Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

2003380: Physics

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Physics

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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 Site: Teaching Logic Gates Through Student Centered Investigation of Video Game Controllers

Lesson/Unit Plan

Subject Area(s): Physics, Computer Science
Course(s): Physics/Physics Honors
Grade Level: 10-12
Suggested Length of Lesson: 240 Minutes

Lesson Summary:
Students will disassemble a Nintendo Entertainment System (NES) controller and describe how they believe it works. Students will learn about logic gate, logic operators, and truth tables. Students will then design their own controller based on a video game genre and design the logic circuit needed for their controller.

Prerequisite Knowledge: Circuits(Voltage, Current, Reisistance), Ohm's Law

Materials/Technology Needed
- NES Remote

Where this Fits/Lesson Dependency
- This lesson is placed after students have learned about circuits.

Lesson Objective(s)/Learning Goal(s) (2-4)
- Students will understand Logic Gates and Truth Tables
- Students will be able to create a logic circuit for a video game controller

Standard(s)/Benchmark(s) Addressed (2-4)
- *Standards:*
  - SC.912.P.10.15 Investigate and explain the relationships among current, voltage, resistance, and power.
  - SC.912.P.10.16 Explain the relationship between moving charges and magnetic fields, as well as changing magnetic fields and electric fields, and their application to modern technologies

Standards for Mathematical Practice
- Make sense of problems and persevere in solving them.
- Model with mathematics.
- Use appropriate tools strategically.
- Reason abstractly and quantitatively.

Instructional Strategies
- Think, Pair, Share
- Scaffolding

Evidence of Learning (Assessment Plan)
- Students will take a pre and post test.

Description of Lesson Activity/Experiences

Day 1: Pre-Test and NES Controller Disassembly

- Give students pretest
- Separate students into groups of no more than four
- Give students NES controller and phillips head screwdriver
- Tell students to carefully disassemble the controller and when they are done write down as a group how they think the controller works, for example how the system understands that a button was pushed.

Day 2: Introduction to Logic Operators (And, Or, Not, and Truth Tables)

- Briefly review the previous day and ask different groups how they think the NES remote worked.
- Discuss how button presses complete a circuit and effect Voltage, Current, and Resistance
- Tell the class that today we will be learning about the logic operators that make this controller work
- Show power point on logic operators and truth tables
- Give examples to work with the class to answer
- Give examples for the students to work together on
- Give examples for the students to work independently on
- Ask students again how the controller works. Work with students to arrive at a diagram of how the buttons and d-pad work.
- Give Ungraded Logic Gate Quiz

Day 3: Students Design their own Remote Based on Video Game Genre

- Tell students that you want them to think of a video game genre and design a controller for that specific genre
- Students will work in groups of no more than four
- Draw the remote on paper and write the logic gates and logic tables for the controller
- Give Ungraded Logic Gate Quiz

Day 4: Students Present their Controllers

- Have the student groups present their controllers to the class
- Give students post test

Recommended Assessment(s) and Steps

- Pre-test is given on the first day to assess prior knowledge
- Throughout the lesson the teacher should be asking questions of students individually, as groups, and as a class to assess their progress
- On days two and three an ungraded quiz should be given to get students used to quizzing on the subject
- Post-test is given on the last day to assess student learning

List of Materials/Resources Used

- Nintendo Entertainment System Remotes
- Screwdrivers

Engineering Connection (60-100 words/3 sentences)

Students will learn about how circuit boards must be designed with inputs and outputs in mind.
Students will learn about logic gates and Boolean logic.
Students will, on paper, design a video game controller to match the design of their video game

Engineering Category (choose one)

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

Key Words

Logic Gate
Logic Operator
And Gate
Or Gate
Not Gate
Truth Table

Introduction/Motivation (written as if talking to students)

How many of you play video games? How many of you have ever played a video game with physical buttons? Do you know how they work?

Lesson Closure (written as if talking to students)

Now you understand some of the thoughts and design that goes into designing a gaming remote. This same logic can be applied to and electronic system that has inputs and outputs. This is the basis of how any electronic device that you interact with works.

Lesson Background & Concepts for Teachers

Important Vocabulary

Term	Definition
Logic Gate	A logic gate is an idealized or physical device that performs a logical operation on one or more binary inputs and produces a single binary output.
Logic Operator	This is a symbol representing a logic gate.
And Gate	A gate that is true if and only if all of its inputs are true.
Or Gate	A gate that is true if any of its inputs are true.
Not Gate	A gate that is true if its input is false.
Truth Table	A diagram of the outputs from all possible combinations of inputs.

Attachments

Pre/Post Test
Logic Gate Powerpoint

References

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