**Arcade Racing Simulators for use in VR Bays**

**Objective:**

In the automotive industry, hydraulics make it easy for cars and trucks to steer, stop, and it also provides the regenerative power to boost fuel efficiency. Hydraulics are also used in a variety of applications across several industries including the stabilization of airplanes as well as large machinery in unlevel conditions. How can you use fluid power to stabilize the seat in a car?

**Project Description**

Teams of students will be tasked with designing a chair to simulate performance as seen in drivers ed or arcade racing. Repurposing a YouTube video from any video game, or pre-prepared map for biking or fitness that already has motion control output... (I.e. vector/speed/direction) a team of students will program the chair that can replicate the anticipated movements that would occur if there were to be a real person operating that car.

**Start with the basics**:

* Slow playback speed to create programming and speed up as you develop.
* Start with pre-sets for (downhill, uphill, left, right 30 degrees) start with basics and then differentiate those commands later.
* Sizing, flow and power output will greatly affect speed, smoothness and performance of the simulator
  + Research and perform sizing calculations before selecting a hydraulic power unit to ensure there is proper pressure available in the system for expected performance.
    - 12V or 24V AC or DC power supplies may not provide the power required for the project with a human occupant)
  + Design of cylinder angles to the chair are important for stability.
  + Management of the flow exchanged between cylinders and valving is critical for sizing

**Materials:**

**Note:** This project is anticipated to cost around $2,000. NFPA may be able to support with component donations or a mentor to assist with project development.

* Square metal frame. Teams can build their own or use 80/20 or a similar product.
* Connection points for cylinders.
* Bucket seat
* 4 cylinders with about 300 pounds in total capacity
  + 75-100 pounds/cylinder
  + 1" cylinder? Consideration for speed and force
  + Note: Cylinders should not be mounted parallel to each other
* Hydraulic Power Unit with 110VAC and built-in safety relief valve.
  + Dual pump with unloader (hi-lo)
* Valving:
  + Standard DO directional valve or cartridge valve technology.
  + 3 position/4 way valves.
  + solenoid with levers
  + Simple on/off: compensated valve, perhaps manual flow controls
* Controller
  + At least 8 PWM outputs
  + At least 4 digital inputs
  + Level sensor (zero point)
  + Inclinometers
  + HMI or just computer for programming
    - PLCs are the industry standard but schools can elect to use Raspberry PI or an equivalent.
  + Incorporation of an E-Stop Emergency Stop Switch
* Others?

**Scoring Criteria (if applicable):**

Does the timing match the video? Did the actions or movements perform as planned?

**Advanced Options:**

* Design with a 3-cylinder axis.
* Add cylinders with feedback and closed loop control.
* Consider restraint for load testing or adding a human occupant. This would require proper testing prior to adding a human occupant.

**NFPA Competencies (if applicable):**

1. Understand fluid power benefits and limitations
2. Conceptual and theoretical understanding of fluid power laws and principles (including energy transfer and power efficiency)
3. Understand fluid power components and circuits
4. Understand the impact of fluid properties, i.e., fluid viscosity, on fluid power system efficiency and performance.
5. Understand machine level requirements and translate into fluid power system requirements
6. Apply design, simulation and analysis tools to fluid power components and systems
7. Appropriately size components in fluid power systems
8. Integrate sensing and electronic control functions with fluid power components and systems
9. Cite hands-on experience with fluid power components and systems
10. Inspect, analyze and develop corrective action for product failure

**Educational Outcomes:**

**Implementation:**

What is the knowledge level? (Ex.High school or early college)

What is the cost per number of students/teams of students served?

How many class hours are needed to complete the project?