

Computer Graphics

Lecture 5

Input Device and Output Devices

Trackball and Space ball

As the name implies, a trackball is a ball that can be rotated with the fingers or palm of the hand, as in Fig. 2-5, to produce screen-cursor movement. Potentiometers, attached to the ball, measure the amount and direction of rotation. Trackballs are often mounted on keyboards or other devices such as the Z mouse (Fig. 2-6).

While a trackball is a two-dimensional positioning device, a space ball (Fig.2-7) provides six degrees of freedom. Unlike the trackball, a space ball does not actually move. Strain gauges measure the amount of pressure applied to the space ball to provide input for spatial positioning and orientation as the ball is pushed or pulled in various directions. Space balls are used for three-dimensional Positioning and selection operations in virtual-reality systems, modelling, animation, CAD, and other applications.



Fig 2-5 A three-button track ball



Fig 2-6 The Z mouse features three buttons, a mouse ball underneath, a thumbwheel on the side, and a Trackball on top.



Fig 2-7 A virtual-reality scene, displayed on a two-dimensional video monitor, with input from a data glove and a space ball.

Light Pens

Figure 2-8 shows the design of one type of light pen. Such pencil-shaped devices are used to select screen positions by detecting the light coming from points on the CRT screen. They are sensitive to the short burst of light emitted from the phosphor coating at the instant the electron beam strikes a particular point. Other Light sources, such as the background light in the room, are usually not detected by a light pen. An activated light pen, pointed at a spot on the screen as the electron beam lights up that spot, generates an electrical pulse that causes the coordinate position of the electron beam to be recorded. As with cursor-positioning devices, recorded Light-pen coordinates can be used to position an object or to select a processing option.

Although Light pens are still with us, they are not as popular as they once were since they have several disadvantages compared to other input devices that have been developed. For one, when a light pen is pointed at the screen, part of the screen image is obscured by the hand and pen. And prolonged use of the light pen can cause arm fatigue. Also, light pens require special implementations for some applications because they cannot detect positions within black areas. To be able to select positions in any screen area with a light pen, we must have some nonzero intensity assigned to each screen pixel. In addition, light pens. Sometimes give false readings due to background lighting in a room.



Fig 2-8 A light pen activated with a button switch.

Digitizers

A common device for drawing, painting, or interactively selecting coordinate positions on an object is a digitizer. These devices can be used to input coordinate values in either a two-dimensional or a three-dimensional space. Typically, a digitizer is used to scan over a drawing or object and to input a set of discrete coordinate positions, which can be joined with straight-line segments to approximate the curve or surface shapes

One type of digitizer is the graphics tablet (also referred to as a data tablet), which is used to input two-dimensional coordinates by activating a hand cursor or stylus at selected positions on a flat surface. A hand cursor contains cross hairs positions on the tablet. Figures 2-9 and 2-10 show examples of desktop and floor-model tablets, using hand cursors that are available with 2, 4, or 16 buttons. Examples of stylus input with a tablet are shown in Figs. 2-11 and 2-12. The artist's digitizing system in Fig. 2-12 uses electromagnetic resonance to detect the three-dimensional position of the stylus. This allows an artist to produce different brush strokes with different pressures on the tablet surface. Tablet size varies from 12 by 12 inches for desktop models to 44 by 60 inches or larger for floor models. Graphics tablets provide a highly accurate method for selecting coordinate positions, with an accuracy that varies from about 0.2 mm on desktop models to about 0.05 mm or less on larger models

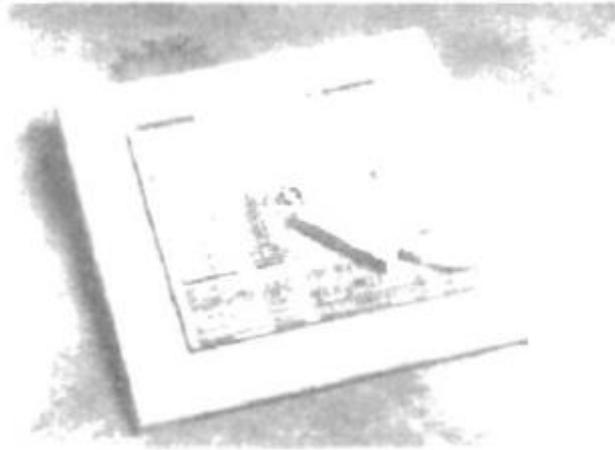


Fig 2-9 The SummaSketch III desktop tablet with a 16-button hand cursor



Fig 2-10 The Microgrid III tablet with a 16 button hand cursor, designed for digitizing larger drawings



Fig 2-11 The Note Pad desktop tablet with stylus.



Fig 2-12 An artist's digitizer system, with a pressure-sensitive, cordless stylus

Many graphics tablets are constructed with a rectangular grid of wires embedded in the tablet surface. Electromagnetic pulses are generated in sequence along the wires, and an electric signal is induced in a wire coil in an activated stylus or hand cursor to record a tablet position. Depending on the technology, either signal strength, coded pulses, or phase shifts can be used to determine the position on the tablet.

Acoustic (or sonic) tablets use sound waves to detect a stylus position. Either strip microphones or point microphones can be used to detect the sound emitted by an electrical spark from a stylus tip. The position of the stylus is calculated by timing the arrival of the generated sound at the different microphone positions. An advantage of two-dimensional acoustic tablets is that the microphones can be placed on any surface to form the "tablet" work area. This can be convenient for various applications, such as digitizing drawings in a book