Mario Kart And Ride Replay Simulation

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Problem/Objectives

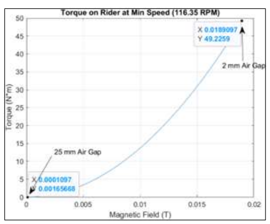
The objective of this project is to improve upon the previously designed Mario Kart gaming simulation by implementing a dynamic resistance system intended to provide a realistic game play experience.

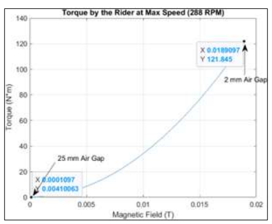
In addition to the Mario Kart gaming improvements, the designed components are also capable of recording real riding data, allowing users to create their own riding courses. Any user with the Mario Kart simulation bike will have the ability to install a custom recorded course and replay the recorded ride. The custom course will provide the user with an accurate representation of the recorded ride, as well as accurate resistance felt by the rider recording the data due to changes of the bike's incline through the course.

Analysis Results from Signoffs

Resistance System:

- An Eddy Current Braking (ECB) system was designed to achieve dynamic resistance felt by the rider.
- Pre-experimental analysis proved that varying the distance of a magnetic field between a rotating conductor such as an aluminum flywheel will create braking torque on the flywheel.
- Using Lenz's law, a mathematic model was created using two neodymium disk magnets at a varying distance of an 8" diameter rotating aluminum flywheel with varying angular velocity.





The graphs above represent the theoretical torque that can be achieved at the proposed minimum and maximum speeds of 116 RPM and 288RPM.

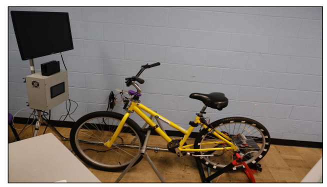
Sensor Wireless Communication:

- Analysis indicated existing steering and speed sensors perform to specification and are adequate to meet the intended performance, including the enhanced resistance and trail ride features
- New design added the convenience of wireless connectivity using Arduino Nano 33 BLE and a Raspberry Pi (RPi)
- Analysis indicated that battery packs would be a sufficient power supply for Arduino microcontrollers providing both wireless connectivity and Bluetooth connectivity
- Battery packs supply power sufficient for 4 hours of constant use each day for 2 week
- Analysis indicated a max transmission latency of 40 ms
- Speed sensor's microcontroller will be used in conjunction with an infrared sensor to accurately measure the speed of the rear wheel

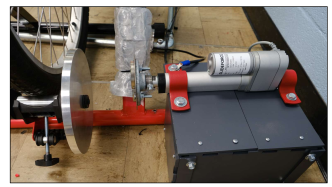
From left, Ray Durlin, Sage Mooneyham, Ben Durlin, Tyler Chittum, Blake Pickett

Experimental Results – Solutions Success

Mario Kart Simulation

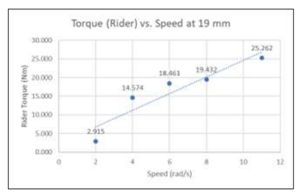


Resistance System



Resistance System:

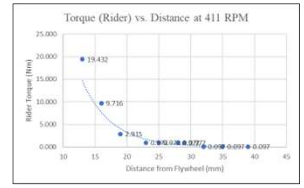
- The experiment was performed by placing a scale underneath the actuator stand to measure the opposing force of the on the magnets.

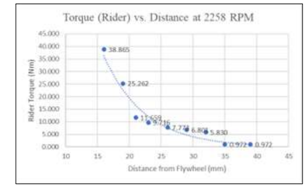


The graph above represents experimental data gathered at a distance of 19mm, which proved the functionality of the resistance system.

- The experiment proved that 54 of the 85 resistance states could be achieved.
- Throughout the testing of the resistance system, it was determined that there were several factors that limited the resistance states to 54, including that the minimum resistance felt by the rider is 0.09716 Nm.
- The maximum torque achieved at the minimum experimental speed of 411 RPM is 0.09716 Nm.
- The maximum torque achieved at the maximum experimental speed of 2258 RPM is 38.865 Nm.

Experimental Results – Continued

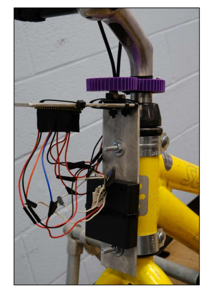


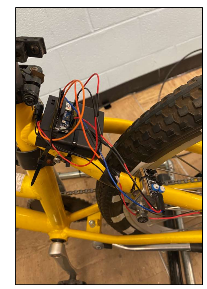


The above graphs represent the data gathered at the minimum and maximize speeds achievable for the experiment.

Sensor Wireless Communication:

- Design enabled data gathered by the speed and steering sensors and the right and left handlebar buttons to be transmitted wirelessly
  - Gathering data, converting it, and sending it via Bluetooth to the master microcontroller, the RPi
- Both the steering sensor and speed sensor each has its own microcontroller, an Arduino Nano 33 BLE, to utilize Bluetooth communication to the central RPi
  - Battery packs supply power sufficient for 4 hours of constant use each day for 2 weeks





The photos above show the Steering Sensor Subsystem (left) and the Speed Sensor Subsystem (right).

Future Work

- Enclose all Steering Sensor Subsystem equipment
- Replace tape on tire with paint or design new means of measuring speed
- Design means to prevent handlebars from turning 360 degrees
- Reduce flywheel size for further evaluation
- Design a means for adding magnets on both sides of the flywheel
- Find a means of decoding Nintendo switch Rumble data output
- Change frame rate of ride replay video based on speed