



Versatility of the Arduino Electronics Platform for High School Computer Science Courses

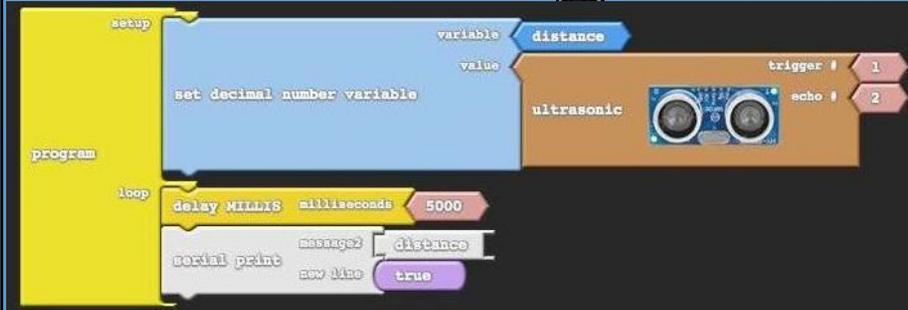
Matt Bajzek, John Casey, Luke Mivshek, Tyler Much, and Dr. Dennis Brylow

Motivation

ECS (Exploring Computer Science) is a successful high school curriculum that introduces students to computer science and technical competency. Currently the main, hands-on robotics unit, unit 6, focuses around the use of a LEGO Mindstorm which, at nearly \$350 for each group in the class, makes the course fiscally unavailable to many schools.

Module Six

The Sixth and final unit of the ECS curriculum centers around robotics via three projects. It strives to keep kids interested in programming while not making it too challenging.



What is an Arduino?

An Arduino is a small and simple computing platform operating upon a similarly small and simple microcontroller board. It has:

- Its own IDE (Integrated Development Environment).
- A straightforward, built in programming language.
- Twenty basic pins for I/O communication with the ability to handle multiple peripherals of different types at once.
- Simple execution with just a setup and a loop.

Why Arduino?

The Arduino offers a very unique set of benefits:

- Flexible Software – All of the Arduino Software is available across the main platforms (Windows, OSX, and Linux), but it is open source as well. This allows for an editable, block-based IDE to be presented to the students in order to keep coding simple while they learn the basics.
- Community & Hardware Availability – The Arduino has a large user community with helpful libraries and tutorials for the myriad of I/O attachments available to be used with it. With such a large group interested in using the Arduino and the ease in which peripherals are connected, the options for I/O attachments are vast. This works with the large amount of pins available on the Leonardo.
- Versatile – The Arduino is capable of having an add on called a shield. This simply means a pre-set up board can be created to be placed on the top of the Arduino. This board

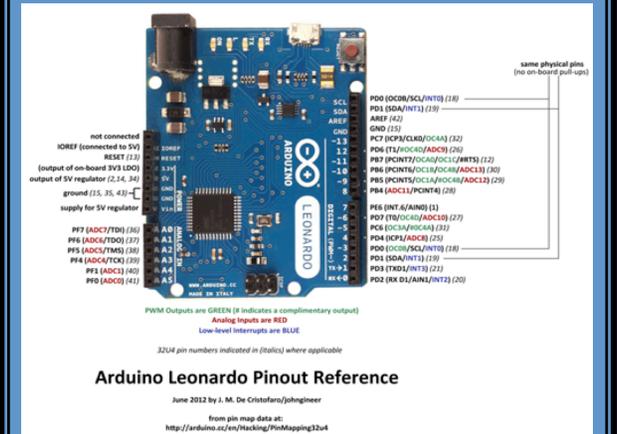
can be anywhere from an adapter to run servo motors or a simple circuit board. We plan to use this feature to create a shield which will have all of the wiring completely set up for the peripherals so that teachers can simply plug in the peripherals to the shield without having to worry about debugging breadboards or learning basic circuitry.

- Cost Effective – Just under \$25, an Arduino Leonardo is slightly over 10% the cost of a single LEGO Mindstorm unit, when including the outside peripherals necessary and aforementioned shield.

Proposed Shield

Adding a custom shield on top of the arduino interface will greatly simplify the learning curve for the teachers and help keep the debugging process negligible. The proposed layout would:

- Make ground and power pins, the shortest in supply by far when multiple peripherals are attached, more widespread and easy to access for all peripherals.
- Cluster pins in the proper order for specific I/O attachments with multiple side-by-side pins, such as setting up the ultrasonic ping sensor so all four necessary pins line up when you put in on the shield itself.
- Give permanent positions to certain elements such as the speaker so the pin numbers need not be adjusted in programming.
- Have a set guideline for placement of peripherals so students do not accidentally start to cross wires and complicate simple projects.
- Completely eliminate the need to use extraneous wires or a breadboard.



This work was supported in part by a Marquette Center for Teaching & Learning Undergraduate Research Grant. Special acknowledgements to Robert Jurantich and ECS. For his insight and expertise with the arduino and connected systems as well as their encouragement for improvement on the current curriculum, respectively.

Resources:
<http://www.adafruit.com/blog/2012/06/03/arduino-leonardo-pinout-reference/>

<http://arduino.cc/en/Guide/Introduction>
<http://www.mscs.mu.edu/~brylow/images/MSCS.png>