Seen In Perspective

Have you ever wondered why certain arcade games such as Asteroids and Battle Zone have such sharp, crisp screen displays compared with those generated by most home computers?

How are those smooth zoom-effects and perspective drawings achieved? Producing them on a home computer is no easy matter, even with plenty of experience. If it were, you'd see more programs that use these techniques. There are very few, and those that exist are not as impressive.

These arcade effects are possible because of the method used to generate the display. This method differs from that used in home computers, not only in the electronics and the programs used, but also in the construction of the display tube itself.

As explained in the article on monitors (see page 132), the picture on a television or monitor tube is produced by moving an electron beam across the phosphor in a series of lines, turning it on and off to produce dots of varying intensities. An image on the screen, therefore, is made up of small dots that lie on a series of lines, like beads on a string. This system is known as 'raster graphics' after the series of lines ('rasters') drawn on the screen by the beam.

As you will notice next time you go into an arcade, the display in the Asteroids game seems to be made up of 'wires', with no solid areas and no shading. Everything that makes up the image is either black or bright, whatever the colour.

This is the clue to the fact that these arcade machines use a different principle to produce the image. Instead of starting with a dot at the top left-hand corner of the screen and building up the picture in lines, they move the dot only to where it is required. Thus, if a square is needed the beam describes a square shape. Making the square bigger or smaller is simply a case of applying a larger or smaller voltage to the deflection coils around the neck of the tube, which are the magnets that actually direct the beam.

Multiple shapes are almost as simple since, after drawing the first one, the beam is simply turned off, moved to a new position and turned on again, and the moves are repeated. Once all the objects have been drawn, the beam is moved back to the start of the first shape and the process repeated.

Since the screen is flat there are only two dimensions in which the beam can be moved. However, convincing three-dimensional effects can be achieved. These effects rely on the same principle but creating them is a more complex process requiring fast trigonometrical calculations.

By varying the values for the angle of view, the object can be made to tilt, rotate, approach the viewer and retreat, and perform other gyrations with satisfying smoothness. There's a side-effect, though, which is caused by the fact that it is difficult to work out when a line should be hidden. Indeed, it is so difficult that it normally isn't attempted, and all the objects seem to be transparent. They look as though they are made of wires — hence the term 'wire-frame graphics'.
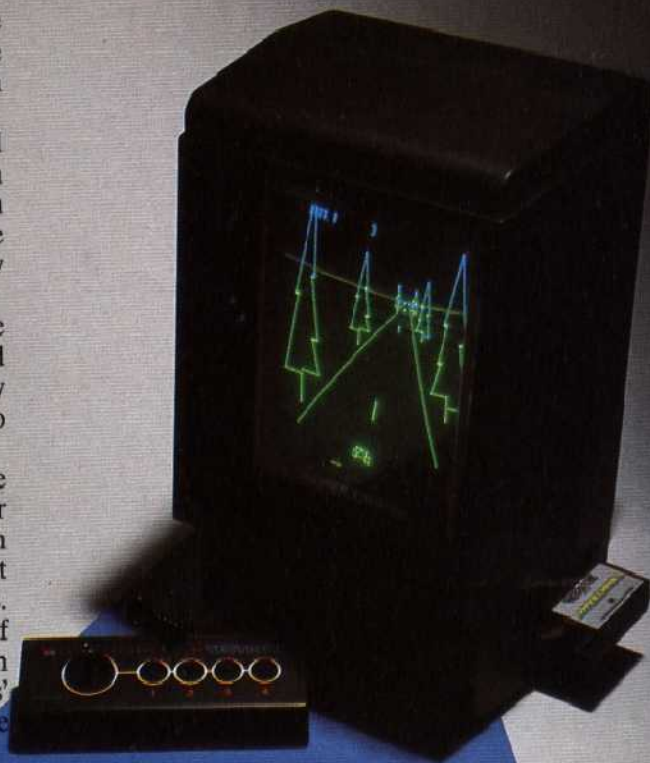
The object is drawn as a series of 'vectors'. A vector is a line with a specified length and direction, and the system is known as 'vector graphics', distinguishing it from the raster graphics system used in televisions and monitors.

How can you achieve these effects at home without buying your own arcade machine? Not long ago this was impossible but now a domestic video games machine called Vectrex is available, which works on the vector graphics principle.

The Vectrex is a specialised console unit with its own dedicated screen and joystick unit. It runs on cartridges, much like any games console, and most of the popular vector graphic games are available on it, plus others unique to the Vectrex. The manufacturers, Milton Bradley, say they intend to introduce a full keyboard and a BASIC programming cartridge as an add-on soon. These machines have a major disadvantage, however. They cannot produce shades of colour or solid areas, and colour is limited to one intensity of one colour — usually green or white.

Some arcade games' colour is achieved by placing coloured overlays on top of the monochrome screen to tint the object drawn underneath. The Vectrex system, which reproduces different games depending on the cartridge, includes transparent plastic sheets printed with the colours and details necessary for each game. These are fitted in front of the screen.

Despite the remarkable effects that can be produced, the vector graphics system is unlikely to attain great popularity. It is somewhat restricted, and vastly improved raster graphics systems will eventually be able to produce equivalent effects. In the meantime, although a cloud hangs over the Vectrex since US production ceased, it continues to be made in Britain and to enjoy success.

Hyperchase

The Vectrex is a dedicated video games console. It is the only domestic unit to make use of 'vector graphics' in its inbuilt screen, rather than the 'raster scan' method used by televisions and monitors.

The photograph shows the car racer game Hyperchase. Unusually, Vectrex has a built-in game — Minestorms — which is automatically run unless another games cartridge is plugged in. A full keyboard and BASIC programmability are hoped for in the future