Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

9009200: iChallenge/Coding Fundamentals

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2019-2020 School Year

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- Remember to do your 3R reflection include an updated copy of your lesson plan, developed assessment tools, presentation materials, to the evaluator. See implementation plan instructions developed by the evaluator. Send within a week after completing the lesson to bonnie.swan@ucf.edu

RET Comet: Student-Centered Investigation of Sensors in Game Controllers

Subject Area(s): Computer Science
Course(s): Coding Fundamentals/iChallenge
Grade Level: Grades 6 to 8
Suggested Length of Lesson: 2-4 class periods

Lesson Summary:
As our devices get smaller and smaller, sensors must also. Today's devices and controllers have dozens of sensors in them. In this lesson, students will explore the relationship of sensors in video game controllers with the output that they experience within the games they play.

Prerequisite Knowledge: Students will need a basic understanding of electrical energy moving through materials (paths) called circuits. They also need to have at least basic experience with game controllers/cell phones interpreting movement.

Materials/Technology Needed

- Sensors/resistors (accelerometer, gyroscope, motion, joystick)
- multimeter
- raspberry pi
- alligator clips/wire
- battery
- lights
- game controllers to deconstruct (wii remotes, etc.)
- Scratch

Where this Fits/Lesson Dependency

This fits into my iChallenge curriculum in game design – semester 1 - as we discuss programming and needs within games we make. It also has a connection to Boolean logic and other operators we discuss.

Lesson Objective(s)/Learning Goal(s) (2-4)

Following this lesson, students will be able to:

- explain what a sensor is.
- explain how sensors are used in video game technology.
- understand how science/technology has impacted the tools we use to play games.
- design a game that would incorporate MEMS sensors.
- design a new/improved game control device

Standard(s)/Benchmark(s) Addressed (2-4)

Standards:

- SC.68.CS-CS.4.4 Identify and describe the use of sensors, actuators, and control systems in an embodied system (e.g., a robot, an e-textile, installation art, and a smart room).
- SC.68.CS-CS.6.3 Identify novel ways humans interact with computers, including software, probes, sensors, and handheld devices.
- CTE-TECED.68.ELCTEC.02.03 Construct physical electrical circuits based upon circuit diagrams.
- CTE-TECED.68.ELCTEC.04.03 Use voltmeters, ammeters, and ohmmeters to obtain accurate measurements.
- CTE-TECED.68.ENGTEC.04.03 Create a model of a

	design solution to an engineering problem.
Standards for Mathematical Practice ▪ Use appropriate tools strategically ▪ Attend to precision	**Instructional Strategies** ▪ allowing project choice ▪ cooperative learning ▪ engaging various learning styles ▪ experiential learning ▪ hands-on / active learning ▪ integrating science and computer technology classes ▪ project-based learning
Evidence of Learning (Assessment Plan) ▪ Score difference between the Pre and Post Tests ▪ Project developed – either redesign of controller or development of game sequence	

Description of Lesson Activity/Experiences

1. Begin with questions to assess what devices students have used to play games and how they communicate with the game (touchscreens, controllers, etc.).
2. Administer pretest.
3. Place students in groups and give each group a controller or device to deconstruct. Assist them as they explore and deconstruct the devices. Encourage students to research on their laptops as they proceed.
4. Once deconstruction is completed, use the PowerPoint to teach about sensors – what they are, what each type measures, how they work.
5. Use Raspberry Pi and various sensors to demonstrate their functions.
6. Discuss possible applications for these sensors.
7. Final project – design and/or develop (depending on resources) a new and improved controller and design a game or game sequence that would incorporate the new abilities within that controller.
8. Administer Posttest.

Recommended Assessment(s) and Steps

- Students will be given a Pretest at the beginning of the exploration. At the conclusion of the exploration, the same questions will be presented and the data will be compared.
- The best evidence, however, will be the project developed by students to design their own game controller or game sequence that will incorporate controller motion.

List of Materials/Resources Used

- Sensors/resistors (accelerometer, gyroscope, motion, joystick)
- multimeter
- raspberry pi
- alligator clips/wire
- battery
- lights
- game controllers to deconstruct (wii remotes, etc.)
- Scratch
- Pre/Post Test
- Controller diagrams
- PowerPoint for lesson

Engineering Connection (60-100 words/3 sentences)

In this lesson, students will learn about the sensors in many of their devices, learn how they work, and then choose whether to engineer a new design for a game controller or to write a game sequence that can make effective use of MEMS sensors.

Engineering Category (choose one)	
	relating science and/or math concepts to engineering (primarily science & math with some engineering)
X	engineering analysis or partial design (primarily engineering with some science/math)
	engineering design process (full engineering design)

Key Words

- circuit
- current
- input
- MEMS
- output
- piezoelectricity
- piezoresistance
- resistance
- sensor

Introduction/Motivation (written as if talking to students)

Who in here plays video games (including consoles, tablets, computers, and cell phones)? What tools do you use to interact with the game? Tell me some things that you do to provide input? (hopefully students will talk about d-pad, sticks, moving the controller, etc.) How do you know that your input is received?

Most (or all) of what you have mentioned involves devices called sensors. In most game devices, these are types of MEMS sensors. In this lesson, we are going to be learning about all of these things and how they impact gameplay. At the end, you will be given the opportunity to redesign an input device to make it even better and to design a game sequence to make the ultimate use of your redesign.

Lesson Closure (written as if talking to students)

During this lesson, we have learned about sensors and input into our video games and how that input affects gameplay. How do you think this will change in the future to make gameplay even better? What are some considerations that game designers should take into account when they design controllers and write the games.

Lesson Background & Concepts for Teachers

Sensors are all around us. They notice changes in the world around them and convert their input, mechanical, chemical, visual, sound, into electrical signals that can be transferred from one place to another. This is the basis for many things we interact with daily and they are essential for our smart devices today. As technology has become more advanced, many of these devices have become smaller and smaller, finally reaching the level called MEMS (Micro-Electro-Mechanical-Systems) sensors. These can be produced in abundance for relatively low cost. Most of them must be viewed using a microscope.

MEMS sensors are present in much of today's technology and are responsible for the responses of our phones when moved and many of our game controllers and remotes when they are moved around.

Important Vocabulary

Term	Definition
circuit	A system of connected materials through which a current can pass.
current	The movement of electrons through a medium.
input	The information being provided to or taken into a system.
MEMS sensor	A Micro-Electro-Mechanical-Systems Sensor, which is a microscopic type of a sensor.
output	The response of a system or device to the input received.
piezoelectricity	An electrical charge present in a material caused by mechanical stress or pressure.
piezoresistance	A change in how much a material resists carrying a charge when placed under stress or pressure.
resistance	The measure of how much a material limits the flow of a current.
sensor	A device that can detect changes in its surroundings and transform them into a signal

Troubleshooting Tips

Make sure that tools for deconstruction are available, along with ensuring student safety during this process.

Other Helpful Information

Attachments

- PowerPoint for lecture
- Diagrams of the controllers (if findable)
- Pre/Post Test and answer key

References

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