

Description

Field of Invention

The subject invention is generally directed to the generation and display of geometric figures on a graphics screen, and more particularly, the invention is a user-friendly procedure that uses a cursor placement device such as a joy stick to both define the initial position and size of the geometrical figure. By geometrical figure, is meant a predefined figure of generally symmetrical shape such as a circle, square, rectangle or other rhombic figure, triangle, trapezoid, or other polygon.

Background of the Invention

There are many situations in the operation of computer generated graphics displays where the user desires to generate geometrical figures such as, for example, a circle. Typically, this is done by invoking a circle generating program which requires the user to input first the center of the circle on the graphics display and then to input the radius of the circle. The program then generates a circle with that center and radius on the graphics display. This procedure works well for many applications, but presumes prior knowledge of the user as to where and what size the geometrical figure should be. In the case of free hand drawings and schematics, the user may not in fact have such prior knowledge and therefore must resort to a tedious trial and error process of graphics generation. Moreover, if different geometrical figures are to be drawn, the system must be able to call for programs specifically tailored for the desired figures.

A specific example of such prior art systems is disclosed in the article entitled "Graphic Interactive Application Monitor" by V. Weissflog, published in Proceedings of the International Conference on Computer Graphic, London, October 1981, pages 281-292.

This article discloses a graphic interactive application monitor using a graphic command language (GIAM). Among others, that program contains commands for creating graphic objects, and changing/manipulating graphic objects. Circles and ellipses are cited as possible geometric objects. The system includes a cursor which is used to define the coordinates of the current point. Once the current point has been defined, the operator must input a specific command, depending upon the desired type of geometrical figure. For instance, the command "CIR50" will draw a circle to the radius of 50 units, whose center is the current point. The same for other geometrical objects: VR 100 for a vector of 100 units length, for instance.

The article also briefly refers to "the manipulation of a graphic object", such as "change of position with or without change of scale" or "change of geometry without change of position", but those rare examples that are given do not concern the drawing of circles, rectangles or the like and the article says nothing about what kind of "manipulation" could be done to draw such objects.

In brief, this document does not disclose or even suggest the process of the instant invention where, after the user has chosen the type of geometrical figure he wishes to draw in a menu or the like, and has pointed to the location on the screen where the figure is to be drawn, the system displays a minimum size figure on the screen and the user just presses a key to cause that figure to be enlarged until the desired size is achieved. Such a process is undoubtedly much more user-friendly than the system disclosed in the above quoted article, since it does not require learning a specific language and does not imply typing successive instructions until the desired figure is displayed.

Of course, the problem of user-friendliness could be also overcome by the use of a digitizer pad as an input to the computer. A digitizer pad would permit the user to generate any size or shape of geometrical figure at any location on the graphics screen. However, commercially available digitizer pads are very expensive and are therefore generally used in correspondingly expensive computer aided design (CAD) designs.

Summary of invention

It is therefore an object of the present invention to provide a user-friendly method of drawing geometric figures on a graphics screen.

It is a further object of the invention to provide a procedure for drawing geometric figures on a graphics screen which is both easy to use and is practiced with relatively inexpensive hardware;

The present invention provides for a process for user interactive generation and display of a geometrical figure on a graphics display screen comprising the steps of

- prompting the user to choose a desired geometrical figure to be drawn on the graphics display screen from a list of geometrical figures, and
- prompting the user to point to a location on the graphics display screen where it is desired to generate the chosen geometrical figure, the pointing being accomplished by the user positioning a cursor on the graphics display screen at the desired location with a

cursor pointing device and pressing a key to signify selection of a location, characterized by the steps of

- responding to the pressing of the key by the user to signify selection of a location by removing the cursor from the graphics screen and drawing the smallest representation of the selected geometrical figure at the selected location, the user thereafter inputting a signal requesting enlargement of the geometrical figure, and
- responding to the user input signal requesting enlargement of the geometrical figure by enlarging the geometrical figure in increments of one pixel until a second user input signal is received indicating the desired termination of the geometric figure expansion, and thereafter re-displaying the cursor while displaying the enlarged geometrical figure.

In the practice of the invention, the type of geometric figure is chosen, typically from a menu displayed for that purpose, and then the user is prompted to point to the desired location of the figure. The user accomplishes this by moving the cursor to the desired location and pressing the ENTER key. At this point, the cursor is XORed to remove it from the screen, and an initial small sized geometrical figure of the type chosen is drawn on the screen. The user then uses a joy stick or the like to cause the figure to increase in size. When the desired size has been attained, the user indicates this by pressing the ENTER key. At this point, size and position of the geometrical figure is stored and the cursor is redisplayed.

The location of the cursor for the original pointing of location may conveniently be the center of the geometric figure. In the preferred embodiment of the invention, the center is in fact chosen for the generation of circles, but the center is not the only location that may be used for the pointing of location of the geometric figure. Another possible convention is to require the user to point to the upper left corner of the box. The box increases in size to the right horizontally and vertically downwardly from this point as the user moves the joy stick down and to the right. Obviously other conventions will suggest themselves to those of ordinary skill in the art based on the following detailed description of the invention.

Brief Description of the Drawings

The foregoing and other objects, aspects and advantages of the invention will be better understood from the following detailed description of the invention taken with reference to the accompanying drawings in which

Figure 1 is a flow chart illustrating in simplified form one specific example of drawing a circle according to the techniques of the invention; and Figure 2 is a flow chart illustrating in simplified form another specific example of drawing a box or rectangle according to the techniques of the invention.

Detailed Description of the Invention

The invention will be described by way of specific examples adapted for use on the IBM Personal Computer. Obviously, the invention is not limited to this specific microcomputer system or even to microcomputer systems and may have useful application to minicomputer systems or even main frame computer systems. However, the invention is particularly useful in microcomputer systems because of the relative economies of such systems and the fact that the invention is itself correspondingly inexpensive.

The first example is the drawing of a circle. The program, which is set forth in more detail hereinafter, presumes that the circle drawing process is used in conjunction with the schematic generator described in European application n° 84.104621.2. In that application, the cursor symbol is chosen from among a plurality of symbols in a symbol table. These symbols are used in the actual construction of the schematic display by placing the symbols at desired locations on the graphics screen and then reading them into memory in response to an interrupt signal produced by the operator pressing a button on the joy stick control. Thus, the first steps in the specific example given of generating a circle involve the exclusive ORing of the old cursor symbol to remove it from the graphics screen and saving the old symbol height and width for later recall. Then, the new cursor symbol's height and width is initialized and the new cursor symbol is exclusive ORed onto the graphics screen. Typically, the new cursor symbol is a conventional small square or rectangle and may blink on and off. Clearly, if the circle generation technique according to the invention were to be used in an environment where the cursor symbol was not initially a schematic character symbol, then the process of exclusive ORing the old cursor symbol and saving its dimensions would not be required.

The user enters the circle generation mode by making the appropriate selection from a menu. Once in the circle mode, the user is prompted to point to the location on the graphics screen where s/he would like the center of the circle. This is done by moving the joy stick, but as previously mentioned, other cursor positioning devices could be used. When the cursor is positioned to the

desired location of the center of the circle, the user presses the button on the joy stick or the ENTER key to signify selection. The button pressing generates an interrupt which is trapped by the program and control is passed to a subroutine which sets a flag signifying the occurrence. Control returns to the program's main loop which checks the flag at a designated point and gives control to the circle routine. The circle routine first exclusive ORs the cursor off the screen and then prompts the user with various circle options. These include change of color (by pressing function key F9), terminate circle expansion (by pressing function key F10), and expand the circle one pixel in radius (by pressing the joy stick button). The circle routine begins by drawing an initial three pixel circle at the initial pointing and starts looping until the function key F10 is pressed. Inside the loop, if function key F9 is pressed, the color variable is changed. Also, the old circle is continuously removed from the screen by exclusive ORing and the position and size data of the old circle are saved. If during this operation the joy stick button or the "+" key is pressed, the radius variable is increased by one pixel and compared to a maximum value of 30. If it is greater than 30, then it is set equal to 30. The new circle is then drawn on the screen. After the function key F10 has been pressed signifying that the user wants the circle expansion to terminate, the circle position and size are saved and the user is prompted to select a fill color for the circle. The user makes a selection from a menu provided for that purpose, and the circle is then filled with the selected color. At this point in the routine, the routine returns to the point in the program at which the circle generation was entered. The Figure 1 is a flow chart which illustrates the circle drawing process just described.

Those skilled in the art will recognize that various modifications can be made from the basic procedure just described for circle generation. First, while the specific example is described in terms of a color graphics embodiment where both the circumference of the circle and the interior of the circle may be selected to have different colors, the procedure is equally well suited for monochrome graphics without these choices of color. The basic technique is the ability to point to the desired center of the circle with the cursor and then to expand the circle until the desired size has been reached. Second, while the specific example requires the user to press either the button on the joy stick or the "+" key to expand the circle by one pixel increments, some other key or control can be used to accomplish the same result. For example, the joy stick which was originally used to move the cursor to point to the center of the circle could, after the joy stick button or the ENTER key was

pressed, then be used to expand the circle by pushing the joy stick in one direction until the desired size was reached. The use of the joy stick for this function would make possible user control in how fast the circle expanded in size, i.e. a slight deflection of the joy stick would produce a slow expansion and a greater deflection of the joy stick would produce a correspondingly greater expansion rate of the circle. Also, it would be possible to decrease the size of the circle by moving the joy stick in the opposite direction. A similar result could be achieved by pressing the "-" key.

The next specific example is the drawing of a square or a rectangle. The chief differences between this example and the specific example of drawing a circle are that (1) the pointing with the cursor is not made to the center of the geometric figure and (2) expansion of the figure is accomplished by manipulating the joy stick. More specifically, the pointing is made to the upper left corner of the square or rectangle. Expansion of the square or rectangle is then accomplished by deflecting the joy stick down and to the right. Figure 2 is a flow chart which illustrates the box or rectangle drawing process just described.

From these specific examples, those skilled in the art will understand that the basic principles of the invention can be expanded to include many other geometric figures of generally symmetrical shape that are susceptible of being stored in a graphics character memory. These figures require some predefined symmetry upon which expansion in one pixel increments is based. For example, in the circle case, expansion is based on increasing the radius by one pixel increments. In the square or rectangle case, expansion is based on increasing the horizontal x and vertical y dimensions in one pixel increments or some ratio of x to y dimensions.

Claims

1. A method for user interactive generation and display of a geometrical figure on a graphics display screen comprising the step of
 - prompting the user to choose a desired geometrical figure to be drawn on the graphics display screen from a list of geometrical figures, and
 - prompting the user to point to a location on the graphics display screen where it is desired to generate the chosen geometrical figure, the pointing being accomplished by the user positioning a cursor on the graphics display screen at the desired location with a cursor point-



desired location of the center of the circle, the user presses the button on the joy stick or the ENTER key to signify selection. The button pressing generates an interrupt which is trapped by the program and control is passed to a subroutine which sets a flag signifying the occurrence. Control returns to the program's main loop which checks the flag at a designated point and gives control to the circle routine. The circle routine first exclusive ORs the cursor off the screen and then prompts the user with various circle options. These include change of color (by pressing function key F9), terminate circle expansion (by pressing function key F10), and expand the circle one pixel in radius (by pressing the joy stick button). The circle routine begins by drawing an initial three pixel circle at the initial pointing and starts looping until the function key F10 is pressed. Inside the loop, if function key F9 is pressed, the color variable is changed. Also, the old circle is continuously removed from the screen by exclusive ORing and the position and size data of the old circle are saved. If during this operation the joy stick button or the "+" key is pressed, the radius variable is increased by one pixel and compared to a maximum value of 30. If it is greater than 30, then it is set equal to 30. The new circle is then drawn on the screen. After the function key F10 has been pressed signifying that the user wants the circle expansion to terminate, the circle position and size are saved and the user is prompted to select a fill color for the circle. The user makes a selection from a menu provided for that purpose, and the circle is then filled with the selected color. At this point in the routine, the routine returns to the point in the program at which the circle generation was entered. The Figure 1 is a flow chart which illustrates the circle drawing process just described.

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pressed, then be used to expand the circle by pushing the joy stick in one direction until the desired size was reached. The use of the joy stick for this function would make possible user control in how fast the circle expanded in size, i.e. a slight deflection of the joy stick would produce a slow expansion and a greater deflection of the joy stick would produce a correspondingly greater expansion rate of the circle. Also, it would be possible to decrease the size of the circle by moving the joy stick in the opposite direction. A similar result could be achieved by pressing the "-" key.

The next specific example is the drawing of a square or a rectangle. The chief differences between this example and the specific example of drawing a circle are that (1) the pointing with the cursor is not made to the center of the geometric figure and (2) expansion of the figure is accomplished by manipulating the joy stick. More specifically, the pointing is made to the upper left corner of the square or rectangle. Expansion of the square or rectangle is then accomplished by deflecting the joy stick down and to the right. Figure 2 is a flow chart which illustrates the box or rectangle drawing process just described.

From these specific examples, those skilled in the art will understand that the basic principles of the invention can be expanded to include many other geometric figures of generally symmetrical shape that are susceptible of being stored in a graphics character memory. These figures require some predefined symmetry upon which expansion in one pixel increments is based. For example, in the circle case, expansion is based on increasing the radius by one pixel increments. In the square or rectangle case, expansion is based on increasing the horizontal x and vertical y dimensions in one pixel increments or some ratio of x to y dimensions.

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 - prompting the user to point to a location on the graphics display screen where it is desired to generate the chosen geometrical figure, the pointing being accomplished by the user positioning a cursor on the graphics display screen at the desired location with a cursor point-



- ing device and pressing a key to signify selection of a location, characterized in that it comprises the additional steps of
- responding to the pressing of the key by the user to signify selection of a location by removing the cursor from the graphics screen and drawing the smallest representation of the selected geometrical figure at the selected location, the user thereafter inputting a signal requesting enlargement of the geometrical figure, and
 - responding to the user input signal requesting enlargement of the geometrical figure by enlarging the geometrical figure in increments of one pixel until a second user input signal is received indicating the desired termination of the geometric figure expansion, and thereafter re-displaying the cursor while displaying the enlarged geometrical figure.
2. The method according to claim 1 wherein the chosen geometrical figure is a circle and the step of pointing by the user indicates the center of the circle.
 3. The method according to claim 1 wherein the chosen geometrical figure is a square or rectangle and the step of pointing by the user indicates a corner of the square or rectangle.

Revendications

1. Procédé de production et d'affichage interactifs, par un utilisateur, d'une figure géométrique sur un écran d'affichage de graphiques, incluant l'étape consistant à
 - inciter l'utilisateur à choisir une figure géométrique désirée devant être tracée sur l'écran d'affichage de graphiques à partir d'une liste de figures géométriques, et
 - inciter l'utilisateur à repérer un emplacement sur l'écran d'affichage de graphiques, où il est souhaitable de produire la figure géométrique choisie, le repérage étant réalisé grâce au fait que l'utilisateur positionne un curseur sur l'écran d'affichage de graphiques à l'emplacement désiré, avec un dispositif de repérage par curseur et enfonce une touche pour signifier le choix d'un emplacement, caractérisé en ce qu'il inclut les étapes additionnelles consistant à
 - répondre à l'enfoncement de la touche par l'utilisateur pour signifier le choix

d'un emplacement au moyen du retrait du curseur de l'écran d'affichage de graphiques et en traçant la représentation la plus petite possible de la figure géométrique choisie à l'emplacement choisi, l'utilisateur introduisant ensuite un signal demandant un agrandissement de la figure géométrique, et

- répondre au signal d'entrée de l'utilisateur demandant un agrandissement de la figure géométrique, par un agrandissement de la figure géométrique selon des incréments d'un pixel jusqu'à la réception d'un second signal d'entrée de l'utilisateur indiquant la fin désirée de l'agrandissement de la figure géométrique, puis afficher à nouveau le curseur tout en affichant la figure géométrique agrandie.

2. Procédé selon la revendication 1, selon lequel la figure géométrique choisie est un cercle et l'étape de repérage par l'utilisateur désigne le centre du cercle.

3. Procédé selon la revendication 1, selon lequel la figure géométrique choisie est un carré ou un rectangle et l'étape de repérage par l'utilisateur désigne un point du carré ou du rectangle.

Ansprüche

1. Verfahren zum interaktiven Erzeugen und Anzeigen einer geometrischen Figur auf einem Graphik-Anzeigeschirm durch den Benutzer, das die folgenden Schritte umfaßt:

Auffordern des Benutzers, eine gewünschte geometrische Figur zu wählen, die aus einer Liste geometrischer Figuren auf dem Graphik-Anzeigeschirm gezeichnet werden soll und

Auffordern des Benutzers, auf eine Stelle auf dem Graphik-Anzeigeschirm zu zeigen, wo die gewählte geometrische Figur erzeugt werden soll, wobei das Zeigen durch den Benutzer dadurch durchgeführt wird, daß ein Cursor auf dem Graphik-Anzeigeschirm mit einer Cursor-Zeigervorrichtung an die gewünschte Stelle geführt wird und eine Taste gedrückt wird, um die Auswahl einer Stelle zu melden, dadurch gekennzeichnet, daß es die folgenden zusätzlichen Schritte umfaßt:

Antworten auf das Drücken der Taste durch den Benutzer, um eine Auswahl einer Stelle durch Entfernen des Cursors von dem