

Computer-aided manufacturing

Overview

Many students have access to and knowledge of CAD (computer-aided design) systems. They are used extensively in Technical Drawing classes and are finding applications in many other TAS subjects. By introducing CAM (computer-aided manufacturing) to the educational process, students are able to see the application of CAD to a physical product.

In Technical Drawing, students can use the computer to draw a 2D object which can be turned on the computer numerically controlled (CNC) lathe to give them a better understanding of 3D concepts and industrial applications of their computer work.

In Technics, Design and Technology and Industrial Technology, students can use CAM to make a whole project, a component of a larger project or modify existing components. They will also gain a greater understanding of computer-based technologies and their applications in industry.

Ideas are included for CNC lathes and CNC milling machines. This snapshot includes an example of a CAD/CAM activity aimed at developing a printed circuit board (PCB).

Related subjects

Design and Technology

Industrial Technology

Technical Drawing

Technics

Information for teachers

The printed circuit board (PCB) activity required access to CAD/CAM software and a CNC milling machine.

The students in this class had previous experience in graphical communication techniques and conversion of circuit diagrams into PCB layout.

They had an understanding of the concepts behind the creation and manipulation of CAD drawings and a knowledge of coordinates and measuring systems used in CAM.

Experiences that develop computer-based capabilities

Students were engaged in activities that provided opportunities to:

- apply CAD/CAM principles to their practical projects (capability 2)
- design circuit boards using an electronics CAD program (capability 2)
- use a CNC milling machine to emulate industrial manufacturing processes (capability 3)
- make comparisons between traditional manufacturing methods and automated CNC manufacturing (capability 4).



Activities using computer-aided manufacturing

CNC machinery can be used to emulate industrial manufacturing. Students will have a better understanding of how CNC machinery is integrated into a production line if they use it themselves to create a component for an existing or new project or visualise a completed 2D CAD drawing in the physical form. One-off projects are suitable as a learning tool, but this type of machinery is best suited for long production runs in industry.

The CNC lathe

The CNC lathe which would be available to students in a school situation is relatively small and should be used only with soft metals, such as brass and aluminium, or some plastics. Do not use timber, as the dust will clog the moving parts.



Sample projects include:

- chess or draughts pieces
- knobs for drawers
- candlestick holders
- turned components for steam, petrol or electric vehicles
- any other symmetrical project that can be turned.

Students can make comparisons between traditional turning methods and automated CNC. Advantages and disadvantages of CNC manufacturing in relation to the size of production runs could be examined as part of existing turning exercises, with the advantage of the CNC lathe using small offcuts of soft metals and nylon.

The CNC milling machine

Like the CNC lathe, the CNC mill is relatively small for school use and requires similar handling. It can be used to reduce material on any small project, like a normal milling machine. The size of the CNC mill will dictate the type of material it will cut. It can be used for single operations or multiple runs for mass production.



A CNC milling machine

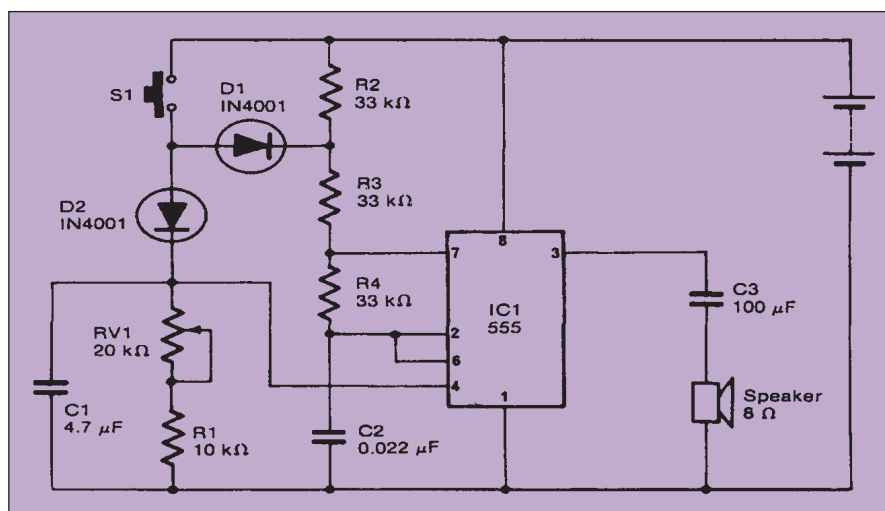
In electronics, the CNC milling machine can be set up to cut out circuit boards. The design is created using an electronics CAD program such as *EasyTrax*, and the mill machines the excess copper away from the board.

The circuit board can be used for any appropriate project, such as a solar car or boat, with other parts being designed and manufactured using CAD/CAM.

Activities involving the use of CAM for electronics

A design brief was presented to the students to construct a printed circuit board (PCB) for use in the construction of an electronic doorbell.

- A circuit diagram was given to students. The components and layout were discussed as a class group.

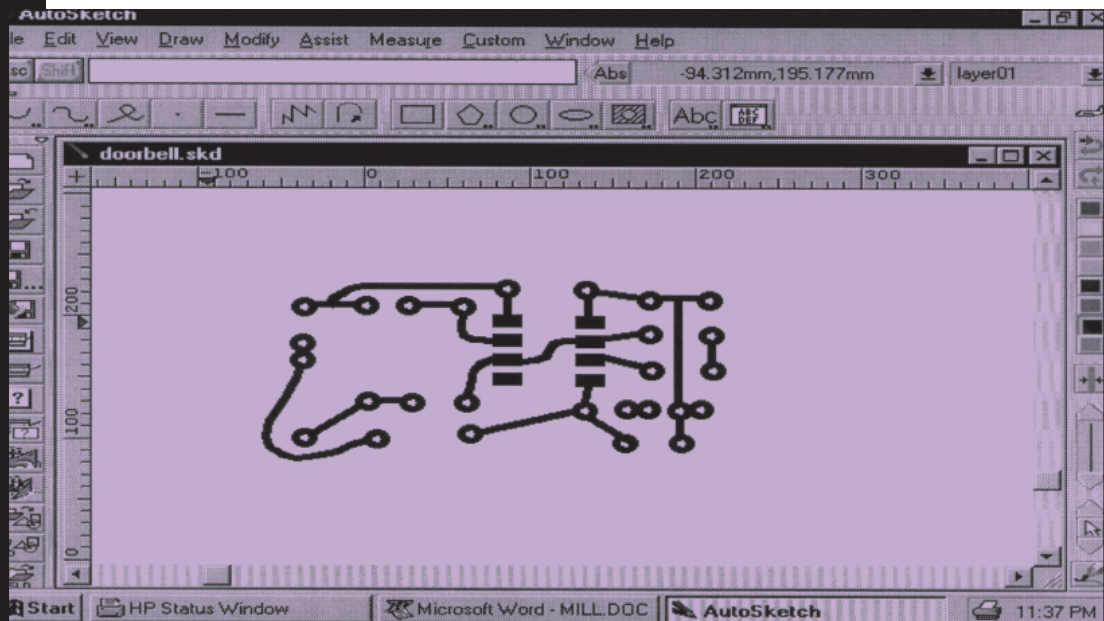


Circuit diagram for the doorbell

- Students used the information on the circuit diagram to draw a PCB diagram on paper showing all the necessary tracks.
- Students worked in pairs to draw their PCB diagram on the computer using an available CAD program such as *EasyTrax* or *Autosketch*. The PCB diagram could also be scanned into the computer from a printed original or a neat freehand drawing.



Printed circuit board (PCB) diagram in Autosketch



- The computer was then attached directly to a CNC milling machine ready to cut the PCB.
- The student's computer drawing was then copied to the CNC software.
- The CNC milling machine was set up to cut out the circuit boards using a 2mm end mill. The mill machines the excess copper away from the board.



Finished circuit board



- Alternatively, if a CNC mill is not available, the CAD drawing could be printed and used in a photo etching processor to make the PCB.