**Project Title:** Pedal to Progress: Exploring Performance Variations in VR Cycling Through Scenario Design and Incentives

**Project Description:**

This project explores how different virtual reality (VR) cycling scenarios, each with unique environmental settings and motivational incentives, influence user performance, engagement, and fitness outcomes. Traditional VR cycling games often lack variety in their gameplay experiences, which can result in reduced motivation and adherence over time. By creating a VR cycling game that features diverse scenarios tailored to specific incentives, this project aims to deliver an engaging and fitness-oriented exergaming experience that appeals to a wide range of users, from beginners to fitness enthusiasts.

The core concept is to design multiple distinct VR cycling scenarios that challenge users in varied ways, replicating real-world motivations and activities to enhance immersion. Each scenario will feature unique objectives, environments, and gameplay mechanics.

These scenarios are designed to replicate different motivational triggers: the urgency of a time-bound task, the thrill of competition, and the stress of evasion, which in turn elicit varied user behaviours and performance patterns. Each scenario will include immersive visuals, dynamic soundscapes, and gamification features like achievements and leaderboards to keep users engaged.

To evaluate the effectiveness of the game, the project will involve a mixed-methods study. Participants will complete each scenario while their performance metrics, such as speed, cadence, power output, heartrate, and time to completion, are recorded. Additionally, qualitative data will be collected through user feedback surveys to understand the scenarios' impact on motivation, enjoyment, and overall experience. The study will also assess how these different gameplay elements influence users' willingness to maintain a fitness routine.

Accessibility is a key focus of the project, ensuring the game is intuitive and welcoming to users with varying fitness levels and technical expertise. The VR platform will offer adjustable difficulty levels and an easy-to-navigate interface, minimising barriers to entry for new users. The project also emphasises scalability, with the potential to integrate new scenarios and gameplay elements in the future.

By combining immersive VR environments with carefully designed motivational incentives, this project aims to contribute to the fields of VR gaming, fitness technology, and exergaming research. It seeks to demonstrate how diverse gameplay experiences can optimise user performance and foster sustained engagement in fitness activities. Beyond academic implications, the project has the potential to inspire commercial VR fitness platforms, offering a model for innovative, accessible, and enjoyable exergaming solutions.

**Aims and Objectives:**

Aim:

To develop a VR cycling game with diverse scenario designs that investigate how variations in environmental settings and motivational incentives impact user performance, engagement, and fitness outcomes. The project aims to address the lack of accessible and engaging VR cycling platforms that cater to users with different fitness levels and interests.

Objectives:

1. Design and Develop Immersive Scenarios
   * Create at least 3 distinct VR cycling scenarios, each with unique environments and incentives:
     + Pizza Delivery Challenge: time-based task in busy and overstimulating environment.
     + Competitive Bike Race: A race against AI opponents in an engaging racecourse.
     + Escape the Police: a high intensity pursuit scenario requiring fast decision-making skills.
   * Risk: Motion sickness in users could reduce immersion.
     + Mitigation: optimise VR graphics and usability features like adjustable camera and locomotion settings.
2. Incorporate Motivational Elements and Feedback
   * Design gamified incentives tailored to each scenario:
     + Time limits for urgency.
     + Leaderboards and rankings for competition.
     + Escaping a pursuing entity for pressure-driven motivation.
   * Include real-time feedback mechanisms to inform users of their performance.
   * Risk: Incentives may not be equally engaging for all users.
     + Mitigation: Collect study feedback to better implement incentives before finalising game design.
3. Evaluate Performance and Engagement Across Scenarios
   * Test user performance metrics such as speed, cadence, power, heartrate, and time to completion across scenarios.
   * Collect qualitative feedback on user engagement, scenario preferences, and perceived motivation.
   * Risk: Users may show varied fitness levels, affecting comparative results.
     + Mitigation: normalise results by grouping participants based on fitness levels and focusing on relative improvements.
4. Ensure Accessibility and Usability
   * Design an intuitive interface and implement adjustable difficulty levels to make the game accessible to users of all fitness levels.
   * Minimise hardware requirements to reduce barriers to entry.
   * Risk: Technical limitations in hardware or software integration
     + Mitigation: Focus on compatibility with commonly available VR systems and thorough pre-testing.

**Feasibility:**

Ethical Approval:

No significant ethical concerns are anticipated for this project as it involves voluntary participation in a VR cycling game. Participants’ data will be anonymised, and informed consent will be obtained before their involvement.

Legal Concerns:

This project will rely on third-party tools like Unity for VR development and potentially commercially available smart trainers for cycling hardware depending on the extent in which hardware compatibility is explored. Unity has free licensing tiers for academic purposes, ensuring compliance. Any sound effects, textures, or models used will be sourced from open-license repositories or created in-house.

Special Resources:

The project requires the following resources:

* VR Hardware: A headset such as the Oculus Quest 2 and cycling hardware like a smart trainer or exercise bike.
* Software: Game development software such as Unity and analytics tools such as Python or R.

**Work Plan:**

**Spring Week 1:**

* Write the initial report.
* Attend VR lab induction with the lab manager.

**Spring Week 2:**

* Set up the Unity VR project.
* Integrate Unity’s XR Hands package for controller-free gameplay.
* Implement data receiver code to collect data from the exercise bike, heart rate monitor, and any additional sensors.
* Develop a data logging system to store collected information in external files (.txt) for later analysis.

**Spring Week 3:**

* Create a hand-tracking-friendly menu screen for selecting different scenarios.
* Develop a prototype bicycle attachment for the player in a temporary sandbox environment.
* Implement a steering mechanism using headset rotations.

**Spring Week 4:**

* Design a city map that accommodates all three scenarios.
* Create a checkpoint/waypoint system to guide players and prevent them from getting lost.
* Develop a modular system to adjust the main map based on scenario requirements, e.g.:
  + Spawn pizza stores and customers for Scenario 1.
  + Add barriers and AI for Scenario 2.
  + Introduce police vehicles and roadblocks for Scenario 3.

**Spring Week 5:**

* Implement a basic AI model and develop Unity behaviour code to enable AI navigation with real-time performance metrics.
* Design the racecourse for Scenario 2 and bake the AI navmesh onto it.

**Spring Week 6:**

* Enhance the AI to chase the player while maintaining an escapable distance, ensuring the user must keep up their speed.
* Introduce roadblocks and obstacles that increase in difficulty over time, integrating these into the AI’s navmesh.

**Spring Week 7:**

* Focus on improving game graphics and completing unfinished visuals.
* Finalise the UI for menus and levels.
* Explore the Unity Asset Store for free or affordable assets to enhance the environments.

**References:**