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PHYSICS WITH ROBOTICS

Annotation

Why physics with robotics? Two reasons - inherent to robotics is measurement and actuation. In other words, in order for a robot to interact with the world, it has to investigate and do something with that investigation. It has to apply what it has "learned". Therefore, we can say that inherent to robotics is investigation and application. The same is true for physics education. In classroom, I encourage my students to investigate and apply what they have learned to something in the real world. Robotics gives us these two aspects of physics education in one very well connected package. Throughout this work, I will try to explain about opportunities to use robotics in classroom for investigation and applied physics projects.

These are not, however, the only reasons we use robotics in our classrooms. Robotics is engaging, promotes creative problem solving, encourages students to represent their ideas in the real world with a precision system, provides excellent feedback and finally, robotics can be easily connected to knowing and learning a great diversity of physics concepts and skills.

Why LEGO® MINDSTORMS® based robotics? Combined, teachers around the world have more than 15 years of experience with this system. I have used the MINDSTORMS system the most. I have found it to be an affordable, durable, and flexible solution for our project needs. The core of my ideas will work with most any sensor/motor based robotics system.

Whether it is LEGO based or not, robotics is a great hook in a classroom environment, engaging reluctant and enthusiastic learners. Teachers will see that these systems provide students with exceptional feedback, helping them to develop their ideas and successfully tinker with physical phenomena as they endeavor to take on various science and engineering challenges. Furthermore, teachers will see that after class has ended, they still have students in the room. Students do not want to leave. They are having a great time challenging themselves and they are often so proud of what they have made that they bring friends later in the day to see their creations.

Key words:physics, robotics, LEGO MINDSTORMS, school education, experiments, demonstrations.

Physics and robotics

Supplement to Existing Curriculum

The purpose of this work is not to replace current school physics curriculum. Instead, the purpose of my work is to supplement school curriculum. I will try to share with teachers in Kazakhstan a set of activities centered on LEGO robotics because they work well to engage students in the process of learning the concepts and skills of physics. But I know that every school and every class within every school is different and those differences warrant adaption. In writing this work, I wanted to focus how every teacher in Kazakhstan can utilize LEGO® MINDSTORMS® in every classroom. Therefore, while the activities of this work do not require any modification to use in the classroom, I encourage teachers

and students to do. I supplement my own physics class with new ideas. The ideas that inspired the activities of this work often came from conversations I had with my own students, teachers and other specialists in fields related to physics education. I hope that the ideas will help to teachers and students to create unique and powerful learning opportunities in classrooms in Kazakhstan.

LEGO® as a Physics Learning Technology

The goal of this work is to describe how the tools of a LEGO® MINDSTORMS® robotics kit fits into a physics learning environment. Because the work itself serves to demonstrate specifically how the LEGO® MINDSTORMS®kit is used in a physics class, my approach in this section is to treat the topic more generally, explaining more about why I chose these tools in our own physics classrooms. This section is also designed to be "food for thought" for teachers and students as they start to modify and create activities. Generally speaking, the components of a LEGO® MINDSTORMS®kit serve as both measurement and design tools. As a measurement tool, they are only limited by the type of sensor to which you can connect. Both the NXT and RCX can be connected to many LEGO and non-LEGO based sensors. As a design tool, they afford the student a great deal of precision in their measurements and they allow students to use the same medium for designing scientific experiments as well as solutions to engineering design challenges.

LEGO® MINDSTORMS® as a measurement tool.

With LEGO built light sensors, thermometers, angle sensors, microphones, and distance sensors, both the RCX and NXT serve as stand-alone measurement tools. Both the NXT and the RCX have a "view" option that allows to see the data streaming in on any sensor directly on the device's screen. The NXT can be set-up quickly for a diversity of short and simple investigations.

With a little more effort, the NXT can be extended to display data from third party sensors as well. For example, teacher can connect the NXT and sensors made by Vernier Software and Technology. Used this way, one can turn the NXT into a customizable data display center.

Using LEGO® MINDSTORMS® for accuracy and precision investigation and design activities.

How often do students discuss "human error" in their lab reports? How often are the data collected by students inconclusive? How often are discussions with students less about what the data are and more about what the data should be? The final point that I wish to discuss in this section about the role LEGO® MINDSTORMS®plays in physics classroom is the issue of accuracy and precision in robot based physics investigations.

While the robotic tools used in the activities of this work enhance student investigations and applied physics design projects, they do not take the thinking out of the process. LEGO® MINDSTORMS®do not necessarily make a student's measurements more accurate. Students will still need to learn and practice the essential skills of experimental design and the methods of science. They will need to determine the parameters of their experiment such as which variables to control, instruments to use, units of measurement, the duration of each run, and the number of runs. They will practice how to analyze data, reading trends and fitting appropriate models. They will practice evaluating the results of an investigation and comparing their results with their predictions.

LEGO® MINDSTORMS®is very helpful in improving the precision of student measurements. The precision of a set of measurements communicates how close the measurements are to each other. Precise measurements have a very small variance. NXT and RCX based experiments come in quite handy when precision is needed. If teacher program the robot to move for 5 wheel rotations, it will travel the same distance every single time. If student program the robot to move its motor at a specified speed, it will do that every single time.

With the exception of low battery issues, students will be very pleased with the precision of the data collected. This will be evident in the activities of this work. Experiencing the precision of data in a LEGO® MINDSTORMS®based investigation opens up students mind to investigations that students did not think possible before.

LEGO® MINDSTORMS® as a physics investigation and design tool.

As a measurement tool, the NXT and RCX stand with meter sticks, stop watches, spring scales, thermometers, digital force meters, digital motion detectors, voltmeters, ammeters, and other instruments in your physics equipment inventory. But, what about the rest of the pieces that come in a LEGO® MINDSTORMS®kit? LEGO is, after all, known as a construction medium. The LEGO blocks, beams, wheels, gears, etc allow students to build a myriad of set-ups for investigations and applied physics projects.

Bridging the gap between physics and engineering

Engineering design challenges are not new to physics classes. From paper airplanes, egg drops, water rockets, toothpick bridges and mousetrap cars, engineering challenges in physics instruction allow students the opportunity to engage in creative, enjoyable, and practical ways. Engineering design challenges gives students an opportunity to talk about physics as it relates to something they created, something practical. Engineering design challenges puts physics to use and immediately answers the question, "Why are we learning this?"

If physics teachers already do engineering design challenges, how doLEGO® MINDSTORMS® kits enhance this form of instruction? They maximize the ratio of equipment to project possibilities. With egg drops, toothpick bridges and mousetrap cars, teacher need to obtain and maintain a steady supply of materials, each set of materials dedicated to only a few types of projects. With LEGO® MINDSTORMS® the number of projects is almost limitless. Perhaps teacher will not do an egg drop project with MINDSTORMS or launch an NXT in a rocket, but with one kit of materials, teacher can do many other very engaging applied physics projects.

Summary

In this work, I emphasize the link between physics investigations and engineering design by providing activities that show students the need to investigate while taking on an engineering design challenge. For example, students will investigate gear ratios while creating a motorized crane or drag car and investigate sound waves while creating a system to make the best ear protection. By having students engaged in projects that synthesize investigations with engineering design, teacher are helping them close the gap between the concepts and skills of physics and the practical use of those skills. In closing the gap, I try to help students take what they learn in the classroom and use it in the rest of their lives.

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Түйін

Мақалада мен физикалық ізденістер мен инжинериялық дизайн арасындағы байланысты көрсету арқылы студенттерге ижинериялық дизайнмен жұмыс кезінде зерттеу жұмыстарының қажеттігін көрсеттім.Студенттерді зерттеу жұмыстарына қатыстыра отырып, мұғалім оларға физика негіздері мен тәжірибелер арасындағы бос орынды толтыруға көмектеседі.

Resume

In this work, I emphasize the link between physics investigations and engineering design by providing activities that show students the need to investigate while taking on an engineering design challenge. By having students engaged in projects that synthesize investigations with engineering design, teacher are helping them close the gap between the concepts and skills of physics and the practical use of those skills.

Özet

Bu makale, ben öğrencilerin bir mühendislik tasarım sorunu üzerine çekerken araştırmaya ihtiyaç gösteren aktiviteler sunarak fizik araştırmaları ve mühendislik tasarım arasındaki bağlantıyı vurgular. Mühendislik tasarımı ile soruşturma sentez projeleri yapan öğrenciler, onlara kavram ve becerileri fiziğin ve bu becerileri pratik kullanımı arasındaki boşluğu kapatıyor.

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Smart home assistant based on Arduino platform

Abstract:

This research paper describes the overall architecture of small robot called “Smart Home Assistant”. Imagine a situation when you leave home and there is nobody at home or just your kids’ stay at home all alone. In this kind of situations, this robot serves as an assistant for you. Because, it will protect your home from suspicious smells, like gas and fire smells; room temperature changes by informing the owner of this apartment via SMS.

Generally a robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous, semi-autonomous or remotely controlled. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. The branch of technology that deals with robots is called robotics. [1] Nowadays, robots do a lot of different tasks in many fields and the number of jobs entrusted to robots is growing steadily. That's why in my opinion one of the best ways how to divide robots into types is a division by their application. There are:

Industrial robots - industrial robots are robots used in an industrial manufacturing environment.

Domestic or household robots - robots used at home.

Medical robots - robots used in medicine and medical institutions.

Service robots – are robots that don’t fall into other types by usage. These could be different data gathering robots, robots made to show off technologies, robots used for research, etc.

Military robots - robots used in military. This type of robots includes bomb disposal robots, different transportation robots, reconnaissance drones.

Entertainment robots - these are robots used for entertainment. It starts with toy robots or the running alarm clock and ends with real heavyweights such as articulated robot arms used as motion simulators.

Space robots - this type would include robots used on the International Space Station, Canadarm that was used in Shuttles, as well as Mars rovers and other robots used in space.

School bots - these types of robots assist teachers in getting children more motivated about learning.