Arduino Controller

Illinois CTE Endorsement Area:

Manufacturing, Engineering, Technology and Trades

Teacher and Student Editions

Original Lesson Developers: Dan Peacock and Stephen Buchs

ILCTE Leader, Gary Cotie

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Converted to Format by Karen Aldworth

Current Phase of Lesson: Phase 3 of 5

Illinois State Board of Education

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Lesson Overview:

This lesson addresses coding by programming an Arduino computer. The Arduino is a low-cost micro-processor that allows students to perform real time control algorithms. This lesson introduces the student to controlling an LED and the basics of electronics associated with this action. It builds upon this foundation to build a stoplight controller system to simulate an intersection. This is an application of a real-world control situation. Once the stoplight is completed, the students move on to a project of their own using the newly learned skills to create some type of a control system. This lesson can be performed in a classroom with electronic equipment or at home with a free cloud application that simulates an Arduino.

Classes or Discipline:
- Engineering
- Electronics / electricity
- Automotive electrical/electronic systems
- Computer Science

Career Cluster:
- Manufacturing,
- Science, Technology, Engineering and Mathematics

Illinois CTE Endorsement Area
- Manufacturing, Engineering, and Technology and Trades

Grade Level(s):
- In a comprehensive Technology program, this topic is appropriate for grades 10-12.

Suggested Days/Minutes: 4-5 class periods of 50 minutes each.

Learning Objectives:
At the conclusion of this lesson, students will be able to:
- Demonstrate control of an LED (light emitting diode).
- Understand the structure of a computer program.
- Experience the creation of a programming algorithm.
- Utilize a simulation tool to perform and test real applications.

Standards Addressed:
- Computer Science Teachers Association (CSTA) Standards
  - 3A-AP-13   Create prototypes that use algorithms to solve computational problem by leveraging prior student knowledge and personal interests.
  - 3B-CS-02   Illustrate ways computing systems implement logic, input, and output through hardware components.

- Standards for Technological Literacy
  - 2. Students will develop an understanding of the core concepts of technology
  - CC. New technologies create new processes.

Enduring Understandings:

- How computer programs control real world applications.
- Simulations are powerful tools and can be useful in many careers .

Resources and References:

1. Access to Internet
2. Student access to computer/Internet for Cloud simulation of free Arduino simulation from tinkerCAD (as of May 2020 not a tablet application) .
3. Teacher Internet access for opening video and/or slideshow
4. Lab with real electronics to build an Arduino system (power supply, LED's, wires, Arduino's, resistors (220 ohm), breadboard).
   Suppliers: www.sparkfun.com   www.elexp.com
   1 x 10K ohm resistors
   1 x pushbutton
   6 x 220-ohm resistors
   Breadboard's
   Connecting wires
   Red, yellow, and green LED's
   Arduino's
   Power supply
5. Handouts:
   Arduino Tutorial Using Autodesk tinker CAD Simulation Student Handout 4_29_2020
6. Apps:
   tinkerCAD (Free version)
7. Videos:
   The World in 2050 Future of the World – Based on Future (12:00 minutes)
   7 Amazing Technologies We'll see by 2030 (3:00 minutes)

Essential Employability Skills:

There are four essential employability skills:
- Personal Ethic: perseverance
- Work Ethic: dependability, professionalism
- Teamwork: critical thinking, effective and cooperative work
- Communication: active listening, clear communication

The focus of this lesson is on perseverance, critical thinking and effective and cooperative work.

Skill	How it is addressed:
Perseverance	The directions for the Arduino Controller are lengthy with numerous step by step operations. The student should build up experience by performing each step to the final product.
Critical Thinking	The whole activity is a step by step operation showing the student different parts of the project. The actual stoplight controller will require thinking skills to put these parts together and code the program to perform the final operation.
Effective and Cooperative Work	In the classroom environment this activity will require students to use actual hardware. They will be placed in groups to perform the work. Working together to complete the project will require cooperation.

Suggested Differentiation Strategies:

- The teacher may have to demo the tinkerCAD program to some students due to potential issues with comprehending the written instructions.
- Based on some of the student's abilities, the teacher may have to reduce the assignment requirements so all students can show progress and success.
- If actual equipment is used in a lab environment, the teacher may have to model several of the hands-on activities.
- Allocating roles to each member of the group can also help pupils organize themselves according to their different skills and capabilities. This approach gives less-able students a way to add value and generate more confidence.

Throughout this lesson the teacher notes and comments are in red.

1. Engage: (15 minutes)

   1. Watch one (or maybe both) of these videos:

     The World in 2050 Future of the World – Based on Future (12:00 minutes)

     7 Amazing Technologies We'll see by 2030 (3:00 minutes)

     Both videos provide a perspective on the future. Your students may be thinking that 2030 and 2050 are a long way into the future. To help them better understand, ask them how old they will be in 2030 and/or 2050. Then ask them to identify some people in their lives that are about that age now.

   2. Discuss these questions in small groups or as a class:

     a. Do you think this will really happen? Why or why not?
     b. What excites you the most about the future?
     c. What skills do you think will be most important to be successful in the future?

     Precise predictions of future technology are seldom accurate. Ask your students about the main form of transportation 120 years ago. Most people walked or rode horses. The airplane was invented in 1903 and 66 years later we were flying to the moon. The rate of technological change is increasing exponentially.

2. Explore: (2-3 hours)

Depending on your classroom setup for this activity, your students will either have a hands-on lab with actual Arduino hardware or the use of a Cloud simulation tool called tinkerCAD.

   1. Set up tinkerCAD access. Your teacher will help you create an account and login
   2. Once you are in, look for a demo of the simulator or some online hardware demonstration. You may be using the simulator or the actual Arduino computers. Both work the same.
   3. Your teacher will provide you a handout illustrating the step by step procedure on how to create an Arduino Stoplight Controller.
     Handout:
     Arduino Tutorial Using Autodesk tinker CAD Simulation Student Handout

   4. Work in a team if you have the actual Arduino computers or work individually if you are using the online simulator – tinkerCAD.
   5. Write down any questions or problems you encounter as you explore how to do this activity.

3. Explain: (20- 30 minutes)

1. Why are simulators important? Why are digital simulators such a powerful learning tool?
2. List several examples of what you can build / design in tinkerCAD.
3. Describe how tinkerCAD works at the core level.

You may also wish to discuss with your students their recommendations for edits or additions to this lesson.

4. Elaborate/Extend: (2-3 hours)

Now use the knowledge you have learned to build a different project. Examples could be:

- Garage door opener
- Security System
- others

Students will construct simulations of their own ideas. Encourage them to be creative. Once they get started, their applications will grow in complexity and function so don't worry if it starts out quite simple.

5. Evaluate:

Your teacher must be convinced you know material presented so he/she may use everything listed or select a few items from the rubric to evaluate your comprehension.

Topic	Below Basic - 0	Basic - 1	Proficient - 2	Advanced - 3
Students will have functional creations of their own ideas in tinkerCAD.	No work shown by student	Some work was created. Student made an effort.	Student created a project and had a few issues with operation	Student finished project and fully demonstrated operation.
Student can accurately explain their projects to others.	Student could not explain their project	Student explained a portion of the project.	Student explained the project, only a few items were missing	Explanation was complete and accurate.
Student will create step by step tutorial. If another student can replicate their ideas with this tutorial then a high level of understanding is shown.	No tutorial created	Tutorial was attempted though was not completed	Tutorial was completed, though a few steps needed more work.	Tutorial was completed and students were able to duplicate the project.
Optional going further: Students create a list of possible problems that could / would occur for this lab.	No list created	Student created a few items though not related	Student created a list with many good items and few not related	Student created a great list of many issues
Optional going further: After using tinkerCAD as a simulator, gave students physical components and had them physically wire it up.	Student was not able to demonstrate any hands-on activity.	Student demonstrated a few hands-on circuit connections	Student demonstrated all circuit connections and could explain what is being connected	Student wired up a complete circuit and demonstrated its operation.

Initiate a discussion asking each student what's 1 thing they learned during this lesson. Allow classmates to expand on the thoughts expressed.	Student has no input.	Student made a comment on something they learned though it was not relevant.	Student made a great comment that was related to the lesson.	Student was right on with the comment . The comment created a great group discussion.

Notes:

All ILCTE lessons are vetted by: Curriculum Leader, Dr. Brad Christensen.

To see a review of this lesson by previous users, please click here.

We invite users of this lesson to click here to leave follow up information and rating.

We would like to publish pictures/videos of your students using this lesson. Please send to Rod McQuality at: rdmcqua@ilstu.edu. By sending pictures, you have met all picture/video release for your school.

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