

Reducing Cost of ECS Module 6: Choosing a Platform

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



Motivation

Exploring Computer Science (ECS) is a high school introduction to computer science curriculum that has seen success in hundreds of classrooms and with almost 9000 students. The current robotics unit is centered around LEGO Mindstorms, which means about \$350 initial cost for each student/group, an amount prohibitive to many high schools and intimidating for those that are hesitant to pilot a computer science course. There needs to be a more financially approachable alternative.

Evaluation Criteria

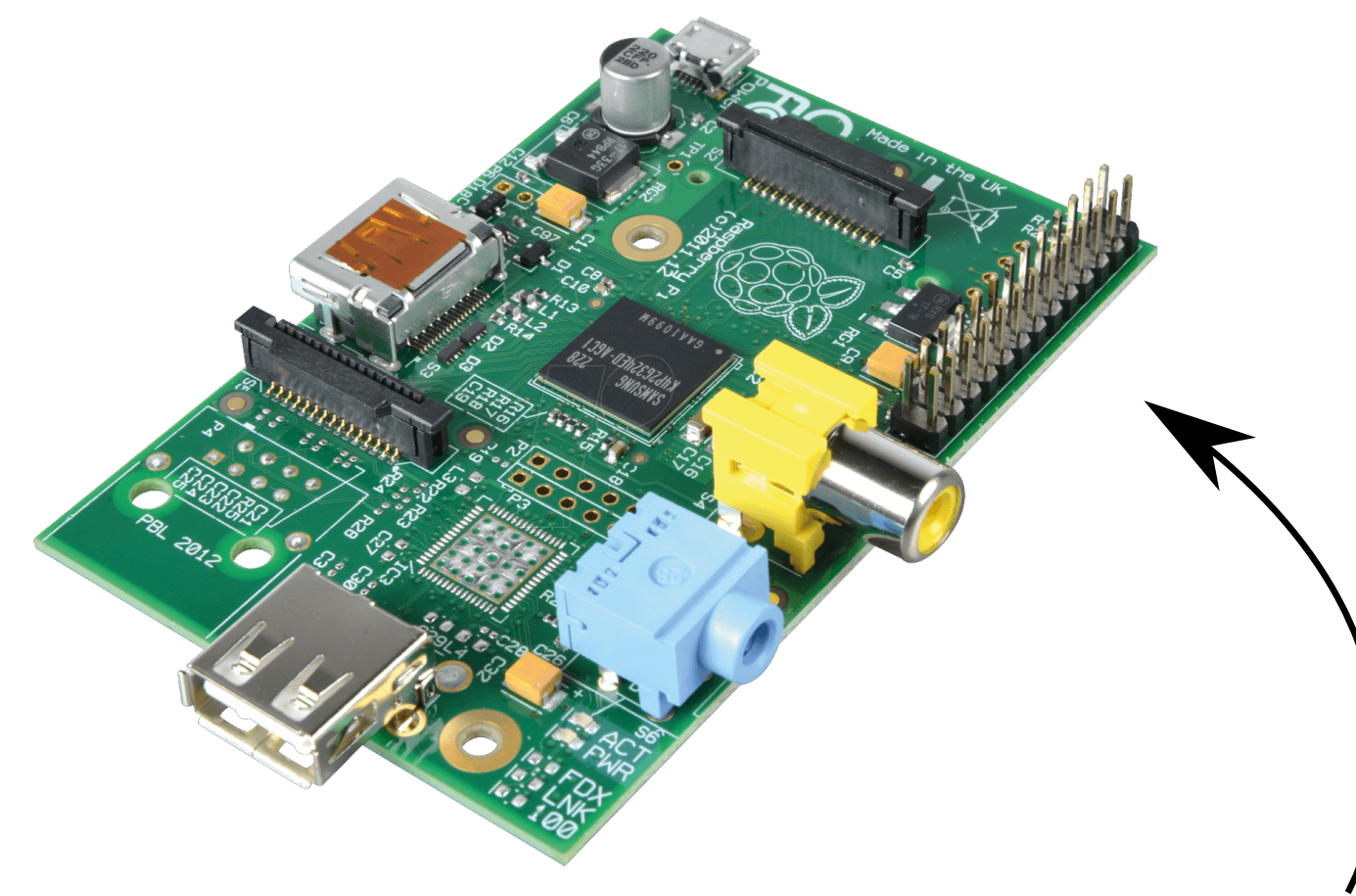
- Price
- Ease-of-use: How easy is it to work with the platform? Does it require additional tools like a breadboard? Is it easy to upload code to the device?
- Familiar software tools: Can students use familiar software tools?
 - Can we modify the software tools to provide an interface more suitable for introduction level high school students and aligned with the nature of the existing course?
- Versatility and future availability: Will it be easy to create new student projects for this platform and will the device be easily available in the future?
- Robustness: Will this platform survive in a high school classroom setting?
- In-class preparation: How long will it take to set up and teach students how to use the new software and hardware?

Raspberry Pi

Price: \$35

Ease-of-use: Bare pins and use of breadboard required. Code loaded from SD card or from serial port (requires serial to USB converter and additional software). Also requires an HDMI display because Scratch must be running on the Raspberry Pi.

Software tools: Scratch. Students are already familiar with Scratch from using it previously.



Versatility & Future Availability: Maximum 18 exposed input/output pins. Device is likely to be available in the future.

Robustness: Some peripherals dangling from the board but sturdy with a case.

In-class preparation: Virtually none for software but a fair bit for teaching students how to use a breadboard.

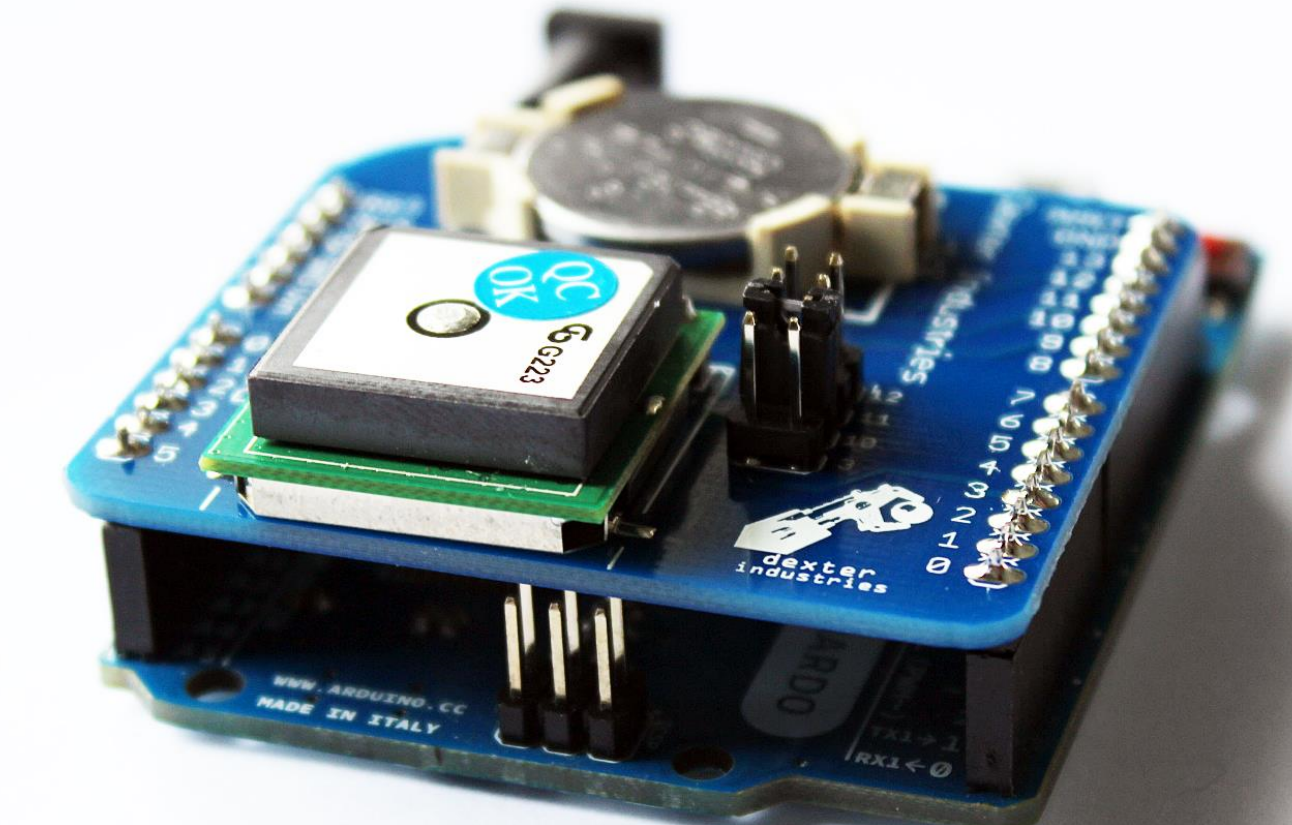
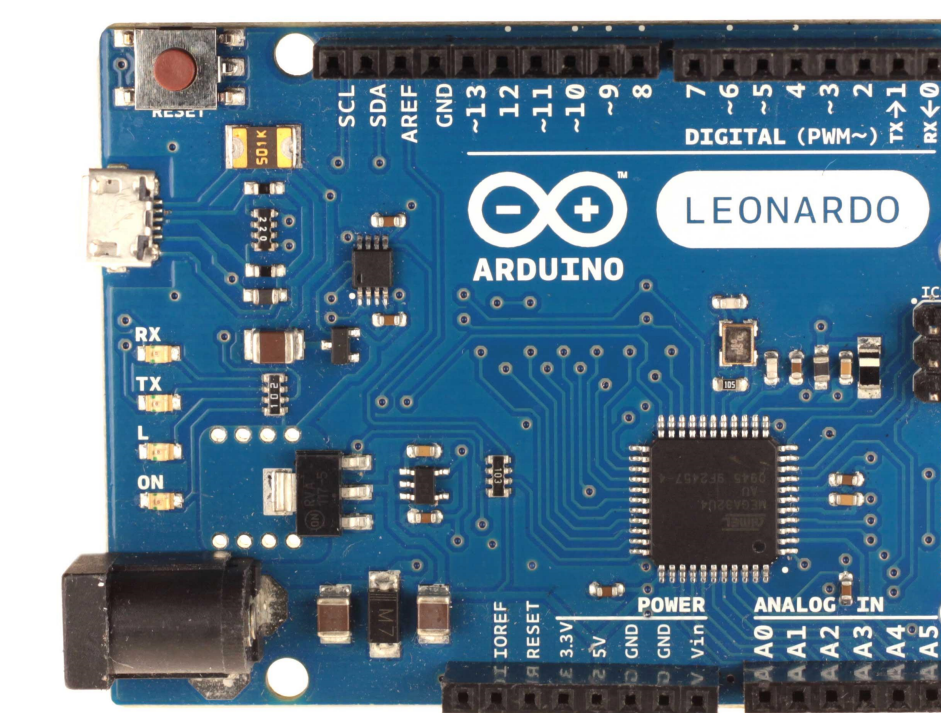
References

<http://www.exploringcs.org/>
<http://blog.ardublock.com/>
<http://scratch.mit.edu/>

Acknowledgements

This work was supported in part by the following: a National Science Foundation REU Supplement to CE21 award CNS-1339392, charitable alumni donations to the Systems Lab at Marquette University's Department of Math, Stats, and Computer Science, and a Marquette Center for Teaching & Learning Undergraduate Research Grant. Additional thanks to Robert Juranitch for his insight and advice.

Arduino (Leonardo)



Price: \$20

An example of a shield for Arduino

Ease-of-use: Labeled pin sockets and can be simplified by a shield. Code loaded over USB port with no additional software outside of the ArduBlocks environment.

Software tools: ArduBlocks, a block language very similar to Scratch and even simpler in some key ways.

Versatility & Future Availability: 20 input/output pins. Even more likely to be available in the future, as the product is led by enthusiasts and has a strong community backing.

Robustness: Not many peripherals dangling from board and a shield will improve robustness.

In-class preparation: Very little for software and for hardware.

Our Decision & Future Work

We have chosen to use the Arduino platform to develop our cheap alternative to module 6 of the ECS curriculum because it out-classes the Raspberry Pi on almost all of our criteria. The Arduino is easier to use and the concept of a shield for the Arduino makes the platform incredibly flexible. We have plans to design a custom shield with most (if not all) of the peripherals required to teach our modified version of module 6. This will prove to be a platform simple enough for high school students and teachers to work with and flexible enough for variation in projects within the module.