# Neato Kart Live: MAC Circuit

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## Project Idea

Inspired by the Mario Kart Live: Home Circuit, this project aims to build a Neato-racing experience that involves multiple Neatos at the same time, with users' ability to create their own circuits, use items during the race, and a UI that users can look at while playing the game.

## Motivation

We as a team wanted to solidify the existing knowledge we learned this semester. This led to thinking about a project that involves the following aspects:

1. The use of multiple frames and conversion of transformations between them. This was briefly touched on during the localization project, but we thought having more experience with this will enhance our understanding.
2. We wanted to touch more on computer vision in robotics, as the only algorithm we used during the last project was color detection while there are so many other cool ways to achieve tasks.
3. Utilizing and controlling multiple Neatos at once, while in some way they communicate or share information with each other.

With the listings of things we wanted to dig deeper into, it will be a great opportunity to invest time in this project.

## Ethics and Responsible Use Statement

Reading the guidelines, it's been hard to clarify possible ethical concerns that can happen with the implementation of this project. There's a possible concern with using Neatos which will be using computer vision, and we will have to figure out ways to exclude personal information. Also, as this project aims to do a competition between people, it will be great to consider the possible impact of having

Although we cannot identify any immediate ethical concerns that might arise from our project, please let us know if there are any that the teaching team identifies.

## Ideas

### Build Your Own Circuit

This can be done in multiple ways, but the approach we have in our mind is using April Tag to build the start point and checkpoints. By driving the circuit building Neato once, it will create a map frame where we know where the April Tags were located. Once the map frame is created and the race starts, it will be possible to convert each Neato's Odom frame to the map frame and figure out the current location of Neatos based on April Tag detection (angle/distance calculation). It will be possible to correct the error in transformation every time each Neato passes by the checkpoint.

One challenge here is to figure out the correct angle/distance from each April Tags as this will be essential in creating the circuit. There might be changes in plans based on how successful we are with this progress.

**Controlling Multiple Neatos**

This is the part that can be challenging. There are two options for this approach:

1. Using a single computer to set up the map and also play the game. This can be done by using Paul's code which enables us to control multiple neatos by giving different topic names. Since every topic runs locally, it will be relatively easy to access each topic.
2. Using a computer to run info about the map and each user access to this through their own computer. This will let more than a certain number of users join the game, and make a cool demo by letting users join the game in real time, but will be very difficult by adding a network aspect to this project.

**UI**

The goal of this project is that the user should be able to play this game without looking at the actual Neatos, but just by looking at the screen. We are considering using the OpenCV window and adding some drawings to build the UI. The UI will include the following aspects:

1. Drawing of the circuit that the user can follow based on the map frame.
2. Current Neato Speed.
3. Rankings.
4. Location of the items, current item the user holds.

**Racing**

A simple Teleop code will be written so that Neatos can be controlled like a racing game (acceleration key, left and right for steering). Also, there should be an indication that the race started/ended, and what are the rankings of the users right now.

**Obtaining/Using Items**

Items are essential in creating the game experience because Neatos are super slow, and it is impossible to pass the Neato in front of you. By having the list of locations of items on the map frame, it will be possible for each user to interact with them:

1. For simplicity, it is possible to just give out one item every time the user passes by the checkpoint. Other than that, we can create a topic that shares the location of item boxes on the map, which each user can receive and obtain items.

2. Items we are considering are bananas, boosters, and possibly turtle shells. Banana's information can be sent as the location on the map frame, and if the user steps on it the Neato will rotate. Boosters are simple, as Neato's maximum speed can be adjusted. The turtle shell is similar to bananas but will be moving around inside the map frame.

## MVP and Stretch Goal

It will be great to implement all the ideas above, but it is clear that we will be over-scoping by doing this. So for the MVP, it will be best to aim to finish the first two ideas, **Build Your Own Circuit** and **Controlling Multiple Neatos**, and implement drawing of the circuit on the user screen from the **UI** part. If we have available time and energy, the rest of the ideas can also be implemented as stretch goals.

## Timeline

Nov 29, 2022 Project Story 1 Due
Dec 9, 2022 Project Story 2 Due
Dec 14, 2022 Project Presentation (Final Period)
Dec 19, 2022 Project Documentation Due

| Sun | Mon | Tues | Wed | Thurs | Fri | Sat |
|---|---|---|---|---|---|---|
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18<br>**Phase 1 Due**<br>(Build Your Own Circuit) | 19<br>Thanksgiving |
| 20<br>Thanksgiving | 21<br>Thanksgiving | 22<br>Thanksgiving | 23<br>Thanksgiving | 24<br>Thanksgiving | 25<br>Thanksgiving | 26<br>Thanksgiving |
| 27 | 28 | 29<br>**Project Story 1 Due** | 30 | 1 | 2<br>(Controlling Multiple Neatos) | 3 |
| 4 | 5 | 6<br>(UI) | 7 | 8 | 9<br>**Project Story 2 Due** | 10 |
| 11 | 12 | 13 | 14<br>**Project Presentation Due**<br>(Stretch Goals) | 15 | 16 | 17 |

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| 18 | 19<br>**Project Documentation Due** (Website & Documentation) | | | | | |

## Risk

We can already expect some challenges for each step, and based on how much time we are drained on them, it is possible that we have to adjust the plan based on the available time left.