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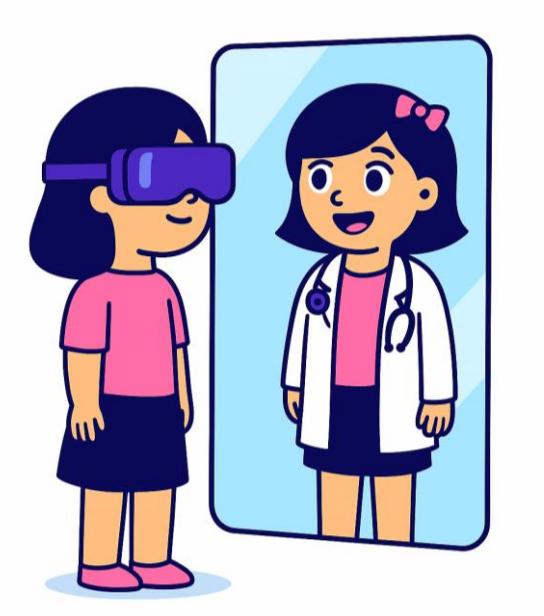

IT423

Introduction to IT project management

ROLETOPIA

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1. Introduction

Children's education and entertainment have rapidly evolved with the advent of innovative technologies such as virtual reality (VR). VR has radically changed the way people learn and interact. Meanwhile, children between the ages of 8 and 12 are spending more time playing video games that focus on fun and competition but often offer no real educational benefits.[1] This has created a gap; children engage in digital gaming for hours without learning important life skills such as teamwork, problem-solving, and responsibility.

The fundamental problem this project addresses is the imbalance between traditional education, which is often theoretical and lacks interaction, and modern video games, which offer fun but rarely build real-life skills. As a result, children miss out on the opportunity to simulate real-life responsibilities in a safe and fun environment.

Our technology solution seeks to bridge this gap by integrating technology to enhance the learning experience. It aligns with modern trends, helps prepare future generations with essential skills, and provides a way for parents and teachers to combine education and entertainment.

This document is divided into three main sections: the Introduction, the Project Initiation (including project description, requirements, dates, and duration), and the Project Scope (covering the scope management plan, requirements management plan, functional and non-functional requirements, scope statement, Work Breakdown Structure (WBS), and WBS dictionary).

2. Project Initiation

2.1. Project Detailed Description

- Problem

In our fast-paced digital world, children spend a lot of time playing video games, which often fail to develop essential life skills such as teamwork, problem-solving, and responsibility. In contrast, traditional education faces significant challenges in engaging children; it remains largely theoretical and doesn't provide enough opportunities to apply what they learn in real-life situations. This discrepancy directly hinders the growth of their skills and the development of their practical abilities.

While some educational programs have sought to be more interactive, they often lack excitement and don't adequately leverage modern technologies capable of capturing children's attention. Hence, the need for an innovative platform based on virtual reality, providing a safe learning environment that combines fun and practical experience, helps children acquire essential life skills in an engaging and effective manner.

- Application solution

"**Roletopia**" is an innovative virtual reality platform that aims to connect education with play in a fun, interactive, and engaging way. It offers children two play options within a shared virtual city: solo play, where the child explores the environment on their own, assumes different roles, and completes tasks independently, which fosters responsibility, self-reliance, and self-determination. Or group play, where children collaborate to complete interconnected tasks that require coordination and teamwork, such as a firefighter putting out a fire before a doctor can treat patients, or a team preparing passengers before a pilot takes off.

To enhance motivation and retention, "**Roletopia**" relies on a simple points-based reward system. Children earn points for making the right decisions or completing tasks, which enhances engagement and encourages positive behavior. By combining fun and responsibility, the platform provides a safe environment that allows children to experiment, learn, and grow, while acquiring essential life skills such as cooperation, problem-solving, and decision-making.

Ultimately, "**Roletopia**" is more than just a game; it's a cutting-edge educational tool that blends entertainment and learning, preparing children to face real-world challenges with confidence, creativity, and team spirit.

- Application Type

- VR Application

2.2. Project Requirements

- Software tools

- **Unity:** A 3D and Virtual Reality (VR) game engine designing and developing the game world.
- **Visual Studio Code:** An integrated development environment (IDE) for writing code in C#.
- **Blender:** free, open-source software for designing 3D models and environments.
- **GitHub:** A platform for managing code versions and collaboration among team members.
- **Google Forms/Microsoft Forms:** For gathering user requirements from parents, teachers, and children.
- **Figma:** For designing the user interface (UI) and user experience (UX) elements within the game.
- **Trello / Jira:** For managing project tasks and tracking progress.

- **Microsoft Word**: Used for documenting requirements, reports, and project deliverables.
- **Project Plan 365**: Utilized for creating Gantt charts, network diagrams, and managing project timelines.
- **Android Emulator**: Enables testing and debugging of the mobile version of the application on virtual Android devices.

- Hardware tools

- **High-performance computers/laptops:** To run development software like Unity and Visual Studio Code.
- **Servers:** To host the virtual world and support multiplayer functionality.

- **VR headsets:** To test the user experience (e.g., Oculus Quest or HTC Vive).
- **Stable internet connection:** To facilitate communication between players.
- **Network Devices**: Includes routers and switches to simulate multiplayer connectivity and ensure stable communication between players.

2.3. Project Dates and Duration

Start	End	Duration
25 September 2025	25 March 2026	6 Months

TABLE 1: PROJECT DATES AND DURATION

3. Project Scope

3.1. Scope management plan

The Scope Management Plan for the "**Roletopia**" project outlines the processes and strategies for defining, managing, and controlling the project's scope. The primary objective is to ensure that all necessary work required to achieve the project goals is clearly identified and systematically executed, while avoiding unnecessary expansion beyond the agreed scope.

To define the project scope, a structured approach will be taken to gather, document, and categorize requirements. This process will include direct consultations with key stakeholders, such as parents, teachers, and the children themselves, to ensure the project remains aligned with educational objectives and user needs. Through analysis and validation, the scope will be refined to ensure clarity and feasibility. A prioritization framework will be implemented to ensure that the most critical aspects of the project are addressed first, incorporating criteria for evaluating and ranking key elements based on impact, resource availability, and alignment with overall project goals. This method helps balance priorities while maintaining efficiency within the project timeline and constraints.

To structure and organize tasks effectively, a Work Breakdown Structure (WBS) will be developed. Using a Top-down approach, the WBS will divide the project into smaller, well-defined components, ensuring that responsibilities are clearly distributed. This breakdown will facilitate structured progress tracking and help maintain focus throughout the development process.

Scope verification will be carried out regularly to ensure that deliverables align with predefined requirements. This will involve engaging stakeholders **(**including children in user testing sessions**)** in the validation process to confirm that output meets expectations and quality standards. Each delivery will undergo formal acceptance, with appropriate documentation, including signatures from stakeholders to confirm compliance with project objectives.

To regulate scope adjustments, a formal change control process will be established. This process will define how change requests are submitted, reviewed, and either approved or

rejected. Each request will be recorded in a change request form detailing its nature and potential impact on the project timeline, budget, and resources. The project manager, in collaboration with stakeholders, will assess these requests to ensure they align with project objectives and maintain focus. A structured evaluation will help maintain project focus and avoid unnecessary deviations while ensuring that approved changes are effectively integrated without disrupting the overall workflow.

3.2. Requirements Management plan

The "**Roletopia**" Project Requirements Management Plan outlines how requirements will be identified, documented, monitored, and controlled to ensure the app's successful implementation. This plan provides a systematic structure that ensures all requirements are aligned with the project objectives and meets the expectations of stakeholders, including children, parents, and teachers.

Initially, requirements will be gathered using structured methods, such as interactive workshops, targeted interviews, and observations of children's digital learning and gaming habits. These methods ensure the project team gains accurate insights into children's motivations, considering the educational goals highlighted by parents and teachers. After gathering requirements, they will be carefully analyzed and recorded in a consolidated document that is subject to periodic review, ensuring continuous alignment with the evolving needs of stakeholders.

Requirements tracking will be supported using a Requirements Traceability Matrix (RTM), which identifies each requirement from its initial definition through design, development, and implementation. This method reduces the possibility of missing key requirements and ensures that each requirement is directly linked to the project's defined deliverables. Additionally, a prioritization framework will be implemented to distinguish high-value features, such as role-based collaborative tasks, from secondary features that can be added later.

Change management will also be a vital component of this plan. Any modification to requirements will be managed through a structured approval process, maintaining the integrity of the project scope while allowing for necessary flexibility. Product evaluation metrics will also be implemented to assess the effectiveness of the implemented solution in

meeting functional and non-functional requirements. By adopting these structured requirements management plan, the project team can maintain a clear, traceable, and monitorable path from requirements gathering to project completion, ultimately ensuring that the application achieves its educational and entertainment objectives.

3.3. Main functional and non-functional requirements

Functional requirements:

1. Users should be able to create and customize their own avatar.
2. Users should be able to choose a professional role from a predefined list of roles such as doctor, firefighter, pilot, teacher, and police officer.
3. Users should be able to interact and communicate with other players in a shared virtual world, working together and collaborating in real time.
4. Users should be able to participate in cooperative missions that connect different roles, allowing them to complete shared tasks and develop teamwork skills.
5. Users should earn points for completing tasks correctly, and as they level up by reaching higher point thresholds, they will receive rewards within the game — such as unlocking new items, tools, or customization options for their avatars.
6. User shall be able to choose between VR mode or mobile mode.
7. Users should be able to join an existing group play session (room).
8. Users should be able to create a new group play session (room) and invite other players to join.
9. Users should receive in-game guidance or instructions to help them understand the roles.
10. Parents and teachers should receive periodic reports about the child's performance, including earned points, completed tasks, and overall progress in the game.

Non-Functional requirements:

- Usability: The interface is user-friendly and suitable for children aged 8 to 12, with specific icons and colours.
- Performance: The system must respond quickly (within 2 seconds between broadcasts and events).

- Security and Safety: The system should protect children's data through secure authentication, encrypted communication, and restricted access to authorized users only, ensuring no external unauthorized connections.
- Compatibility: The app must run on IOS and Android platforms with support for popular virtual reality headsets.
- Scalability: The platform should be able to support at least 500 concurrent players without performance degradation.

3.4. Scope Statement

Scope Description	The "**Roletopia**" project will deliver an interactive Virtual Reality (VR) and mobile platform designed for children aged 8 to 12. The system allows children to create avatars, take on real-life roles (e.g., doctor, firefighter, pilot, teacher, shopkeeper), and collaborate in shared missions that promote teamwork, problem-solving, and responsibility. Points and rewards will be integrated to encourage engagement and skill development. The project scope excludes advanced AI-driven features, integration with external VR platforms beyond supported devices, and any content not suitable for children.
Project Deliverables	The project will provide a fully functional VR and mobile application that supports multiplayer collaboration, customizable avatars, and interconnected role-based missions. It will include a points and rewards system, as well as a reporting feature for parents and teachers to monitor children's performance. The system will also deliver a secure backend infrastructure and a user-friendly interface appropriate for children.
Acceptance Criteria	The project will be considered successful when children can register, create avatars, choose roles, and participate in interactive missions that require teamwork. The system must accurately assign points and rewards, generate performance reports for parents and teachers, and run smoothly on VR headsets and mobile devices. Additionally, it must comply with data protection and safety regulations for children while ensuring a seamless user experience.

Project Constraints	The development of the project is limited to a six-month duration (25 September 2025 – 25 March 2026). It requires access to VR headsets such as Oculus Quest or HTC Vive, compatible mobile devices, and a stable internet connection to support multiplayer features. Furthermore, the project must comply with data security and child-safety regulations, while remaining within the specified functional and non-functional requirements.
Project Assumptions	It is assumed that children will have access to VR headsets or mobile devices and stable internet connections. Parents and teachers are expected to cooperate by providing feedback during testing and by using the reporting system to monitor performance. The project team is assumed to have access to the necessary software, hardware, and VR platforms required for development and testing.

TABLE 2: SCOPE STATMENT

3.5. WBS

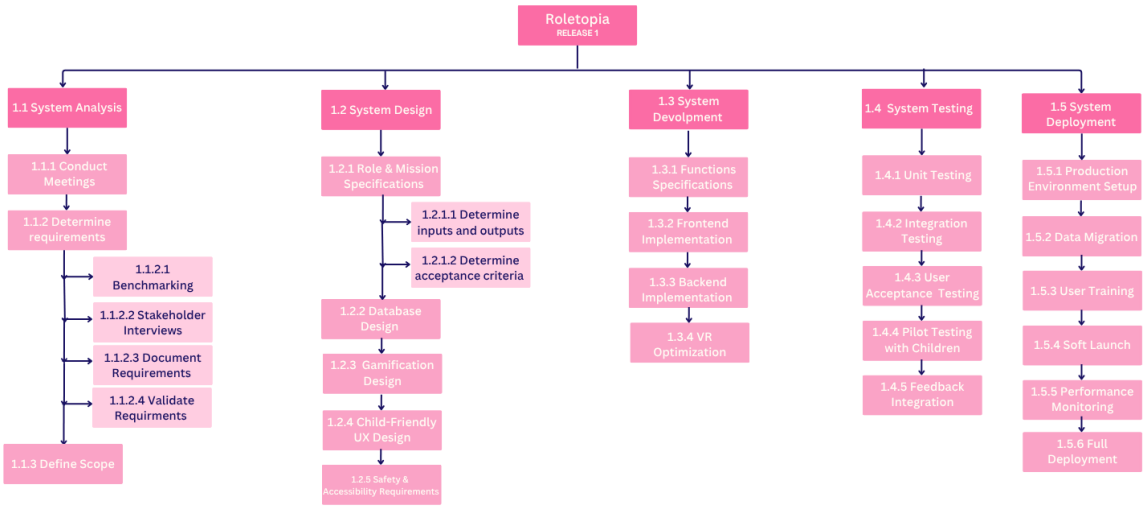

FIGURE 1: WBS CHART

3.6. WBS dictionary

WBS Dictionary
Project Title: Roletopia
WBS item number: 1.1.1
WBS item name: Conduct Meetings
Description: Organize and facilitate internal meetings with project team members, including developers, educators, designers, and project managers, to align on goals, clarify requirements, and ensure shared understanding of the platform's educational and technical direction. These meetings will help coordinate tasks, resolve issues, and maintain progress across all phases of development.

TABLE 3: WBS DICTIONARY 1.1.1

WBS Dictionary
Project Title: Roletopia
WBS item number: 1.1.3
WBS item name: Define Scope
Description: Identify and document the project's objectives, deliverables, boundaries, and key requirements to establish a clear understanding of what will and will not be included in the Roletopia platform. This process involves collaborating with stakeholders, educators, and the development team to determine functional features, educational outcomes, and technical constraints. The defined scope will serve as the foundation for planning, execution, and change control throughout the project lifecycle.

TABLE 4: WBS DICTIONARY 1.1.3

WBS Dictionary
Project Title: Roletopia
WBS item number: 1.2.4
WBS item name: Child-Friendly UX Design
Description: Design a user interface that is intuitive and visually appealing for children aged 8 to 12. The UX must include age-appropriate icons, colors, and navigation patterns to ensure ease of use and accessibility across devices. The design must also support in-game guidance and instructions.

TABLE 5: WBS DICTIONARY 1.2.4

WBS Dictionary
Project Title: Roletopia
WBS item number: 1.3.3
WBS item name: Backend Implementation
Description: Develop the server-side infrastructure to support multiplayer interaction, user account management, and secure data handling for the VR application. This includes setting up a scalable database to store user profiles, mission progress, and rewards; building APIs to manage communication between the VR client and server; and implementing real-time networking to enable group sessions and role coordination. The backend must ensure fast response times, data protection, and seamless performance within the VR environment.

TABLE 6: WBS DICTIONARY 1.3.3

WBS Dictionary
Project Title: Roletopia
WBS item number: 1.4.4
WBS item name: Pilot Testing with Children
Description: Conduct supervised testing sessions with children aged 8 to 12 to evaluate the VR application's usability, engagement, and clarity of role-based missions. Observation will focus on how children interact with the VR app—how they navigate the interface, understand instructions, complete tasks, and collaborate with others in multiplayer scenarios. Feedback will be collected through structured forms, verbal input, and behavioral observation, and used to refine gameplay mechanics, mission flow, and interface design before final release.

TABLE 7: WBS DICTIONARY 1.4.4

4. Project Planning (WBDS Table)

The following table illustrates "**Roletopia's**" work breakdown structure (WBS). In our analysis, we assume employees adhere to a standard work schedule of 8 hours per day, 5 days per week.

Phase Name	Start Date	End Date	Duration	Qualifications	Tools	Deliverables
1.1 System Analysis	25/09/2025	19/10/2025	25 days	System Analyst, Stakeholder, Educational Consultant	Google Forms, Microsoft Forms, Trello, Jira	Requirements Document, Stakeholder Interviews Report, Scope Definition, Benchmarking Report
1.2 System Design	20/10/2025	26/11/2025	38 days	System Architect, UI/UX Designer, VR Specialist, Game Designer	Figma, Blender, Unity	Role& Mission Specifications, Database Design, Gamification Design, Child-Friendly UX Design
1.3 System Development	27/11/2025	15/01/2026	50 days	Unity Developer, C# Developer, Backend Developer, 3D Modeler, VR Developer	Unity, Visual Studio Code, Blender, GitHub	Frontend Implementation (VR App), Backend Implementation, VR Optimization
1.4 System Testing	16/01/2026	24/02/2026	40 days	QA Tester, Child Development Specialist,	Unity, VR Headsets (Oculus	Unit Testing Report, Integration Testing Report, Pilot Testing with

				Teachers, Parents	Quest/HTC Vive), Jira	Children, Feedback Integration
1.5 System Deployment	25/02/2026	23/03/2026	27 days	DevOps Engineer, System Administrator, Trainer, Support Specialist	AWS/Azure, Docker, Kubernetes, Monitoring Tools, Training Materials	Production Environment Setup, Data Migration Report, User Training Materials, Soft Launch Report, Performance Monitoring Dashboard, Full Deployment Documentation

TABLE 8: WBDS TABLE

5. Technical Outcomes and Charts

In this section, we used Project Plan 365 to display the network diagram, Gantt chart, timeline, task allocation table, and task dependency table.

5.1. Network Diagram with critical path

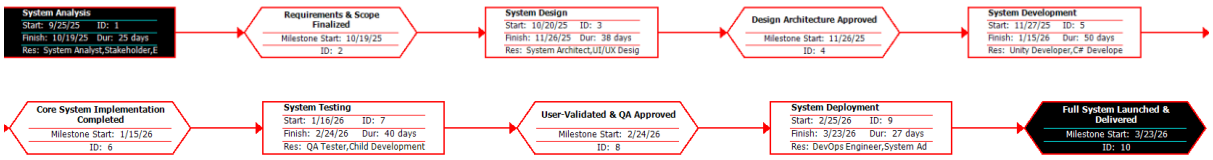

FIGURE 2:NETWORK DIAGRAM WITH CRITICAL PATH

• Critical Path and Milestone

The network diagram presents a complete view of the project lifecycle, consisting of ten sequential phases that begin with system analysis and conclude with the delivery of the new UI and deactivation of the old system. The critical path includes System Analysis, System Design, System Development, System Testing, and Final Delivery—each representing a vital stage that directly influences the project's success and timely completion. Every phase marks a strategic shift in progress, while each milestone reflects the achievement of a major deliverable such as finalized requirements, approved designs, or production deployment. These milestones serve as checkpoints for quality assurance and ensure the project transitions smoothly and confidently from one stage to the next.

5.2. A complete Gantt Chart

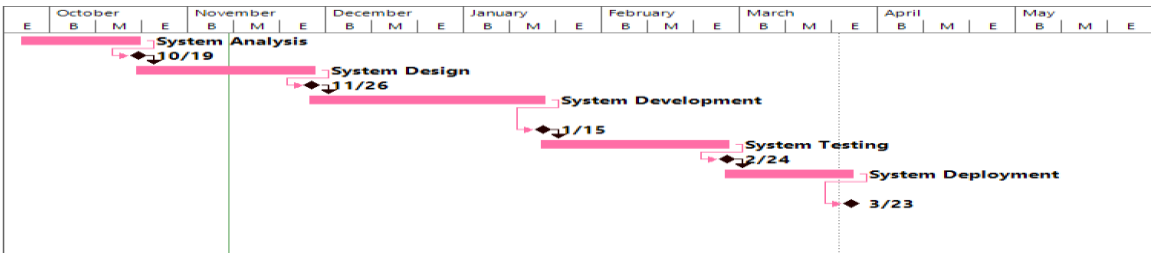

FIGURE 3: GANTT CHART

5.3. Project Timeline

Task Name	Duration	Start	Finish	Work	Predecessor	Resource Names	% Complet
System Analysis	25 days	Thu 9/25/25 8:00 AM	Sun 10/19/25 5:00 PM	600 hrs		System Analyst, Stakeholder, I	0%
Requirements & Scope Finalized	0 days	Sun 10/19/25 5:00 PM	Sun 10/19/25 5:00 PM	0 hrs	1		0%
System Design	38 days	Mon 10/20/25 8:00 AM	Wed 11/26/25 5:00 PM	1,216 hrs	2	System Architect, UI/UX Desig	0%
Design Architecture Approved	0 days	Wed 11/26/25 5:00 PM	Wed 11/26/25 5:00 PM	0 hrs	3		0%
System Development	50 days	Thu 11/27/25 8:00 AM	Thu 1/15/26 5:00 PM	2,000 hrs	4	Unity Developer, C# Develope	0%
Core System Implementation Completed	0 days	Thu 1/15/26 5:00 PM	Thu 1/15/26 5:00 PM	0 hrs	5		0%
System Testing	40 days	Fri 1/16/26 8:00 AM	Tue 2/24/26 5:00 PM	1,280 hrs	6	QA Tester, Child Development	0%
User-Validated & QA Approved	0 days	Tue 2/24/26 5:00 PM	Tue 2/24/26 5:00 PM	0 hrs	7		0%
System Deployment	27 days	Wed 2/25/26 8:00 AM	Mon 3/23/26 5:00 PM	864 hrs	8	DevOps Engineer, System Adn	0%
Full System Launched & Delivered	0 days	Mon 3/23/26 5:00 PM	Mon 3/23/26 5:00 PM	0 hrs	9		0%

FIGURE 4: PROJECT TIMETABLE

5.4. Task allocation schedule

Task Name	Duration	Start	Finish	Work	Predecessor	Resource Names	% Complet
System Analysis	25 days	Thu 9/25/25 8:00 AM	Sun 10/19/25 5:00 PM	600 hrs		System Analyst, Stakeholder, I	0%
Requirements & Scope Finalized	0 days	Sun 10/19/25 5:00 PM	Sun 10/19/25 5:00 PM	0 hrs	1		0%
System Design	38 days	Mon 10/20/25 8:00 AM	Wed 11/26/25 5:00 PM	1,216 hrs	2	System Architect, UI/UX Desig	0%
Design Architecture Approved	0 days	Wed 11/26/25 5:00 PM	Wed 11/26/25 5:00 PM	0 hrs	3		0%
System Development	50 days	Thu 11/27/25 8:00 AM	Thu 1/15/26 5:00 PM	2,000 hrs	4	Unity Developer, C# Develope	0%
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System Testing	40 days	Fri 1/16/26 8:00 AM	Tue 2/24/26 5:00 PM	1,280 hrs	6	QA Tester, Child Development	0%
User-Validated & QA Approved	0 days	Tue 2/24/26 5:00 PM	Tue 2/24/26 5:00 PM	0 hrs	7		0%
System Deployment	27 days	Wed 2/25/26 8:00 AM	Mon 3/23/26 5:00 PM	864 hrs	8	DevOps Engineer, System Adn	0%
Full System Launched & Delivered	0 days	Mon 3/23/26 5:00 PM	Mon 3/23/26 5:00 PM	0 hrs	9		0%

FIGURE 5:PROJECT TASK ALLOCATION

5.5. Task dependencies table

Task Name	Duration	Start	Finish	Work	Predecessor	Resource Names	% Complet
System Analysis	25 days	Thu 9/25/25 8:00 AM	Sun 10/19/25 5:00 PM	600 hrs		System Analyst, Stakeholder, I	0%
Requirements & Scope Finalized	0 days	Sun 10/19/25 5:00 PM	Sun 10/19/25 5:00 PM	0 hrs	1		0%
System Design	38 days	Mon 10/20/25 8:00 AM	Wed 11/26/25 5:00 PM	1,216 hrs	2	System Architect, UI/UX Desig	0%
Design Architecture Approved	0 days	Wed 11/26/25 5:00 PM	Wed 11/26/25 5:00 PM	0 hrs	3		0%
System Development	50 days	Thu 11/27/25 8:00 AM	Thu 1/15/26 5:00 PM	2,000 hrs	4	Unity Developer, C# Develope	0%
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System Deployment	27 days	Wed 2/25/26 8:00 AM	Mon 3/23/26 5:00 PM	864 hrs	8	DevOps Engineer, System Adn	0%
Full System Launched & Delivered	0 days	Mon 3/23/26 5:00 PM	Mon 3/23/26 5:00 PM	0 hrs	9		0%

FIGURE 6: PROJECT TASK DEPENDENCES

6. Cost Estimation

6.1. Development Cost

- AFP (Adjusted Function Points)

Total Function Points (FP) = number of inputs + number of outputs + number of files + number of inquiries + number of interfaces

- Inputs FPs: 35
- Outputs FPs: 45
- Files FPs: 25
- Inquiries FPs: 20
- Interfaces FPs: 25

Function Points = 35 + 45 + 25 + 20 + 25 = **150**

Adjusted Factor (AF) = **1.15**

Adjusted Function Points (AFP) = FP × AF = 150 × 1.15 = **173 AFP**

- ASLOC (number of lines of generated code)

Since the programming language C# (Unity Engine) will be used to develop the application, it produces an average of 100 lines of code per function point.

ASLOC = Adjusted Function Points × SLOC/FP

ASLOC = 173 × 100 = **17,300 LOC**

- Number of staff –Month

The productivity is estimated at 600 (lines of code per staff-month).

$$\frac{17{,}300}{600} = \mathbf{28.8\ staff\text{-}months}$$

Given that the project duration is 6 months,

$$\frac{28.8}{6} = 4.8 \approx \mathbf{5\ people}$$

- Salary for development staff

Salary for development staff = (Number of persons × salary average × number of months)

$5 \times 10{,}000 \times 6 = \mathbf{300{,}000\ SAR}$

- Effort estimation using COCOMO model

For the **Roletopia** project, we have selected the Semi-Detached Model as it best represents our project characteristics. This model is ideal for medium-sized projects where the development team has a mix of experienced and less experienced members. Our VR educational platform involves moderate complexity with integration of Unity, backend systems, multiplayer functionality, and VR optimization. The team structure includes developers with varying levels of experience in VR development, which aligns with the semi-detached model's assumptions. Additionally, there are some constraints on requirements and schedule, making this model more appropriate than the organic model while not being as rigid as the embedded model

Based on the Semi-Detached COCOMO model, we use the following constants:

- a = 3.0
- b = 1.12
- c = 2.5
- d = 0.35

- Cost drivers

Cost Driver Category	Cost Driver	Rating	Multiplier	Justification
Product Attributes	Required Software Reliability	Nominal	1.00	The application requires a dependable level of stability to ensure smooth interaction for children. Its core functions operate within predictable scenarios and controlled environments, making a **nominal reliability level** fully adequate for achieving consistent performance throughout typical educational VR use.
Product Attributes	Database Size	Nominal	1.00	Moderate data volume for storing user profiles, points, and progress reports.
Product Attributes	Product Complexity	High	1.15	VR integration with multiplayer features and real-time coordination adds complexity.
Computer Attributes	Execution Time Constraint	Nominal	1.00	No strict real-time processing required beyond normal gameplay response.
Computer Attributes	Main Storage Constraint	Nominal	1.00	Adequate hardware and server resources are available.
Computer Attributes	Virtual Machine Volatility	Low	0.87	Stable development environment with consistent configuration and minimal changes.
Personnel Attributes	Analyst Capability	Nominal	1.00	Skilled analysts defined the scope and educational requirements clearly.
Personnel Attributes	Applications Experience	Nominal	1.00	Team has moderate experience with similar interactive systems.
Personnel Attributes	Programmer Capability	High	0.86	Developers demonstrate strong problem-solving and coding skills.
Personnel Attributes	Virtual Machine Experience	High	0.90	Developers have extensive experience with Unity's runtime environment.

Personnel Attributes	Programming Language Experience	High	0.95	Team has strong experience with C# and object-oriented design.
Project Attributes	Modern Programming Practices	High	0.91	Agile methods, version control, and regular testing are applied.
Project Attributes	Use of Software Tools	Very High	0.83	Advanced tools like Unity, Blender, GitHub, and automated testing enhance productivity.
Project Attributes	Required Development Schedule	Nominal	1.00	Six-month timeline is achievable without excessive pressure.

Table 9: Cost drivers

Effort Adjustment Factor (EAF):

EAF = 1.00 × 1.00 × 1.15× 1.00 × 1.00 × 0.87 × 1.00 × 1.00 × 0.86 × 0.90 × 0.95 × 0.91 × 0.83 × 1.00

EAF = 0.42

- ### Effort using COCOMO model

Using the Semi-Detached model formula:

Effort (E) = a × $(KLOC)^b$ × EAF.

Where:

LOC = 17.3 (17,300 LOC ÷ 1,000)

a = 3.0

b = 1.12

EAF = 0.42

E = 3.0 × (17.3)^1.12 × 0.42 = 3.0 × 24.35 × 0.42 = 30.4 person-months

Development Cost = 30.4 × 10,000 = 304,000 SAR

Given the project duration is 6 months with an average team of 5.5 people, the adjusted cost is 330,000 SAR.

Cost Comparison:

• Method 1 (Function Points): 300,000 SAR

• Method 2 (COCOMO): 304,000 SAR

• Difference = |304,000 - 300,000| ÷ 300,000 × 100% = 1.3%

The 1.3% difference is within the acceptable 20% range, confirming the reliability of both estimation methods.

6.2. Tools Cost

Type	Tool	Cost (SR)
Software	Unity	Free
	Visual Studio Code	
	Blender	
	GitHub	
	Google Forms / Microsoft Forms	
	Figma	
	Trello / Jira	
	Android Emulator	
	Microsoft Word	570 SR
	Project Plan 365	800 SR
Hardware	High-performance laptops	5 x 3500 = 17,500 SR
	VR Headsets (Oculus/Vive)	2000 SR
	Servers	5000 SR
	Stable internet setup	300 SR
	Network Devices	700 SR
Total Cost	Software + Hardware	26,870 SR

Table 10: Tools Cost

6.3. Total cost

The formula that we used to calculate the total cost of our project is:

Total Cost = Development Cost +Tools Cost

Total Cost = 304,000 +26,870 = **330,870 SR**

7. Quality Attributes

Quality attribute	Description	Measurement	Assessment
Usability	Children aged 8-12 can navigate the VR app easily and intuitively, with a user-friendly interface that includes clear icons and colors suitable for their age group.	Task Success Rate	**Task Success Rate =** Number of users who successfully completed the task _____ × 100 Number of users who attempted the task
Performance	The system must respond quickly (within 2 seconds between broadcasts and events).	Average Transaction Latency (seconds)	**Latency Success Rate =** Number of events < 2 Seconds _____ × 100 Total Number of events
Security and Safety	The system should protect children's data through secure authentication, encrypted communication, and restricted access to authorized users only, ensuring no external unauthorized connections.	Encryption Success Rate (%)	**Encryption Success Rate=** Successfully Encrypted Communication Requests _____ Total Communication Requests

Compatibility	Users can access the app on both Android and iOS without functionality loss. The VR mode supports Oculus Quest and HTC Vive headsets.	Coverage	**Platform Compatibility Score =** Number of Supported Devices/OS Versions _____ × 100 Total Target Devices/OS Versions
Scalability	The platform should be able to support at least 500 concurrent players without performance degradation.	Concurrent Users Capacity	**Scalability Score =** Actual Concurrent Users Supported _____ × 100 Target Concurrent Users (500)

TABLE 11 QUALITY ATTRIBUTES

8. References

[1] Akron Children's Hospital, "Kids and video games: The good and the bad," Akron Children's Inside, Feb. 13, 2023. [Online]. Available: https://www.akronchildrens.org/inside/2023/02/13/kids-and-video-games-the-good-and-the-bad/ [Accessed: Sep. 29, 2025].