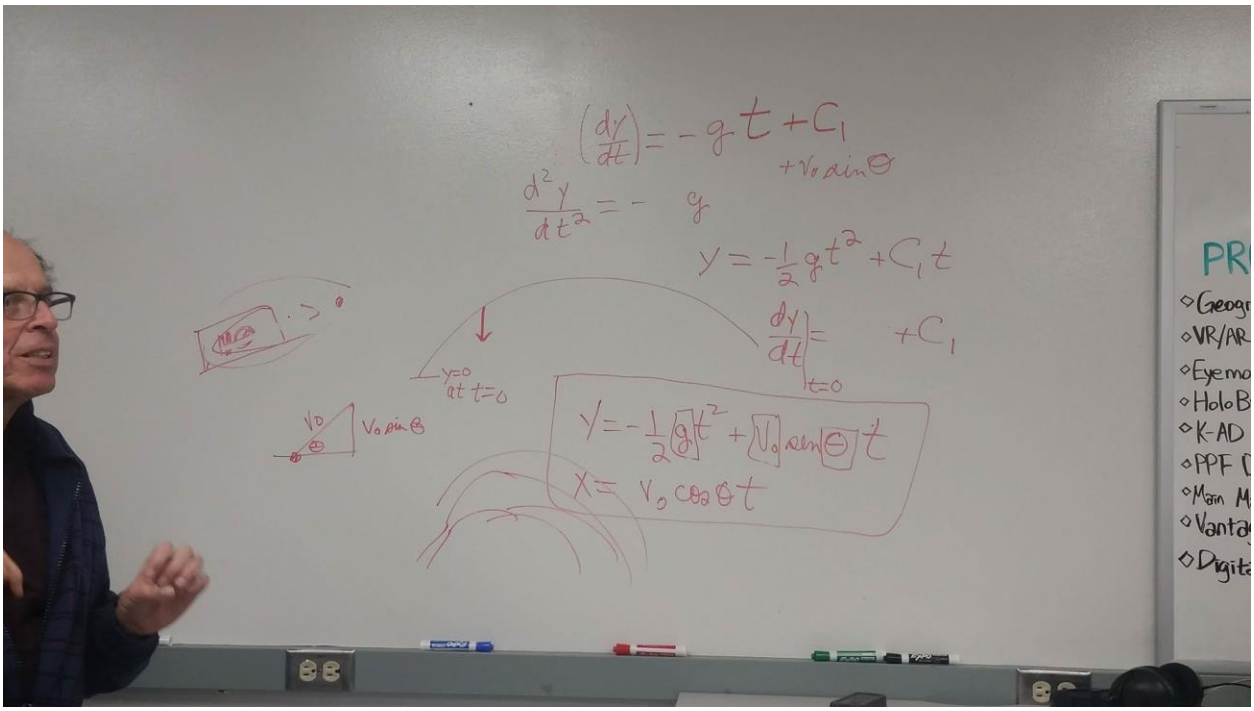
**Physics World Application Level**

**Intro:**

The goal of this simulation is to give students a more hands on approach in a virtual environment to learn and experience parabolic motion in physics. Instead of teaching students about the various equations and solving problems to learn concepts, we wanted to provide teachers with a tool to help students visualize and see how parabolic motion is affected by various factors. The main factors we considered were velocity, angle, gravity. Not only do students see the parabolic motion of the cannon ball (based on their velocity and angle), but they also learn to adapt and change those properties to hit desired targets. This gives a more immersive experience to users that gives an applicable approach to teaching students. In addition to the simulation, we have also provided students with the basic equations used that affect the trajectory of the cannon ball, so that they can go back notice the variables and values that affected the trajectory of their shot.




Instructions;

- When you enter the world, walk up to the cannon. Take a second to look around at the various surroundings and moving objects.
- Read the text boxes on the left, which will provide instructions for new users.
- Notice how based on the user's pull and angle, they can change the velocity and angle of the cannon.
- Pull the trigger back and release it and try to hit the targets in the scene.

**Cannon:**

In the Unity Hierarchy:

The cannon game object is made up of several smaller game objects. One of the most important is the CannonPivot game object which is only a position and rotation in space. This determines how the cannon direction and pivot will change when you pull on the handle. You have to be careful with this pivot position in the inspector because it may not look like it's in the correct position when you select it but it should actually work fine.

The cannon script:

The idea behind the cannon is that the farther back you pull the handle, the higher the velocity is when it shoots out. Read the comments in the script for more information. There are two portions of code at the bottom of the script that control how the cannon detects if a Vive controller is close enough to the handle to pull the handle back.

**Text:**

We are using the free TextMeshPro plugin to render the text ui. We are choosing this over the default unity text because it renders text much **crisper** and gives a lot more **customization options**. Note that with this plugin we have to include the line **"using TMPro"** in any script we are editing it. The TextMeshPro objects are of type **"TMP_Text"**. For more documentation on how to use this asset visit its documentation site (or look for specific questions on Google).

The way the text appears on screen is through the **scripts attached to each individual object**. For example, the velocity and angle text on the cannon is found on the script Cannon.cs and the text on the targets such as the boats can be found in the script Destructible.cs.

We have also included Tutorial text boxes that update to give the users instruction on the steps to take when running the simulation. Step by step, the user can follow the directions and will only appear during the first time the cannon is shot, giving them a grasp of the mechanics of the sim.

Background:

Ship Objects:

Ships are created by giving them collision, rigid body and destructible scripts. These give the objects properties that are interactable in the scene.
Ships are scripted with a set speed that moves further away from the cannon. When contacted with a cannon ball, and explosion animation plays to signal that the target was hit. The ships are also linked with a Text box that indicates the Horizontal and Vertical Distance away from the cannon.

# Physics World: Trajectory Path Finder

What we've done:

- Last year PhysicsWorld team implemented a trajectory-guessing game
  - We want to teach them the intuition of the basic physics formulas

$$y = \sin(v)t - (\tfrac{1}{2})gt^2 \qquad x = \cos(v)t$$

- This term, we have added levels with varying angles, initial velocities, and gravities

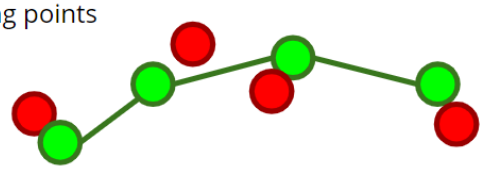
Plans for next term:

- Make new UI screen including level select and introductory video
- Create a worksheet or test afterwards to see how well students learned from the project

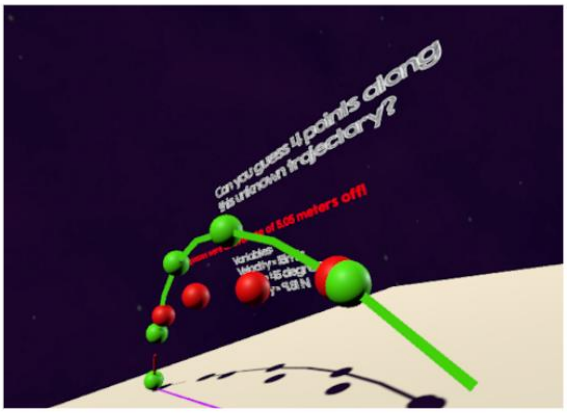
End goal:

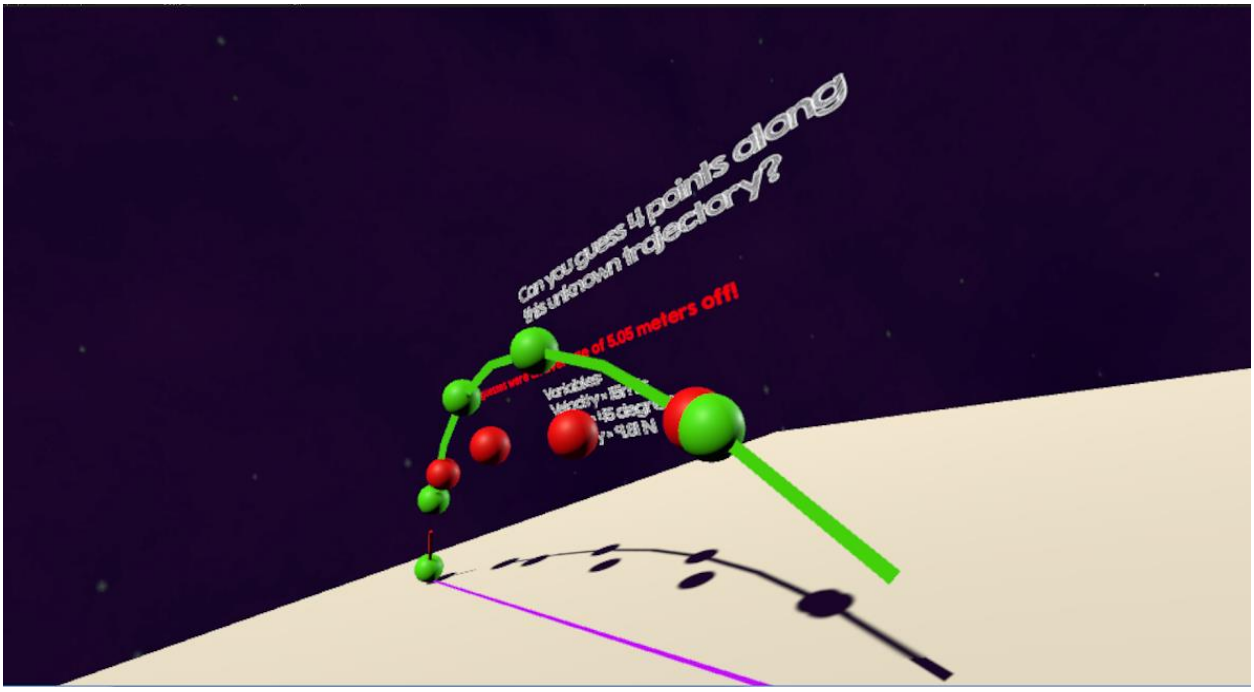
- Implement a way to draw a line instead of just guessing points
- Add an applied level at the end

***Try out the demo!!!***



# Physics World: Trajectory Path Finder





Can you guess if points along
this unknown trajectory?