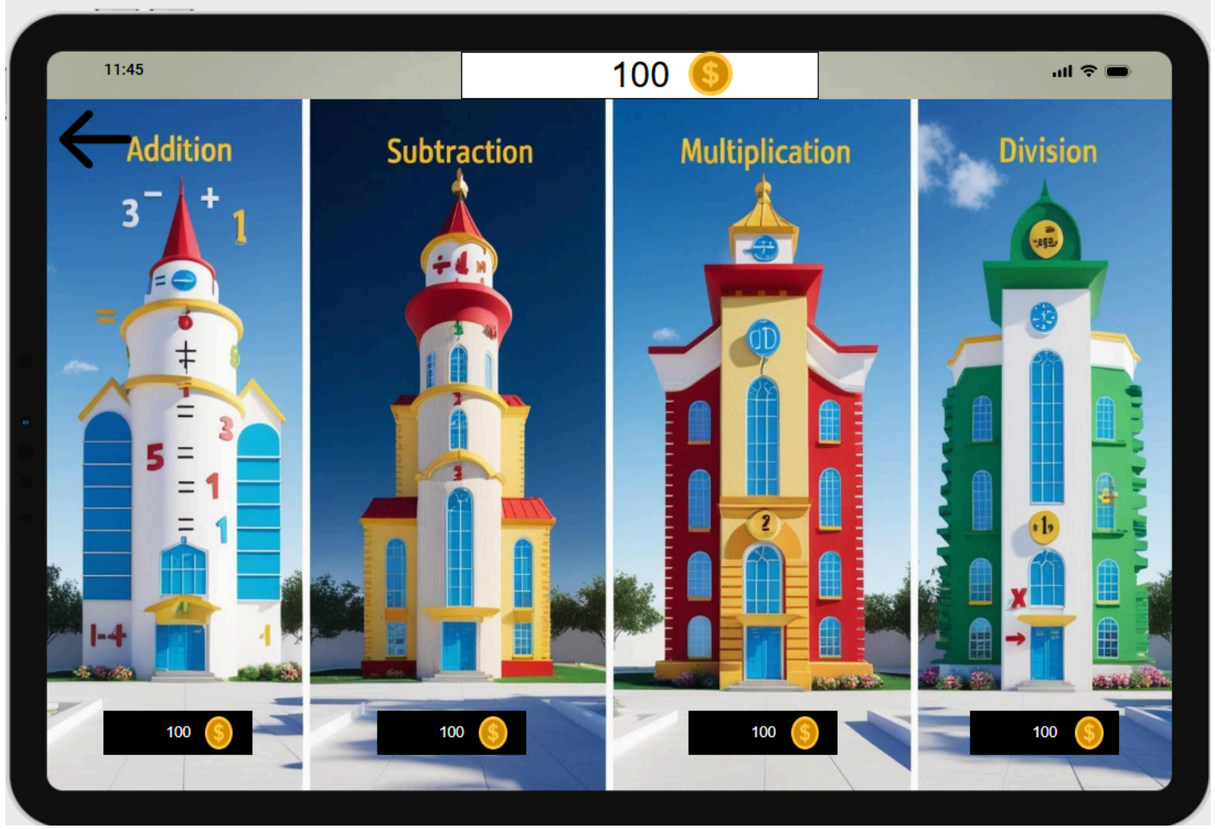
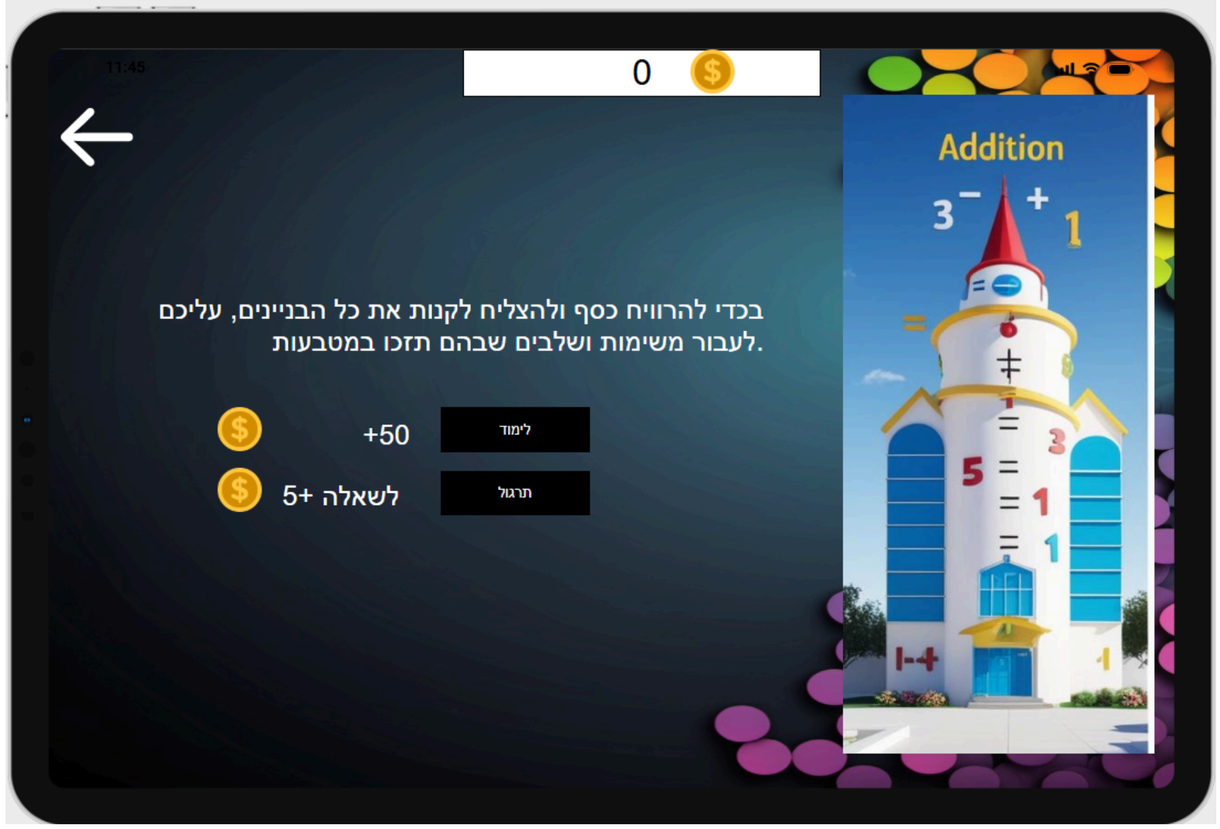
APP ILLUSTRATION





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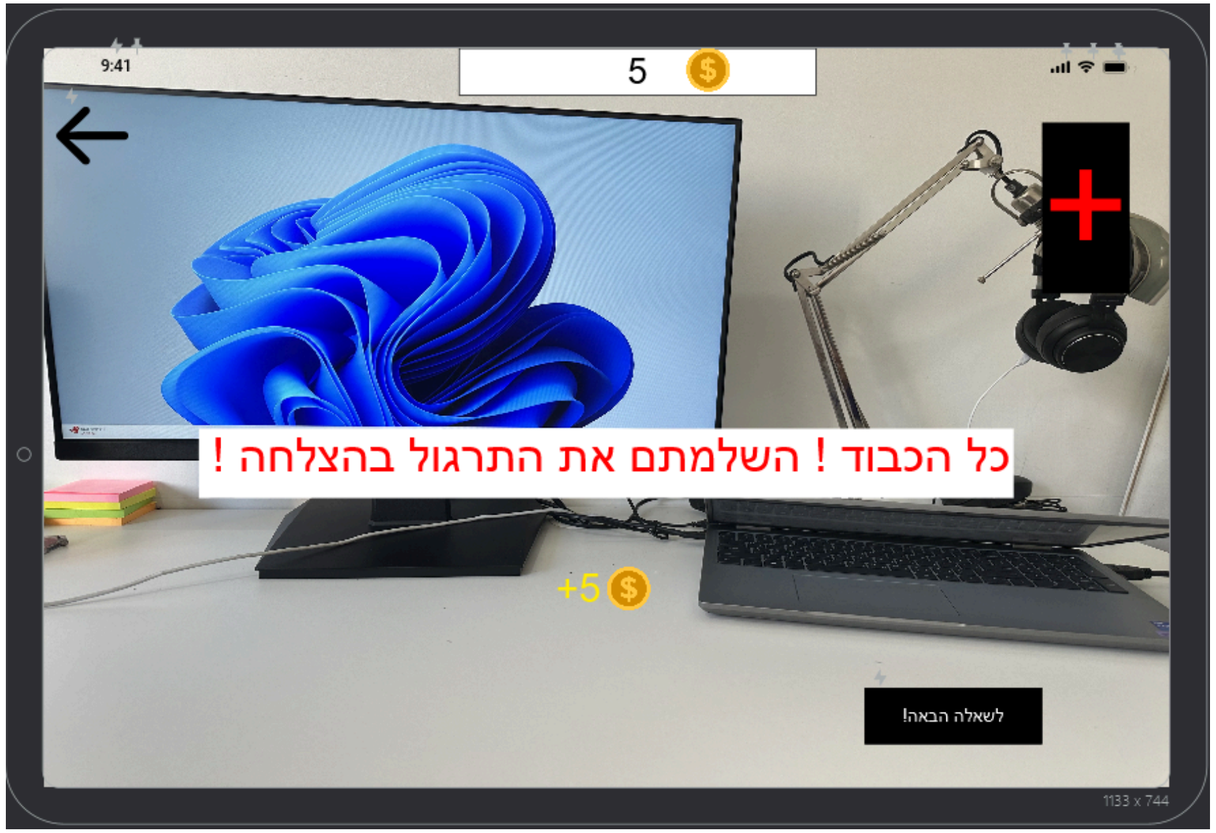

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CHALLENGES IN THE DEVELOPMENT

- TRACKING ACCURACY FOR AR OBJECTS.
- USER ENGAGEMENT: ENSURING THE GAME REMAINS INTERESTING AND MOTIVATING.
- ENHANCING AR STABILITY AND OBJECT RECOGNITION.
- EXPANDING THE CONTENT TO COVER A WIDER RANGE OF MATH PROBLEMS.
- FAST RESPONSE TIME

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CONCLUSION

- THE GAME HAS EVOLVED BEYOND TRADITIONAL MATH LEARNING INTO AN INTERACTIVE AR EXPERIENCE. BY SCANNING SURFACES TO DISPLAY HOLOGRAPHIC BUILDINGS, USING HAND GESTURES FOR ELEVATOR CONTROL, AND INTEGRATING REAL-TIME ANIMATIONS FOR SOLVED EXERCISES, THE GAME PROVIDES A COMPLETELY NEW WAY TO ENGAGE STUDENTS IN MATHEMATICS.

- FUTURE GOALS:
- EXPAND TO MORE SUBJECTS.
- IMPROVE APP ACCESSIBILITY AND PERFORMANCE.

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Q&A?