

# SuperTuxKart Telemetry & Frustration Analysis Report

## 1. Telemetry Collection Overview

SuperTuxKart was modified to record gameplay telemetry during every frame of a race. A logging mechanism was added to capture player inputs, kart dynamics, and environmental conditions such as whether the kart was on the ground. Each race session received a unique game ID, allowing all frames from the same run to be grouped later. (Details are given in [github](#) repository)

A total of 168 gameplay sessions were recorded across 21 tracks, 4 difficulty levels, and 2 runs per track–difficulty combination. The data was exported into CSV logs for analysis.

## 2. Frustration Indicators

To assess gameplay difficulty and player frustration, three behavioral signals were extracted for every race session:

- i. Off-Ground Ratio:* Measures how often the kart is airborne or loses contact with the track. High values typically indicate jumps, falls, or being pushed off-track, events that interrupt flow and are commonly frustrating.
- ii. Sudden Speed Drops:* Captures how many times the kart rapidly loses speed. This usually reflects collisions, hitting walls, or falling from the track.
- iii. Steering Instability:* Counts how often the player switches steering direction abruptly. Frequent direction flips indicate challenging curves, overcorrection, or difficulties with maintaining control.

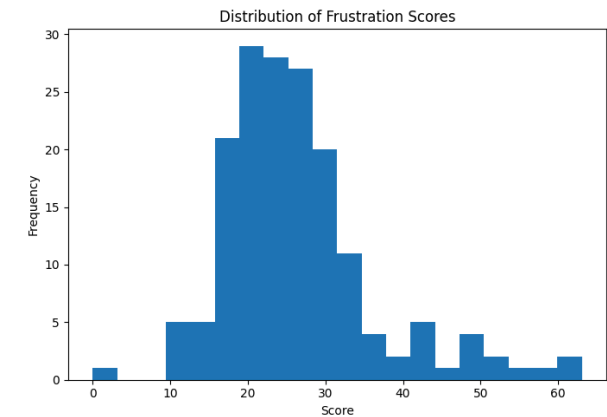
## 3. Frustration Score

A composite frustration score was built from the three signals. Off-ground events and sudden speed losses were given the highest importance because they cause the most severe disruption, while steering instability contributed a smaller yet meaningful component. This produced one frustration value per race.

$$\text{FrustrationScore} = 0.4 \times \text{OffGroundRatio} + 0.4 \times \text{SpeedDropCount} + 0.2 \times \text{SteerChanges}$$

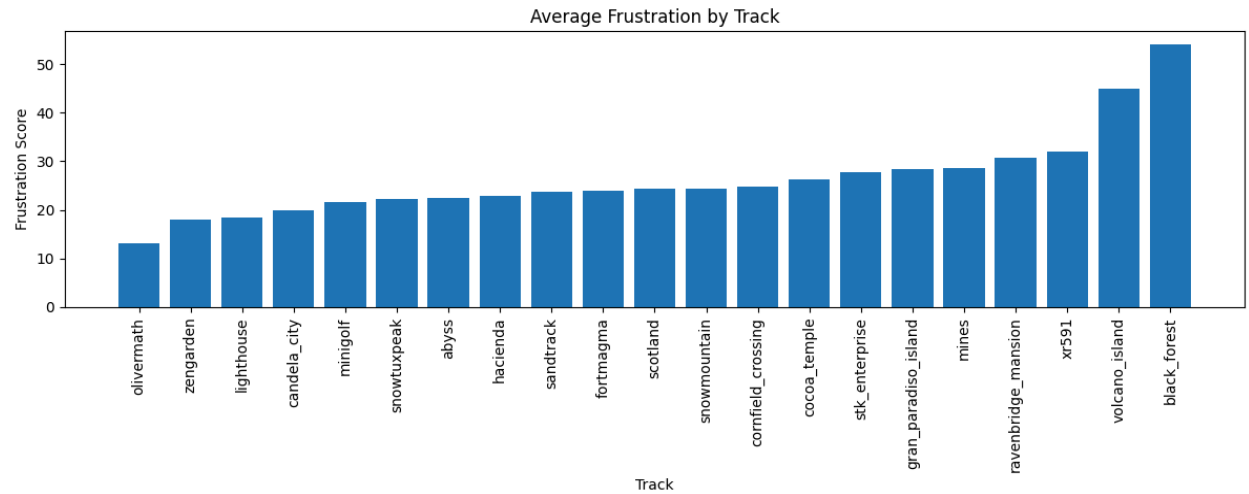
## 4. Track-Based Analysis Results

*Frustration Score Distribution:*



Across all sessions, most races generated moderate frustration. A few sessions, however, showed very high frustration, almost always tied to tracks containing significant jumps, narrow turns, or vertical changes. This confirms that the metric depicts real gameplay challenges.

*Average Frustration by Track:* Tracks exhibited clear differences:



- *Higher frustration tracks:* Tracks with higher frustration usually had difficult layouts, for example, very sharp turns, sudden changes in direction, steep slopes, or many obstacles on the road.
- *Lower frustration tracks:* Tracks with smoother curves, fewer interruptions, and more predictable layouts.

This indicates that frustration is strongly tied to track design.

### 5. Implications for Track Design

A larger dataset collected from many players and many repeated runs would help identify the exact areas of each track that cause high off-ground ratios, sudden speed drops, or unstable steering. With more data, developers could pinpoint which jumps make players fall too often, which corners cause frequent crashes, and which sections lead to over-corrections in steering. These areas could then be improved by smoothing ramps, widening tight turns, adjusting obstacle placement, or adding clearer visual guidance.

At the same time, it is important to balance difficulty. Some challenging sections are fun and make the game exciting. The goal should not be to remove all difficulty, but to ensure that tough areas feel fair, not frustrating. A richer dataset would help developers to create the right balance between challenge and enjoyment.

### 6. Limitations of the analysis

- Only one player generated all data (skill and playstyle bias).
- Each configuration was tested twice, providing limited samples per track.
- Real-world player variation and multiplayer conditions were not captured.

### Links

1. Github repository: <https://github.com/emon-swe-sust/SuperTuxCart-analysis>
2. ChatGPT log: <https://chatgpt.com/share/6925cbd5-0a04-800a-941e-bdf1161a07f0> [Additionally used copilot while working on vscode]

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