Introduction

Summary:

This course is intended for beginning ECEN students taking ECEN 191 at BYU. We assume that students taking this course have a high school level education and are not required to know anything about electrical engineering or hobby engineering. If you are a beginner this is the course for you.

Learning Outcomes:

The final product from this course is a simple autonomous car named the AutonoMouse. Students will learn the following skills while developing their car:
- Learn what Arduino is
- Learn how to solder pins onto a PCB
- Learn how to code Arduino Nano
- Learn prototyping with breadboards
- Learn how LED's work
- Learn about servos and pulse width modulation signals
- Learn about voltage regulators
- Learn how to spin a servo
- Learn how to work a sensor
- Learn about HC-SR04
- Learn about PCBs
- Learn to solder a PCB
- System integration
- Troubleshooting

Materials You Need to Buy:

The following materials you will need to buy yourself:

Arduino Nano wout/RC				
Part	Quantity	Unit Price	Subtotal	Notes
1 inch diameter bottle cap	2		$0.00	Buy your own, Gatorade bottles work best
Zip ties	3	$0.03	$0.09	
Arduino Nano	1	$4.00	$4.00	
Switch-SPDT-BB	1	$0.06	$0.06	
Voltage Regulator (Q-7805CT)	1	$1.65	$1.65	
0.1 uF Ceramic Capacitors	1	$0.06	$0.06	

0.33 uF Ceramic Capacitor	1	$0.06	$0.06	
9V Battery	1	$1.25	$1.25	
Battery Cap	1	$0.44	$0.44	
1x3 Male header	2	$0.06	$0.12	
1x4 Female header	1	$0.08	$0.08	
1x15 Female header	2	$0.30	$0.60	You might need to buy a larger one and then break off the pins you need
Continuous Servo	2	$1.80	$3.60	
PCB	3	$0.40	$1.20	$0.40 per in^2, Submit a project request (see below)
Sensor Sonar	1	$2.20	$2.20	Sensor-Ultrasonic used for angry engineers
LED Colored	1	$0.05	$0.05	
CABLE-USB A-Mini	1	$0.99	$0.99	
Acrylic	1	$1.62	$1.62	$0.08 per in^2, Submit a project request (see below)
Laser Time Acrylic	2	$0.06	$0.12	
		Total	$18.19	

Buy these from the ECEN shop. This is a requirement for part of this lab. (This table is just an estimate for these parts, pricing may have changed) Also, take the time to get acquainted with the ECEN shop. It is a valuable resource on campus.

Project Requests:

Some things you can buy from the shop because they are unique or custom made. There are two of these for this lab: the PCB and acrylic base. The PCB will be milled and acrylic base laser cut by the shop. (The shop also offers 3D printing services).

PCB:

First, search the GitHub repository in your web browser (https://github.com/BYU-ELC/AutonoMouse). Then navigate to Arduino_Nano->Build_Files->Chassis1.1 and download the project files contained in Chasiss1.1_2021-09-01.zip.

Next, search the ELC project request application (https://ece.byu.edu/project-requests) and click the button "Request Form". It will take you to a google form. Follow the instructions to fill out the form with your information. Things to watch out for: select **PCB prototyping** for "Requested Service"; **single-sided** for "Single or Double Sided"; **BYU ID #,** not netID, for Student ID; and **Class** for "Purpose". Click submit.

After you submit the shop will send you a confirmation email. **You must respond with the gerber files from the zip folder** in order to mill your PCB. Within the zip file attach all the files located within CAMOutputs->GerberFile with extension ".gbr" files to your email response.

After your PCB is finished the ELC will let you know when to pick it up.

Acrylic Base:

The acrylic base project request processing is similar to the PCB.

First, search the GitHub repository in your web browser (https://github.com/BYU-ELC/AutonoMouse). Then navigate to Arduino_Nano->Build_Files and download Arduino_Nano_chassis.svg. This file will allow the shop to laser cut your car's base.

Next, search the ELC project request application (https://ece.byu.edu/project-requests) and click the button "Request Form". It will take you to a google form. Follow the instructions to fill out the form with your information. Things to watch out for: select **Laser Cutting** for "Requested Service"; **I would like to use acrylic supplied by the shop. Use any available acrylic on hand** (unless you would like to provide or choose your own) for ""Material"; **1/8th inch** for "Thickness"; **BYU ID #,** not netID, for Student ID; **Class** for "Purpose"; and **4.5 inch x 4.5 inch** for "Major Dimension for scaling". Click submit.

After you submit the shop will send you a confirmation email. **You must respond with the .svg vector file** in order to mill your PCB. Attach Arduino_Nano_chassis.svg to your response email.

After you base if finished the ELC will let you know when to pick it up.

Other:

- 2 inch diameter bottle caps for wheels (Gatorade bottle caps work nicely for this)
- Computer (this is for programing; a laptop works best because you can bring it into the lab but a desktop at home would also work)

Tools Required:

You will need access to the following tools. These can be found in student workshops in the ELC CB41, or you may buy your own as part of your personal electronic kit.
- Breadboard
- Jumper Wires
- Hot glue gun+hot glue
- Soldering station

How to Access Code for the Labs:

In this course you are not required to know how to code, however, you will still need to know how to download and use Arduino IDE to upload code to your Arduino Nano. Each time the labs ask you to download and upload code go to https://github.com/BYU-ELC/AutonoMouse. This is a GitHub repository that stores all the files for this course. If you're familiar with GitHub you can

git clone the repository if you're not familiar then navigate to **Arduino_Nano/Labs/(lab# that you're on)**. The code file is a .ino file. Copy and paste the code into Arduino IDE and you'll be good.