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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 their 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

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.
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 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.

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