A Brief Artbotics Exploration for Educators

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Abstract

The purpose of this project was to design a three-hour session for educators on art and robotics. The intent of the theme and project-based session is to give educators a sense of what a student experiences during an Artbotics course. The session follows a similar, albeit compressed, workflow that is implemented in the Artbotics courses: introduction to the hardware and software tools, interactive character theme for wire sculpture activity, and a final exhibition. This paper details the background, activity exploration, and Artbotics session planning.

1   Introduction

Robots provide an interactive way to teach science, technology, engineering, and mathematics (STEM) concepts. As outlined in [1], goal-oriented, thematic integrated curriculum, and project-based approaches are the primary methods used in educational robotics. Qualitative and quantitative results from educational robotics assessments indicate the activities had positive impact on the students [2][3][4][5].

Art is a core topic for youth education, despite it commonly being a point of debate. It is difficult to determine just how art benefits other fields. Eisner details the difficulty of measuring the art education benefits, although intuitively they are understood [6][7]. Practicing art allows students to explore transforming their visions, ideas, and feelings into an art form [6]. Eisner outlines lessons learned while practicing art and how they are useful elsewhere [7]:
1. There can be more than one answer to a question and more than one solution to a problem; variability of outcome is okay.
2. The way something is formed matters.
3. The importance of imagination and of refining and using the sensibilities.
4. The capacity of an art form to touch us depends on the relationships that are composed by artists.
5. Intrinsic satisfactions matter.
6. The importance of being flexibly purposive in the course of one's work.

Blending art and robotics is not a new concept, as Wilson discusses in [8]. It is, however, a relatively new concept within the field of education. There are benefits to teaching youth robotics and art, as previously discussed. The combination of robotics and art provides a new perspective to explore STEM concepts. Students are encouraged to transform their visions, ideas, and feelings into an art form using robotics as the media. Programs, such as those in [9][10][11][12], have focused on blending are and robotics to explore STEM concepts. There is an inherent need for creativity, visualizing, and interaction design within the robotics field; thus

blending art and robotics is natural and practiced [8]. Approaching robotics from an artistic perspective may prove useful in exposing youth to STEM concepts.

Artbotics is a collaborative effort, between the University of Massachusetts Lowell, the Revolving Museum, and Lowell High School, focused on revealing art and computing concepts using robotics [13]. It started in 2006 as a pilot summer program for graduating high school and early college students. Since then, the program has grown to support an annual summer program for middle school, after school program for high school, and semester courses for college. A two-day educator workshop is held during the summer to disseminate Artbotics. The preliminary feedback on the Artbotics curriculum was positive; the students felt engaged in the creating process [9]. The programs have grown since the time of the publication.

STREAM is an annual educator workshop exploring how to use robotics in teaching STEM [14]. The two-day workshop provides educators with a breadth of hands-on activities involving robot technologies intending to inspire instruction. The workshop also provides the opportunity to share new methods and technologies, such as Artbotics. Dr. Holly Yanco directs Artbotics and the STREAM Workshop. She would like to include an Artbotics session in the 2010 STREAM Workshop to take place at iRobot in Bedford, MA; this would complement the other robotics sessions on the agenda.

1.1 Question and Objectives

Is it possible to give educators a motivating and useful introduction to the Artbotics concept in a three-hour timeframe?
1. Using the Artbotics high school and college classes as inspiration, design a three-hour session for approximately 50 educators.
2. Incorporate progressive techniques discussed in class and utilized in the Artbotics class: project-based activity [15], group collaboration [16], and intrinsic motivation [17].
3. Evaluate the program impact through solicited feedback and observed educator involvement.

1.2 Approach

The following tasks were implemented in designing the workshop:
1. Understand the constraints and prior workshop practices to influence the short session design.
2. Get familiar with the Artbotics kit to understand the tools.
3. Design an activity for the session attendees.
4. Determine what documentation is needed to support the session.
5. Consider evaluation questions to obtain feedback.

2 Artbotics Session Goals, Constraints, and Workflow

The goal of the session is to give educators a sense of what it is like being in a full Artbotics program. Due to logistical constraints, the session has to be carefully scoped and supported to meet this goal. For instance, sample code and limited hardware will be used.

The logistical constraints are:
1. Timeframe = 3 hours
2. Audience = ~50 adult educators (assume they are not familiar with the hardware)
3. Hardware = standard Artbotics kit containing a Super Cricket board, motors, and sensors.

The session has three primary phases: introduction of tools, theme-based activity, and exhibition. This is the general flow employed in the other Artbotics programs.

During the ***introduction of hardware and software tools***, the educators will form groups of three to four members around them, and each will have their own Artbotics kit and materials. Laptops for coding will be shared. Sharing laptops and having each member work with code and design materials was found most effective in prior two-day workshops. The intent is to promote group collaboration and idea sharing between the members while maximizing hands-on time. The groups will be given a basic overview of the hardware through hands-on practice. It is necessary to present the tools, or media, to the educators. The goal is to get them familiar so they are encouraged to explore the media.

The majority of the time will be devoted to the ***theme-based activity***. This is the project-based portion of the workshop. In the Artbotics course, the students are given a theme for the gallery show. The students explore the robotics media under the given theme. The educators will have a similar experience. Although the session will not end with a gallery showing, there is an exhibition. The educators will be given a theme and additional supporting materials to guide their exploration.

The final phase of the session is the ***exhibition***. The art pieces will be set out on the tables for display. The attendees may then walk around and interact with the characters. The act of displaying work is a traditional tactic in art education; presenting the piece is owning the piece for better or worse.

3   Activity Design

3.1   Inspiration – Wire Sculpture

Wire sculpture is simple, straight forward, and inexpensive in regards to materials needed. It involves forming wire into a shape for communicating an artistic idea. Artists have been bringing attention to the art form; it started with the work of Alexander Calder who is credited with inventing wire sculpture [18]. Wire sculpture also gives users the opportunity to explore in 3D space. I chose wire sculpture as the activity art form due to the ease of use and 3D space potential.

3.2   Materials

Here is the list of materials needed for a wire sculpture activity (see Figure 1):
1. Wire cutters

2. Three gauges of wire: 22, 26, and 28
    a. 22 gauge is sturdy enough, yet malleable, to create a small-size frame.
    b. 26 gauge is more malleable and useful for securing sensors, lights, and motors to the framework.
    c. 28 gauge is very malleable and most useful for esthetic aspects.
3. Hands for manipulating the wire
4. Tissue paper (optional for the session)
5. Miscellaneous supplies such as tape and glue (optional for the session)

Figure 1 Wire sculpture materials.

Although the standard Artbotics kit contains numerous pieces (see http://artbotics.cs.uml.edu/index.php?n=HowTo.BuildAKit), attendees will be given the following to use:
1. Cricket board using Logo programming
2. USB board for downloading code from the laptop
3. Two DC motors
4. Two light bulbs
5. IR distance sensor
6. Photocell light sensor

3.3 Experimenting with Materials

In order to determine the level of difficulty, I experimented with using the materials to create an art piece. My original idea was to create an interactive plant form with a rough wire structure for a pot and flowing wire pieces representing the plant. When a user is within a given distance (approximately 10 centimeters), one of the plant forms moves and lights up; otherwise the form is static. The pot structure lights up when the ambient light of the environment goes below a defined threshold.

The code to create the straightforward behavior took minimal time to produce; including download of the recommended packages for Artbotics, perusing online documentation, Cricket board setup, and sensor exploration. The following represents the Logo code:

```
to eplant
  a, setpower 2
  c, setpower 8
```

```
d, setpower 8
ifelse sensora > 50
  [d, on]
  [d, off]
if sensora > 50
  [a, onfor 30]
ifelse sensorf > 125
  [c, on]
  [c, off]
eplant
end
```

The sculpture took the infinite more time to produce. As with all artistic explorations, this one did not go as planned, nor did it turn out as originally hoped. Getting familiar with the materials took a great deal of time (hours beyond two days of effort were not tracked). The wire required familiarity with the gauges to effectively employ. Designing the movement took significant time due to the lack of designated hardware (i.e. gears); available materials were employed to enable movement. The lights needed to be soldered as well. The images in Figure 2 represent the plant form progression from the early stages (top) to late (bottom). The two images on the top show the wire framework. The two on the bottom show the plant form with incorporated sensors.
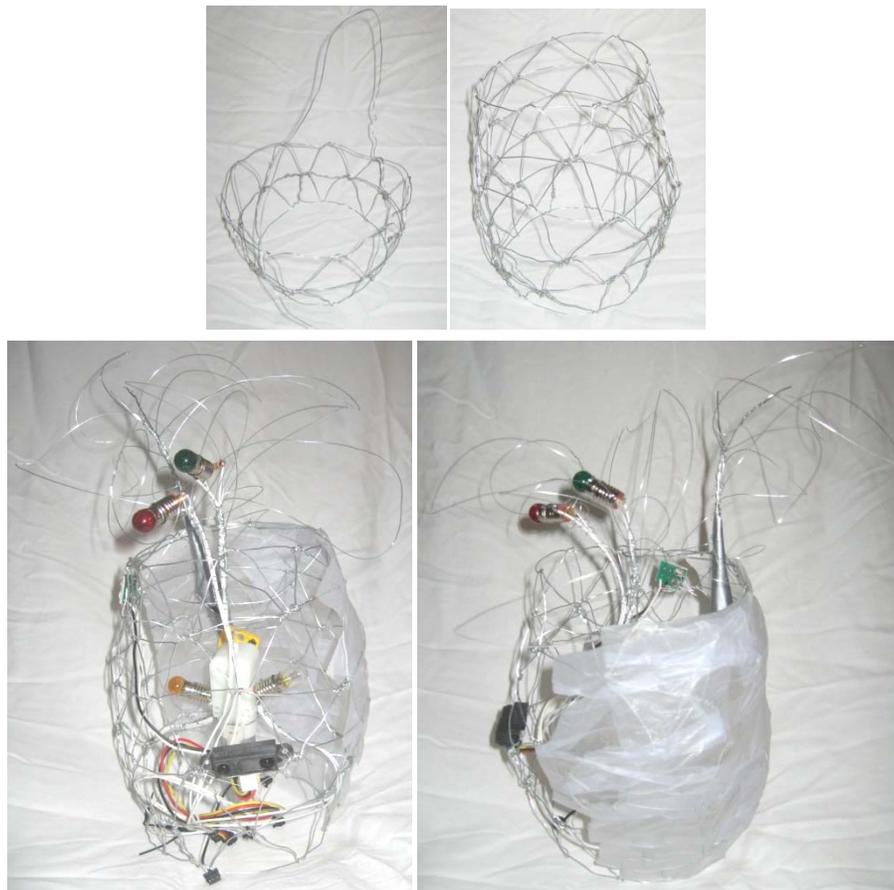

Figure 2 Wire sculpture progression.

The last stage of the materials exploration involved using wet tissue paper to create a skin around the surface of the wire framework. Part of this is visible in the bottom right image in Figure 2. The final experimental sculpture is displayed in Figure 3.
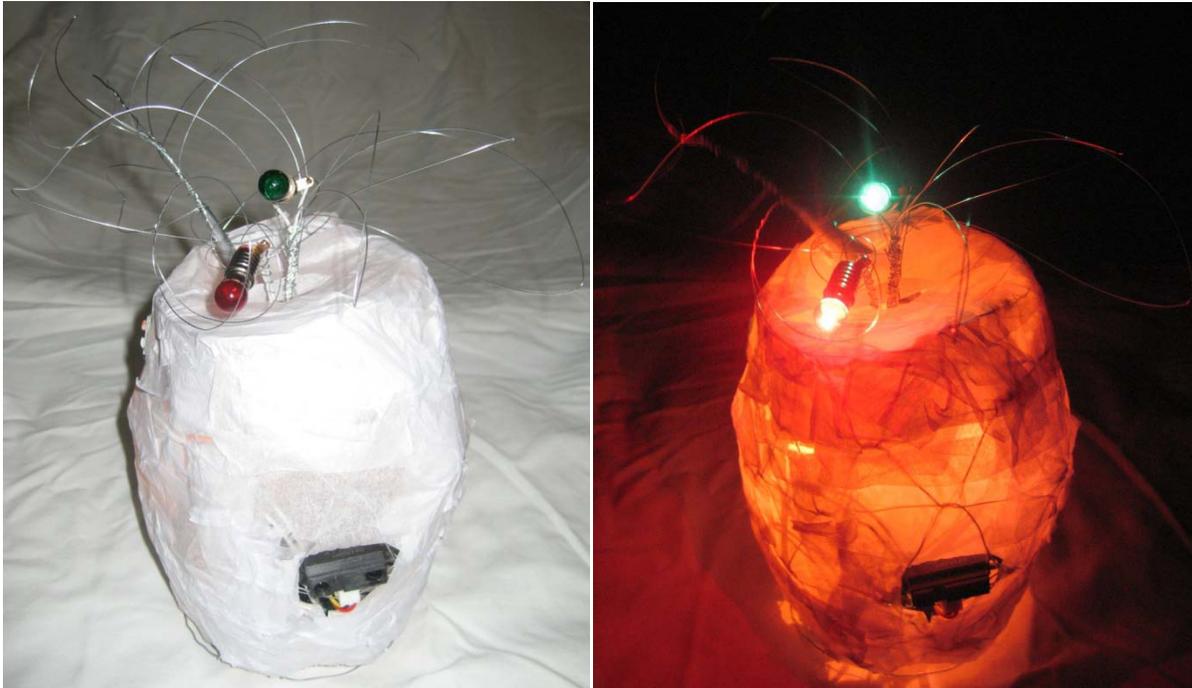

Figure 3 Final experimental sculpture in the light (left) and in the dark (right).

3.4 Standard Wire Form

It is not feasible to expect all session attendees to explore the Artbotics concept through wire sculpture in 1.5 hours without having a stock form to expand upon. Hours went into the experimental sculpture; attendees may have a hard time with this. The experience should be positive and somewhat fruitful.

The most basic 3D form to build from is a cube. The cube provides a solid structure to support the Cricket board (see Figure 4). Attendees may then use this framework to create, if they choose. Some attendees may not want to use the form and explore on their own.
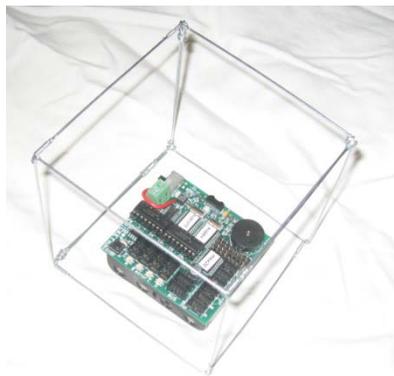
Figure 4 Cube structure for workshop activity.

3.5   Theme

The Artbotics courses often use a theme to drive the inspired art pieces produced by students and eventually displayed in a gallery. As stated by the authors of [11], open-ended themes promote problem finding in addition to problem solving. The three-hour session would benefit from a theme that would provide room for attendees to create and be expressive. The suggested theme is *interactive characters*, such as that shown in Figure 5.

Photo removed due to copyright restrictions.

Figure 5 Interactive character sculpture from the Spring 2007 Artbotics course.
http://artbotics.cs.uml.edu/index.php?n=Photos.CollegeSpring2007

3.6   Initial Feedback

Diana Coluntino and Adam Norton, instructors for Artbotics, provided feedback on the session design plans. Both liked the idea of a wire sculpture. However, the short time frame and potential large attendance will prove challenging. Diana suggesting providing as many prefabricated materials as possible; she explained how constraints often encourage unique creativity. She liked the idea of having the cube for the stock framework. This provides everyone with a common base to build; it would be interesting to see how people view the cube differently. Additional materials, like colorful sticky craft foam, will add a decorative aspect to the wire sculptures. Adam pointed out that it would not be possible to put 50 people through a show-and-tell at the end; an exhibition is necessary with a group this size. Most importantly, the session needs to be constructive and enjoyable.

4   Supporting Documentation

The following documentation was assembled to support the program:
1. Artbotics session agenda and overview
2. Hardware reference
3. Software reference

5   Lessons

Wire materials provide a blank canvas by which to create. It is critical to help attendees move from idea to play quickly given the time constraint. It may be easy for attendees who do not have any idea of what to do.

Ideas should be kept simple due to the time constraint. I spent a significant amount of time working with the wire material trying to produce the sample piece. This would not be easy to do in a short timeframe.

Group collaboration is critical in the creation process. Although I was creating my own sample piece, I did consult with colleagues on ideas and implementation issues. However, it was beneficial to create my own piece in order get experience with the hardware and the code.

The Artbotics kits provide basic sensors, motors, and lights yet require some assembling. The lights need to be soldered for use. Supplementary equipment is needed for the DC motors if attendees are given the option to create a moving piece. I spent a few hours finding materials that would work with the DC motor to create reliable and desirable movement.

The provided hardware will limit the size of the art pieces produced. The standard wire lengths for the lights and motors are six to eight inches in length. This will encourage incorporating the Cricket board into the art piece as well.

The iCode Project website may be of use in sharing sample code and documentation, as suggested by Dr. Yanco [19]. It would provide an online environment to post code; attendees could use the site to share code and view work after the workshop is over.

6   Conclusions

Based on the materials exploration and planning discussed, it will be possible to implement a three-hour Artbotics session for educators during the 2010 STREAM Workshop. The agenda for the session is outlined in the session support documentation. An Artbotics introduction will take place in the first 15 minutes. The following 30 minutes is allocated for hardware and software tool introduction. This is a realistic estimate given the simplicity of the software and straightforward nature of the hardware. An hour and a half is designated for the theme-based activity. Attendees who choose to use the standard cube frame may do so. The final 45 min are saved for exhibition.

7   Future Work

This is an ongoing planning effort. Based on the initial feedback, I will conduct a second activity exploration using the designated theme and the cube frame and the recommended prefabricated craft materials. A practice session will also be conducted with a small group of students. This will provide a sense of how easily students can work with the cube frame to produce an art piece

in 1.75 hours. Necessary adjustments to the activity will be made pending the outcome of this activity.

The ultimate goal for this effort is executing the three-hour Artbotics session during the 2010 STREAM Workshop. The evaluation of the program will determine activity usefulness in giving educators a sense of being in an Artbotics class. Items to include in the evaluation will address effectiveness of the three-hour Artbotics session. The evaluation results will be used to drive improvement for future educator sessions.

8   References

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