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Research Proposal: Player-Centric Dynamic Difficulty Adjustment

Research Focus and Objectives

The research our team will be focusing on is the topic of Dynamic Difficulty Adjustment (DDA) systems in games tailored for single-player and cooperative multiplayer games. Firstly, a simple definition of DDA in an article by Xenon Stack, "AI algorithms can modify the game's difficulty based on a player's skill level or performance. This ensures that players are continuously challenged without feeling overwhelmed or bored.

(<https://www.xenonstack.com/blog/trends-in-gaming-industry>)

Beyond simple metrics like player deaths, our research will focus on creating a model that analyzes a wider range of in-game behaviors, such as resource management, tactical positioning, objective efficiency, and exploration patterns, to build a comprehensive profile of a player's or a team's collective skill. The primary objective is to create a DDA system that can subtly and intelligently adapt to the game's AI-driven challenges in real-time. By doing so, we aim to keep solo players or co-op groups in a consistent state of "flow", maximizing their engagement and satisfaction by ensuring the difficulty is always challenging yet fair.

Demonstration and Showcase

The demonstration will be a small-scale game prototype, likely prototyped using a commercial game engine such as Unity, and we will use an action game or horde shooter to showcase the DDA system as a core feature. The demo will be designed to showcase how the system adapts to players with differing skill sets. On-screen visualizations will illustrate in real-time how the system analyzes player performance and makes adjustments to game parameters. For example, it will show changes in enemy AI aggression, the complexity of attack patterns, the quantity of spawned enemies, or the availability of resources based on the players' actions. The goal is to clearly demonstrate how the system provides a tailored and engaging experience for a low-skill and high-skill player, all within the same game.

Value for Professional Game Developers

This research is highly valuable to professional game developers as it directly addresses player retention in Player vs. Environment (PvE) focused games. A sophisticated DDA system can significantly reduce player churn caused by frustration from insurmountable difficulty spikes or boredom from a lack of challenge. For instance, notoriously difficult single-player games like FromSoftware's *Elden Ring* or *Sekiro: Shadows Die Twice* could use such a system to become more approachable for a wider audience without compromising the core challenge that their fans celebrate. Furthermore, in cooperative titles like *Helldivers 2* or *Deep Rock Galactic*, a player-centric DDA could dynamically adjust the intensity of enemy encounters based on the

squad's coordinated efficiency and resource levels, ensuring that teams of varying skill levels experience a consistently thrilling and rewarding challenge, ultimately leading to a larger, more satisfied, and more engaged player base.