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WINLAB | Wireless Information Network Laboratory

Cyber-Physical Simulation of Mario Kart

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Overview

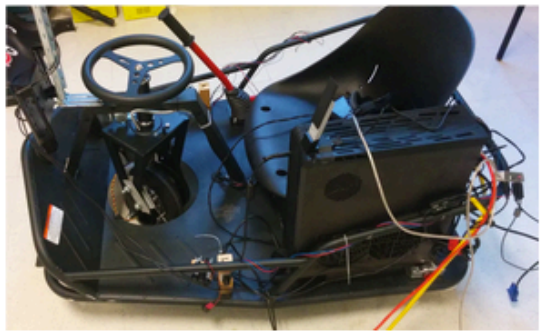
The purpose of this project was to design and develop a realistic virtual reality simulation of the game Mario Kart for a human driver on a real go-cart within a test track.

The following components were provided as a starting base:

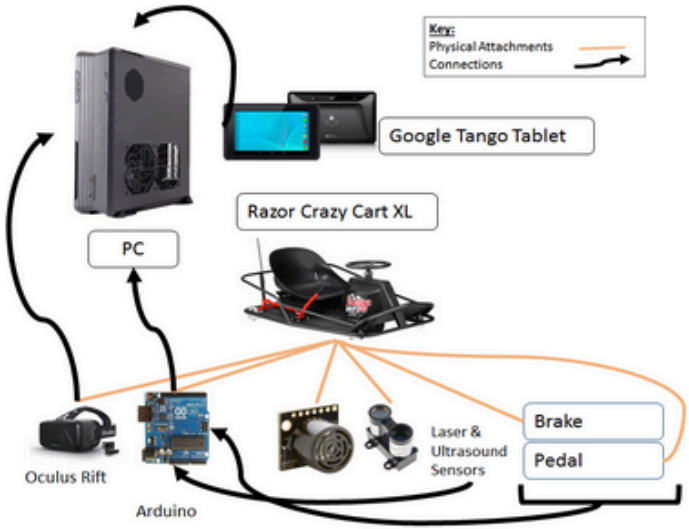
- Razor Crazy Cart XL
- Windows 8.1 PC
- Oculus Rift DK2
- Google Project Tango tablet
- Arduino Uno platform
- Ultrasonic and laser distance sensors

These technologies were grouped and connected to form the system model based on the following high-level criteria:

- Virtual reality for immersion into Mario world
- Protocol for driver safety (driving blind!) by incorporating hardware and software
- Mechanical and software additions to allow various gadgets to interface with each other to create a seamless VR experience



System Model



Virtual Reality

- Race track is built in Unity to the scale of ORBIT testbed facility
- Unity in PC displays to Oculus headset with a heads-up display for sensor information and relevant warning messages
- Player and camera movement shown inside the headset are determined by pose data from Tango tablet

Safety Features

- Arduino reads distance values from sensors
- Disconnects gas pedal when readings fall below safe threshold (3 meters)
- Caution message is displayed in VR headset based on sensor measurements to signal possible collisions in real world

Integration of technologies

- Established socket connection over WiFi between Tango and PC for localization
- Created serial port connection to allow 2-way comms between Unity and Arduino
- Optimized performance to improve update rates for the rendering of the virtual world

Challenges

- Networking between instances of Unity running on Project Tango tablet and PC
- Creating dynamic HUD in stereoscopic 3D
- Interfacing Arduino with the gas pedal
- Receiving various sensor data in Unity without decrease in performance
- Minimizing drift, lag, and stutter in cart movement and head rotation

Results

Videos will be available on the website!

Future Work

- Extend the model for multiple players
- Complete the ongoing addition of brake and its safety automation
- Enhance response time and reduce networking lag
- Speed throttling for off-track driving
- Add more Mario Kart game elements (ex: banana peel, mushroom)

References

1. Unity C# API
2. Project Tango Unity API
3. Oculus Rift DK2 Unity API
4. PulsedLight Github Repository
5. RobotMonkeyBrain's *Good Enough Guide to Unity's Unet Transport Layer (LLAPI)*
6. Goldstone, Will, *Unity Game Development Essentials*

https://sites.google.com/site/winlabmariokart

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