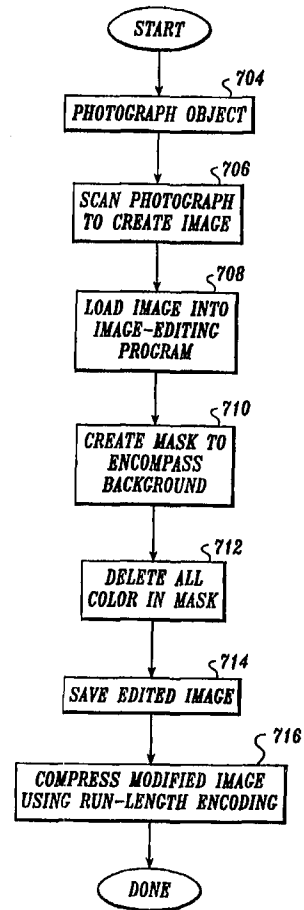


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(54) Title: METHOD OF DISPLAYING THREE-DIMENSIONAL IMAGES

(57) Abstract

A method of transferring digital data from a server computer (104) to a client computer (116) for three-dimensional viewing of an object is disclosed. The method includes downloading a first portion of the digital data and displaying the downloaded portion, while the remaining portions are downloaded and encapsulated with program code to produce a display object. When the digital data represents three-dimensional graphics, the digital data represents a series of two-dimensional images of a three-dimensional object that are taken along different viewing angles. Each input received as a result of manipulation of a directional input device (124) results in a change in the two-dimensional image being displayed, thereby creating the appearance of three-dimensional rotation of the displayed object. Prior to downloading, the two-dimensional images that provide the three-dimensional viewing are compressed by creating a mask (710) encompassing the background of the image (214), deleting the color within the mask (712), and compressing (716) the resultant data using Run Length Encoding.



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METHOD OF DISPLAYING THREE-DIMENSIONAL IMAGES

Field of the Invention

The present invention relates to the presentation of digital information on a client computer, and in particular, the visual display that allows three-dimensional
5 viewing of an object on a client computer connected to a network.

Background of the Invention

In recent years, there has been a tremendous proliferation of computers connected to the Internet. Many of the computers are used to access the Worldwide Web (WEB). Combined with the recent commercialization of the WEB, this has
10 created a need to efficiently present digital information on client computers connected to the Internet. Digital information includes visual information as well as sound. Visual information includes varying formats for displaying two-dimensional still graphics, animated graphics, and three-dimensional graphics. A computer can download digital information from a WEB server, and execute a WEB browser
15 program to translate the digital information into a visual or audio form perceptible by the user.

A client computer downloads WEB pages in a format known as "Hypertext Markup Language" (HTML) for viewing with a WEB browser running on the client computer. HTML includes commands for formatting text, linking to digital data, and
20 receiving input from a user at a client computer. HTML is designed to be platform independent, so a WEB page can be displayed on any computer with a compatible browser program.

A WEB browser interprets the content and commands within an HTML file in order to properly display the content within the file. However, a WEB browser is not

able to properly interpret all formats of digital data. In order to provide the flexibility to download and display digital data in formats "foreign" to a WEB browser, several techniques have been developed. One such technique is to utilize a supplementary program, called a "helper application," which is installed on the client computer, typically by downloading the program over the Internet. The WEB browser is able to associate specific file formats with specific helper applications, and invokes the proper helper application when the WEB browser is called upon to interpret and display the foreign digital data.

Another method of interpreting and displaying digital data utilizes small programs, or applets, that are downloaded each time they are needed. An applet may, for example, present animation in the middle of a displayed WEB page on the client computer. An applet running on a client computer may request that digital data be downloaded from a WEB server to be used, i.e., displayed, on the client computer.

JAVA is a programming language used to create applets. JAVA is an object-oriented language, and applets written in JAVA are object oriented. JAVA code is organized into classes. A class includes a set of methods that define the behavior of a class object. A JAVA program is compiled into byte-codes. Byte-codes are low-level instructions that are not specific to a particular machine, thereby allowing a JAVA program to be executed on different types of computers. A JAVA program, in the form of byte-codes, is downloaded to a client computer along with an associated HTML file.

File compression techniques are commonly used to reduce the size of files prior to transmission over the Internet. Run Length Encoding is a well-known computer technique for compression digital data. In Run Length Encoding, a repetition of a particular sequence of digital data is replaced with a single occurrence of the repeated data and an indication of the number of times that the sequence is repeated. LZW compression, which is the subject of U.S. Patent No. 4,558,302, is one well-known method of Run Length Encoding. The "Graphics Interchange Format[®]" (GIF) is a well-known file specification employing LZW compression.

JPEG compression is another well-known method of Run Length Encoding. The JPEG compression scheme is used to create a file interchange format known as JPEG file interchange format (JFIF).

Despite the rapid technological advances relating to the provision and downloading of digital data for displaying visual information, a need exists for

improved methods and techniques. This is especially true relative to providing images for three-dimensional viewing.

Summary of the Invention

5 In accordance with this invention, a method of displaying a three-dimensional image represented by digital data on a client computer connected to a communication medium, such as the Internet, is provided. The three-dimensional image is made up of multiple two-dimensional images, each two-dimensional image being referred to as a frame and being a visual image of the object along a different line of sight (i.e., taken at a different viewing angle). By selectively and sequentially displaying the two-dimensional images, a three-dimensional image of the object is observed in which the object appears to rotate about a predefined axis that extends through the object. Rotation can be "automatic" (i.e., achieved without user input) or can be controlled by user activation of an input device such as a mouse or selected keys of the computer keyboard.

15 In the currently preferred arrangement of the invention, a three-dimensional object is represented by three rows of frames (two-dimensional images), with each row of frames including 18 two-dimensional images. In this preferred arrangement, the lines of sight associated with the 18 frame elements of each row of frames are angularly spaced apart from one another and pass through the center of the three-dimensional object to be displayed. The lines of sight associated with the three frames in each column of frames are angularly spaced apart from one another and lie in an imaginary plane that passes through the center of the three-dimensional object and is perpendicular to an imaginary horizontal plane.

25 In the operation of the invention, a computer program is received by the client computer through the communication medium and is executed on the client computer. More specifically, the client computer executes a command, and receives, in response, a portion of the digital data representing the first two-dimensional image (i.e., the first frame). The first two-dimensional image is displayed on the client computer display. The client computer then receives additional portions of the digital data through the communication medium. The additional portions include digital data representing two-dimensional images (frames) to the left and the right of the first frame. In response to directional input from a directional input device, such as a mouse, the client computer displays either the left frame or the right frame. If the directional input represents the left direction, the left frame is displayed, and if the directional

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