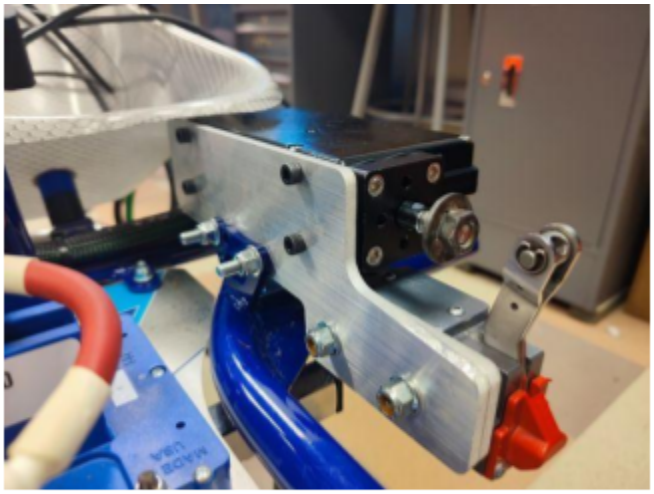
Executive Summary

Triton AI is a student organization led by Jack Silberman which focuses on artificial intelligence application and robotic competition. For this project, Triton AI required a hybrid mobile vehicle that has both autonomous and human control on an electric go-kart platform, and the team needed to discover a simple, replicable, and low-cost design for the public. To achieve this, two primary subsystems' designs were requested by the sponsor: autonomous brake and steering systems with electric or mechanical disengagement mechanism switching to manual control. The primary control for the two systems is through Controller Area Network (CAN), which is a universal vehicle standard that allows the microcontrollers to communicate with other components without a host computer.

Project platform: MSTEM3 from TOP KART

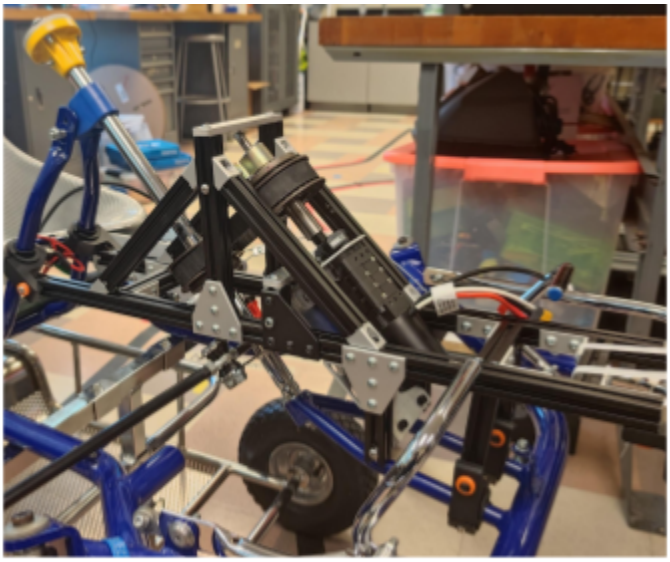
Due to the limited space available on the go-kart platform, the mounting position of each subsystem needed to be placed on the side or above the chassis because the human driver would occupy most of the middle space of the kart. In the existing solution, the brake system was initially sitting under the driver's left knee, which restricted the room for placing a large linear actuator. To improve this, the team needed to elevate the seat by inserting multiple 3D printed spacers and customized a set of brackets to carry the brake system.



The position of brake system

The key decision of Kar-tech linear actuator was affected by several specifications:

1. 400.34 N (90 lbf) dynamic force and 1334.47 N (300 lbf) static force providing more than enough for deceleration of the go-kart.
2. CAN bus communication enabled precise position control.
3. The built-in contactless sensor for stroke position measurement.
4. The built-in clutch mechanism allows the master cylinder's lever to retract freely when the power is off.



Final design of BLDC motor, gearbox assembly

The steering system consisted of a combination of brushless DC (BLDC) motor and gearbox, external encoder, and a set of pulley and timing belt. Since the go-kart needed to carry over 208.652 kg weight, including human driver and all necessary electronics components, the motor required 50 Nm (35 ft lb) to suffice a proper steering. In this project, the team chose the NEO Brushless Motor and MAX Planetary System Kit as the gearbox. This option had the advantage of quick assembly and rich program access. And because of the versatility of the BLDC motor in

many industries, the built-in application could accelerate the integration of the software development. The disengagement mechanism of the steering system was planned to be an electromagnetic clutch. The advantage of this design was that the human driver does not need to worry about fighting with the high gear ratio during manual driving. However, the lead time was too long to allow the team to implement, which would be the primary task for the following MAE156B team. Thus, the current design of steering would be fully autonomous.