Thesis Project Portfolio

Space Debris Tracking CubeSat

(Technical Report)

Monetization Models in Video Games

(STS Research Paper)

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Executive Summary

The Space Debris Tracking CubeSat project was conceived to bridge a crucial gap in orbital surveillance by developing a sensor capable of detecting small-scale debris, thereby enhancing spacecraft safety in increasingly congested low Earth orbit. On the other hand, the teenage growth spurt of the gaming industry has led to many stretch marks, one of which being the monetization strategies which, while being very pleasing to shareholders, have come under scrutiny from leveraging psychological tactics that can lead to detrimental consumer behaviors. While not directly related, both of these projects aim to understand, and ultimately protect us against ourselves, solving the problems the earlier and more turbulent technologies have generated.

The Space Debris Tracking CubeSat project aims to address the increasing threat posed by small orbital debris in Low Earth Orbit (LEO). With the expansion of large satellite constellations such as Starlink and Iridium, collisions with untracked debris smaller than 10 cm present a growing risk to operational spacecraft. A particle as small as 3mm can still potentially rip a hole in the ISS, and most satellites are even more vulnerable. To mitigate this issue, our project focuses on developing a sensor system capable of detecting, tracking, and transmitting data on small-scale space debris. This sensor will be integrated into a modular CubeSat platform designed for deployment in LEO.

For this capstone project, our goal was to design, prototype, and evaluate technologies required to create such a device in order to advance the technology readiness level of the primary systems involved. We created simulations to measure statistics of the expected amount of debris our satellite could track over the course of an orbit and to what accuracy and certainty. We found

that, due to the limitations of the cubesat platform, we would likely only see single digit counts of debris per orbit, however, the accuracy of these orbits would persist over a considerable duration before the data was obsolete. Because of our low “coverage” of the total amount of estimated millimeter space debris, this cubesat would serve more as a debris distribution validator, refining our understanding of how the density of millimeter debris changes over space and time.

The gaming industry has seen rapid growth, however, monetization models like battle passes and loot boxes have raised ethical concerns due to their reliance on psychological manipulation, such as fear of missing out and gambling mechanics. This research seeks to explore ethical monetization models that balance player well-being with developer revenue. The evolution of gaming monetization has shifted from traditional one-time purchases to a variety of models, including microtransactions, downloadable content, subscriptions, and in-game advertisements. To analyze this problem, I will apply both Technological Determinism and the Social Construction of Technology to understand monetization trends.

While F2P games remove financial barriers to entry, they often employ microtransactions, loot boxes, and psychological tactics to maximize player spending, leading to ethical concerns and potential links to Internet Gaming Disorder (IGD). Studies show that monetization structures, more than genre, correlate with IGD, as recurrent spending mechanisms encourage compulsive behavior. Critics argue that such models manipulate consumer behavior, particularly through virtual currencies that obscure real-world costs, and have prompted calls for stronger digital consumer protections. In contrast, P2P models provide a more transparent gaming experience, reducing risks associated with compulsive spending, making them a more ethical alternative.