Teacher Notes – Steady Hand Game Project

Introduction

The aim of this 7 week (2hr lessons) project is to design and manufacture an electronic product based on the SCR/thyristor circuit. The project will introduce or reinforce the use of resistors, thyristors and LEDs. Students will learn about various aspects of electronics including the systems approach, components and circuit diagrams as well as product design. They will learn new or develop existing practical skills i.e. soldering, graphics and RMT skills.

This is a rough guide and the time needed for each activity will vary between schools and groups. These notes are based on experience with year 9 groups of approximately 20 students of mixed ability and sex in an average state school. The lessons are broken up into 7 2hr sessions.

The project is primarily aimed at KS3 students but is also excellent for KS2 students where suitable facilities exist and also KS4 students as it reinforces the use and application of resistors and thyristors and other important concepts covered by the GCSE syllabus.

An excellent way of helping students understand the electronics is by using the training system. It allows students to change various components, input and output and therefore is an effective way of prototyping. It is also very good for exam revision as it is relevant to past exam questions.

If you have any comments to make about the project and notes or you would like to contribute then please contact us.

Aims and objectives

The project is to design and make an electronic product – a steady hand game - using a latching thyristor circuit. The steady hand game must indicate when the wire is touched and it must also 'latch' to prevent cheating.
The project will enable students to experience the design and manufacture of simple electronic
circuits.

CONCEPTS:
- Electronic circuits.
- PCB design.
- Design and manufacture.
- Model making.
- Evaluation.

OBJECTIVES:
Pupils should understand:
- The need to investigate the background to a problem.
- How to select appropriate components to build simple electronic circuits.
- How to select appropriate tools and materials.
- The importance of planned manufacture.

• The need to build models to evaluate design ideas.
• How to improve a product by evaluation.

SCIENCE OPPORTUNITIES:
• Understanding of circuit theory.
• Resistance/ Ohms law.
• The importance of latching circuits
• The thyrsitor as a latch

WIDER CURRICULUM OPPORTUNITIES:
• Accurate measurement and marking out.
IT OPPORTUNITIES:
• Use of Crocodile Clips to develop and test circuit ideas.
• Graphic packages to help generate design ideas .
• PCB design and production.
OTHER OPPORTUNITIES:
• Product styling.

Week 1 – Introduction and Investigation

Please note: There are different possible outcomes of this project and these notes have been written with the aim of producing a steady hand game

Aims:
Review safety in a workshop, state safety rules as a group.
Introduction to project, show previous examples
Explain the different skills they will be learning

- Electronics
- CAD
- Circuit design
- PCB design etc

Write design brief and design specification

Teaching input:
Discuss the project with the class
The importance of product evaluation is the design process
Teach about briefs and specs, their use in industry and importance, use examples such as mobile phones, electrical goods, games machines, cars and other things they are familiar with
Teach about designing products that are fit for purpose and aiming products at particular consumer groups

Student:
Discuss and record workshop safety rules
Evaluate several electronic products – the aim of this is to understand the key components of an electronic product – PCB + components, battery, switches, wiring, case etc
Discuss as a class
Teach about briefs and specs, their use in industry and importance, use examples such as mobile phones, electrical goods, games machines, cars and other things they are familiar with
Research existing and similar products using for example the internet or catalogues, produce an image board in small groups
Design Brief – maybe give them it – e.g. Design and make an electronic steady hand game that indicates when the wire is touched and prevents cheating
Specification – discuss as a class

Resources:
Examples of existing practical outcomes
Examples of image boards
Access to ICT or product catalogues
A range of old electronic products to evaluate

Homework:
Bring £1.50 (suggestion) to pay for the project
Diary record

Week 2 – Designing the Product

Aim:
Design the product, an electronic steady hand game that indicates when the wire is touched and is designed to prevent cheating - concentrate on fitness for purpose and target audience
Produce a 3D model
Evaluate designs

This is a suggestion; modify to suit your requirements
Build with an MDF base and an MDF background which has been shaped and decorated and drilled to accommodate LED(s) – 5, 8 or 10mm, the PCB will be behind the background as will the battery – PP3. The wire 'course' will be in front of the background and the ends of it will be put through holes to the back of the background.

Teaching input:
Explain what is required using examples of previous work or a teacher's example. For the decoration a good way to do this is to cut the base from a piece of MDF 15x15cm and use a small block as a stand at the back, glue together with PVA.

Produce an example design and display using an OHP or on the whiteboard

Student:
The designs can produced by students drawing a 15x15cm box and drawing the design inside it, it must be pointed out that the design cannot be to small or just the square they started with.

Around the design the students should put labels and underneath evaluate the design stating who it would be for, a particular person or group. They should produce at least 3 and explain why they have picked the design they will make.

The next stage would be to produce a 3d model, depending on how long the designing takes this could be done in class and/or as homework. If it is done for homework then a cereal box can be used.

Resources:
Drawing resources
Card for 3D models
Examples of previous work

Homework:
Finish designs and 3d model
Diary record

Week 3 – Manufacturing the base and background or casing

Aim:
Manufacturing the base and background
Decorating the base and background

Teaching Input:
Review health and safety
Provide assistance to students during practical

Resources:
Each student will need a piece of 3mm MDF15x15cm for the background and a piece of MDF 15x15cm for the base
Holes will need to be drilled for the wire course to be inserted through, this will need to be very sturdy, reinforce the area with a thick block of MDF that is glued in position with PVA
Access to suitable materials
Access to tools
Access to paints

Demonstration:
Demonstrate to the students how to cut and finish MDF bases and backgrounds with appropriate tools paying close attention to H&S
Demonstrate how to manufacture the bike light case
Demonstrate how to use a pillar drill to drill the holes for the LED(s) and wire course paying close attention to H&S

Student:
Students to cut and finish their backgrounds with a coping saw and glass paper, make sure the room is well ventilated
Students to drill the holes for the LEDs and wire course
Students to decorate their backgrounds

Homework:
Maybe finish decorating at home or during lunch/break/after school
Diary record

Week 4 – Electronics

There is quite a lot in this lesson and it may be that some bits are left out. If you have the facilities available a good idea is to concentrate on Crocodile Clips and Real PCB.

Aim:
Introduction to electricity and electronics – current and voltage
Power supplies – Mains, solar, wind, sea, batteries, parallel and serial
Introduction to the Systems approach – systems have an input, process and output, relate to examples they are familiar with, e.g. microwave oven

Teaching input:
Discuss the lesson aims with the class and use Q&A to reinforce.

Student:
Worksheet – Identify Input, Process and Output components on a worksheet, stronger students can state the function of the components by using research material, class books, wall charts etc.
Discuss as a group
Introduce the electronic circuit with a worksheet – this could be constructed using Crocodile Clips, the circuit being used is a simple thyristor circuit
The first task if for students to identify the various components and suggest their function
Go through the answers with the group then give an explanation of the circuit and how it works.
Introduction to PCBs and Q&A – what they are, what they are made of and why, where they are found, how they are made etc. This maybe a good opportunity to do a demo of how to make a PCB using a workshop etch tank – if possible. This is also a good opportunity to introduce Real PCB or an alternative PCB design package and allow students to design a PCB of their own, this could be reinforced using a worksheet where students identify mistakes in a PCB design

Resources:
Worksheets
ICT facilities including Crocodile Clips and Real PCB
Examples of components
PCB examples
Etch facilities

Demonstration:
Using Crocodile Clips and Real PCB
Producing a PCB in an etch tank – there are some good resources for this on the Rapid website

Homework:
Apply the systems approach to a household appliance, differentiate by ability, more able to do a more complex appliance, less able simpler.
Or
Worksheet, for example identify mistakes on PCB designs
Diary record

Week 5 - Soldering

Aim:
Introduction to soldering
Students start soldering

Teaching input:
Q&A session, what is solder, why these materials, why solder etc
Discuss health and safety
Discuss quality issues

Demonstration:
Demonstrate soldering, insert component securely, bend legs back a little, heat the area including the leg for 5 seconds, apply a small amount of solder, take solder away, take iron away – aim for a neat 'mountain' of solder around the leg, it is very important that soldering is not rushed and that legs do not touch as this will cause a short circuit – there are some good resources on the Rapid website

Student:
Activity – Start soldering
This will depend on the individual teacher as to how it is organised. It may be that 1 component is soldered at a time; each student doing the same or the students may be given the component list and components and be allowed to complete the task independently

The LED(s)
How this is done will depend on the final outcome. If wires need attaching to the LED these steps may be followed. Remember long leg is +ve.
Cut a length of red wire
Strip about 2cm of the plastic sleeving
Twist to stop fraying
Wrap around the longer leg
Apply a thin coat of solder
Snip off any excess wire
Insulate with rubber tubing/heat shrink
Repeat with black wire for shorter leg

Resources:
Soldering equipment
Tools

Homework:
Storyboard on how to solder or make LEDs with wires (6 steps), this helps reinforce the skill as it would be likely they will solder again in the future in D&T
Or
Led worksheet – identify 10 things at home that contain an LED
Diary record

Week 6 – Finish Soldering and Assemble Product

Aim:
Finish soldering
Finish any other practical work
Construct final product
Test

Teaching input:
Discuss with Q&A quality control and testing
Discuss test sheets
Help students as required

Student:
Finish all practical work
Students to produce a test sheet
Test circuit using test sheet

Resources:
Access to tools

Homework:
Diary record

Week 7 - Evaluation

Students who have not finished practical work should complete any unfinished practical work and assemble final product

Aim:
Evaluation

Teaching input:
Discuss the importance of evaluation in design and technology

Student:
Produce a detailed production plan of their projects
Evaluate their work
Complete any unfinished work
Put folders into order
Students may complete a test based on the project – this may be set as homework

Resources:
Worksheets
Test sheet
Access to tools

Homework:
Diary record
Complete test