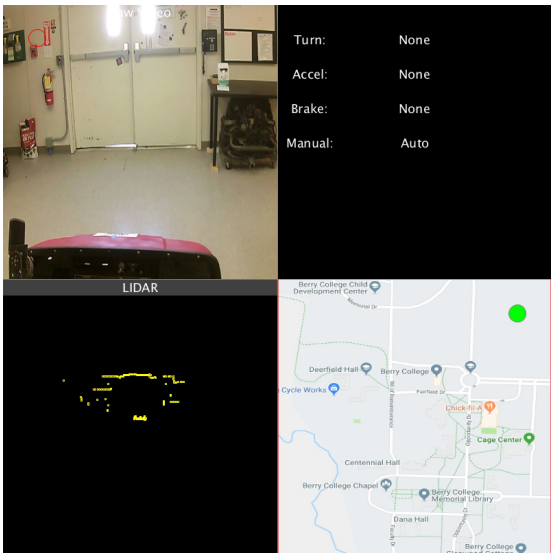
OttoKart Challenge Document

Challenge #0: User Interface

In this challenge, you are to develop a simple graphical user interface to show what commands the Processing sketch is sending to the OttoKart. Currently, this information is being shown using text in the upper right hand panel (400 x 400 pixels). You must make graphics to show the following information instead:



- statusTurn
  - 0 - Stop Turn
  - 1 - Left Turn
  - 2 - Right Turn
- statusAccel
  - 0 - Accel Stop
  - 1 - Accel Slow
  - 2 - Accel Walk
  - 3 - Accel Release
- statusBrake
  - 0 - Brake Stop
  - 1 - Brake Slow
  - 2 - Brake Walk
  - 3 - Brake Release
  - 4 - Brake Full
- statusManual
  - true - Manual On
  - false - Manual Off
- steerCounter (Neg - Left // Pos - Right)
- isSafeSteer
  - true - SafeSteer On
  - false - SafeSteer Off

Challenge #1 : Obstruction Avoidance (LIDAR)

In this challenge your ultimate goal is to be able to navigate around obstacles that are in front of the OttoKart. The testing criteria is as follows:

Objective #1 - Emergency Stop

The OttoKart (pink) will be positioned ~25 yards away from the LabKart (green). The OttoKart must accelerate to the WALK speed setting. When it detects the LabKart, the OttoKart should come to a complete stop. Repeat the test with a lab garbage can (to represent a pedestrian).

Effectiveness will be measured on the final distance between the OttoKart and the obstacles. A collision will result in an automatic zero for the assignment.

Objective #2 - Lane Shifting

The OttoKart (pink) will be positioned ~25 yards away from the LabKart (green). The OttoKart must accelerate to the SLOW speed setting. When it detects the LabKart, the OttoKart adjust its course to maneuver around it and resume its course. Once it has resumed its course, it should come to a stop.

Effectiveness will be measured on the final alignment between the OttoKart and LabKart. A collision between the two karts or any other vehicle will result in an automatic zero for the assignment.

Suggestions:

- Begin with the OttoKart in a stationary position and running the software. Have a team member slowly drive the LabKart toward the OttoKart and observe the response on the LIDAR.
- The LIDAR is a 360° sensor. You will need to distinguish between objects in front of the sensor and objects to the side or behind the sensor (including to OttoKart itself).
- Once you have created an algorithm, test it first by using the method above where it stays stationary and the LabKart drives toward it. Observe the brake and accelerator pedals and adjust your algorithm accordingly.
- When performing a live test, someone should always be in the driver's seat of the OttoKart and ready to hit the brakes. If an emergency stop is necessary, press the brakes, turn off the kart, press both emergency stops, and exit the software. Once the OttoKart is neutralized, reposition the kart and start again.

Challenge #2 : Local Navigation (Image Processing)

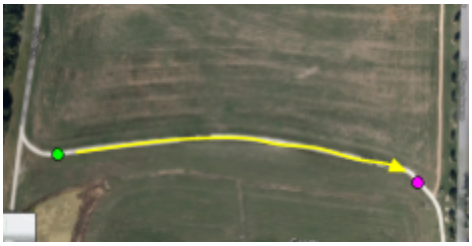
In this challenge your ultimate goal is to be able to navigate a stretch of Viking Trail in the OttoKart. The testing criteria is as follows:

Objective #1 - Maintaining Course

The OttoKart (pink) will be positioned on the section of Viking Trail running along the Road of Remembrance. The OttoKart must accelerate to the WALK speed setting. It must stay within the bounds of the sidewalk until the end of the section after which the OttoKart can be manually disabled.

Effectiveness will be measured by the relative straightness of the path taken and the number of times the OttoKart deviates from the sidewalk.

Objective #2 - Dynamic Navigation



The OttoKart (pink) will be positioned on the section of Viking Trail running along Deerfield. The OttoKart must accelerate to the SLOW speed setting. It must stay within the bounds of the sidewalk until the end of the section after which the OttoKart can be manually disabled.

Effectiveness will be measured by the ability of the OttoKart to navigate the curved path and the number of times it deviates from the sidewalk.

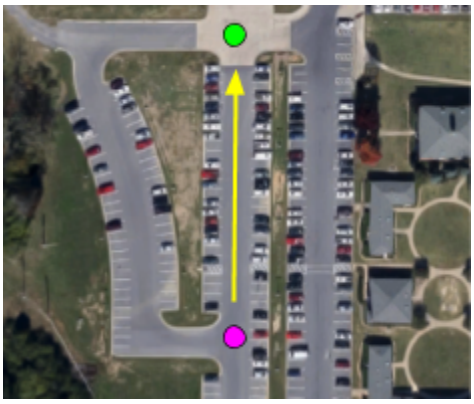
Suggestions:

- Begin in the LabKart and drive each section several times, paying close attention to how you are adjusting the steering wheel. Then *VERY CAREFULLY* have the close their eyes while a teammate gives them simple directions, e.g. “left”, “straight”, or “right” to navigate the path. Use this experience to inspire your algorithm.
- Use the OttoKart with the manual steering controls (but control the accelerator and brake with your feet) and steer along each path using the buttons. Carefully observe the effects that small changes in the steering has on the direction of the kart.
- Develop your algorithm to first only control the steering. This way you can manually control the brake and accelerator as you hone your program.
- Be aware that changing lighting conditions may affect the video input.
- Take care to not exceed the turning limits of the OttoKart (it can only turn left or right so much). Exceeding this limit may result in damage to the OttoKart and will negatively affect your performance grade.
- Always be ready to deactivate the kart using the emergency stop switches and manually activating the brake.

Challenge #3 : Global Positioning (GPS)

In this challenge your ultimate goal is to be able to navigate around a predefined path using GPS coordinates. The testing criteria is as follows:

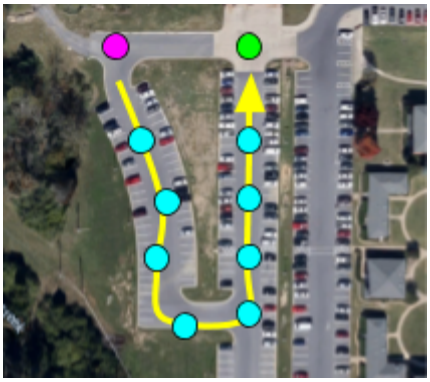
Objective #1 - Single Point Navigation



The OttoKart (pink) will be positioned at a given GPS point in the testing lot. The OttoKart must accelerate to the SLOW speed setting and navigate to the targeted GPS point. It should come to a stop when it is within 5 meters of the given targeted GPS point.

Effectiveness will be measured on the final distance between the OttoKart and the targeted GPS point. Any collision will result in an automatic zero for the assignment.

Objective #2 - Multi-Point Navigation



The OttoKart (pink) will be positioned at a given GPS point in the testing lot. The OttoKart must accelerate to the SLOW speed setting and navigate to a series of given GPS points. It should come to a stop when it is within 5 meters of the final GPS point.

Effectiveness will be measured on the number of GPS points the OttoKart is able to navigate to. Any collision will result in an automatic zero for the assignment.

Suggestions:

- Develop an algorithm that determines the current direction of the OttoKart and the ideal direction to the given GPS point.
- GPS works best when moving (even slowly) so try to keep the kart moving.
- Once you have developed an algorithm, use the LabKart to test it by having one teammate drive and the other read off directions, e.g. “left”, “straight”, “right”, “stop”, “go” to navigate to the GPS point.
- An additional GPS sensor is available that can be used separately from the OttoKart.
- Use several previously recorded GPS points from the sensor to look for a pattern and rule out any erroneous readings.
- Mind your speed! Traversing slight hills can give your algorithm very little time to react.
- When performing a live test, someone should always be in the driver's seat of the OttoKart and ready to hit the brakes. If an emergency stop is necessary, press the brakes, turn off the kart, press both emergency stops, and exit the software. Once the OttoKart is neutralized, reposition the kart and start again.