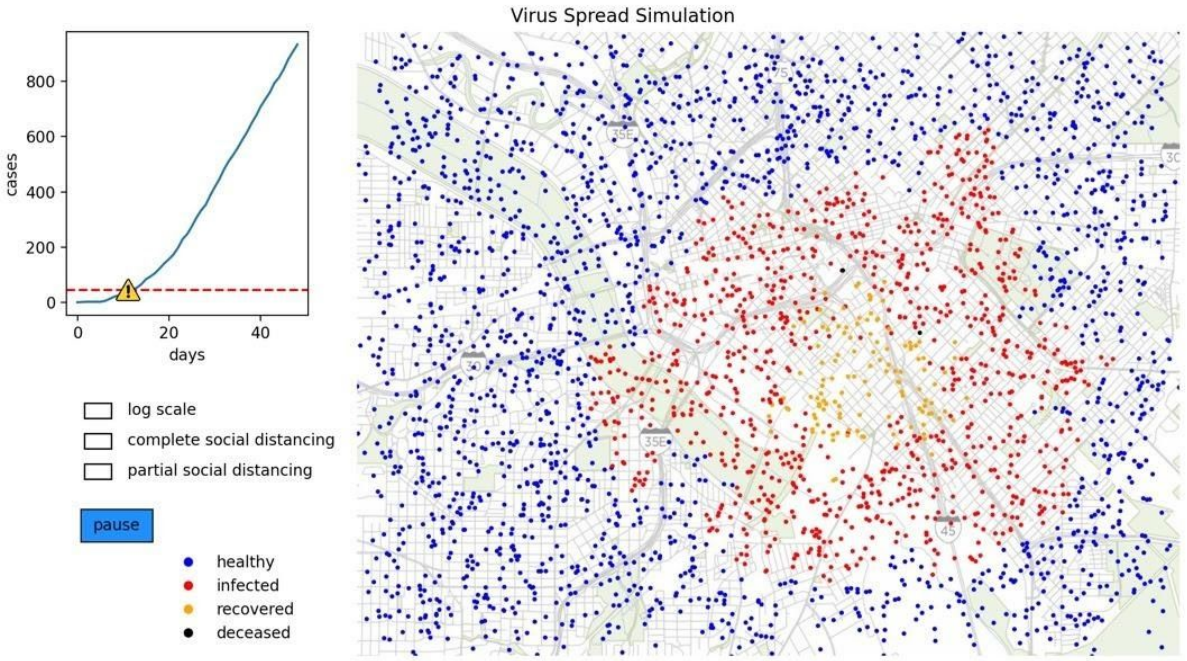
Online Summer Program
Summer 2020

Program Content

# Projects	3
Start Date	July 1, 2020
End Date	Aug. 15, 2020
Project # 1	Virus Spread Simulator
Project # 2	The Pong Project
Project # 3	Adaptive Cruise Control
Hours of Content	75
Support	Live video mentorship & online support forum

Virus Spread Simulator



Scholastic Concepts covered

Exponential and logarithmic functions (TEKS 111.40.5)
AP Statistics Unit 6: Inference for Categorical Data
NGSS Engineering Design (HS-ETS1)
Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
Design a solution by breaking the problem down into smaller, more manageable problems that can be solved through engineering.
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints
Use a computer simulation to model the impact of proposed solutions to a complex real-world problem

Technical Concepts

Python
Vectorized programming
Simulation
Data visualization

Tools Required

Windows, Mac, or Linux computer 2015 or newer with command-line access and ability to install software (for coding)

Project	**Virus Spread Simulator**
Project Class Dates	**July 1 – July 15, 2020**
Online Support Forum	**Available 24/7 with response within 24 hours**
Live Video Mentor Support	**2 hours per day, 3 days a week (hours vary)**
Course content availability	**July 1 through Dec. 31, 2020**

Work at your own pace with help if you get stuck

We've created detailed instructions so you can work through the project at your own pace. If you have questions or get stuck, you can post in the online forum and the teaching team will answer or you can get mentorship by video chatting with the mentors during the live video support hours.

Project Outline

1. What Should the Simulation Do?
2. How do we make it?
    a. Attributes
    b. Animation
    c. Get your toolbox ready
3. Introduction to Python
    a. Variable and Data Type
    b. Function
    c. List and Index
    d. Dictionary
4. The Problem of Distance
    a. Introduction to Python Class
    b. Distance Calculation Using Class
    c. Calculate distance for the entire population
    d. How to calculate distance faster
    e. Performance
5. Set up the simulation
    a. Constructor
    b. Movement
    c. Identify who is too close to a sick person
    d. Identify new cases
    e. Plot and Animate
    f. Self.ax: map plot
    g. Self.stats_ax: line plot
6. Sit back and watch your simulation run
    a. What do you see?
    b. Why exponential?
    c. Logarithmic Scale
    d. What happens if we let the virus spread?
7. After infection
    a. Herd Immunity
8. Effect of social distancing
    a. Implementation
    b. CheckButton
    c. Effect of social distancing
    d. How about partial social distancing?
9. Additional features
    a. Pause Button
    b. Health status legend
10. Implement your own features

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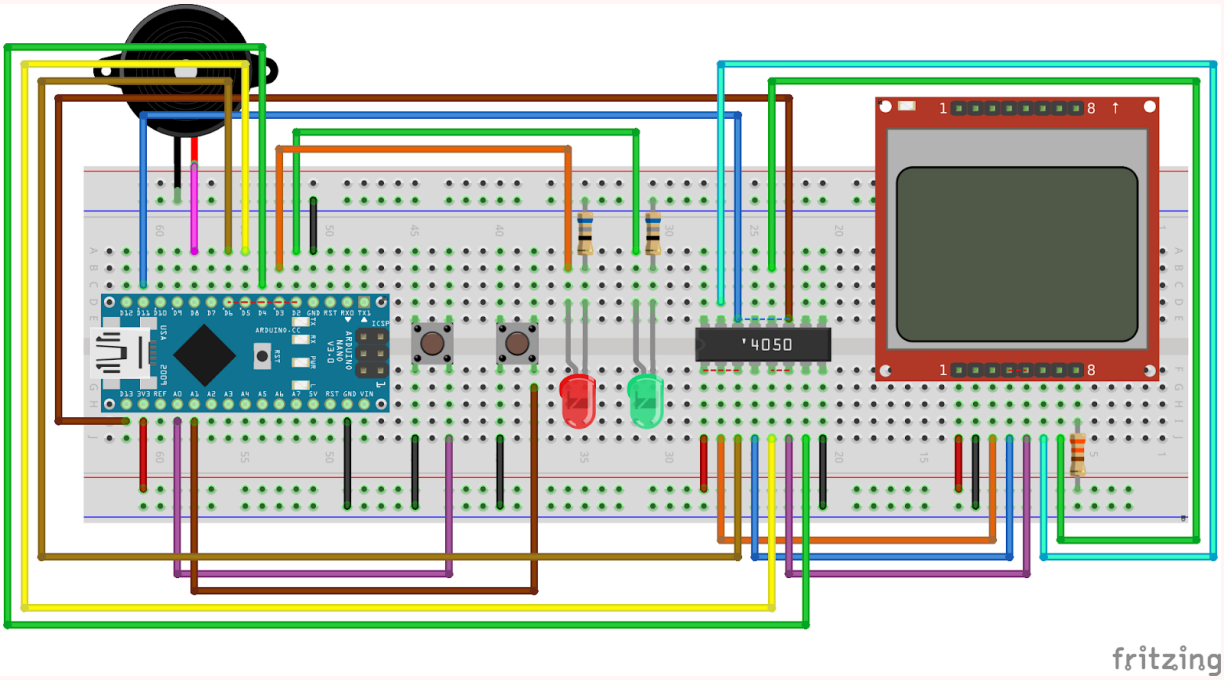

Overview

In this project, you will learn how to wire a circuit and write code for a pong game. You will practice solving and modeling linear equations in the process. Although the above schematic looks complicated, it is no more difficult to build than a Lego kit. This lab is expected to take approximately 20 hours.

Scholastic Concepts Covered

- CC.2.2.HS.D.10 Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.
- CC.2.2.8.B.3 Analyze and solve linear equations and pairs of simultaneous linear equations.
- CC.2.2.HS.D.9 Use reasoning to solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

Embedded Systems Concepts Covered

Software

- C++ programming
- Arduino IDE + Libraries
- Serial monitor
- ADC (analog to digital converter)

Hardware

- Reading and wiring a schematic
- Prototyping on a breadboard
- SPI or I2C (serial interface for data transfer

Project	**The Pong Project**
Project Class Dates	**July 16 – July 31, 2020**
Online Support Forum	**Available 24/7 with response within 24 hours**
Live Video Mentor Support	**2 hours per day, Mon – Fri (hours vary)**
Course content availability	**July 16 through Dec. 31, 2020**

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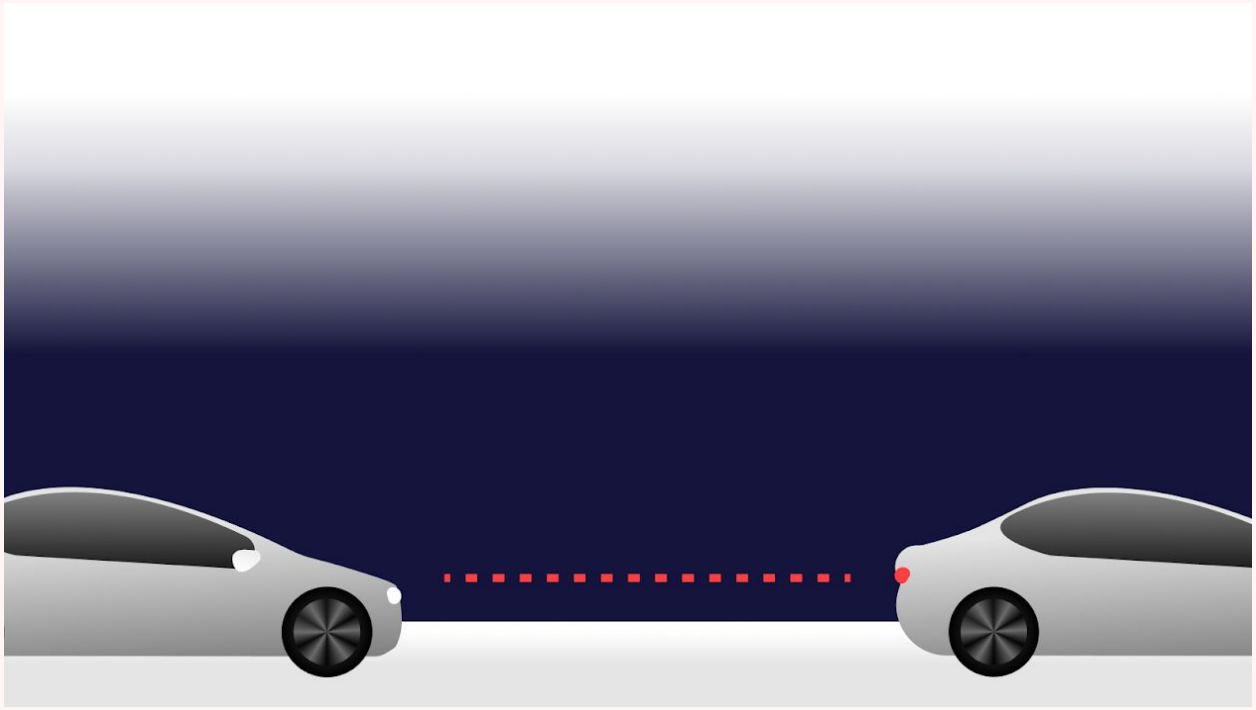
Project Outline

1. Introduction and installing software
    a. Installing VS Code
    b. Installing PlatformIO
2. Initial Hardware Concepts
    a. Bill of Materials
    b. What is a Circuit?
    c. Arduino Nano
    d. Breadboard
    e. LEDs and Resistors
    f. Building your first circuit
    g. Push Buttons
    h. Using the Arduino to turn on an LED
    i. Push Buttons as inputs to the Arduino
    j. Piezoelectric Buzzer
3. Now we're talking "Digital"
    a. Reading a Schematic and Wiring a Circuit
    b. The Digital Alphabet
    c. The LCD
    d. Level Shift, Arudino Nano and LCD
4. Math Concepts: Linear Equations
5. Embedded Programming: Coding in Arduino
    a. Installing Arduino Libraries
    b. How to code for an Arduino
6. Putting it all together
    a. Testing the LCD
    b. Filling in the skeleton code
7. Suggested Readings

Adaptive Cruise Control



Ever wonder about the science behind automating electromechanical systems? This project will look into a branch of engineering known as control theory and have you writing the autopilot software for your very own virtual car!

Scholastic Concepts Covered

- AP Physics
    - Unit 1, Kinematics, 1.1-1.2
    - Unit 2, Dynamics, 2.4-2.7
- Common Core Math
    - Interpret the structure of expressions
    - Create equations that describe numbers or relationships
    - Represent and solve equations and inequalities graphically
    - Interpret functions that arise in applications in terms of the context
    - Understand the concept of a function and use function notation
- NGSS (PS, Motion and Stability)
    - Planning and Carrying Out Investigations
    - Analyzing and Interpreting Data
    - Using Mathematics and Computational Thinking
    - Constructing Explanations and Designing Solutions
    - Obtaining, Evaluating, and Communicating Information
    - Cross-cutting concepts, structure and function

Tools Required

Windows, Mac, or Linux computer 2015 or newer with command-line access and ability to install software (for coding).

Project	**Adaptive Cruise Control**
Project Class Dates	**Aug. 1 – Aug. 15, 2020**
Online Support Forum	**Available 24/7 with response within 24 hours**
Live Video Mentor Support	**2 hours per day, Mon – Fri (hours vary)**
Course content availability	**Aug. 1 through Dec. 31, 2020**

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Project Outline

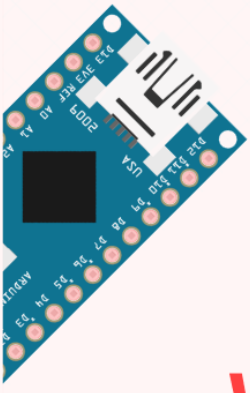
1. Naively trying to drive
2. Motivation for Control Theory
3. Feedback Control
4. Integral and Derivative Control
5. More sophisticated controllers
6. Experiment
7. Report

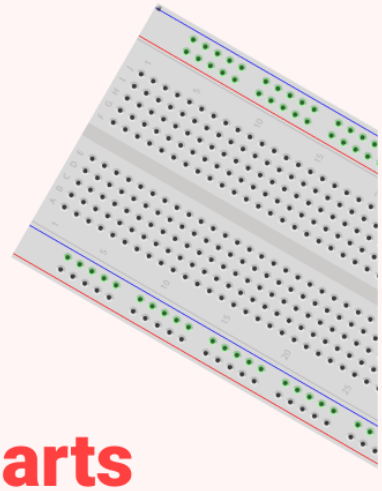
Enroll Now

Program Fees: $499

Registration: Enroll at https://summer.inventxyz.com/

Contact: info@inventxyz.com





We'll ship you the parts with easy online instructions

If you get stuck, we're just a video chat away

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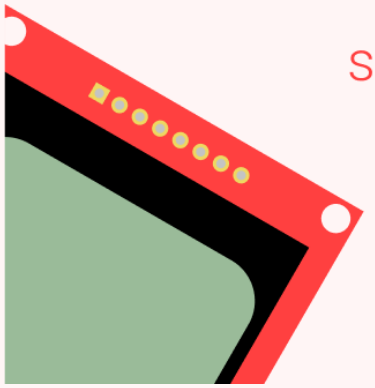

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