Using electronics to design a controlled environment

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Abstract

Design using a systems approach to electronics is easily realisable in schools. It is not being carried out in many schools because of the problems teachers have encountered in manufacturing electronic circuits and the pressures of the National Curriculum.

The authors believe that designing electronic systems can play a stimulating and significant part in the design and technology curriculum. They have written a SATRO project to be published this Autumn that will encourage teachers to use electronics as a design medium and support them in carrying out the work. The focus of the project is using electronics to control environments. This paper will discuss the issues raised in writing the project and in piloting the work in school.

Introduction

Electronics is not being widely used in schools as a medium for design and technology. Despite a growth of electronics work in schools in the eighties, the introduction of the National Curriculum seems to have pushed electronics back into the Science department. Talking to teachers it would appear that there are two main reasons for this. The first is that electronics is an area of knowledge that many teachers feel uneasy about their own ability to deliver. The second is the pressure of time schools are under, and the difficulty of a group of mixed ability children being able to realise any significant outcomes in the time that might be available for an electronics project.

The authors were commissioned by the Standing Conference for Schools' Science and Technology (SCSST) to work with John Allum and Heather Reid to write a curriculum resource pack that would encourage, stimulate and support the teaching of electronics at Key Stages 3 and 4. Martin Coleman and David Thompson were also in the writing team, and the Educational Broadcasting Services Trust produced the video, directed by David Williams. The pack we produced, Environments Under Control[1] was sponsored by the Institution of Electrical Engineers (IEE) which represents the electronics industry as a whole, rather than by one particular company as is more usual with SCSST/ SATRO projects.

Previous work (QuickTrack[2] and The Airedale Project[3]) had made us confident that the problems of time and of teacher confidence could be answered by using a systems approach rather than a component approach to the work. Schools can use sub-system blocks, such as System Alpha[4], to prototype circuits, and use circuit design software, such as QuickTrack, to produce circuit boards of good quality for a system of the pupil's own design.

Knowledge and Skills Developed

A range of skills is developed through this work; practical skills of working with electronic construction, including soldering and drilling; basic fault finding skills of testing to check whether an electrical supply is present or not, and whether a signal is high or low; reference skills of reading simple data sheets for relevant information. IT skills are developed through using very simple menu-driven CAD software to design the board and a spreadsheet to cost the project.

The work builds an understanding of how electronic systems work at systems level, and generates an awareness of everyday applications of control. There is scope for more able pupils to work at greater depth, whilst nearly all pupils are able to produce working circuits of quality. Pupils do not require a deep understanding of electrical theory, and teachers need a familiarity with the systems approach and the equipment used, rather than a physics degree.

The concern of the SCSST/SATRO project is to stimulate the use of this approach and to encourage electronics to be used in a design context. Pupils are engaged in researching and drawing up a specification for their system, reviewing it, building it, testing it and evaluating it.

Environments as a Context

The choice of a context for this work involved a great deal of debate amongst the project team. Communications engineering, though attractive to pupils and an area where the British electronics industry is strong, was ruled out as being too difficult

Ideas Web

Fire detection

SAFETY	Access	preventing crowds lighting emergency exits and warning procedures
	'Clean' environments	food manufacture and storage laboratories/hospitals/manufacturing
COMFORT	Environment friendly for people or plants or animals: house, incubator, workplace, greenhouse, aeroplane	air control humidity heating lighting sound/music
	Energy Efficiency	
	Creating Effects	
SECURITY	Controlling access	detecting entry to a forbidden area restricting access to 'key holders' detecting and deterring intruders
	Controlling what leaves	Library/Shop
	Controlling what enters	Airport Security

to model in schools. Military applications, while another area of strength industrially, are unsuitable for work in schools. One of our main concerns was to attract girls into the work. This was a key reason for choosing the context of designing environmental control, which we felt was an area that would be seen as relevant and interesting by girls.

Environmental control provides an application of electronics that is familiar to children in their own lives. It encourages a clear identification of inputs, process and outputs because these parts are likely to be physically separate. It is easy for a team to work together on the project, with different pupils playing different roles. It clearly relates to design concerns in industry. Finally it provides a design problem that pupils can easily model in schools.

The International Convention Centre at Birmingham is the main focus of the video in the pack. It was chosen as a stimulating and exciting example of a modern environment that uses electronic control systems in a wide variety of ways. However the purpose of the video is not to say "Here is a flashy controlled environment, now make a low quality imitation". The video sets out to draw the attention of the pupils to how modern environments use electronic control systems for control in a number of ways that are not immediately apparent to the casual visitor. It shows features of systems used for comfort, safety and security, and looks at the issues that the designers had to consider when drawing up their design proposals and specifications. It explores the different roles that people played in the teams involved in designing, installing, testing and operating the systems.

The manufacture of part of the system at a West Midlands plant gives an introduction to small batch PCB production. Production techniques using photo-sensitive boards are illustrated further in the booklet. The pack encourages pupils to consider the process of designing a controlled environment, and then to model some of that work in their own school. The text provides guidance on how environmental control systems can be modelled in school, advice on manufacturing circuits and equipment requirements.

Realising the Work in Schools

Work carried out by Year 9 pupils at Greenhead Upper School in Keighley provides a case study in

the booklet. This is used to help teachers to plan how they might realise their own project, and to build their confidence in attempting to do so. At Greenhead pupils worked in teams of three designing a control system for a model play area that they had built earlier in the year. The booklet shows the work of three girls on their project, and their response to the module. At the IDATER conference we will be showing work from the case study and final drafts of the SATRO resources.

References

1 ENVIRONMENTS UNDER CONTROL, SCSST 1992, 76 PortlandPlace,London W1N 4AA

2 QUICKTRACK, National Council for Educational Technology 1990,Sir William Lyons Road, Science Park, Coventry CV4 7EZ

3 THE AIREDALE PROJECT, Bradford Local Education Authority 1991
Dorset Street Centre, Dorset Street, Little Horton, Bradford BD5 OLT

4 SYSTEM ALPHA, Unilab Ltd
The Science Park, Hutton Street, Blackburn BB1 3BT