How-To Document
Go-Baby-Go

Putting together the Go-Baby-Go Car with
Universal Control and
Parental Override through BlueTooth Connectivity

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Table of Contents

This document is put together to allow parents and caregivers of children with disabilities to create an inexpensive vehicle that will provide independent mobility (or simulated independent mobility) for the child at a low cost to the family. Rather than spending thousands of dollars on an electric wheelchair for their young child. Any family can develop this car by following our clear instructions. We have provided an outline of the list of items needed; along with instructions on wiring the Ride-On-Toy-Car, installing the Arduino IDE, configuring the Bluetooth connection, installing the Joystick, installing the Arduino, and finally how to install the Mobile App.

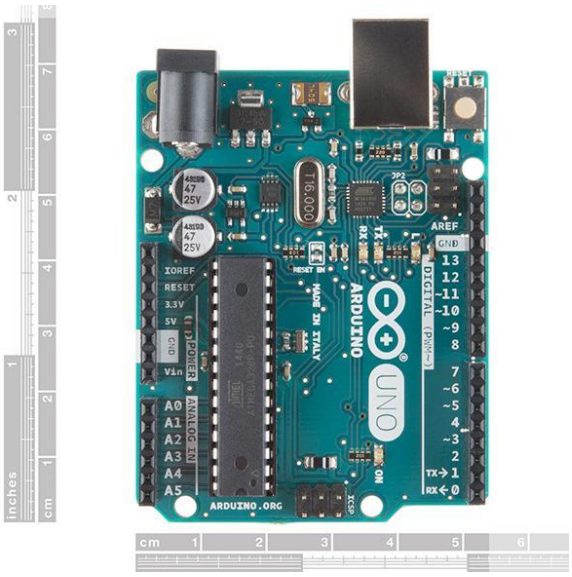
It is our hope that these instructions will provide families with hours of enjoyment watching the children explore their world.

Special thanks to Dr. Maggie Vanderberg and Kyle Winfree for their outstanding direction and encouragement to our team in the completion of this project.

Items Needed:

A) **Ride-On-Toy-Car** with a 6V or 12V battery must have two motors.
Available online and in major department and toy stores
Search terms: electric ride on toy car; power ride on toy car. Cost: $130 -- $300

B) Arduino Uno
Available online and in electronics stores. Cost: $15.00 - $20.00 Search Terms: Arduino Uno
The Arduino Uno is a microcontroller board, a small computer on a single integrated circuit. It is also called an embedded system. The Arduino Uno is a very small computer which operates simple machines.



C) USB Type A/B connector

This may be purchased online or at an electronics store. Search Terms: “Print Cable” (Type A male to Type B male) (this may come with the Arduino Uno) Cost:$3.00 - $12.00 *be aware of the length of the cable you will need -- distance from computer to the Arduino.*

D) 2 Motor Controllers MD10C (revision 3)

These may be purchased online or at an electronics store: Search Term: 10A Bi-Directional DC Motor Driver, 5-30V, 30A peak. Cost: $15.00 each.

E) Joystick (Atari 2600 or 5 Pin 4/8 Joystick)

This may be purchased online or at an electronics store: Search Term: "Atari 2600 Joystick Controller" or "5 Pin 4/8 Joystick" Cost: $12.00 - $18.00 *Only one needs to be purchased, either one will work completely. Simply consider which one seems easiest for your child to manipulate*.

Optional Items

These optional items may make it easier to adhere the items to the vehicle. These items may not be necessary depending upon where the Arduino Uno and the Motor controllers are located on the vehicle.

F) **Velcro tabs** :These item may be purchase online or at any retail store selling office supplies.Cost: $3:00 - $6.00

G) Protective covers for Arduino Uno

This item is most easily purchased online. Search term: Protective cover for Arduino Uno. Cost: $2.00 - $7.00.

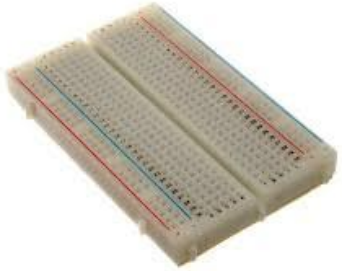
TOOLS -- Many families have these items in their home or can borrow from a friend or neighbor.

H) Soldering iron

This item can be purchased at any local hardware store or online. Search term: Soldering Iron. Cost: $8.00 - $50.00 *Price difference involves different tips/higher temperature/protective gear For the purposes of this project the least expensive soldering iron is sufficient.*

I) Breadboard 170 point breadboard

This item is used in the car connections. It may be purchased at any local electronics store or online. Search term: “Breadboard 170 point” Cost: $4.00 - $15.00 *Price difference involves nothing of significance. The board with the numbers on it may make it easier for you to ensure the proper connections.*



J) HC-08 Bluetooth Transmitter

This item can be purchased at any electronics store or online. The six pins will attach to the breadboard Search Terms “HC-08” Cost: $8.00 -$10.00

K) Wire cutters or sharp knife

This item can be purchased at any local hardware store or department store or online.
Search terms: Wire Cutters" "Exacto Knife" Cost $2.00 -$10.00

L) Emergency cutoff switch (on/off)

This item can be purchased at any local hardware or automotive store or online.
Search Terms: "Toggle Switch" "On/Off Toggle Switch" Cost $2.00 - $8.00

M) Rectangular Wooden Board

This item can be purchased at any local hardware store or Craft Store online.
Search Terms: "Wooden Mounting Board" Cost: $2.00 - $10.00 *You must consider the size of items placed on the board as well as the location of the board on the vehicle Our board was about 7x8 inches and about ½ inch thick. It was an extra piece in one of our homes.*

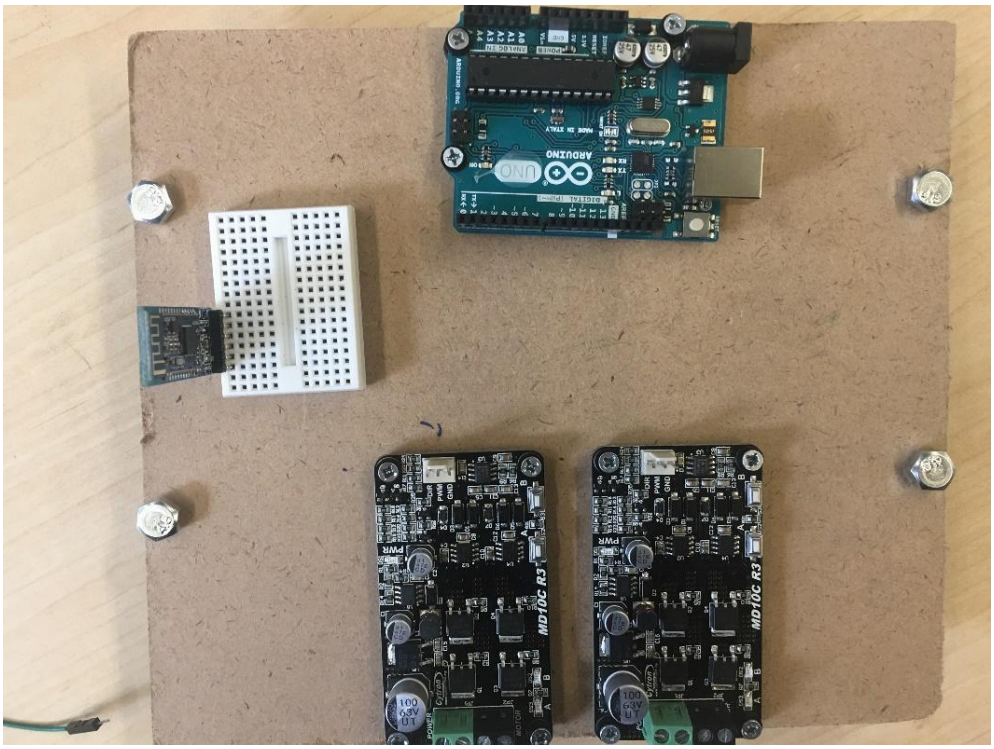
Checklist

Ride-On-Toy-Car with a 6V or 12 V battery	
Arduino Uno	
USB Type A/B connecto	
2 Motor Controllers MD10C (revision 3)	
Joystick (Atari 2600 or 5 Pin 4/8 Joystick)	
Velcro tabs Optional	
Protective covers for Arduino Uno	
Soldering Iron	
Breadboard 170 point breadboard	
HC-08 Bluetooth Transmitter	
Wire cutters or sharp knife	
Emergency cutoff switch (on/off)	
Rectangular Wooden Board	

How to wire the onboard system

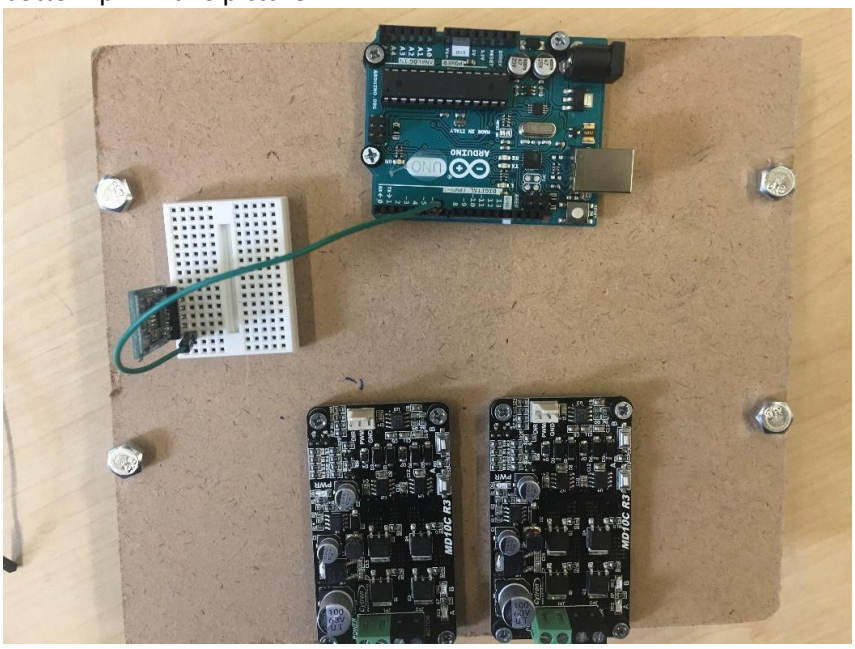
Step 1: Mounting the System on one wooden board

- Four pieces of equipment will be attached to the wooden board: The Arduino Uno, two motor controllers and the breadboard.
- Using two .065 plastic spacers to keep the Arduino Uno off of the wooden board, and three screws, mount the Arduino Uno on one side of the wooden board.
- Using two .065 spacers below each motor controller and 4 screws for each motor controller attach the motor controllers on the side of the board opposite the Arduino Uno.
- The breadboard may be attached to the wooden board with any glue. Place the breadboard on a side between the Arduino and the motor controllers.
- Attach the HC-08 (Bluetooth Adapter) to the breadboard.



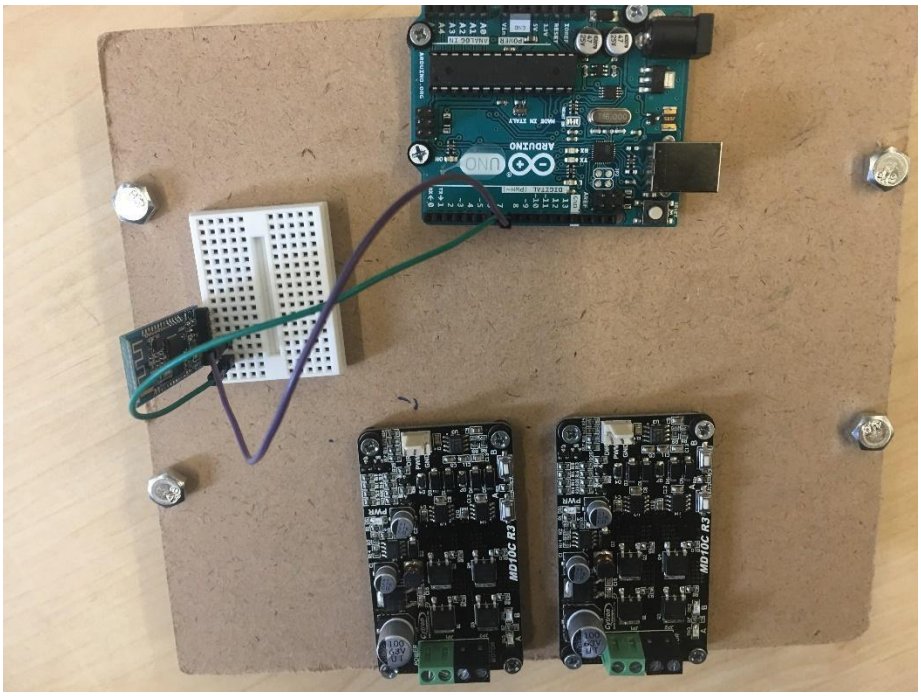
Step 2: Wire Arduino Uno to Bluetooth Module on Breadboard

The first jumper wire (you may use any color wire --this image is a green wire) is used to keep track of 'state'; start with digital pin 6 on the Arduino Uno to the state pin on the Bluetooth module which is the bottom pin in this picture.



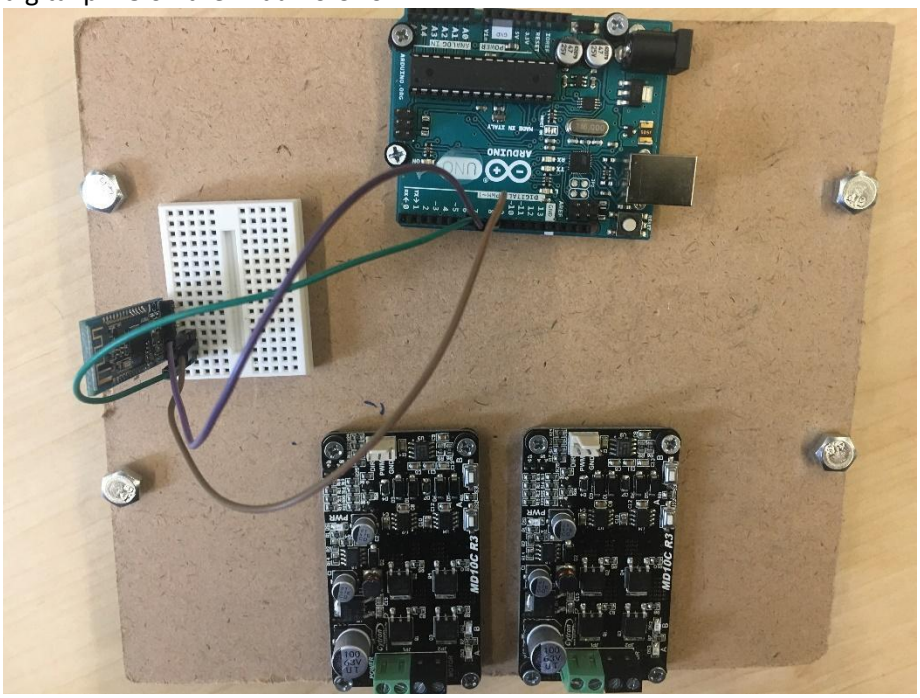
Step 3: RXD pin

Run a jumper wire (any different color) from the RXD pin (third pin from the bottom) on the Bluetooth module to digital pin 7 on the Arduino Uno.



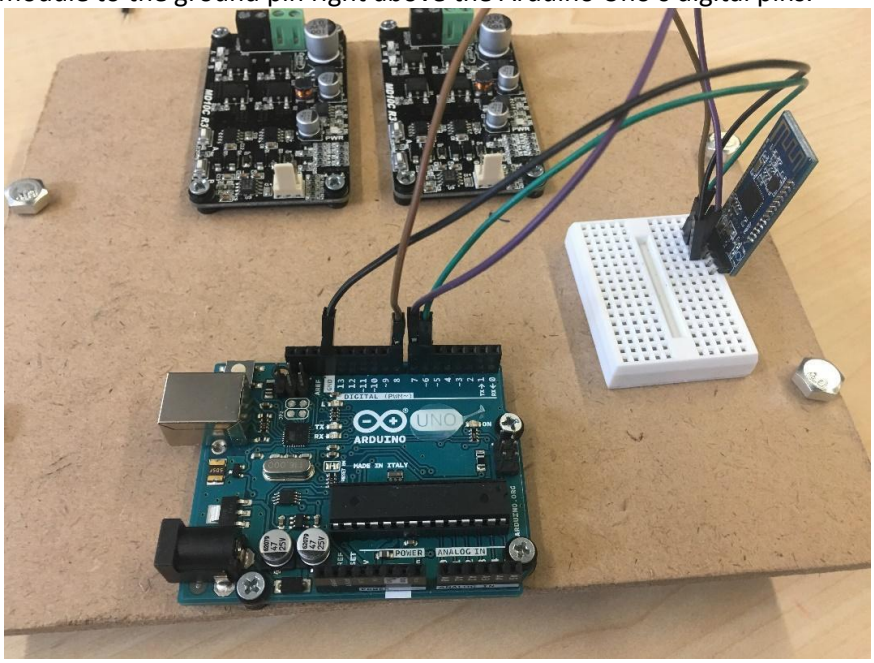
Step 4: TXD pin

Run a jumper wire (third color) from the TXD pin (second pin from bottom) on the Bluetooth module to digital pin 8 on the Arduino Uno.



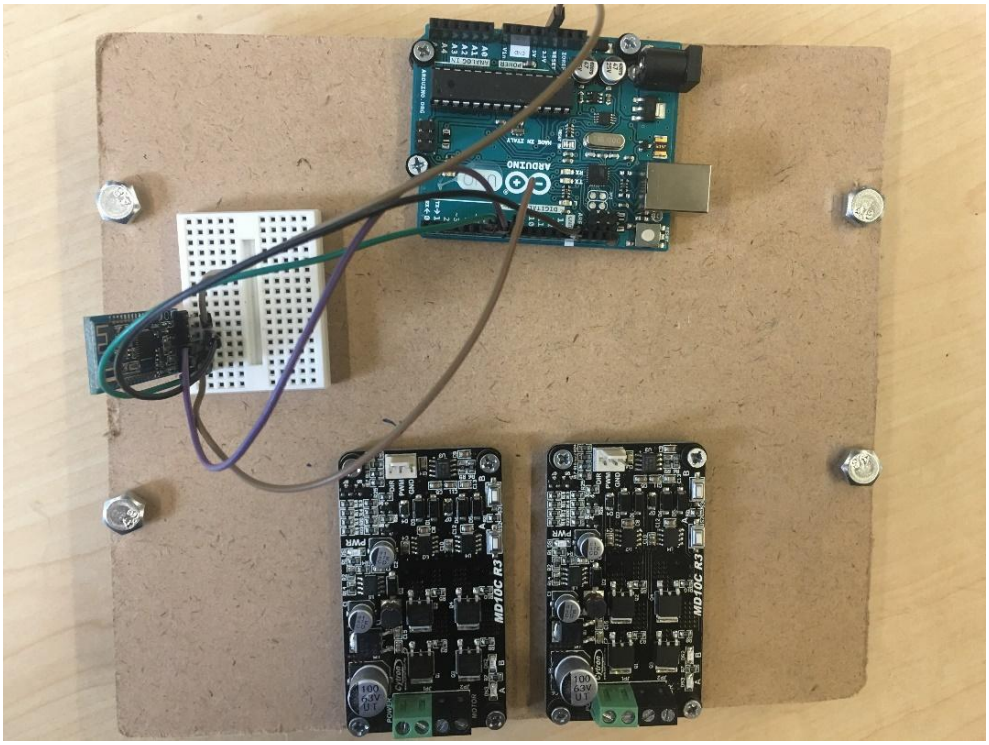
Step 5: Ground pin

Run a jumper wire (fourth color) from the ground pin (fourth pin from the bottom) on the Bluetooth module to the ground pin right above the Arduino Uno's digital pins.



Step 6: VCC pin

Run a jumper wire (fifth color - if available) from the VCC pin (fifth from bottom) on the Bluetooth Module to the 3.3V pin on the Arduino Uno. The 3.3V pin is located in the power pins on the Arduino Uno. The power pins are located on the other side of the Arduino Uno



Step 7: Arduino IDE and Bluetooth configuration

Run the bluetoothAtCommandConfigurator.ino at this point on the Arduino Uno to configure the Bluetooth module. Please see the “How to Configure Bluetooth Module” section of this document to complete this.

How to install Arduino IDE

The Arduino IDE (Integrated Development Environment) is a set of basic software tools that allows computer to read the Arduino code. This must be installed before we can flash the Arduino Code from the Computer to the Arduino.

Step 1: Go to https://www.arduino.cc/en/Main/Software

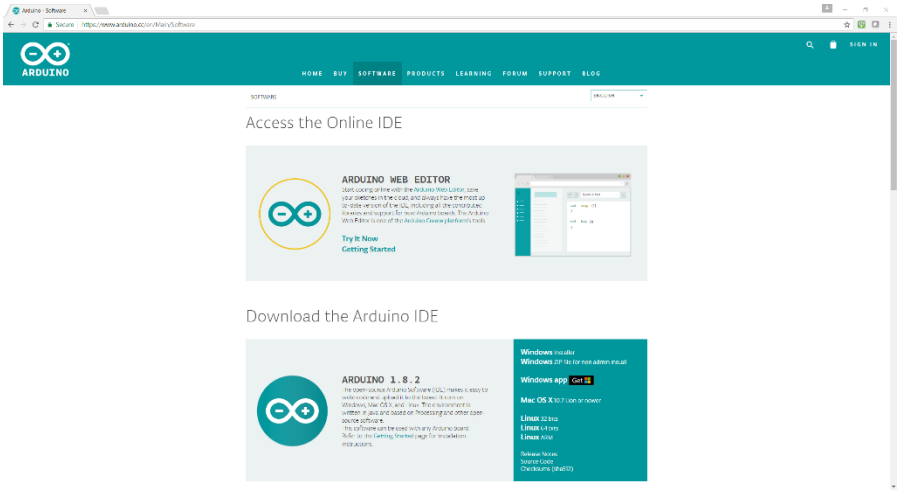


Figure 1. Arduino IDE download page

Step 2: Scroll down to Download the Arduino IDE

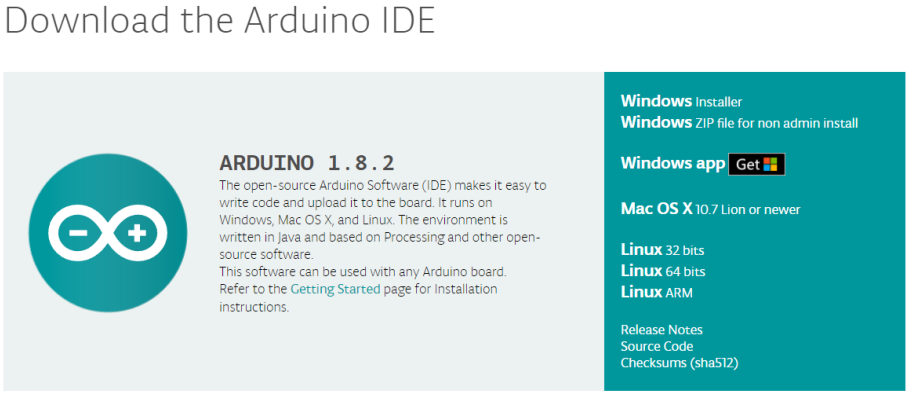
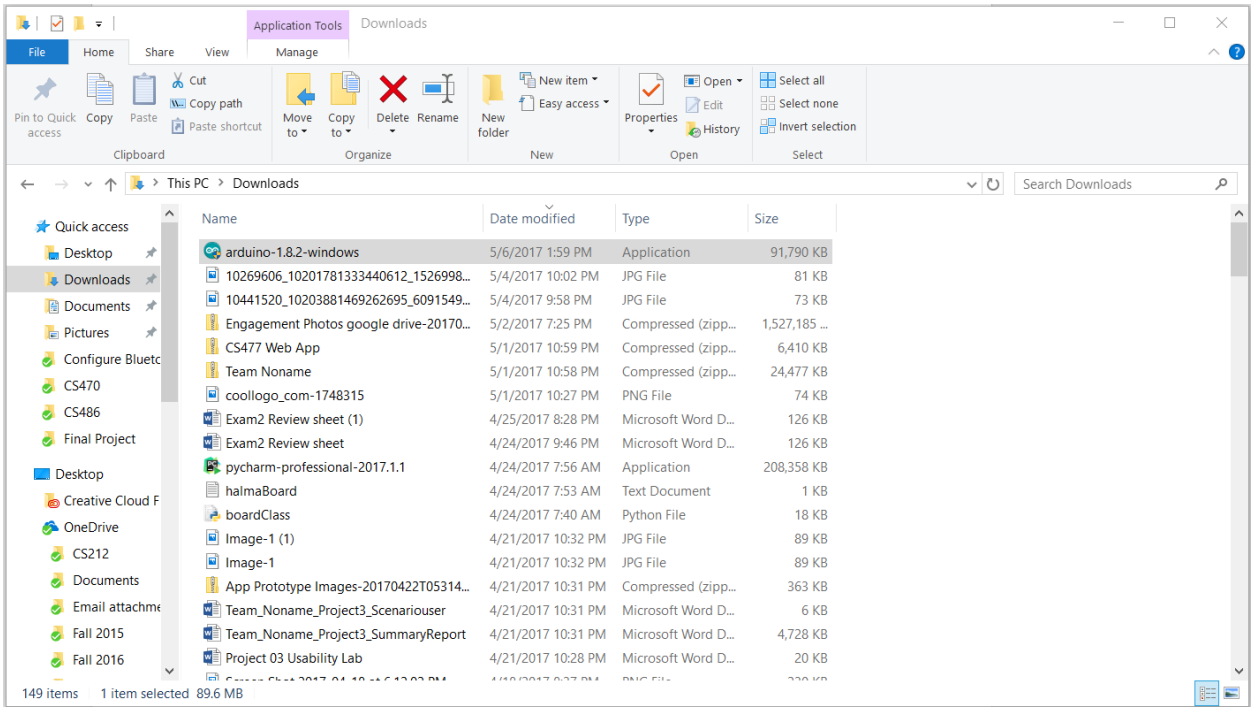


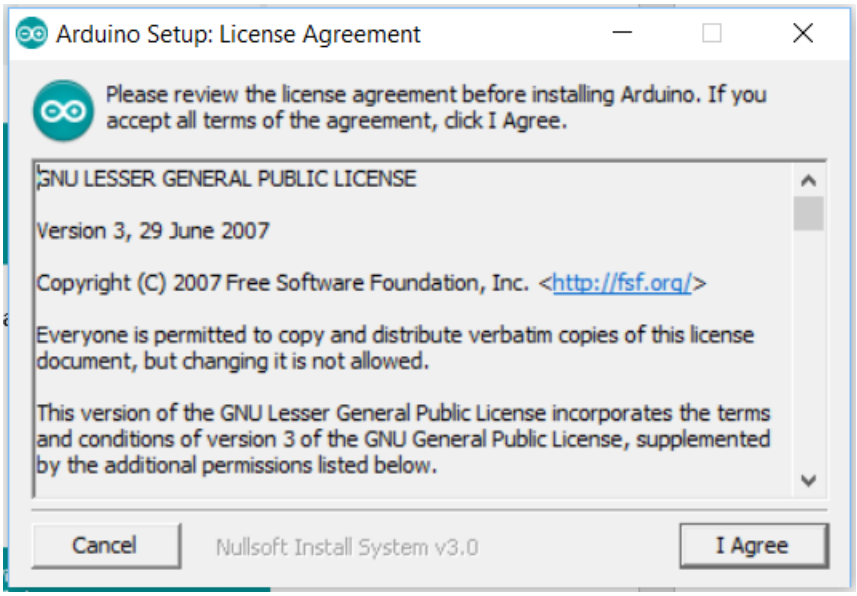
Figure 2. Download section

Step 3: Download the software by clicking on “Windows Installer” if you have a windows computer, Mac OS X if you have a mac computer, or Linux if your computer is running a version of Linux.

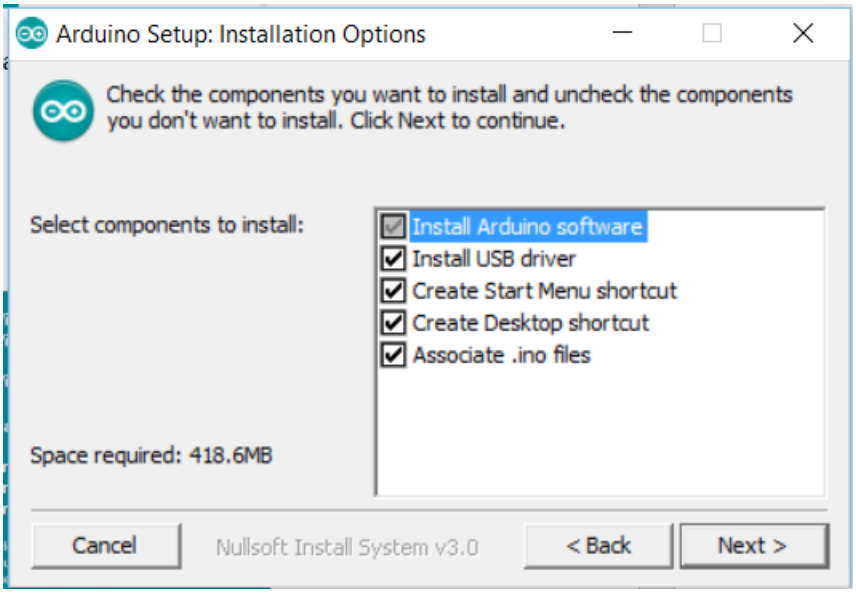
Step 4: After downloading the proper installation file. Go to where it was saved on the computer. In this case, it was the downloads folder of the computer used for this guide. Then double click on the file to start it.



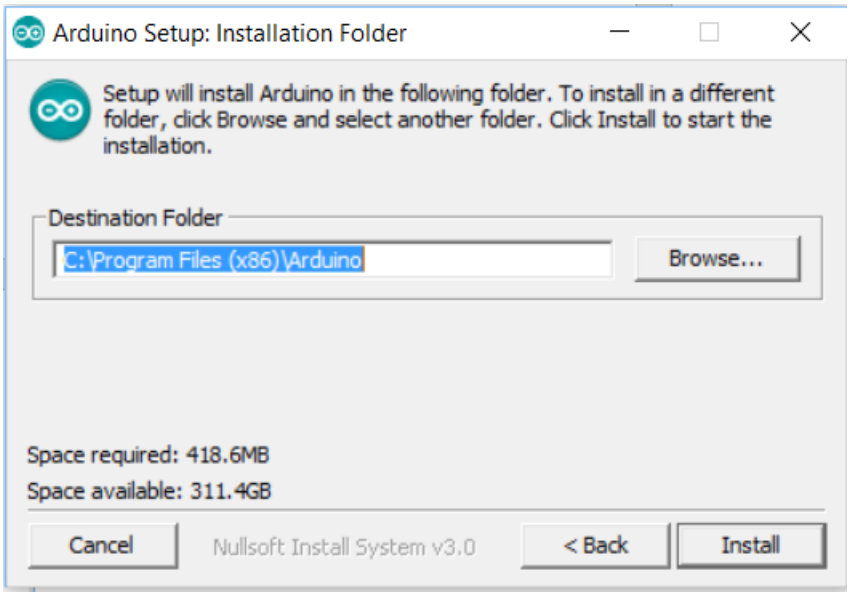
Step 5: After double clicking on the file a user agreement will show up. Read through it if you must but you must click “I Agree” for the software to install. So, click “I Agree”.



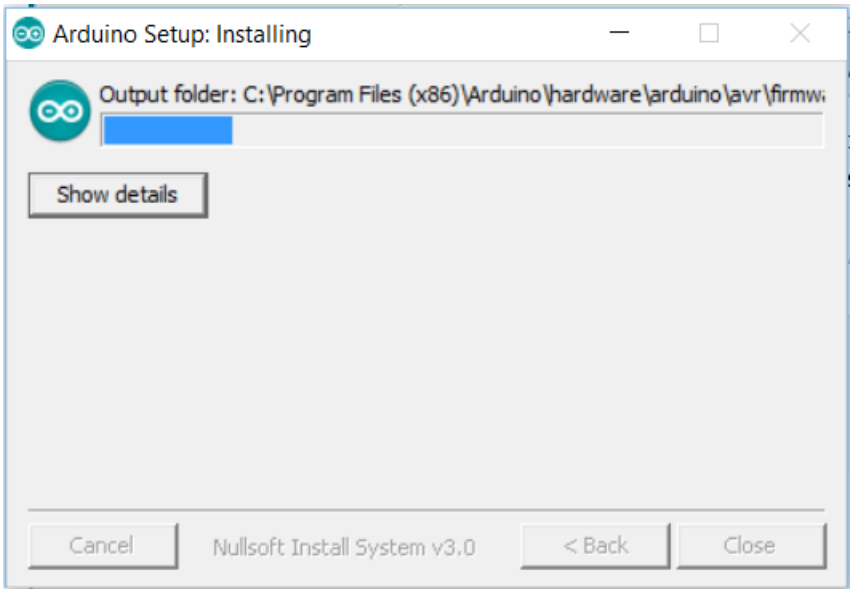
Step 6: After clicking on “I Agree”, the next screen will have several pre-checked boxes that have been prechecked. Leave them checked and click on “Next”.



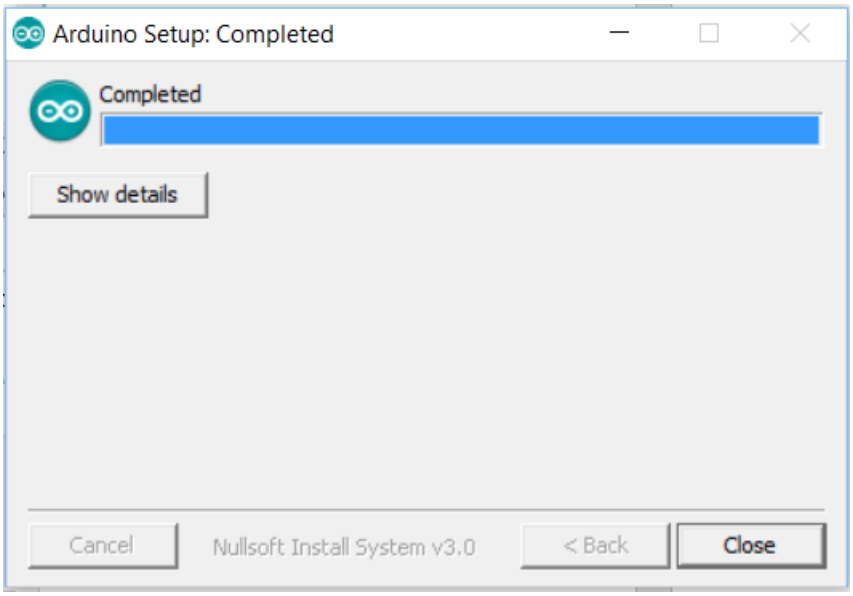
Step 7: After clicking Next the next screen is going to ask you where to install the program on the computer. Leave it alone and click “Install”. You may choose a different location, however the program will place a shortcut ICON on your desktop. Then click “Install”.



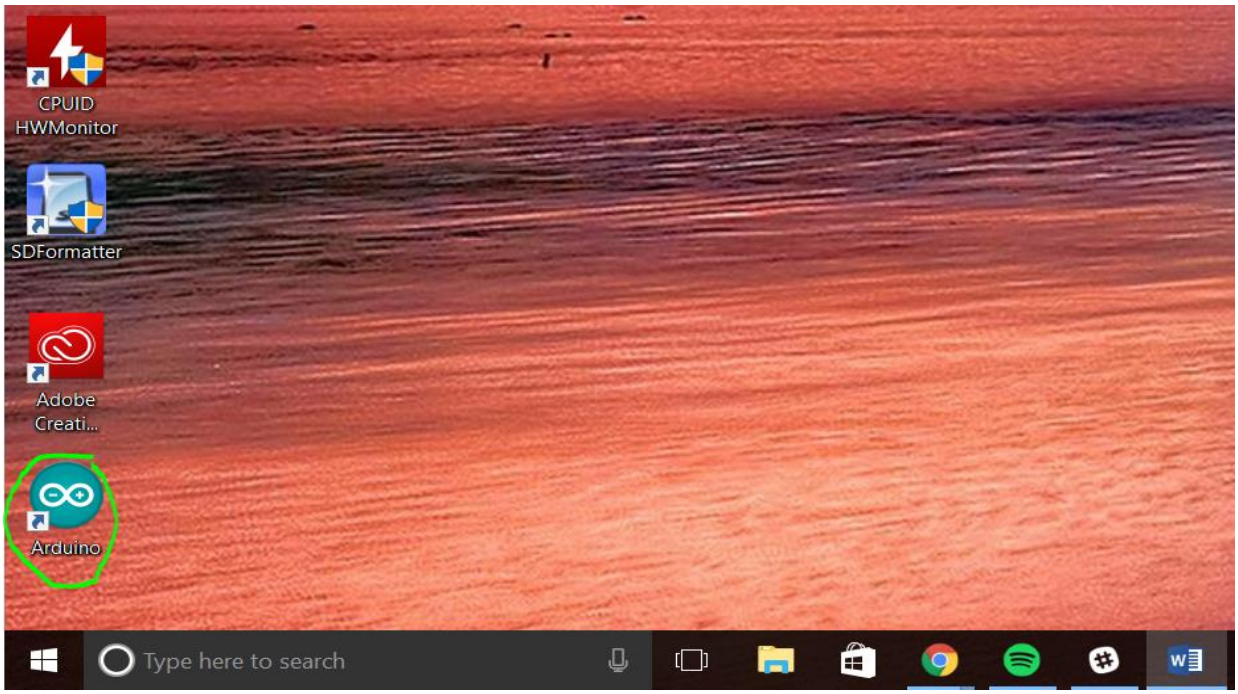
Step 8: Let the program finish installing. This should not take longer than 5 minutes depending on your computer's hardware.



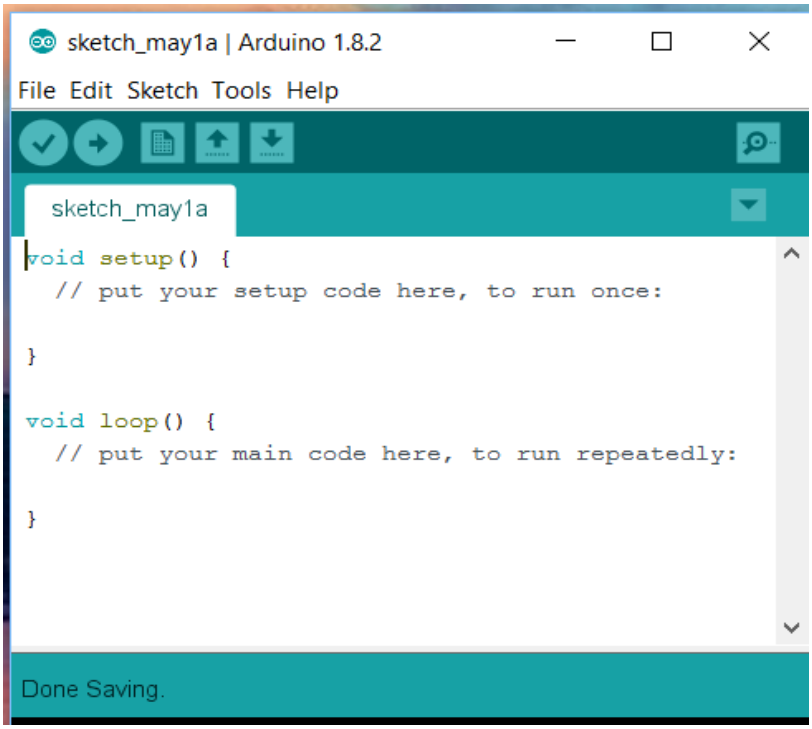
Step 9: After the program, has finished installing it will say "Completed". Then click 'close' in the bottom right corner.



Step 12: Now go to your computer's desktop screen. There should be a shortcut on it that says Arduino underneath it. (Shortcut circled in green below).



Step 13: Double click on that Icon to make sure that the Arduino IDE was installed correctly. The window below should appear. Congratulations, you have successfully installed the Arduino IDE!

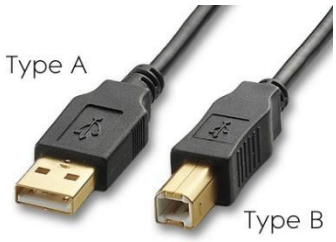


How to configure the HC-08 Bluetooth module

The Bluetooth module will have the information for the Arduino to talk to the Bluetooth.

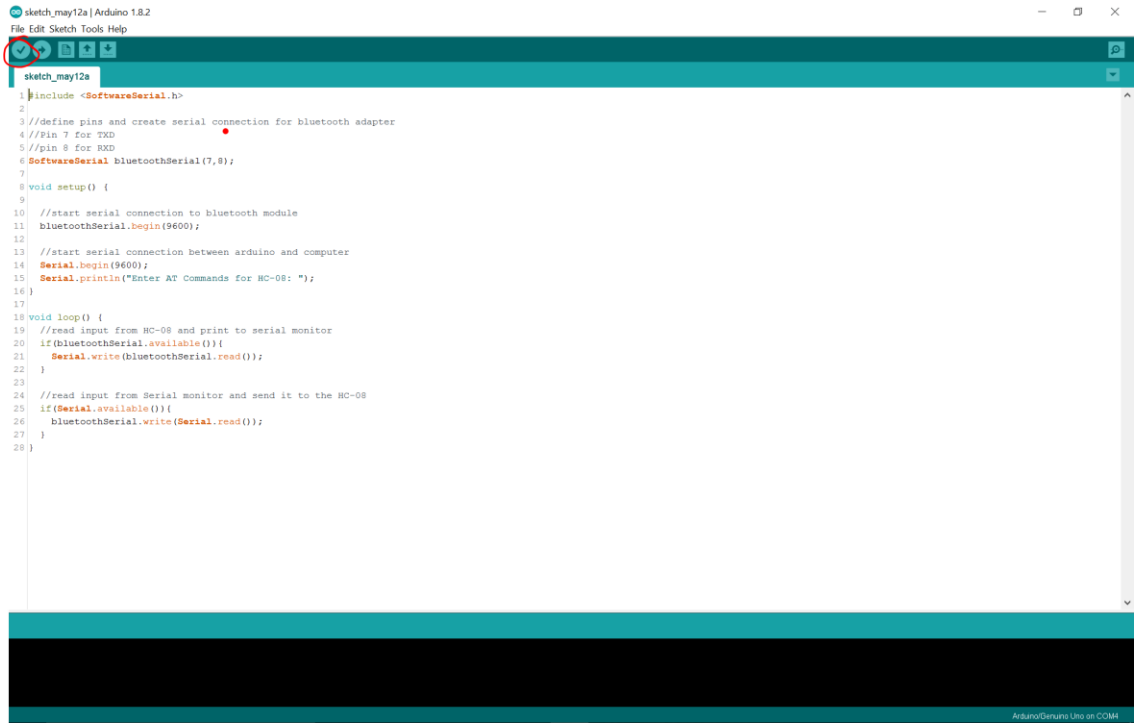
Step 1: Download Bluetooth Configuration (bluetoothAtCommandConfigurator.ino) file from GitHub link: https://github.com/ajt239/Arduino-Team-Bam-Master

Step 2: Plug the Arduino System into the computer with USB type B connector connected to the Arduino Uno and the USB type A connector connected to the computer.

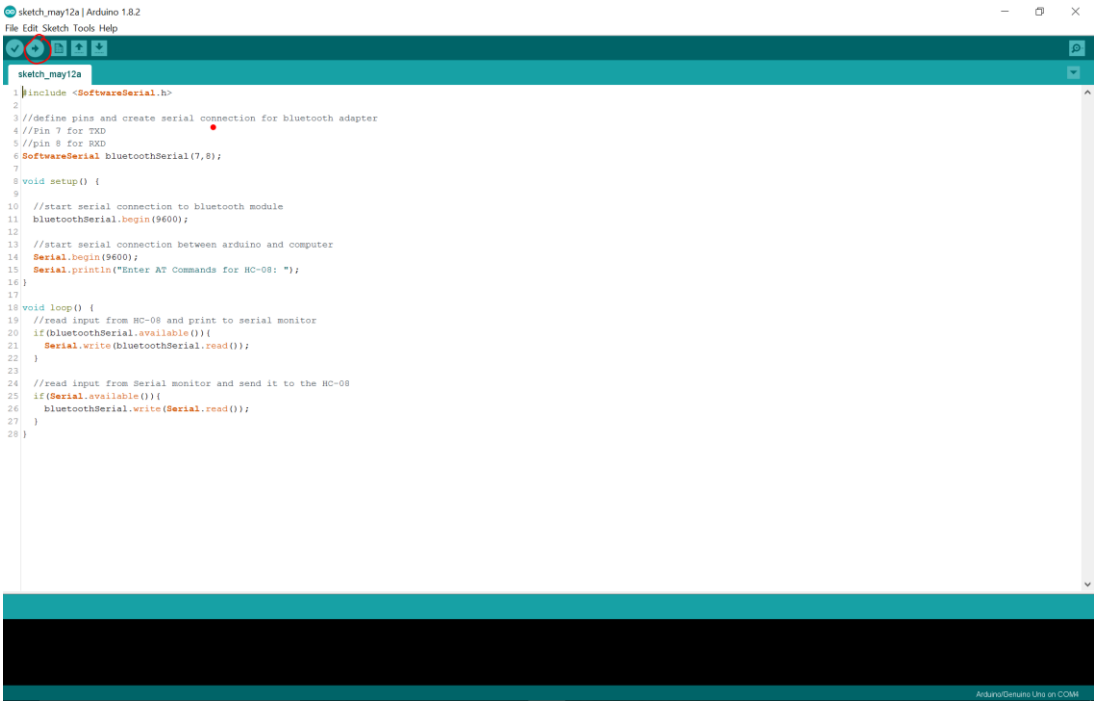


Step 3: Double click on the downloaded file to open it in the Arduino IDE.

Step 4: Once the file is open in the Arduino IDE, click on the check mark in the upper left. There will be a green (progress) bar that shows up in the lower right hand corner. Let this green bar finish.



Step 5: Once the green bar has finished and no errors have occurred. Click the button right next to the check mark button in the upper left corner. This button looks like an arrow pointing to the right. Another green bar should appear in the bottom right. Wait till it is done to go on to the next step.



Step 6: When the green bar has finished, click on the magnifying glass button in the upper right (below the “x” button) to close the application.

Step 7: A new window should appear after the next step. This is called the “Serial Monitor” This is what will allow us to change the settings of the Bluetooth module. The green arrow below shows where we will type our commands. And the orange arrow will show where the Bluetooth module will tell us what is going on.

Step 8: Now we will figure out the name of the Bluetooth module that will show up in the application we will type the command (without the quotation marks but include the question mark) “AT+NAME?”. Then click on Send button (or press enter on the keyboard.)

After clicking on Send (or pressing enter), The screen will read “Enter AT Commands for HC-08:” a new line will appear. This line will say “OK+Name: “ and the name of the module. In this case it showed “OK+Name:SH-HC-08”, which is the name of the module used to create the guide is SH-HC-08. The name of the module is the name of the Bluetooth device you want to connect to when you connect with the mobile application.

Step 9: This step can be skipped if you do not want to change the name of the Bluetooth module. To change the name of the module type in the Serial Monitor “AT+NAME(New Name)”. For example, “AT+NAMETEAM BAM”, which will name the module “TEAM BAM”. Then press enter or click Send.

After clicking on Send or pressing enter, below where it says “Enter AT Commands for HC-08:” a new line should appear. This line will say “OK+SET:(New name)”. This means the modules name has been changed. For example, ours said “OK+Set: TEAM BAM”.

Step 10: Now we are going to check what the pairing passcode is for the module. This is the passcode that is needed to connect to the Bluetooth module through the mobile application. To do this type in “AT+PASS?” without the quotation marks(but with the question mark). Then click on Send or press enter.

After clicking on Send or pressing enter, below where it says “Enter AT Commands for HC-08:” a new line should appear. This line will say “OK+PASS: (pair passcode)”. For example the one used to make this guide said “OK+PASS: 000000”, which means the pairing passcode is “000000” without the quotation marks.

Step 11: This step is to change the pairing passcode, skip if you like yours. To change the pairing passcode for the Bluetooth Module type in the command “AT+PASS(new pairing passcode)” without the quotation marks. For example to change the code to “123456” we would type “AT+PASS123456” without the quotation marks. Then click on send or press enter.

After clicking on Send or pressing enter, below where it says “Enter AT Commands for HC-08:” a new line should appear. This line will say “OK+SET: (new pairing passcode)”. For example the one used to make this guide said “OK+Set: 123456”, which means the new pairing passcode is “123456” without the quotation marks.

Step 12: Now to make sure the Bluetooth module is setup to require the passcode upon connection. Type in the command “AT+TYPE?” without the quotation marks (but with the question mark). Then click on Send or press enter.

After clicking on Send or pressing enter, below where it says “Enter AT Commands for HC-08:” a new line should appear. This new line will say “OK+GET: (a number)” this number is how you turn the paring passcode on or off. If it says “OK+GET: 0” or “OK+GET: 1” please move on to the next step because it needs to be set to 2 for pairing passcode to be turned on properly.

Step 13: Now to turn on the pairing passcode type in the command “AT+TYPE2” without the quotation marks. Then click on Send or press enter.

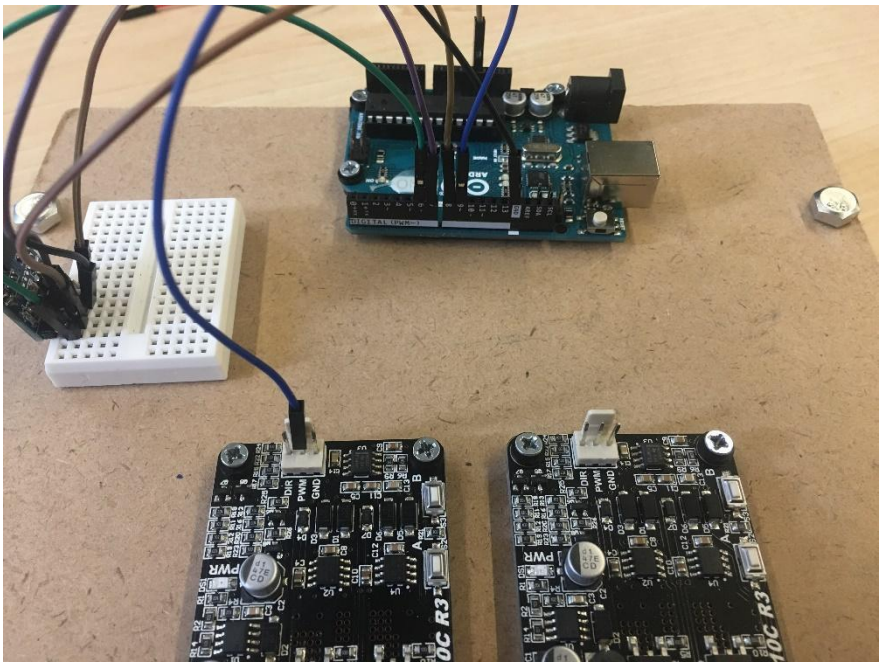
After clicking on Send or pressing enter, below where it says “Enter AT Commands for HC-08:” a new line should appear. This new line will say “OK+SET: 2”, this means that now the pairing passcode is enabled on the Bluetooth Module. This means that everytime a mobile devices pairs with the Bluetooth module the user will have to know the passcode that was set above.

Picture Reference:

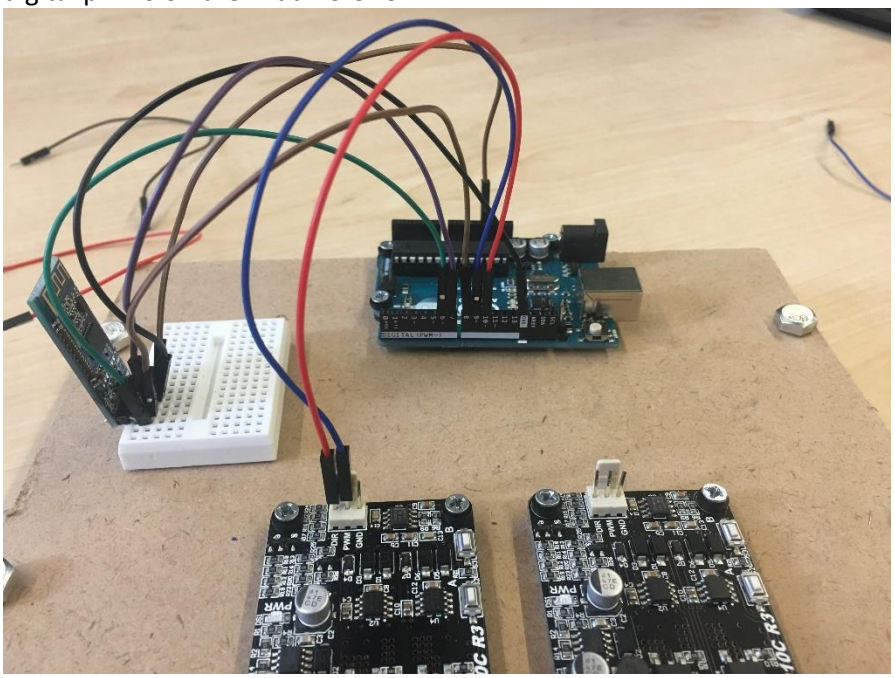
- Anon. 2017. [2016 Civic EX NA] Finally Video While Driving. (May 2017). Retrieved May 15, 2017 from http://www.civicx.com/threads/2016-civic-ex-na-finally-video-while-driving.9983/page-4

How to wire the Onboard System Part 2 Steps 8- 15

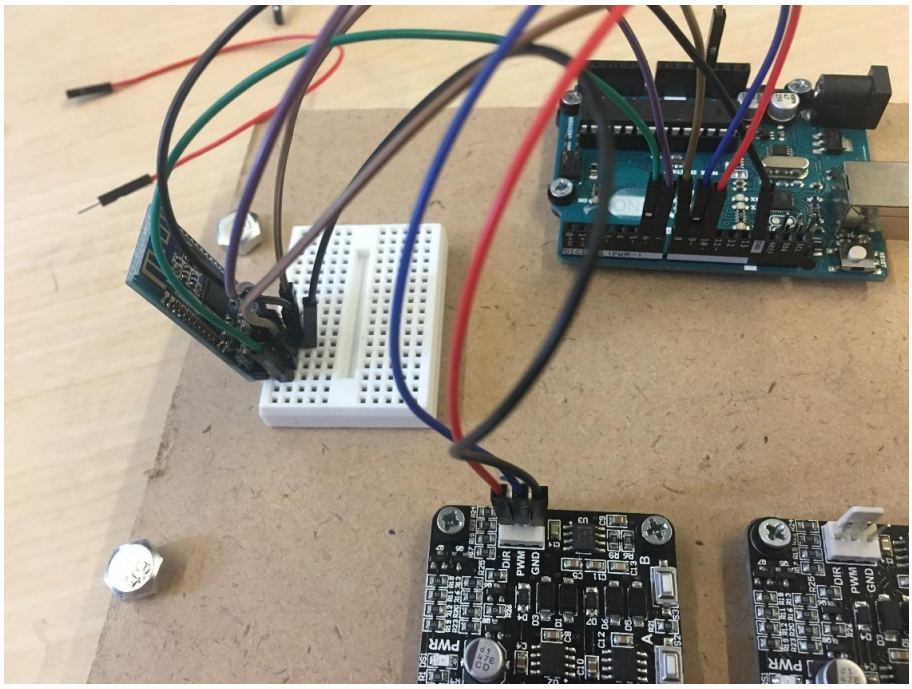
Step 8: Arduino Uno to motor Controllers
Now to start wiring the Arduino Uno to motor controllers. Run a jumper wire from the PWM pin on the left motor controller (this is the middle pin of the white parts of the motor controllers) to digital pin 9 on the Arduino Uno.



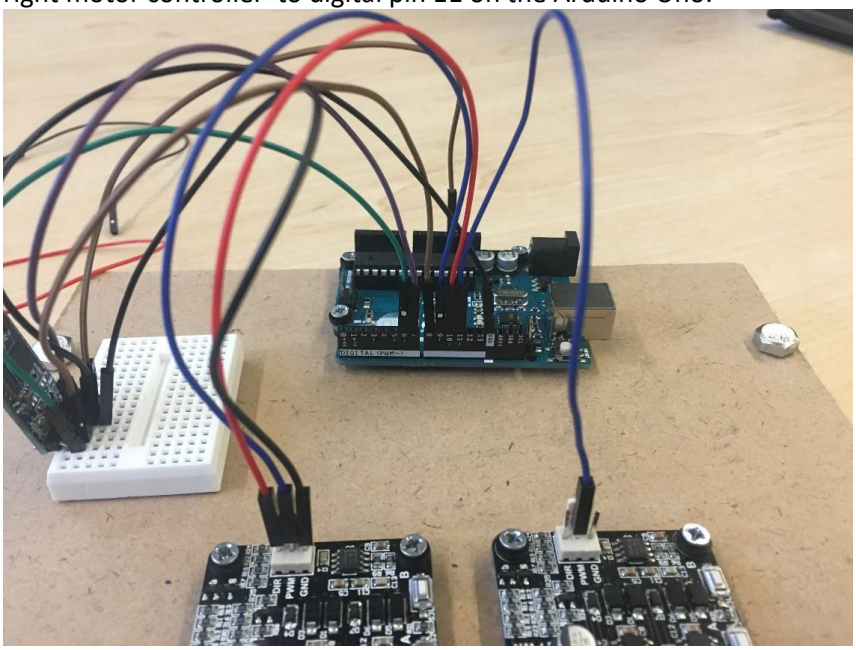
Step 9: DIR pin to pin 10
Run a jumper wire from the DIR pin on the left motor controller (leftmost pin --red in this image) to digital pin 10 on the Arduino Uno.



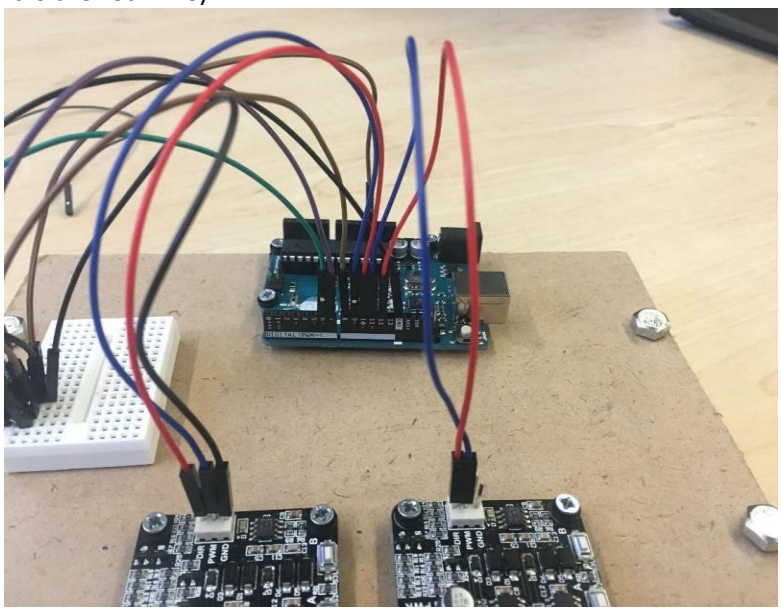
Step 10: Add a grounding wire
Run a jumper wire from the GND pin on the left motor controller (rightmost pin --in this image black wire) to the breadboard, it is placed 'behind' the ground pin for the Bluetooth module on the breadboard. [This is necessary because the Arduino Uno doesn't have enough grounding spots for everything.



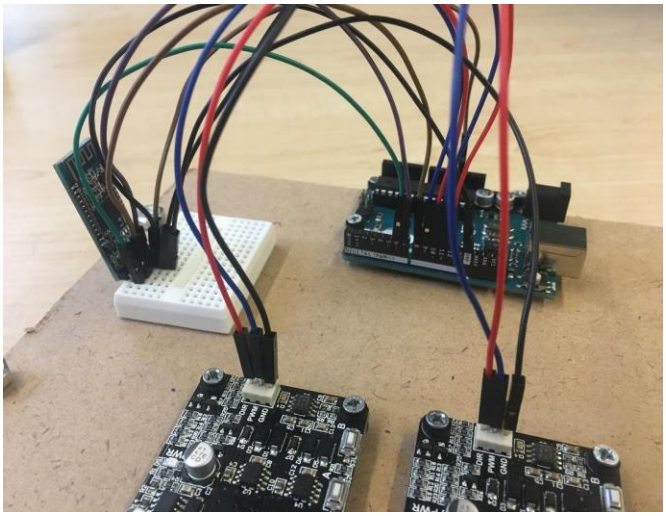
Step 11: Right motor controller
Run a jumper wire (it helps to have the colors match the left motor controller) from the PWM pin on the right motor controller to digital pin 11 on the Arduino Uno.



Step 12: DIR pin to pin 12
Now run a jumper wire from the DIR pin on the right motor controller to digital pin 12 on the Arduino Uno. (in this image it is the red wire)



Step 13: Extra Grounding right motor controller
As in step 10 run a jumper wire from the GND pin on the right motor controller (rightmost pin) to the breadboard, it is placed 'behind' the ground pin for the Bluetooth module on the breadboard. [This is necessary because the Arduino Uno doesn't have enough grounding spots for everything.]



Step 14: Attach the left motor wires to the left motor controller and the right motor wires to the right motor controller. Then attach the positive and negative wires from the wiring harness from the battery to motor controllers + and – inputs to power the motor controllers and to power the motors.

This completes the onboard system wiring.

How to wire Arcade joystick (5 pin 4/8 way joystick)

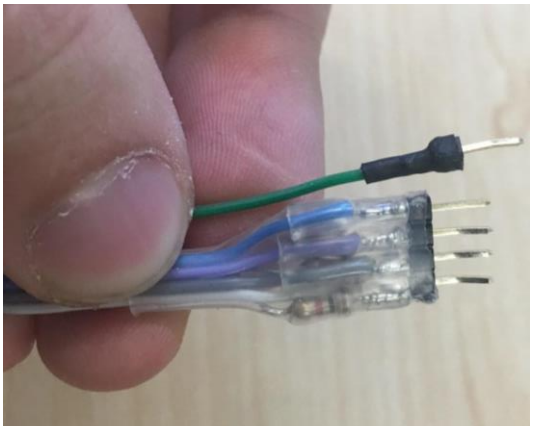
Step 1: Connecting wires to joystick pins.

The joystick will have four pins on the underside of one side. We need to connect wires to these exposed pins of the joystick in order for the joystick to direct the car. ***Before the first step of actually soldering the wires, we need to place the four colors of the shrink wrap on the wires so that we can pull it down over the wire after soldering. (white/black/red/blue/green --see image). The shrink wrap just slides over the wires.***

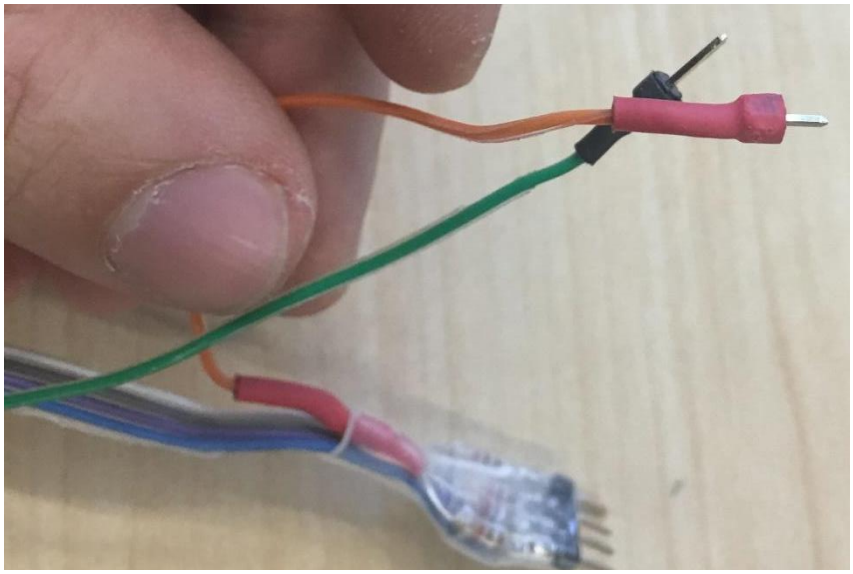
Step 1 Solder the wire to the pins. [Soldering is fairly easy, but it may help you to watch a YouTube video on how to do it] Then pull the heat shrink over the exposed connection to protect it (you may need tweezers.) Finally you will need to heat the shrink wrap with a blow dryer or a candle.

The pins on this joystick from top to bottom represent:
forward (white heat shrink),
backward (black heat shrink),
right (red heat shrink),
left (blue heat shrink), and
ground (green heat shrink).

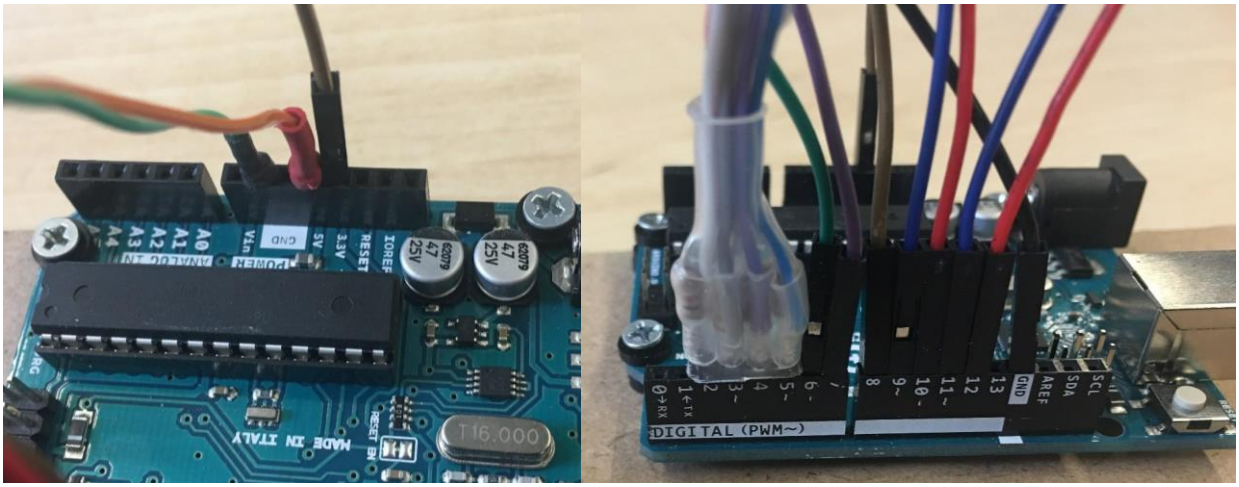
Step 2: Attach wires to male pins
The left image below is an example of what is attached to the Arduino. The sticks on the left (male pins) will be placed into the Arduino. We need to attach the other end of the wires (from step 1) to the female end of the connector.
First insert the resistors into each of the four receivers then attach the wires to each resistor. The ground pin will not have a resistor attached. IF possible have the shrink wrap colors match from step 1. (In our image we had run out of the matching colors)



Step 3: Setting up power to Arduino
After attaching the resistors to each individual directional pin, twist the other ends of the resistors into a bundle. Then solder a new wire (orange wire in this image) onto that bundle and attach a pin. This pin will then go to the power on the Arduino. After everything Is soldered apply heat shrink to protect everything.



Step 4: Attach the ground wire to the ground pin in the analog section of the Arduino Uno. Attach the wire connected to the resisters to the 5v pin in the power section of the Arduino Uno. Then connect the forward pin to digital pin 2, backward pin to digital pin 3, right pin to digital pin 4, and left pin to digital pin 5. These pin placements are crucial so the car can be correctly controlled.



This completes the Joystick Wiring.

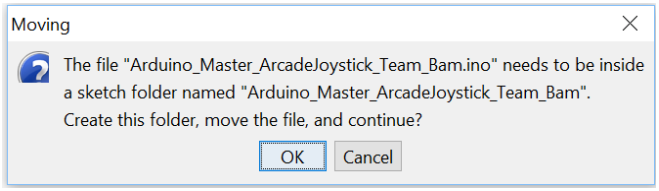
How to flash Arduino Uno with code

Step 1: Go to this GitHub link: https://github.com/ajt239/Arduino-Team-Bam-Master . On the right hand side there is a green button that says “Clone or download”. Click that button and then click on download zip.

Step 2: Go to where that zip folder was downloaded to. Then extract files out of the zip folder. This is done by right clicking on the zip folder then click on “Extract All…”. Then a new window is going to appear. Then click on “Extract”. The extracted files should open in a new window after it is done extracting.

Step 3: We went over the bluetoothAtCommandConfigurator in the “How to configure the HC-08 Bluetooth module”. For this example we will be using he “Arduino_Master_ArcadeJoystick_Team_Bam” file, which is meant for being used when the arcade joystick is plugged into the Arduino Uno. Double click on that file in the folder.

Step 4: a new window will appear to create a folder to store the file in for the Arduino IDE with the options of “OK” and “Cancel”. Click on “OK”.

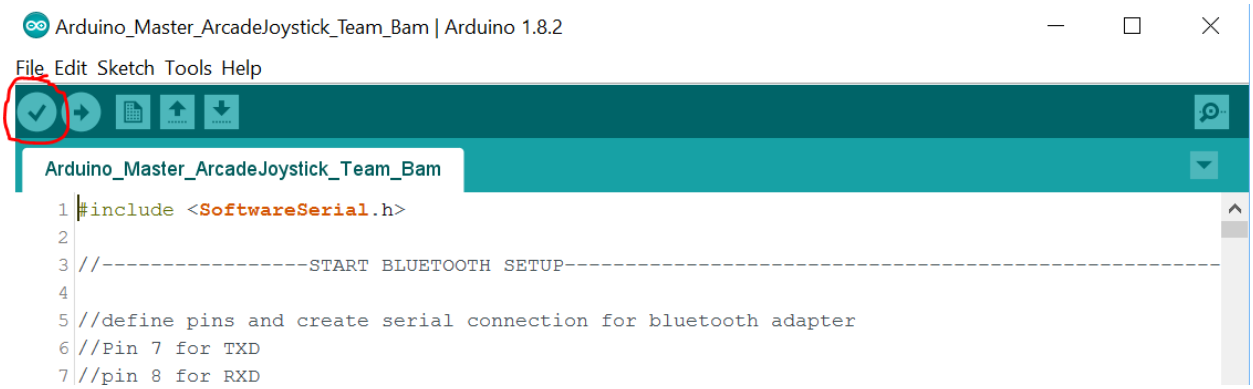


Step 5: After clicking ok, the Arduino IDE will open the file that you double clicked on.

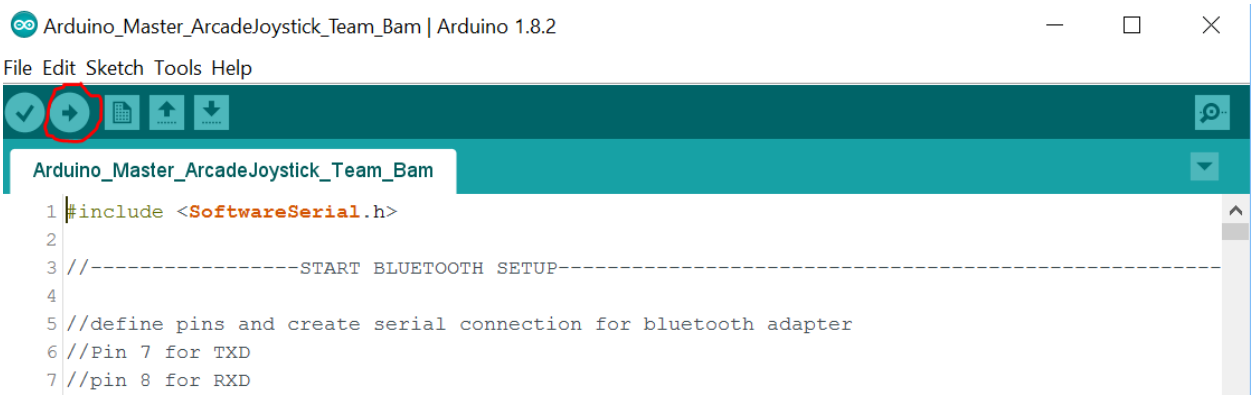
Step 6: Plug the Arduino Uno into the computer now. This is done using a male USB type A to male USB type B cable (also known as a printer cable).

Step 7: In the Arduino IDE, up at the top it says tools. Click on that and then go down to port and click on that. Then click on the port that has the Arduino Uno plugged into it.

Step 8: After choosing the port the Arduino Uno is connected to, click on the check mark as shown below. A green load bar will then appear in the bottom right hand corner. Let that load bar finish and disappear.



Step 9: After the load bar disappears you are ready to flash the Arcade joystick code onto the Arduino so that Arcade joystick will be able to control the car. This is done by clicking on the arrow pointing right. After clicking it a green load bar will appear in the same place as before. Let it finish loading and disappear.



Step 10: After the green bar disappears from the last step the Arduino is now ready to be used with the Arcade style joystick to control the car. Follow these steps for flashing the code for other control devices, just choose the appropriate file for that controller.

Step 11: Now you can unplug the Arduino from the computer and it is ready to go!.

How to use the mobile application:

Step 1: Get the mobile application onto your phone
Step 2: Launch the mobile application
Step 3: On the first page of the application is the home page. Press the "Begin" button on the screen to continue.
Step 4: If the car is already on skip this step. If the car is not on turn the car on.
Step 5: Press the scan button to search for your Bluetooth module. A list of discoverable devices should appear. Press the connect button next to the name of your Bluetooth Module.
Step 6: Then enter your pairing passcode to finish connecting to the device.
Step 7: Now that you are connected press the button that says "Go" on it to take you to the controller page. At the top of this page there is a variable speed bar. This allows the user to set the maximum speed the car can travel at start at 0%, 25%, 50%, 75% and finally 100%. The default for the application is 100%. Below that is the "Emergency Stop" button. Press this to stop the car and to take control away from the child. Press it again to give control back to the child. Below that is a directional pad that will allow the parents/guardians to control the car while the emergency brake is engaged.

Instructions - How to run the app on any phone

1. Download the code from the GitHub .
    a. Save the folder "GoBabyGoUniversalController" somewhere where you can easily find it. For example, you can save it to your desktop.
2. Download the IonicView app from the App store or Google Play store onto your phone.
3. Follow the instruction on the IonicView app to create an IonicView account
4. Upload the Go-Baby-Go Universal Controller code to your Ionic account:
    a. Open your command line
    b. Use the 'cd' command to navigate into the "GoBabyGoUniversalController" directory
    c. Type in the command "ionic upload" and press enter. It will ask for your IonicView account credentials. Enter those, and the app will be uploaded onto your Ionic account.
5. Open the Go-Baby-Go app through the IonicView app:
    a. Open the IonicView app on your phone
    b. Navigate to the apps on your account. The GoBabyGoUniversalController app should be there. If it is not, try refreshing the app, or repeat step 4.
    c. Click on the app name, this should open the app.

You can now run the app on your phone!

Taking the app to the next level...

Because the current version of Ionic has some issues when trying to build a production version of the app, we were not able to build an APK (Android Package File). Building an APK creates a file that you can easily download onto an Android phone and install, creating a fully functioning app. Creating an APK should be as simple as a few command line commands. If a new version of Ionic fixes the bugs, or the documentation is updated to include the correct instructions, building a production version of the app will be completely possible. Feel free to give it a shot! Here is the link to the Ionic documentation that goes over how to deploy an application: https://ionicframework.com/docs/intro/deploying/