DOBOT V2

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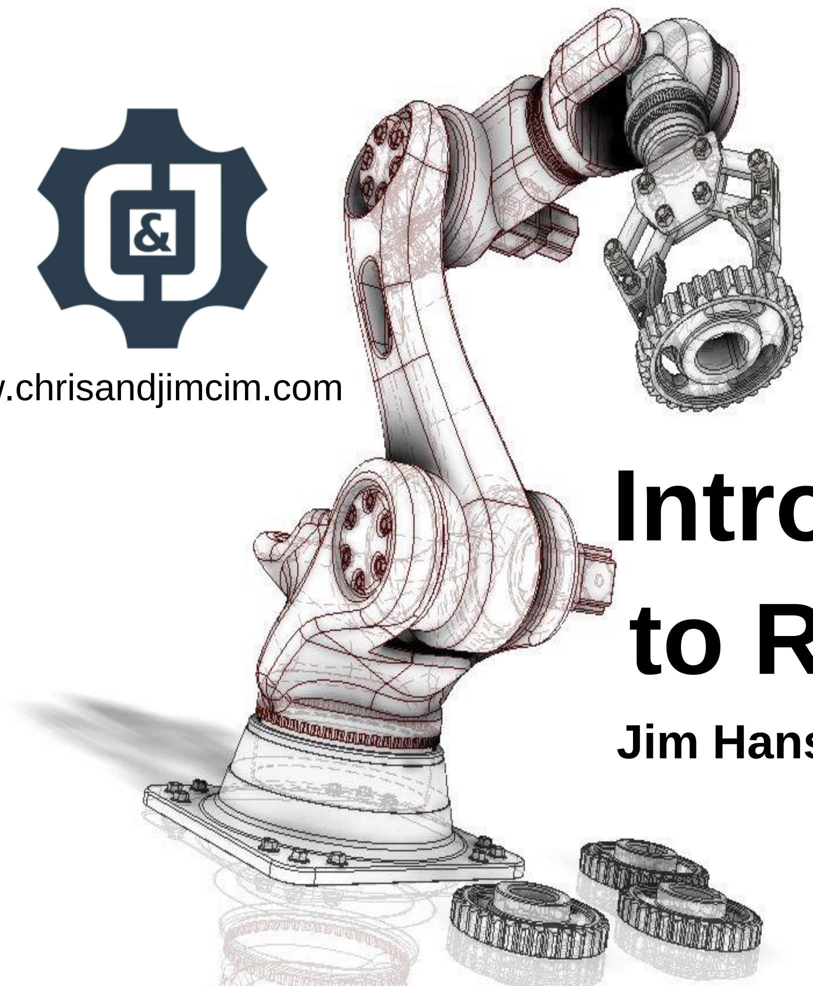

Introduction to Robotics

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Introduction

This curriculum was designed to teach high school and college level students the basics of robotics, as used in industry.

Table of Contents (List of Activities & Presentations)

Students learn about different types of robots and how they move. Acts as an investigation with the Dobot Magician and its motions and use.
Essential questions answered in this activity include:

- What's the difference between Move Linear and Move Joint?
- What's the difference between absolute and relative coordinates?
- What's the difference between teaching and recording points?
- How do you start up and connect the Dobot Magician?
- How do you utilize a robot arm to move through a group of points by using the pen end effector and writing the word "CIM"?
- How do you use the DobotStudio Teach and Playback Module?

Students learn what industrial robotic arms are used for and apply what they learn by doing pick and place routines with the Dobot magician.
Essential questions answered in this activity include:

- How does a robot perform a pick and place operation?
- What end effector works best?
- What are Pick and Place conventions in industry?
- How do I attach the Mechanical Gripper to the Dobot?
- How do I record positions with the Dobot?
- How do I easily edit a program in DobotStudio?

Students learn how to simplify repetitive routines by using Jumps and Loops. Using the Dobot Magician, students use jump and loop commands to complete a dipping operation that simulates anodizing.
Essential questions answered in this activity include:

- What is anodizing?
- What is a JUMP, and how is it easier?
- What is a LOOP, and how does it make my life easier?
- When would I use a Jump or a Loop?
- How does a vacuum gripper work?

Students develop an understanding of using outside inputs to make a robot start routine. In this investigation they use a digital switch to tell a robot when to start.
Essential questions answered in this activity include:

- What is Tool Center Point (TCP)?
- What is a digital input?
- What's the difference between analog and digital inputs?
- What is a resistor? A pull down resistor?
- Why do I need a pull down resistor?

Students develop an understanding of palletization, and how robots manipulate rectangular objects to fit together on a pallet. Using the Dobot Magician, students complete a palletization operation.
Essential questions answered in this activity include:

- What is palletization, and why is it important?
- What is roll angle? How do I calculate it if I have to?
- How do I make the Dobot Magician do a roll angle?
- How do I complete a palletization operation with a Dobot Magician?

Students develop an understanding of how robots can communicate with one another through the use of inputs and Outputs. Students use two Dobot Magicians to complete a two robot operation without timing.
Essential questions answered in this activity include:

- How do I make a robot send a signal?
- How do I get a robot to receive a signal?
- How is this done in Dobot Studio Software?

Students develop an understanding of how robots can communicate with other devices, like microcontrollers, through the use of inputs and outputs.
Essential questions answered in this activity include:

- How do I get a robot to send and receive a signal?
- How do I make my microcontroller send and receive signals?
- How is this done in Dobot Studio Software?
- How do I wire the hardware to make this happen?
- How do I troubleshoot a complex robotic system?

Students develop an understanding of workcells and the interaction of different machines to complete a manufacturing process.
Essential questions answered in this activity include:

- How do you integrate robots and other part of a work cell to complete a given task?
- How do you safely communicate between a microcontroller and a robot?
- What are the different types and styles of inputs and outputs needed to complete your given tasks?
- Which end of arm tooling is most appropriate for your work cell?
- Where would it be appropriate in your programming to use either absolute or absolute programming?
- What components of the DobotStudio software did you need to complete this task?

What is the difference between a robot's accuracy and repeatability?

Advantages of Using the Dobot Magician

After thorough testing for almost a year, we have found the following advantages in our classrooms:

- Multiple ways to program, including a Blockly version that can be used by younger PLTW students all the way down to the elementary level. DobotStudio software also allows you to program the robot in a similar manner as a real industrial arm, via XYZ coordinates.
- The Dobot can be programmed very easily by dragging the arm and clicking a button to store XYZ coordinates.
- The DobotStudio software is constantly updated, and every time I have asked for a feature to be fixed or added, it has been addressed in the next version.
- Dobot Studio software is a free download and can be installed for free on every computer in your classroom without any licensing problems.
- The Dobot hardware connects to the software first time every time.
- Dobots come pre-built; no worrying about whether or not your students will build them correctly.
- Dobot Magician is very accurate; actually, more accurate than the box states. About +/- 0.17mm. http://chrisandjimcim.com/how-accurate-is-the-dobot-magician/ This is a factor of at least 100x's better than other ones we have used in class before. The Dobot's repeatability day after day is superior as well.
- The Dobot has more than 15 inputs & outputs, many more than any robot we have ever used in our classroom. The Dobots I/O's are varied and can deal with 3.3, 5 and 12V, as well as servo motors.
- The Dobot uses highly accurate stepper motors, not hobby servos.
- The Dobot's electronics are all enclosed and protected.
- The Dobot has many end effectors, just like an industrial arm. These include a 3D printer, laser engraver, suction cup gripper, pneumatic gripper, and a pen.
- The Dobot is machined aluminum with plastic covers and is very well built, is very sturdy and very durable.
- The Dobot's payload and range of motion is much greater than that of other robots we have used in the classroom.
- The Dobot has many industrial grade accessories like a slidebase, vision system and conveyor.

Curriculum Standards

The standards defined below are far reaching and very large in scope. They include the following standards:

- Standards for Technological Literacy
  https://www.iteea.org/File.aspx?id=67767

- Next Generation Science Standards
  http://www.nextgenscience.org/ pg 102

All the activities in this curriculum, once completed, will cover all of the standards outlined below, and most of them multiple times.

Standards for Technological Literacy	
The Standards for Technological Literacy (STL) were developed by the International Technology and Engineering Educators Association (ITEEA) and are available as a complete download for free here: https://www.iteea.org/File.aspx?id=67767	
2-W	*Standard:* Students will develop an understanding of the core concepts of technology. *Benchmark:* Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.
2-Z	*Standard:* Students will develop an understanding of the core concepts of technology. *Benchmark:* Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.
2-AA	*Standard:* Students will develop an understanding of the core concepts of technology. *Benchmark:* Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.
2-BB	*Standard:* Students will develop an understanding of the core concepts of technology. *Benchmark:* Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.
8-H	*Standard:* Students will develop an understanding of the attributes of design. *Benchmark:* The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype.

8-I	*Standard:* Students will develop an understanding of the attributes of design. *Benchmark:* Design problems are seldom presented in a clearly defined form.
8-J	*Standard:* Students will develop an understanding of the attributes of design. *Benchmark:* The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.
8-K	*Standard:* Students will develop an understanding of the attributes of design. *Benchmark:* Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.
9-I	*Standard:* Students will develop an understanding of engineering design. *Benchmark:* Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.
9-J	*Standard:* Students will develop an understanding of engineering design. *Benchmark:* Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
9-K	*Standard:* Students will develop an understanding of engineering design. *Benchmark:* A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.
9-L	*Standard:* Students will develop an understanding of engineering design. *Benchmark:* The process of engineering design takes into account a number of factors.
11-N	*Standard:* Students will develop the abilities to apply the design process. *Benchmark:* Identify criteria and constraints and determine how these will affect the design process.
11-O	*Standard:* Students will develop the abilities to apply the design process. *Benchmark:* Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.
11-P	*Standard:* Students will develop the abilities to apply the design process. *Benchmark:* Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.
11-Q	*Standard:* Students will develop the abilities to apply the design process. *Benchmark:* Develop and produce a product or system using a design process.
11-R	*Standard:* Students will develop the abilities to apply the design process. *Benchmark:* R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12-P	*Standard:* Students will develop the abilities to use and maintain technological products and systems. *Benchmark:* Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.
Next Generation Science Standards	
The **Next Generation Science Standards** is a multi-state effort to create new education **standards** that are "rich in content and practice, arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked **science** education." More information can be found here: http://www.nextgenscience.org/ pg 102	
HS.ETS1.2	Engineering Design
	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS.ETS1.3	Engineering Design
	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
DCI - ETS1.B	Engineering Design - Developing Possible Solutions
	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety , reliability , and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
DCI - ETS1.C	Engineering Design - Optimizing the Design Solution
	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6)
	Science and Engineering Practice - Planning and Carrying Out Investigations
	Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
	Science and Engineering Practice - Using Mathematics and Computational Thinking
	Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

	Crosscutting Concepts - Systems and System Models
	• A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. • Systems can be designed to do specific tasks. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
	Connections to Engineering, Technology, and Applications of Science
	Influence of Science, Engineering, and Technology on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HSETS1-3)