Augmented Reality Grenade Trajectory Display

PennState

★Capstone Team

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★Company

Night Vision and Electronic Sensors Directorate

(NVESD)

US Army 3

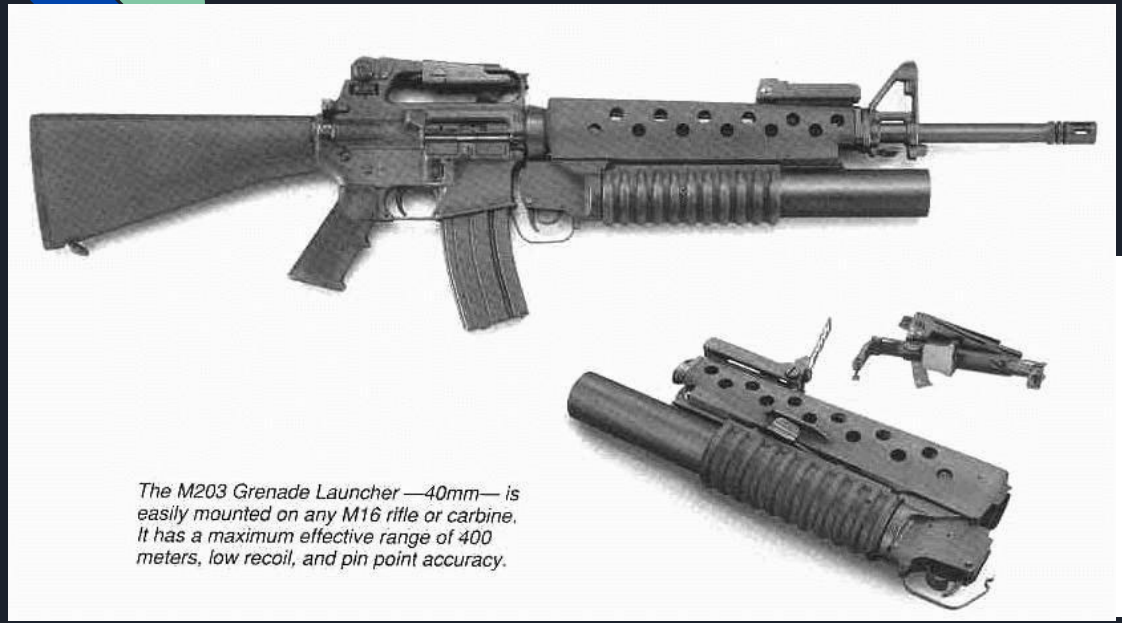
★Project Objective

- Create an augmented reality proof of concept program for the M203 and M320 Grenade Launching devices by utilizing the Microsoft HoloLens to project a real time trajectory arc onto the user’s vision based on the current three dimensional position and angle of the user’s weapon.

★Project Requirements

1. Trajectory based on real time sensor input data including initial height, angle, and velocity
2. Proof of concept of trajectory on PC simulation
3. Documentation of feasibility

★Weapons: M203 and M320



The M203 Grenade Launcher —40mm— is easily mounted on any M16 rifle or carbine. It has a maximum effective range of 400 meters, low recoil, and pin point accuracy.

★Microsoft HoloLens

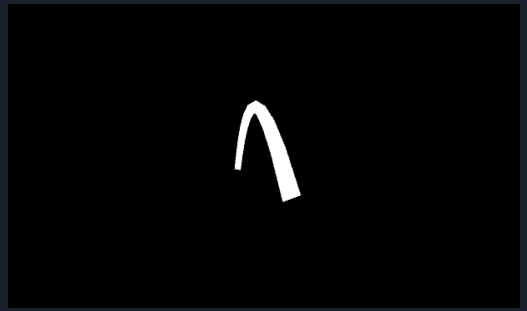
Microsoft

1. HoloLens is a platform for Augmented Reality

2. Using Unity and Visual studios, we are creating the overlay of the trajectory which will create the arc on the screen of the HoloLens

3. HoloLens also allows us to track the barrel of the weapon as well as map the environment for more accurate trajectory

4. Currently the angle, velocity and height for the arc are manually changed in Unity, but the next step will be to use the sensors in order to input the data into the HoloLens program and dynamically change the values.

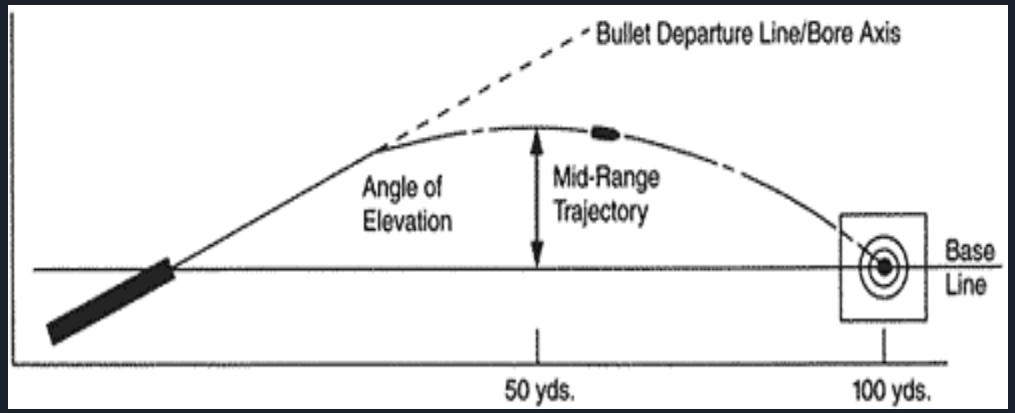


★Weapon Mounted Sensor

- Real time data about weapon inclination for trajectory calculation
- Weapon angle of inclination can be determined by measuring the direction of gravity
- MPU6050 accelerometer and gyroscope
- Acceleration data transferred via wire to Arduino Uno (I2C bus)
- Angle of inclination calculated by Arduino and sent wirelessly to hololens

★Physics behind the project

- **Ballistic trajectory** can be defined as the path of an unpowered object that moves only under the influence of gravity and atmospheric friction, with its surface providing no significant lift to alter its course.



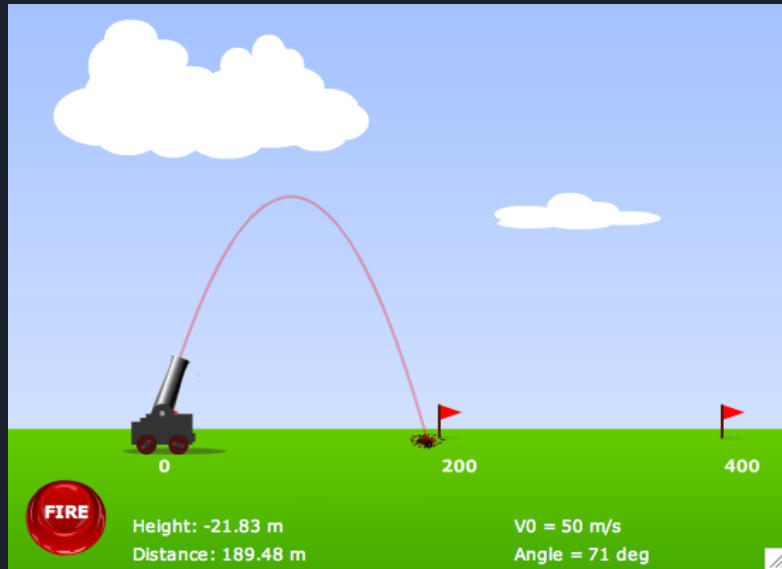
★Ballistic Trajectory Calculations:

To understand the motion of the grenade, velocity can be resolved into horizontal and vertical components. The trajectory of the grenade launcher can be calculated by simple equations of motion :

- Horizontal Motion : $x(t) = v_x t$
- Vertical Motion: $y(t) = v_y t - (1/2)gt^2$

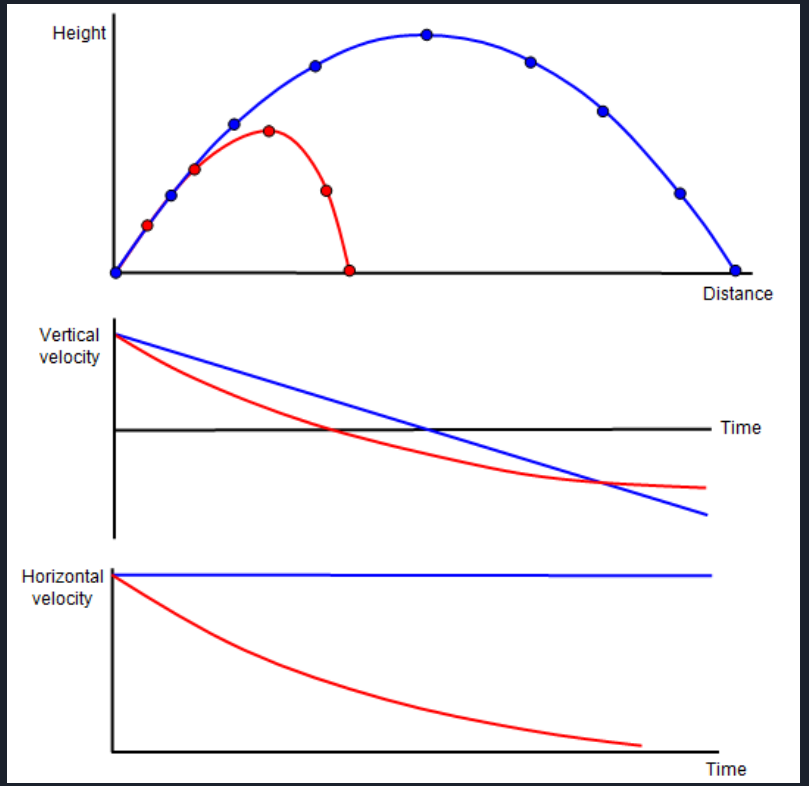
With the help of the equations of motion,we can also derive:

1. Maximum Height
2. Time of flight
3. Range
4. Maximum range with angle



★Effect of air resistance

- The air resistance needs to be taken into consideration when estimating the projectile of the grenade because the effect of the air resistance can reduce the distance of the flight as well as change the direction of the motion.
- The faster the grenade goes, the larger the effect of air resistance.
- Different area has different air resistance.
- k=(ρAC)/2m



★To Do: (Future goals and the visit)

We can add our future goals and also write about the visit to the base

Thank you

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