Flappy VR: A Motion-Controlled Flying Experience

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Introduction

Motivation

The goal of this project was to create an engaging and immersive virtual reality (VR) experience that leverages **motion-based controls**. Inspired by the simplicity and addictiveness of *Flappy Bird*, I wanted to reimagine the mechanics for VR, allowing players to control a bird by **flapping their arms**. The challenge was to design **intuitive motion-based mechanics** that feel natural while incorporating physics-based movement in Unity.

What I Built

Flappy VR is a game where players embody a bird and navigate through a floating world. Instead of tapping a screen or pressing a button, players flap their arms while holding VR controllers to generate lift and propel forward.
The experience includes:

- **Realistic physics-based flight mechanics** using Unity's Rigidbody system.
- **Flap detection** based on analyzing motion data from the left and right VR controllers.
- **Dynamic obstacles and scoring system**, where players collect coins and land on platforms. Some platforms decrease the score, encouraging strategic movement.
- **Randomized obstacle spawning** to ensure unique playthroughs.
- **Sound effects that correspond to different collisions**, enhancing feedback and immersion.

Related Work

Inspirations

- **Flappy Bird** – The core gameplay idea was inspired by *Flappy Bird*, where **timing and precision** are key.

- **VR Fitness Games** – Titles like *Beat Saber* and *Supernatural VR* inspired the motion-based control mechanism.
- **Birdly** – A VR flight simulator that allows users to control flight using full-body motion, reinforcing the feasibility of my approach.

References

- **Unity Documentation**: Physics, Rigidbody, and XR Interaction Toolkit.
- **Research on Motion-Based VR Interactions** – Papers on gesture-based input in VR guided my approach to flap detection.

Implementation

Development Process

1. Setting Up Unity XR

- Created a Unity project with the **XR Interaction Toolkit**.
- Configured an **XR Origin** with a camera representing the player's head.
- Implemented **VR controller tracking** to detect motion.
- imported **environment** via unity assets for skybox and terrain.

2. Player Motion and Controls

- Attached a **Rigidbody** to the player to enable physics-based movement.
- Designed an **algorithm to detect arm flapping** and convert it into upward and forward motion.
- Implemented **force application** based on arm movement speed and frequency.

3. Physics & Movement

- Experimented with different **flap force values** for natural-feeling movement.
- Used Unity's built-in **gravity** instead of manually applying a downward force.
- Applied **constraints to prevent unintended rotation** and maintain stability.

4. Obstacle and Scoring System

- Coins and platforms have different **tags** to trigger specific score changes.
- Used **collision detection** to determine successful landings and score adjustments.
- Implemented **randomized spawning** of coins and platforms upon game start, ensuring replayability.

5. Audio Feedback System

- Different collision sounds were added for:

    - Collecting coins.
    - Landing on score-increasing platforms.
    - Hitting obstacles (negative feedback sound).
- Each sound is assigned based on the object's tag.

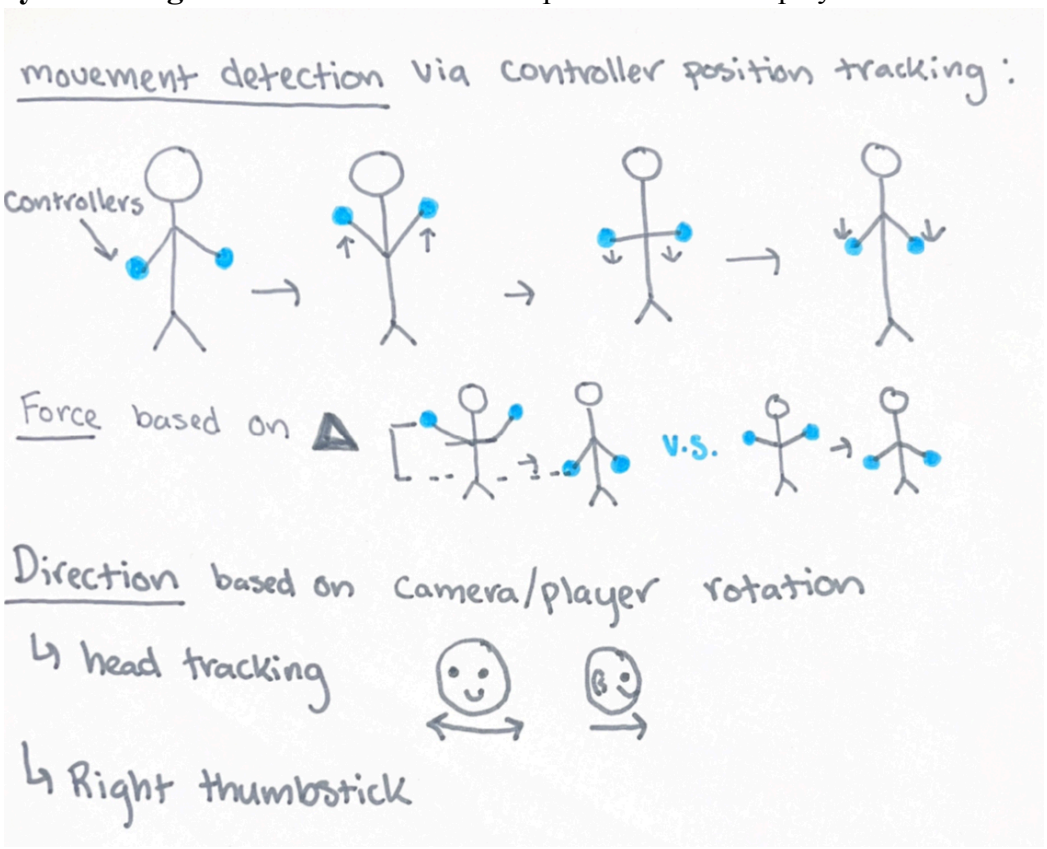
6. Debugging & Optimization

- Fixed issues related to **rigidbody physics** and unintended floating.
- Ensured **smooth flap detection** by refining motion thresholds.
- Improved **console logging** for better debugging within Unity.

Technical Details

- **Unity XR Interaction Toolkit** for VR integration.
- **Rigidbody physics** for movement.
- **C# scripting** for motion detection and game mechanics.
- **TextMeshPro** for in-game UI elements.
- **Randomized spawning system** for obstacles.

Figures & Diagrams

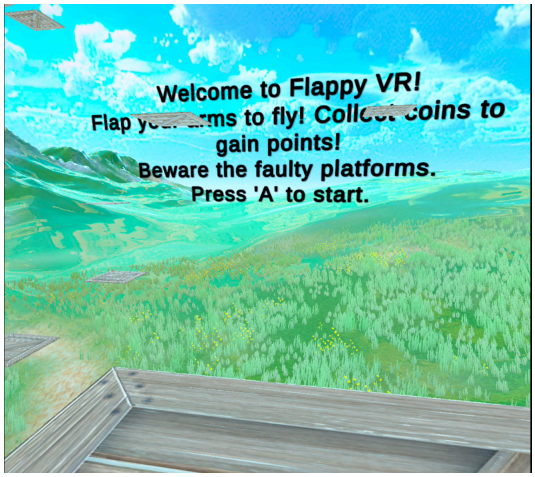
- **System Diagram**: Shows how motion input translates into player movement.
- 

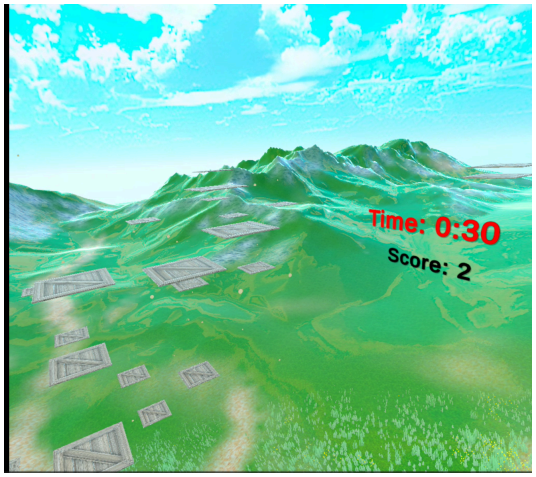
- **Code Snippets**: Key sections of the motion detection (flap) and physics handling logic.

```
void FixedUpdate()
    {
        if (!hasStarted) return; // Stop movement until game starts

        // Detect controller movement
        Vector3 leftPos, rightPos;

        if (leftController.TryGetFeatureValue(CommonUsages.devicePosition, out leftPos) &&
            rightController.TryGetFeatureValue(CommonUsages.devicePosition, out rightPos))
        {
            Vector3 leftVelocity = leftPos - previousLeftPos;
            Vector3 rightVelocity = rightPos - previousRightPos;

            previousLeftPos = leftPos;
            previousRightPos = rightPos;

            float flapSpeed = (leftVelocity.magnitude + rightVelocity.magnitude) / 2;

            Debug.Log("Flap Speed: " + flapSpeed);

            if (flapSpeed > flapThreshold)
            {
                Debug.Log("Flap detected! Applying force.");

                float flapMultiplier = Mathf.Clamp(flapSpeed * 2, 1, 3);

```

```
                Vector3 force = (Vector3.up * flapStrength *
flapMultiplier) +
                                (headTransform.forward *
forwardBoost * flapMultiplier);

                rb.AddForce(force, ForceMode.Impulse);
                // Play flap sound
                if (flapSound != null)
                {
                    flapSound.Play();
                }
            }
        }
    }
```

- **Gameplay Screenshots**: Illustrates the player navigating between platforms.





Future Work

Enhancements

- **Better Flap Detection**: Improve the motion tracking algorithm to reduce false-positive flaps.

- **More Engaging Levels**: Introduce different platform types and varying distances to increase challenge.
- **Multiplayer Mode**: Implement a competitive mode where players can race against each other (stretch goal).

Additional Features

- **Power-ups** (e.g., temporary speed boost, slow motion, extra points).
- **Customizable bird avatars**.
- **Leaderboard integration** for high scores (*coded this, but it currently needs debugging*).

Using AI for Debugging

Challenges Faced

- **Unintended Floating on Game Start** – Incorrect Rigidbody settings caused uncontrolled movement.
- **Flap Detection Issues** – The controller motion wasn't being read correctly.
- **Console Logging Problems** – Debug messages weren't appearing, making issue tracking difficult.

How AI Helped

- Identified **mistakes in my physics setup**, such as inconsistent force application.
- Debugged **motion tracking**, improving controller detection and movement calculations.
- Refined **force values** to ensure realistic flight mechanics.
- Optimized **logging techniques** for better debugging.

Through AI-assisted debugging, I was able to iterate faster, fix issues efficiently, and refine the game mechanics for a smoother experience.

Conclusion

Flappy VR reimagines *Flappy Bird* in an **interactive, motion-controlled VR format**, making flight mechanics feel more intuitive and immersive. The game engages players through **real-world movement**, providing an exciting and physically active experience. Debugging with AI significantly accelerated development, helping to refine physics and motion detection while improving the overall playability.

GitHub Link (code and builds): https://github.com/JordynRabinowitz/FlappyVR