Microcontrollers to Teach Scenic Automation

Jonathan Shimon
Department of Theatre and Dance
University at Buffalo
Buffalo, New York, United States
jrshimon@buffalo.edu

Abstract— **Introducing students to the fundamentals of automation can be a massive undertaking for faculty. Scenic automation systems can be very complex; in order to prepare students for this emerging area of technical theatre it behooves faculty to find innovative ways to fit the foundations and concepts into curriculum. Many automation solutions exist on the market, from plug and play to component level, they are all in the thousands of dollar and take up significant space. It would be impractical for each student in an undergraduate program to have their own system. Arduino microcontrollers that incorporate motors, switches, LEDs, and potentiometers are readily available and cost effective. The open source environment has encouraged many tutorials and project examples online. These embedded electronics allow the students to engage in basic programming that mimic the use of a PLC for a fraction of the cost and size. Microcontrollers facilitate scaled down automation which is approachable by students in all disciplines of technical theatre. Bringing these exercises into the classroom allows the students to understand automation and electrical basics such as wiring schematics, feedback, speed reduction, circuit design and more.**

I. INTRODUCTION

Introducing students to the fundamentals of automation is a massive undertaking for technical faculty. Scenic automation systems can be very complex. In order to prepare students for this emerging area of technical theatre it behooves faculty to find innovative ways to fit the foundations and concepts into curriculum. Many automation solutions exist on the market. Ranging from plug and play to component level, they generally cost in the thousands of dollars and take up significant space. It would be impractical for students in an undergraduate program to have their own system.

II. APPROACH

Arduino microcontrollers that can incorporate motors, switches, LEDs, and potentiometers are readily available and cost effective. The open source environment has encouraged many tutorials and project examples online. These embedded electronic systems allow the students to engage in basic programming that mimic the use of a PLC (Programmable Logic Controller) for a fraction of the cost and size.

Figure 1. Arduino Tinker Kit

III. HARDWARE

The kits purchased for student use were from Sparkfun, an electronics manufacturer and distributer based in Colorado. "The Tinker Kit" was selected for its varied contents and low cost. The contents of the kit are shown at right. Similar kits are available in a range of sizes from alternate vendors.

The cost of the kit is $49.95, however Sparkfun offers 20% educator and bulk discounts.

https://www.sparkfun.com/products/13930.

Figure 2. Students using the Tinker Kit

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IV. ONLINE TUTORIALS AND RESOURCES

In addition to many tutorials available online, Sparkfun has an experiment guide. This guide has 11 activities which can be brought into the classroom. This gives a foundation in circuit design, data flow, sensor integration, and motor use. The students are able to go at their own pace and focus in on the concepts they find difficult or of specific interest. https://learn.sparkfun.com/tutorials/experiment-guide-for-the-sparkfun-tinker-kit/introduction-to-the-sparkfun-tinker-kit.

Experiment 1: Blinking an LED

Experiment 2: Reading a Potentiometer

Experiment 3: Driving an RGB LED

Experiment 4: Driving Multiple LEDs

Experiment 5: Reading a Button Press

Experiment 6: Reading a Photoresistor

Experiment 7: Reading a Temperature Sensor

Experiment 8: Using a Servo Motor

Experiment 9: Driving a Motor with an H-Bridge

Experiment 10: Controlling a Motor with Inputs

Experiment 11: Reading Serial Data

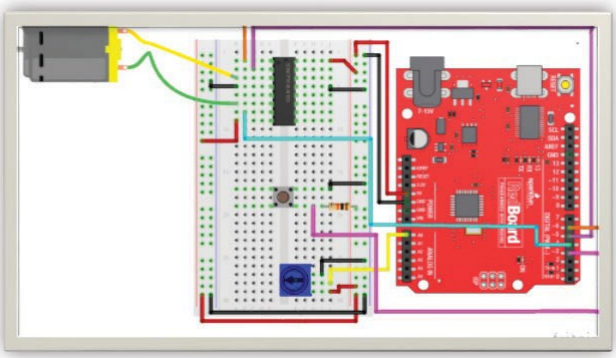

Figure 3. Circuit Diagram from Sparkfun Experiment Guide

V. SOFTWARE

Arduino has its own IDE (Integrated Development Environment) software, which is based on C/C++. The IDE allows error checking, connection to the microcontroller, and a few other functions. This allows students to modify code versions and push changes quickly. The coding aspect can be overwhelming, however, there are many examples within the experiment guide.

The open source nature of the platform facilitates community sharing of code and projects. The coding should not be a hurdle for anyone interested in utilizing arduinos.

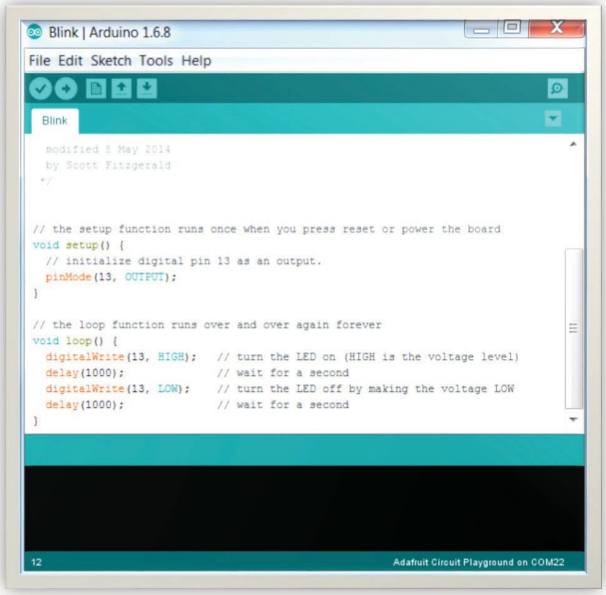

Figure 4. Arduino Integrated Development Environment (IDE)

VI. CONCLUSION

Arduinos provide a low cost learning platform, which facilitates the foundations of an introduction to scenic automation principles. The online community of developers and end users using equivalent devices to create is infinate, providing documentation and tutorials unparalleled in the theatre technology realm. Although these open source microcontrollers lack some quality control and life safety capabilities that industrial controllers offer they have earned a place in the education and toolbox of future theatre automation practitioners.

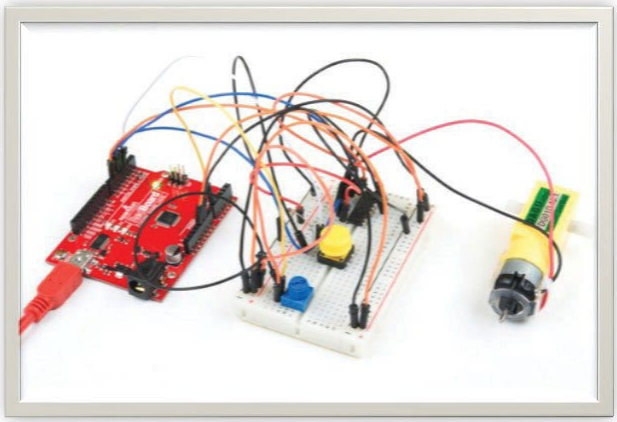

Figure 5. Controlling a motor with input devices