**GRIFFIN - A VIRTUAL EXPERIENCE**

**Capstone Project Report**

**MID SEMESTER EVALUATION**

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# ABSTRACT



This document introduces the "Virtual Flight Simulator for Children" project, a pioneering endeavor aimed at creating an engaging and educational virtual reality experience for young learners aged 4-8. The project's core objective is to provide an immersive platform that combines entertainment and learning, fostering creativity and physical activity.

Much like a digital playground, the proposed solution seeks to address the lack of interactive educational games for this age group. By integrating body tracking technology and real-world object interactions, the project aims to offer a novel way for children to learn and play simultaneously.

The virtual flight simulator, at the heart of the project, offers an imaginative environment where children can control their avatars through body gestures. This gesture-based interaction enhances both entertainment and physical engagement, contributing to a healthier screen time experience.

Furthermore, the project incorporates educational content aligned with recognized standards, ensuring that children not only enjoy the virtual world but also acquire valuable skills and knowledge.

By fostering a connection between the virtual and physical realms, the "Virtual Flight Simulator for Children" project aspires to provide a holistic and enjoyable learning journey, catering to the developmental needs of young minds.

# DECLARATION



We hereby declare that the design principles and working prototype model of the project entitled

“Griffin- A Virtual Experience” is an authentic record of our own work carried out in the Computer Science and Engineering Department, TIET, Patiala, under the guidance of Dr. Jhilik Bhattacharya during 7th semester (2023).

Date: 24th August, 2023

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Lastly, we would also like to thank our families for their unyielding love and encouragement. They always wanted the best for us and we admire their determination and sacrifice.

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# INTRODUCTION



#### Project Overview

A virtual flight simulator for young children (4-8 years). The aim of this project is to

explore the navigational experiences of flying in a virtual environment via body

gestures. This project aims to create a virtual flight simulation for children that allows

them to engage with the virtual world using gestures and real-world objects using their

devices’ webcam. It provides a fun learning experience, and some source of physical

activity wherein young children can exercise and enjoy themselves in the comfort of

their room.

The project also offers a simulation of various worlds and exciting and interactive

powerups. Children can use their laptops, desktop, or tablet to run this application.

There is no need for any other hardware equipment to experience the simulation. Realworld

objects can be used by the children to enable power-ups and additional features

inside the virtual world. The child can complete guided missions enabling a goaloriented mindset.

#### Need Analysis

The project is needed to make young children acquainted with technology and give

them a virtual experience aimed at making learning enjoyable with real-world objects,

along with keeping them engaged and active. It allows for

**1. Market Demand:** The market for educational games and interactive learning

tools is rapidly growing, and there is a high demand for innovative and engaging

products. The project idea fulfils this demand by providing an immersive and

interactive experience for children using real-world objects, and body tracking

technology.

**2. Target Audience:** The target audience for our game is children aged 4-8 years

old, a demographic that is often overlooked in the gaming industry. By creating

a game that caters specifically to this age group and aligns with their learning

objectives, we can tap into a niche market that has significant potential.

**3. Learning Objectives:** The game is designed to make learning enjoyable while

developing cognitive and physical skills such as problem-solving, decisionmaking, coordination, and spatial awareness. This aligns with current

educational trends that emphasize experiential learning and interactive tools.

**4. Innovative Features:** The incorporates innovative features such as real-world

object interaction and body tracking technology, which sets it apart from other

educational games on the market. These features provide an immersive and

interactive experience that keeps children engaged and active while promoting

learning. The addition of real-world object power-ups will provide a unique

twist to traditional character simulator games.

**5. Scalability:** The game can be easily adapted to different platforms, making it

scalable and accessible to a wider audience.

At the end, This project aims to meet the growing demand for games that utilize body

posture recognition by creating a unique and engaging game that allows players to

control a character using posture recognition, and collect real-world objects as powerups. The use of innovative technology and unique gameplay will provide a competitive

advantage in the market and improve user acquisition and retention metric

#### Research Gaps

This project addresses crucial research gaps in the field of interactive technology for young children:

**1. Limited Body Gesture Integration:** Current virtual environments lack research on body gesture navigation tailored for 4-8-year-olds, prompting this project to explore its effectiveness.

**2. Learning-Centric Flight Simulaters:** Scarce research focuses on educational flight simulators for children. This project aims to create a learning-oriented simulator for skill development.

**3. Impact of Real-World Object Integration:** The unexplored concept of integrating real-world objects as power-ups in virtual environments drives this project to investigate its potential impact.

**4. Neglected 4-8 Age Group:** The underserved gaming demographic of 4-8-year-olds lacks attention in research. This project aims to fill this gap with an age-appropriate game.

**5. User Acquisition and Retention in Child-Centric Games:** Research on user metrics for child-centric games with innovative technology is lacking. This project aims to examine the impact of unique features on user engagement.

By addressing these gaps, the project contributes both academically and practically, enriching interactive technology experiences for young children.

#### Problem Definition and Scope

**Problem definition**

The challenge at hand pertains to the absence of educational games tailored for the 4-8-year-old age group that effectively employ body tracking technology and incorporate real-world objects. Despite the rise in popularity of virtual reality games for children, the interactive learning aspect remains underdeveloped, limiting the potential for holistic growth.

**Scope**

The project aims to create a virtual flight simulator that:

1. Utilizes Body Tracking and Real-World Objects: The simulator will integrate body tracking technology and real-world objects to enable intuitive interaction.

2. Targets 4-8 Age Group: It will be tailored for young children, considering their cognitive and motor skills development.

3. Promotes Active Learning: The simulator will require physical activity for engagement to counter the sedentary effects of screen time.

4. Fosters Entertainment and Education: Guided missions will facilitate problem-solving, decision-making, coordination, and spatial awareness skills in an engaging manner.

5. Enhances Wellbeing: The interactive and physically active experience will positively impact children's health.

6. Is Accessible: The simulator will run on laptops, desktops, and tablets without extra hardware.

7. Offers Diversity: It will feature various environments and interactive power-ups for engagement and exploration.

In conclusion, the project focuses on creating an educational virtual flight simulator that combines body gesture interaction, real-world object integration, active learning, and entertainment for 4-8-year-olds, addressing a critical gap in this domain.

#### Assumptions and Constraints

**Assumptions**

• Access to appropriate hardware and can use it effectively.

• Safe environment with adult supervision

• Accessible to kids with different skill levels and abilities.

• Age-appropriate learning objectives for 4-8-year-old kids.

**Constraints:**

• Designed to run on existing hardware

• Strict timeline and budget

• Limit the complexity of the concepts that can be introduced.

• The game's pose detection model may have limitations in terms of accuracy and responsiveness, which could impact the player's experience.

#### Standards

The following standards are applicable to the project:

To ensure the effectiveness, safety, and compatibility of the virtual flight simulator, the project will adhere to the following standards:

1. Child Safety and Online Privacy Standards:

- Children's Online Privacy Protection Act (COPPA): The simulator will comply with COPPA guidelines, safeguarding children's online privacy and safety.

- ISO 8124 Safety of Toys: The design and content will meet ISO 8124 standards, minimizing potential physical and psychological risks associated with toys.

2. Accessibility Standards:

- Web Content Accessibility Guidelines (WCAG): The simulator's user interface will align with WCAG guidelines, ensuring accessibility for children with disabilities.

3. Educational Content Standards:

- Common Core State Standards (CCSS): Educational content will adhere to CCSS, aligning learning objectives with recognized educational standards.

4. Technology and Interactivity Standards:

- WebGL and WebXR Standards: Implementation of WebGL and WebXR technologies will follow relevant standards for reliable and secure browser-based experiences.

- Interactive Digital Media Standards: Industry best practices for interactive digital media will be observed, guaranteeing engaging and age-appropriate interactions.

5. User Interface and Experience Standards:

- User-Centered Design (UCD): The user interface will adopt UCD principles, ensuring an intuitive experience, particularly for young users.

- Fitts's Law: Interactive elements will adhere to Fitts's Law, optimizing size and placement for seamless interaction.

6. Data Security and Storage Standards:

- General Data Protection Regulation (GDPR): Any user data handling will comply with GDPR regulations, prioritizing user data security and privacy.

7. Performance and Compatibility Standards:

- Device Compatibility: The simulator will be developed for compatibility across various devices, including laptops, desktops, and tablets.

By adhering to these standards, the virtual flight simulator project aims to deliver a high-quality, safe, and enriching experience for young users. It will ensure user satisfaction, accessibility, and alignment with relevant regulations and expectations from parents, educators, and relevant authorities.

**1.7 Approved Objectives**

1. A fully functional and interactive flight simulator using the user’s camera .

2. To incorporate real-world objects, such as airplanes and aviation-related concepts, into the game to help kids learn about the principles of aerodynamics and other STEM fields in a fun and interactive way.

3. To design the game to be both educational and entertaining, with features that keep kids engaged and active while they learn. The simulator will also allow the player to choose his/her preferred character or virtual world. 4. To conduct user testing with 4-8-year-old kids to gather feedback and insights that can be used to improve the game's design and functionality.

5. To optimize the game's performance, ensuring that it runs smoothly on a variety of devices and platforms, and that it is accessible to a wide audience.To create a userfriendly interface that allows kids to easily navigate the game and learn at their own pace. An optional power-ups feature that allows the user to interact with real-world objects and use them as power-ups in the game itself.

6. Obstacles will be provided to make the game more interactive.

7. A working unity application that is capable of running on most desktop devices

8. To provide support and guidance for parents and educators who use the game as an educational tool, including documentation, training materials, and resources for further learning.

**1.8 Methodology**

The methodology we will use is as follows:

1. Start by creating the basic character model: This could be a 3D model of a character, or we could use an existing character model from the Unity asset store.

2. Add animations to the character model: This will give our character some basic movements like flying, landing, and taking off.

3. Implement pose estimation: To control the character, we implement a pose estimation system that can detect simple gestures like tilting up,down, left and right.

4. Map pose to character movements: Once we have the gestures in place, we map them to the animations we created in step 2. For example, tilting the body left could move the character towards the left.

5. Identify objects to be used as power-ups: Choose real-world objects that can be easily recognizable by the pose recognition system. For example, The player could use a circular object like a ball or a rectangular object like a piece of paper.

6. Implement image recognition: To detect real-world objects as power-ups, we implement image recognition in our game.

7. Train the image recognition model: To detect the objects as power-ups, we’ll need to train the image recognition model on several examples of the objects we’ve chosen. We would do this by capturing several images of the objects and using them to train the model.

8. Map objects to power-ups: Once the image recognition system is up and running, we map the objects to specific power-ups in our game. For example, detecting a circular object could give the character a speed boost, while detecting a rectangular object could give the character invincibility for a set period.

9. Add object detection to the game: Finally, we’ll add object detection functionality to the game. This will cause the game to detect the real-world objects and trigger the appropriate power-ups when they are detected.

10. Add obstacle detection: To make the game more challenging, we’ll need to add obstacle detection to the character simulator. This will cause the character to avoid obstacles like trees and buildings as it flies through the air.

11. Add scoring and game-over conditions: Finally, we’ll need to add a scoring system that keeps track of the character's progress, as well as game-over conditions that occur when the character crashes into an obstacle.

12. Calibrating and fine-tuning the game

13. Testing the game on real world users before deployment

14. Deploying the game on suitable platform to be used as an application or a website based on the game features and size post creation

With these steps in place, we should have a basic Unity gesture-based character simulator up and running with real-world objects as power-ups.

**1.9 Project Outcomes and Deliverables**

1. Increased engagement and excitement around learning: By providing an immersive experience that allows children to explore and learn about the world of flight, the virtual flight simulator can help to spark their curiosity and interest in science and technology.

2. Improved spatial reasoning and motor skills: The use of computer vision technology can help to improve children's spatial reasoning abilities, as well as their hand-eye coordination and motor skills, as they navigate and control their virtual airplane. The virtual flight simulator can improve kids’ spatial awareness by giving them a sense of how objects move in three-dimensional space.

3. Enhanced problem-solving skills: The virtual flight simulator can also help to improve children's problem-solving skills, as they learn to troubleshoot and adjust their flight path, along with using real world objects as powerups. Also, it improves problem solving skills by presenting challenges related to navigation and flight control

4. Increased exposure to technology: By introducing children to the world of computer vision and virtual world design, the flight simulator can help to arouse their curiosity in STEM fields

5. Improved confidence and self-esteem: Successfully navigating and controlling a virtual airplane can be a challenging and rewarding experience for children, which can help to boost their confidence and self-esteem as they master new skills and overcome obstacles.

**1.10 Novelty of work**

The uniqueness of this project lies in its innovative approach to integrating technology, education, and physical activity for young children in the 4-8-year-old age group. While virtual reality games are gaining traction, this project introduces several novel aspects:

1. Body Gesture Interaction: Unlike conventional virtual environments, this project incorporates body tracking technology, enabling children to navigate and interact with the virtual world through intuitive gestures. This approach adds an element of physical engagement and promotes motor skill development.

2. Real-World Object Integration: The integration of real-world objects as power-ups and interactive elements introduces a tangible and immersive aspect to the virtual experience. Children can bridge the gap between the physical and virtual worlds, enhancing their understanding and enjoyment.

3. Targeted Age Group: The focus on children aged 4-8 is a unique aspect. Most educational games target older children or teenagers. By catering to this specific age range, the project fills a gap in the market and provides an age-appropriate learning and entertainment solution.

4. Active Learning: The project promotes physical activity by requiring body movements for navigation and interaction. This approach addresses concerns about sedentary behavior associated with screen time and aligns with current trends in active learning.

5. Educational Integration: The simulator goes beyond mere entertainment by incorporating guided missions aligned with learning objectives. It encourages problem-solving, decision-making, coordination, and spatial awareness while providing an enjoyable experience.

6. Diverse Environments and Power-Ups: The inclusion of various virtual environments and interactive power-ups introduces an exploratory aspect, fostering curiosity and engagement.

7. Cross-Platform Accessibility: The project's adaptability to different devices, such as laptops, desktops, and tablets, without requiring additional hardware, ensures accessibility and convenience for users.

In summary, the novelty of this project lies in its integration of body gesture interaction, real-world object engagement, active learning, and educational content specifically tailored for the 4-8-year-old demographic. By amalgamating these elements, the project creates a unique and enriching virtual flight simulator experience that blends entertainment, education, and physical activity in an unprecedented manner.

# REQUIREMENT ANALYSIS



#### 2.1 Literature Survey

#### 2.1.1 Theory Associated with problem area

#### The creation and deployment of virtual flight simulators for educational and recreational purposes, particularly catering to young children, are deeply influenced by theoretical frameworks underpinning immersive learning and experiential education. At its core, the concept of immersive learning draws from the principles of experiential education, enabling a hands-on and participatory learning environment. By harnessing body tracking technology and gestures, the project capitalizes on the potential of virtual flight simulators to engage children physically within the virtual realm. This approach aligns with theories that emphasize learning through active involvement and practical engagement, allowing children to not only grasp aviation concepts but also cultivate problem-solving skills, decision-making abilities, and spatial awareness. Furthermore, the utilization of virtual reality, a burgeoning area, builds on the idea that technological advances can enhance educational methodologies by providing interactive and memorable experiences, potentially reshaping the way children learn about aviation and related subjects.

#### 2.1.2 Research Findings for Existing Literature

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.** | **Roll no.** | **Name** | **Paper Title** | **Tools/** | **Findings** | **Citation** |
| **No.** |  | **Technology** |
| 1 | 102017095 | Anjali Rana | Virtual reality flight simulator | Flight simulator using virtual reality can provide strong sensations like being in a plane cockpit | In this paper, it is developed a virtual reality flight simulator. The virtual reality flight simulator is intended to act as the conventional flight simulator that simulates the environment of real flight. In addition, it can be used anywhere and anytime. | [1]Valentino, Kelvin & Christian, K. & Joelianto, Endra. (2017). |
| 2 | VRFlight Simulator | VRFlight Simulator that runs on Android mobile devices with an external Bluetooth controller, the degree of realism it provides and its effect on player’s enjoyment.. | Presented Beats-Per-Minute (BPM), a microservice-based platform for ongoing collection, examination, and visualization of health-related data from activity trackers. | [2] Yang, J. C. et al. (Eds.) (2018) |
| 4 | 102017183 | Suarabh | Exploring Body Gestures as Natural User Interface for Flying in a Virtual Reality Game | players wear an Oculus Rift DK2 HMD with headphones, and controls their flying movements using pre-defined body gestures captured by a Kinect tracking sensor. | The paper consisted of a VR game called Beyond..It consisted of 2 phases – Pilot Study One: “Flying” Body Gestures | [3] Tong, Xin & Pekcetin, Serkan & Gromala, Diane & Machuca, Frederico. (2017). |
| 5 | "The Progress of Human Pose Estimation: A Survey and Taxonomy of Models Applied in 2D Human Pose Estimation," | Aims in determining the position or spatial location of body key points (parts/joints) of a person from a given image or video. | Analyzed changes in physical activity behaviors using wrist accelerometer data to understand behavior patterns | [4] T. L. Munea, Y. Z. Jembre, H. T. Weldegebriel, L. Chen, C. Huang and C. Yang, |
| 6 | Using wearables and machine learning to enable personalized lifestyle recommendations to improve blood pressure | Wearables, machine learning | Investigated personalized lifestyle recommendations to improve blood pressure using wearable devices and machine learning | Chiang, P.H., Wong, M. and Dey, S., 2021 [6] |
| 7 | 102067008 | Aurav | Real-time 3D arm motion tracking using the 6-axis IMU sensor of a smartwatch | Smartwatch with IMU sensor. | Proposed a real-time 3D arm motion tracking using a smartwatch's IMU sensor to estimate wrist and elbow positions | Wei, W., Kurita, K., Kuang, J. and Gao, A., 2021, July [7] |
| 8 | Habit Tracker and Advisor using Mobile Application for Health Monitoring | Mobile application | Introduced a Habit Tracker mobile app for monitoring daily performance, incentivizing better habits, and suggesting activities | Kondaveeti, H.K., Dalai, A.K., Selavaraj, P. and Reddy, G.V., 2021, January [8] |
| 9 | Sensor-driven achieving of smart living: A review | Sensor-driven technology | Summarized research papers demonstrating how sensors can be utilized for various smart living applications, including activity tracking and sleep monitoring | Leelaarporn, P., Wachiraphan, P., Kaewlee, T., Udsa, T., Chaisaen, R., Choksatchawathi, T., Laosirirat, R., Lakhan, P., Natnithikarat, P., Thanontip, K. and Chen, W., 2021 [9] |
| 13 | 102017026 | Vanshaj | An FPGA System for Driver Mobile Usage Detection and Heart Rate-Based Health Monitoring | FPGA-based system, dashboard camera, smartwatch | Proposed FPGA-based system for driver health monitoring using facial and heart rate data, aiming to reduce accidents through real-time monitoring | Heenetimulla, H.S.M., Das, S.K., Sahoo, G.K. and Singh, P., 2022, November [13] |
| 14 | Semantic Constraints Specification and Schematron-Based Validation for Internet of Medical Things’ Data | Semantic constraints, IoT data | Addressed challenges of data quality and privacy in predicting personal well-being using fitness trackers by enforcing semantic constraints on IoT data | Koren, A., Jurčević, M. and Prasad, R., 2022 [14] |
| 15 | IoT based Soldier Health and Position Tracking System | IoT and GPS-based system | Proposed a low-cost, reliable IoT and GPS-based system for tracking and monitoring soldiers' health and location in real-time | Prasanna, J.L., Kumar, M.R., Santhosh, C., Kumar, S.A. and Kasulu, P., 2022, March [15] |

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#### 2.1.3 Problem Identified

- Despite the proliferation of virtual reality games for children, there's a notable absence of educational offerings that leverage body tracking technology and real-world object integration to create engaging and interactive learning experiences for the 4-8-year-old demographic.

- While young children possess a fascination for flight, traditional flight simulators are often too intricate for them to comprehend and enjoy. Moreover, prolonged screen time among children can have adverse effects on their health and well-being.

- Consequently, a distinct need emerges for a virtual flight simulator explicitly tailored to young children, providing an avenue for them to interact with the virtual realm through body gestures and tangible objects. This platform aims to not only impart knowledge but also deliver an entertaining and physically active learning journey.

- In response to this identified gap, the project endeavors to develop a virtual flight simulation that offers engaging and dynamic experiences, enabling young children to indulge in physical activity while enjoying themselves in the comfort of their surroundings.

#### 2.1.4 Survey of tools and technologies used

In the process of crafting the technological framework for the "Eyes on Health" initiative, we draw insights from a diverse array of tools and technologies employed in similar contexts. These tools have been carefully selected to empower our project with the capabilities essential for its successful realization. Here, we present an overview of the tools and technologies harnessed, each contributing to the comprehensive solution offered by "Eyes on Health":

**Arduino Nano and Sensors**: Employing Arduino Nano alongside temperature sensors, heart rate sensors, accelerometers, and gyroscopes, we enable accurate data capture, essential for monitoring vital indicators.

**ESP32 with Camera**: The integration of an ESP32 module with a camera bolsters the project with real-time video streaming capabilities, augmenting the live monitoring feature.

**Mobile App Development with Flutter**: The utilization of the Flutter framework facilitates the development of a user-friendly and intuitive mobile application. This app ensures seamless interaction and engagement for both elderly individuals and caregivers.

**Web Application Development with HTML, CSS, and JS:** Through the amalgamation of HTML, CSS, and JavaScript, we construct an accessible and dynamic web interface that enhances user experience and accessibility.

**Backend Development with Express.js and Node.js**: Leveraging the capabilities of Express.js and Node.js for backend development, we establish robust data management and routing systems, ensuring efficient data flow between devices and databases.

**Database Management with MongoDB:** The choice of MongoDB as the database management system guarantees efficient and structured storage of vital data, providing a foundation for effective data retrieval and analysis.

These tools collectively form the technological backbone of "Eyes on Health," enabling the project to meet its overarching objectives. By thoughtfully integrating these tools and technologies, we pave the way for a comprehensive and transformative solution that brings about enhanced health monitoring, user engagement, and caregiver support.

#### 2.2 Software Requirement Specification

**2.2.1 Introduction**

2.2.1.1 Purpose

The purpose of the "Virtual Flight Simulator for Children" project is to create an engaging and educational virtual environment for young children (ages 4-8) to experience flight using body gestures and real-world object interaction. The primary objectives are:

To introduce children to technology in an enjoyable and interactive manner.

To provide an immersive and physically active learning experience.

To address the lack of age-appropriate flight simulators for young children.

To encourage problem-solving, decision-making, coordination, and spatial awareness skills development.

To offer a novel approach to blending entertainment and education.

2.2.1.2 Intended Audience and Reading Suggestions

The intended audience for the project includes parents, educators, and caregivers of young children aged 4-8 who are seeking interactive and educational entertainment options. Additionally, children within the specified age group will directly benefit from the virtual flight simulator experience. Recommended reading includes "Play and Learning in Early Childhood Education" by Marilyn Fleer and "Digital Play: Computer Games and Language Aims" by Kyle Mawer and Graham Stanley.

2.2.1.3 Project Scope

The project's scope encompasses the creation of a virtual flight simulator tailored to young children, allowing them to engage with the virtual world using body gestures and real-world objects. The features included in the simulator's scope are:

Body Gesture Interaction: Utilizing body tracking technology for navigation and interaction.

Real-World Object Integration: Allowing children to use physical objects to activate power-ups and interact with the virtual environment.

Age-Appropriate Content: Designing the simulator's content to align with the cognitive and motor skills development of children aged 4-8.

Guided Missions: Providing structured missions that encourage skill development and problem-solving.

Diverse Environments and Power-Ups: Creating various virtual worlds and interactive elements to enhance engagement.

Active Learning: Promoting physical activity through body movements for interaction, countering sedentary behavior.

User-Friendly Interface: Designing an intuitive interface suitable for young children to navigate and enjoy the simulator.

By encompassing these elements, the project seeks to deliver an innovative and enriching virtual flight simulator experience, meeting the entertainment and educational needs of young children.

**2.2.2 Overall Description**

**2.2.2.1 Product Perspective**

The "Virtual Flight Simulator for Children" is conceived as an innovative educational and entertainment platform for children aged 4-8. It offers an immersive virtual flight experience that utilizes body tracking technology and real-world object interaction. The simulator is designed to provide an engaging and interactive way for young users to explore flight concepts, enhance cognitive skills, and promote physical activity. The system operates as a standalone application, requiring no additional hardware, and aims to be adaptable across laptops, desktops, and tablets. By integrating playful learning scenarios, guided missions, and captivating environments, the project aims to meet the demand for age-appropriate and technologically enriched learning experiences for children.

**2.2.2.2 Product Features**

Body Gesture Interaction: The simulator employs body tracking technology to allow children to control their virtual characters and engage with the environment using natural movements.

Real-World Object Integration: Young users can use physical objects as power-ups and interactive elements within the virtual world, enhancing the immersive experience.

Guided Missions: The system presents guided missions that challenge children to complete objectives, fostering problem-solving and decision-making skills in an entertaining manner.

Age-Appropriate Content: The simulator's content is tailored to the cognitive and motor skills development of children aged 4-8, ensuring an engaging and educational experience.

Diverse Environments and Power-Ups: Children can explore various virtual worlds and encounter interactive power-ups, encouraging exploration and curiosity.

Active Learning: By necessitating physical movements for interaction, the simulator promotes physical activity, mitigating the sedentary effects of screen time.

User-Friendly Interface: The interface is designed to be intuitive and easy for young users to navigate, ensuring a seamless and enjoyable experience across devices.

By incorporating these features, the "Virtual Flight Simulator for Children" project aims to create a unique and valuable educational tool that combines entertainment, active learning, and technological innovation for the targeted age group.

**2.2.3 External Interface Requirements**

**2.2.3.1 User Interfaces**

The "Virtual Flight Simulator for Children" project aims to provide an intuitive and user-friendly experience for its young audience. The user interface design is centered around simplicity and easy navigation. To ensure accessibility for children aged 4-8, the interface will be thoughtfully crafted to offer straightforward interactions and seamless engagement. The virtual flight experience will be visually appealing and engaging, promoting active learning through body gestures and object interactions.

**2.2.3.2 Hardware Interfaces**

The project requires devices capable of running the virtual flight simulator application. These include laptops, desktops, and tablets. While no additional hardware is necessary for basic interaction, children can enhance their experience by using real-world objects as interactive elements. The application is designed to utilize the device's webcam for body tracking, enabling children to control their characters using natural movements.

**2.2.3.3 Software Interfaces**

The simulator will be accessible through modern web browsers supporting HTML5, ensuring compatibility across various devices. The utilization of responsive design principles ensures a consistent experience regardless of the device used. JavaScript will facilitate dynamic functionality, enhancing the interactivity of the virtual environment. The project will incorporate a backend MongoDB database to securely store user data, contributing to effective data management. Additionally, integration with third-party APIs for push notifications, geolocation, and authentication will enhance the overall usability and user experience of the application, making it seamless and engaging for children.

**2.2.4 Other Non-functional Requirements**

**2.2.4.1 Performance requirements**

Real-time Interaction:

The virtual flight simulator must offer responsive real-time interaction, minimizing latency during body gesture tracking and object interaction for an immersive experience.

Smooth Animation and Rendering:

The simulator should maintain smooth animation and rendering, ensuring a visually appealing and seamless virtual environment.

User Interface Responsiveness:

The user interface should respond promptly to user actions, ensuring intuitive navigation and interactions.

Hardware Resource Utilization:

The application should be optimized to utilize hardware resources efficiently, preventing excessive battery drain or device slowdown.

Cross-Platform Compatibility:

The simulator must perform consistently across various devices, including laptops, desktops, and tablets, ensuring a uniform experience.

**2.2.4.2 Safety requirements**

User Safety Assurance:

The virtual flight simulator should ensure that all virtual environments and interactions are safe and suitable for the targeted age group (4-8 years).

Age-Appropriate Content:

All content, missions, and scenarios presented in the simulator should be age-appropriate, promoting safe and meaningful learning experiences.

User-Friendly Interface:

The user interface must be designed with simplicity in mind, enabling young children to navigate the simulator without confusion or difficulty.

Physical Health Considerations:

The project should promote healthy interaction and play, advising against strenuous movements that could potentially lead to discomfort or health issues.

**2.2.4.3 Security requirements**

Data Privacy:

The simulator should uphold data privacy by not collecting or storing personal information about the young users without explicit parental consent.

Secure User Authentication:

For parental controls or user-specific settings, robust user authentication mechanisms should be implemented, ensuring access only to authorized individuals.

Child Safety Measures:

The application must incorporate features to prevent unintended exposure to external content, ensuring a secure and controlled environment for young users.

Content Filtering:

The simulator should include content filtering to block inappropriate content or interactions that may not align with the project's educational objectives.

Parental Control:

Implement parental control features that allow parents or guardians to customize settings, monitor usage, and ensure a safe and controlled experience for their children.

**2.3 Risk Analysis**

Data Privacy and Security:

Risk: Sensitive health data collected by the virtual flight simulator could be vulnerable to data breaches without proper security measures.

Mitigation: Implement robust data encryption, secure storage practices, and stringent user authentication mechanisms. Regular security audits should be conducted to identify and address vulnerabilities.

Usability and Accessibility:

Risk: The young age of the target audience (4-8 years) could lead to usability challenges, resulting in user frustration and misuse.

Mitigation: Design the user interface with simplicity in mind, using large icons, clear labels, and intuitive controls. Provide step-by-step instructions and interactive tutorials to guide children through interactions.

Reliability and Accuracy:

Risk: Inaccurate tracking of body gestures or object interactions could undermine the overall experience and learning outcomes.

Mitigation: Thoroughly test the accuracy and reliability of body tracking technology and interaction mechanics. Regular calibration and sensor maintenance should be conducted to ensure accurate results.

Content Interpretation:

Risk: Young users might misinterpret virtual environment elements or interactions, affecting their engagement and learning experience.

Mitigation: Provide age-appropriate guidance and explanations within the virtual world. Incorporate visual cues and interactive tutorials to guide children's interactions and understanding.

Physical Comfort and Safety:

Risk: Prolonged use of the simulator could result in discomfort or even physical harm due to poor design or materials.

Mitigation: Prioritize ergonomic design and user comfort. Conduct thorough ergonomic assessments and tests to ensure that the simulator does not cause discomfort, skin irritation, or injury.

Screen Time Awareness:

Risk: Extended usage of the virtual flight simulator could contribute to excessive screen time, potentially impacting children's physical and mental health.

Mitigation: Implement features that promote breaks, set time limits, and provide notifications to encourage healthy screen time habits. Include prompts for physical activity to balance screen engagement.

Parental Guidance:

Risk: Parents might have concerns about the content or safety of the virtual environment.

Mitigation: Offer parental control settings that allow parents to monitor and control their child's interactions. Provide detailed information about the simulator's educational content and safety features.

By addressing these potential risks and implementing appropriate mitigation strategies, the "Virtual Flight Simulator for Children" project aims to create a safe, engaging, and educational environment for young users, promoting both physical activity and learning.

# Methodology Adopted



#### 3.1 Investigative Techniques

In the pursuit of a comprehensive understanding of the "Virtual Flight Simulator for Children" project and its potential impact, a diverse range of investigative techniques has been employed. These techniques are thoughtfully selected to align with the project's objectives and ensure a thorough exploration of its various dimensions.

User Testing and Observations:

User testing and observations are foundational to gaining insights into how children interact with the virtual flight simulator. Through controlled testing sessions, the project team observes how children engage with the system, their ease of use, and any challenges they encounter. This technique is justified by its ability to uncover usability issues, preferences, and navigation patterns. The observations provide a firsthand understanding of user behaviors, aiding in refining the user experience.

Educational Pedagogy Analysis:

Given the project's educational focus, the investigative technique of educational pedagogy analysis is relevant. This involves studying established educational theories and practices suitable for the target age group. By aligning the simulator's content with recognized pedagogical approaches, the project aims to ensure meaningful learning experiences. The analysis informs the design of missions, challenges, and interactive content that align with educational objectives.

Survey and Feedback Collection:

The project employs surveys and feedback collection as a technique to gather insights from parents, guardians, and educators. This technique aids in understanding their perspectives on the simulator's educational value, entertainment quotient, and potential improvements. By gathering feedback, the project team can iteratively enhance the simulator to meet the expectations and needs of both young users and their caregivers.

Expert Evaluation:

Leveraging expert evaluation, the project seeks feedback from child development experts, educators, and user experience professionals. This technique ensures that the simulator's content, interactions, and design align with best practices in child engagement and education. Expert evaluations provide valuable input for refining the simulator's curriculum, challenges, and overall educational impact.

Analytics and Interaction Tracking:

Incorporating analytics and interaction tracking within the simulator allows for data-driven insights. This technique involves tracking user interactions, time spent on various activities, and patterns of engagement. By analyzing this data, the project team gains insights into which aspects of the simulator are most engaging, which challenges may need adjustment, and how children progress through the virtual world.

In summary, the chosen investigative techniques—user testing, educational pedagogy analysis, survey and feedback collection, expert evaluation, and analytics—complement each other to offer a holistic exploration of the "Virtual Flight Simulator for Children." These techniques provide multifaceted insights into user experiences, educational alignment, stakeholder perspectives, and usage patterns, thereby informing iterative improvements and ensuring the simulator's effectiveness.

**3.2 Proposed solution**

The "Virtual Flight Simulator for Children" project envisions an innovative solution that merges cutting-edge technology with the aim of delivering an immersive and educational experience tailored for young users. At its core, the proposed solution seeks to address the learning needs and physical activity requirements of children aged 4-8, while ensuring a safe and engaging virtual environment.

Simulation Environment:

The proposed solution centers around a dynamic and captivating simulation environment. This virtual world is meticulously designed to spark the curiosity and imagination of young users. From soaring through the skies to exploring interactive landscapes, the simulation environment offers a diverse range of scenarios that blend entertainment with learning.

Gesture-Based Interaction:

A defining feature of the proposed solution is gesture-based interaction. This innovative approach empowers children to control their virtual characters using intuitive body gestures. By utilizing webcams and motion sensing technology, the system tracks movements, translating them into in-game actions. This interaction paradigm not only enhances engagement but also promotes physical activity, aligning with the project's goal of providing a fun and active learning experience.

Educational Content Integration:

The proposed solution seamlessly integrates educational content within the simulation. Guided missions and challenges are thoughtfully designed to foster problem-solving skills, spatial awareness, and decision-making abilities in young users. Each activity is aligned with recognized educational standards, ensuring that learning objectives are met while children enjoy the virtual experience.

Real-World Object Integration:

To elevate engagement further, the solution integrates real-world objects as interactive elements within the virtual environment. Children can use everyday objects as power-ups and enhancements, fostering a tangible connection between the physical and digital worlds. This integration encourages creativity and exploration, enriching the overall experience.

User-Centric Interface:

The interface of the proposed solution is tailor-made for young users, prioritizing simplicity and intuitive navigation. Large icons, clear instructions, and minimal text ensure that children can independently navigate the simulation. The user-centric design fosters autonomy, enabling children to embark on learning adventures without constant assistance.

Parental Engagement:

Recognizing the importance of parental involvement, the proposed solution includes features that allow parents and guardians to monitor their child's progress. Progress reports, achievements, and educational milestones can be accessed, fostering communication and engagement between children and caregivers.

In summary, the "Virtual Flight Simulator for Children" project's proposed solution encapsulates a fusion of technology, education, and entertainment. Through a captivating simulation environment, gesture-based interaction, educational content integration, and real-world object engagement, the solution aims to provide an enriching, interactive, and physically active learning experience for young users.

**3.3 Tools and Technologies**

OpenCV: Object detection for activating the powerups inside the application will be assisted in real time using OpenCV, a Python library that allows you to perform image processing and computer vision tasks.

TensorFlow and MoveNet: Posture estimation which enables controlling the main character through various movements and gestures will be implemented in real time using MoveNet which detects 17 key points of a body quickly and accurately.

Blender: The game character, powerups and the entire collection of objects inside the scene, which can include rocks, trees et cetera are modelled and designed inside Blender, which is a free and open-source 3D computer graphics software.

Unity3D: The game is set up and designed inside Unity3D, a cross-platform game engine developed by Unity Technologies. It enables game programming, game animation, cinematics, physics, lighting, and various other parts of the game design process.

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# DESIGN SPECIFICATIONS



**4.1 System Architecture**

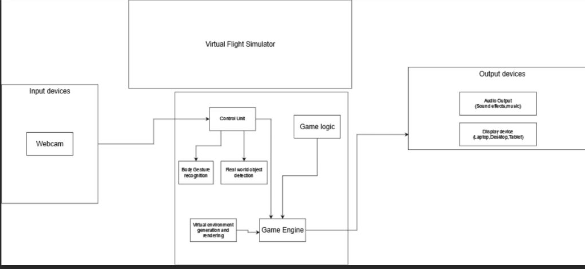
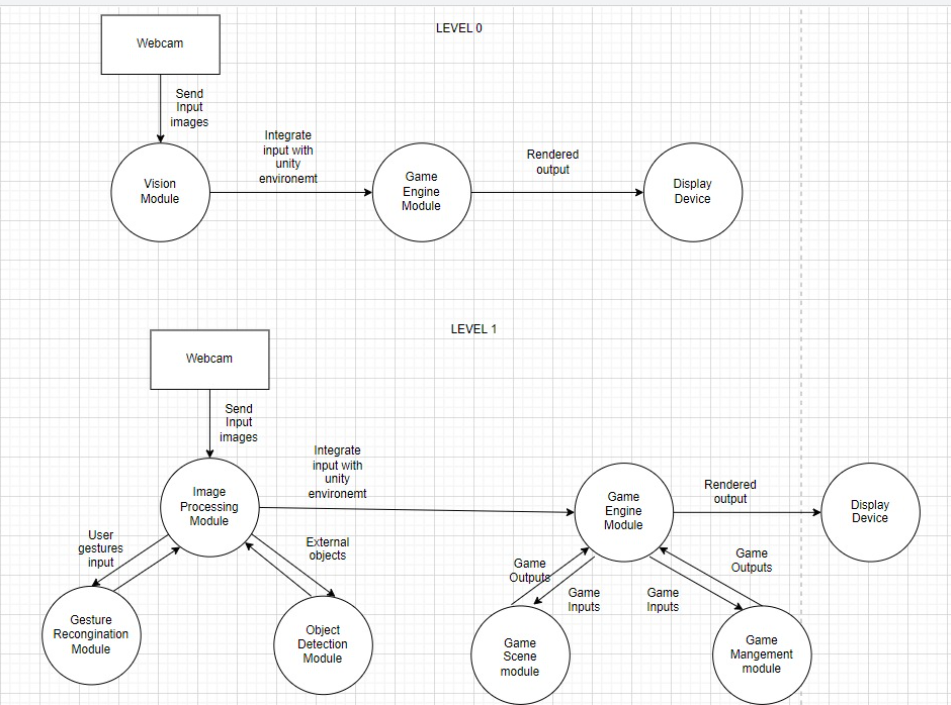
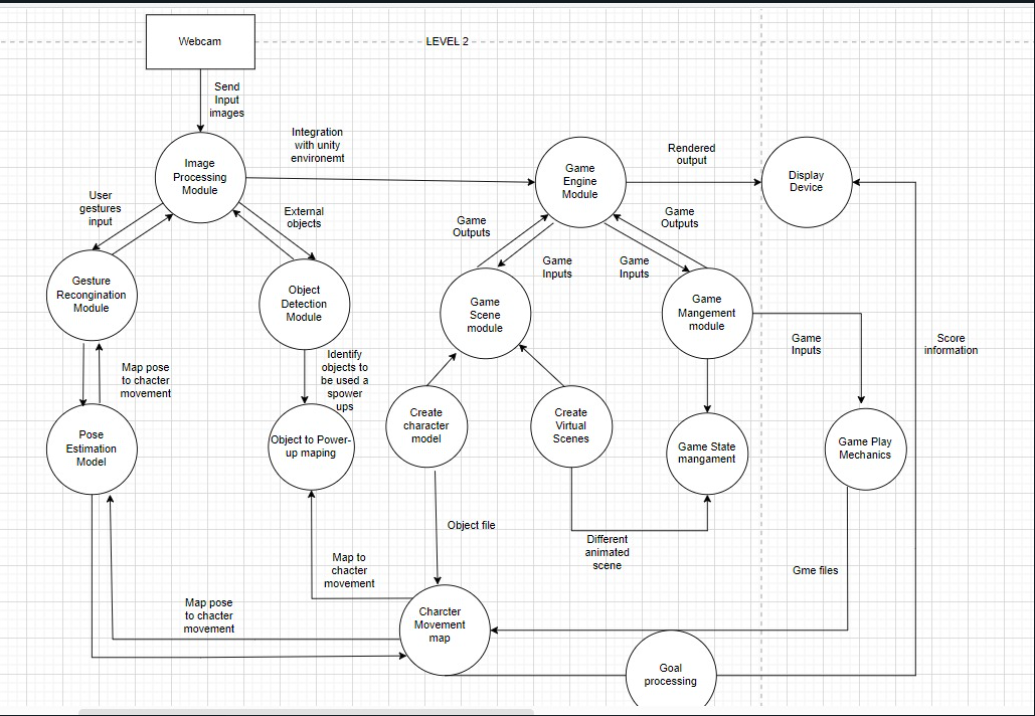


Fig 4.1 Block Diagram

**4.2 Design level diagram**



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# CONCLUSIONS AND FUTURE SCOPE



**5.1 Work accomplished**

The "Virtual Flight Simulator for Children" project has achieved significant milestones in line with its core objectives. Notable accomplishments include:

Gesture-Based Interaction: Successful implementation of body gesture interaction, enabling young users to control virtual characters and engage with the environment through natural movements.

Real-World Object Integration: Integration of real-world object interaction, enhancing immersion and interactivity within the virtual world.

Age-Appropriate Content: Development of educational content aligned with the cognitive and motor skills development of children aged 4-8.

Guided Missions: Creation of engaging guided missions that encourage problem-solving and decision-making skills in a fun and entertaining manner.

Responsive Interface: Design and implementation of a user-friendly interface optimized for children's intuitive navigation and interaction.

These achievements align with the project's objectives:

Engaging Learning: Gesture-based interaction and object integration offer an engaging learning experience for children.

Physical Activity Promotion: The project's design promotes physical activity and movement, contributing to children's well-being.

Innovative Approach: By combining technology, education, and entertainment, the project innovatively addresses the learning needs of young children.

**5.2 Conclusions**

The "Virtual Flight Simulator for Children" project has reached a pivotal stage, marked by significant accomplishments and a promising trajectory. Through successful implementation of gesture-based interaction, real-world object integration, age-appropriate content, and user-friendly design, the project has laid a strong foundation for an immersive, educational, and entertaining virtual experience for young users.

Key takeaways include:

Objective Alignment: Accomplishments closely align with the project's aim of creating an engaging and educational flight simulator for children.

User-Centric Design: The project's emphasis on age-appropriate content and intuitive interface design ensures a positive experience for young users.

Collaborative Efforts: Successful implementation requires collaboration between technical, design, and project management teams, highlighting the interdisciplinary nature of the project.

The "Virtual Flight Simulator for Children" project's achievements set the stage for a promising future, promising substantial benefits for young users' entertainment, education, and physical activity.

**5.3 Social benefits**

The "Virtual Flight Simulator for Children" project holds several social benefits for its target audience:

Enhanced Learning: Children benefit from an engaging and educational platform that fosters cognitive skills and problem-solving abilities.

Active Entertainment: The simulator promotes physical activity and offers an alternative to sedentary screen time.

Tech Exposure: Children gain exposure to technology in a controlled and educational environment.

Parental Involvement: The simulator encourages parent-child interaction, allowing parents to engage in their child's learning journey.

Safe Exploration: Children can explore imaginative virtual worlds while staying within a secure and age-appropriate digital environment.

In summary, the project contributes positively to children's learning, activity levels, and technology exposure, fostering a holistic and enriching experience.

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# APPENDIX A: REFERENCES



[1] Valentino, Kelvin & Christian, K. & Joelianto, Endra. (2017). Virtual reality flight simulator. 9. 21-25.

[3] Tong, Xin & Pekcetin, Serkan & Gromala, Diane & Machuca, Frederico. (2017). Exploring Body Gestures as Natural User Interface for Flying in a Virtual Reality Game with Kinect. Electronic Imaging. 2017. 60-63. 10.2352/ISSN.2470-1173.2017.3.ERVR101

[4] T. L. Munea, Y. Z. Jembre, H. T. Weldegebriel, L. Chen, C. Huang and C. Yang, "The Progress of Human Pose Estimation: A Survey and Taxonomy of Models Applied in 2D Human Pose Estimation," in IEEE Access, vol. 8, pp. 133330-133348, 2020, doi: 10.1109/ACCESS.2020.3010248

[5] M. Andriluka, S. Roth and B. Schiele, "Pictorial structures revisited: People detection and articulated pose estimation," 2009 IEEE Conference on Computer Vision and Pattern Recognition, Miami, FL, USA, 2009, pp. 1014-1021, doi: 10.1109/CVPR.2009.5206754.

[6] L. Pishchulin, M. Andriluka, P. Gehler and B. Schiele, "Poselet conditioned pictorial structures", Proc. IEEE Conf. Comput. Vis. Pattern Recognit., pp. 588-595, Jun. 2013

[7] A. Toshev and C. Szegedy, "DeepPose: Human Pose Estimation via Deep Neural Networks," 2014 IEEE Conference on Computer Vision and Pattern Recognition, Columbus, OH, USA, 2014, pp. 1653-1660, doi: 10.1109/CVPR.2014.214.

[8] Y. Yang and D. Ramanan, "Articulated pose estimation with flexible mixtures-ofparts", Proc. CVPR, pp. 1385-1392, Jun. 2011

[9] A. Rahmadani, B. S. Bayu Dewantara and D. M. Sari, "Human Pose Estimation for Fitness Exercise Movement Correction," 2022 International Electronics Symposium (IES), Surabaya, Indonesia, 2022, pp. 484-490, doi: 10.1109/IES55876.2022.9888451

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