US 20090235151A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2009/0235151 A1

(43) Pub. Date: Sep. 17, 2009

Bates et al.

(54) METHOD AND APPARATUS FOR ASSOCIATING THE COLOR OF AN OBJECT WITH AN EVENT

(75) Inventors: **Daniel Bates**, Manhattan Beach, CA (US); **Jorge Geaga**, Los Angeles, CA (US)

Correspondence Address:
KATTEN MUCHIN ROSENMAN LLP
(C/O PATENT ADMINISTRATOR)
2900 K STREET NW, SUITE 200
WASHINGTON, DC 20007-5118 (US)

(73) Assignee: **Creative Frontier, Inc.**, Los Angeles, CA (US)

(21) Appl. No.: **12/472,761**

(22) Filed: **May 27, 2009**

Related U.S. Application Data

(63) Continuation of application No. 09/679,391, filed on Oct. 3, 2000, now abandoned.

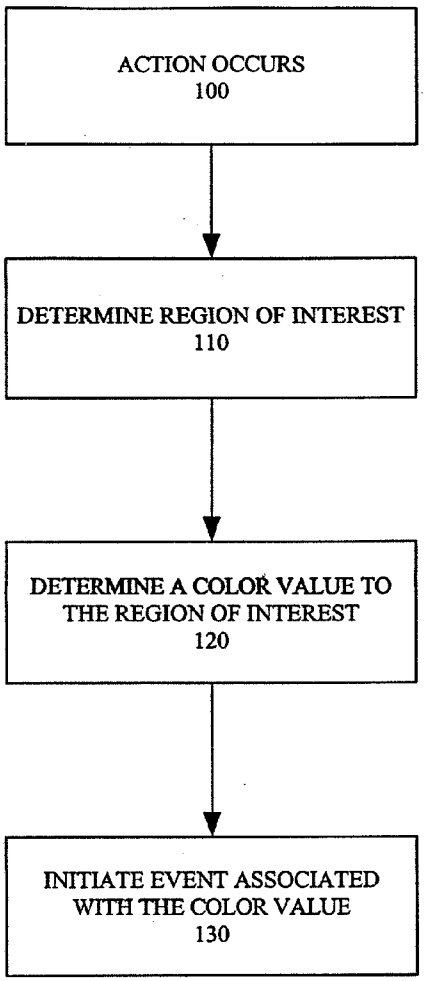
Publication Classification

(51) **Int. Cl.**
G06F 17/00 (2006.01)

(52) **U.S. Cl.** **715/205**; 715/700

(57) **ABSTRACT**

Method and apparatus for associating the color of an object with an event preferably provides linked information for the object in any one of a plurality of succeeding video frames based only on the color value of the object. Preferably, at least one computer is coupled to a GUI and to a pointing structure, and is configured to: (i) identify coordinates of the object in a first video frame where the pointing structure has pointed; (ii) determine the color values of the identified object; (iii) store the color values of the identified object; (iv) detect an action of the object being selected in any one of the plurality of succeeding video frames; (v) determine the color values of the selected object; (vi) determine whether the selected object color values correspond to the stored color values; and (vii) automatically provide the linked information to the GUI only when the color values correspond.



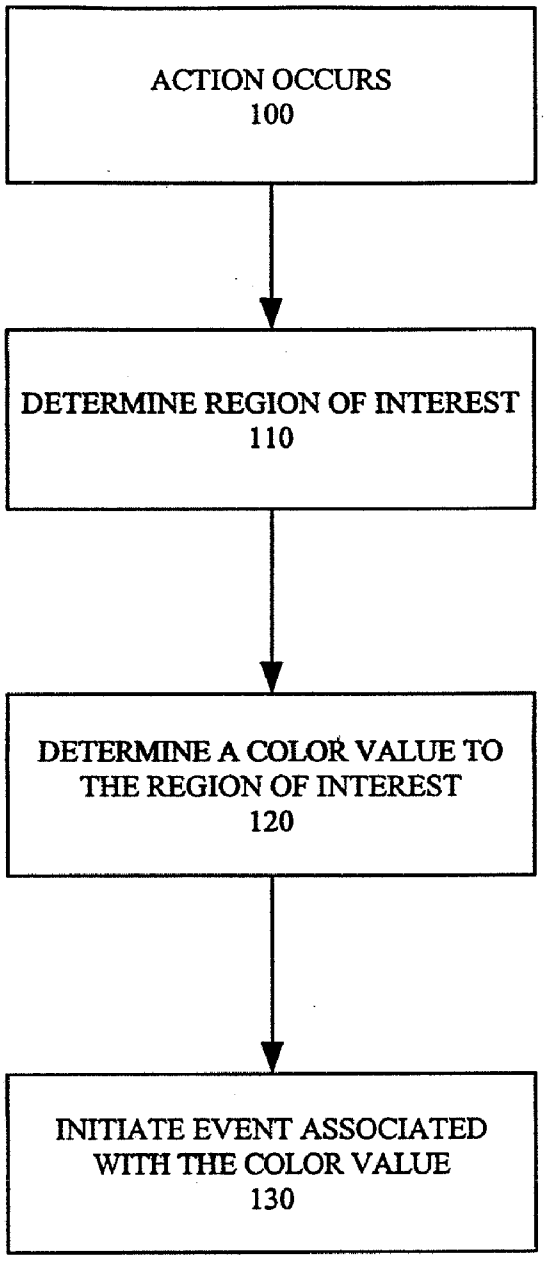

ACTION OCCURS
100
DETERMINE REGION OF INTEREST
110
DETERMINE A COLOR VALUE TO THE REGION OF INTEREST
120
INITIATE EVENT ASSOCIATED WITH THE COLOR VALUE
130

FIGURE 1

FIGURE 2

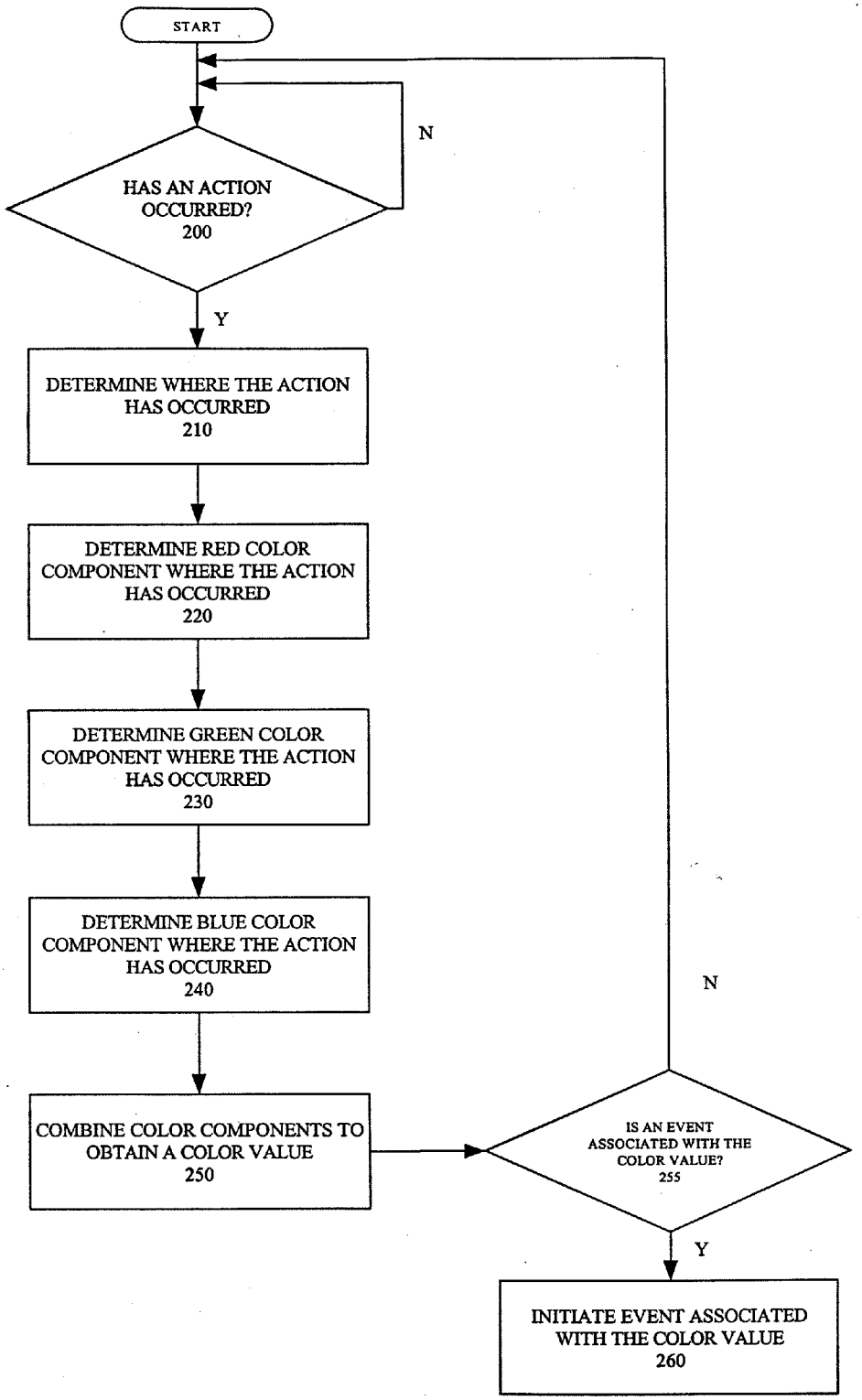
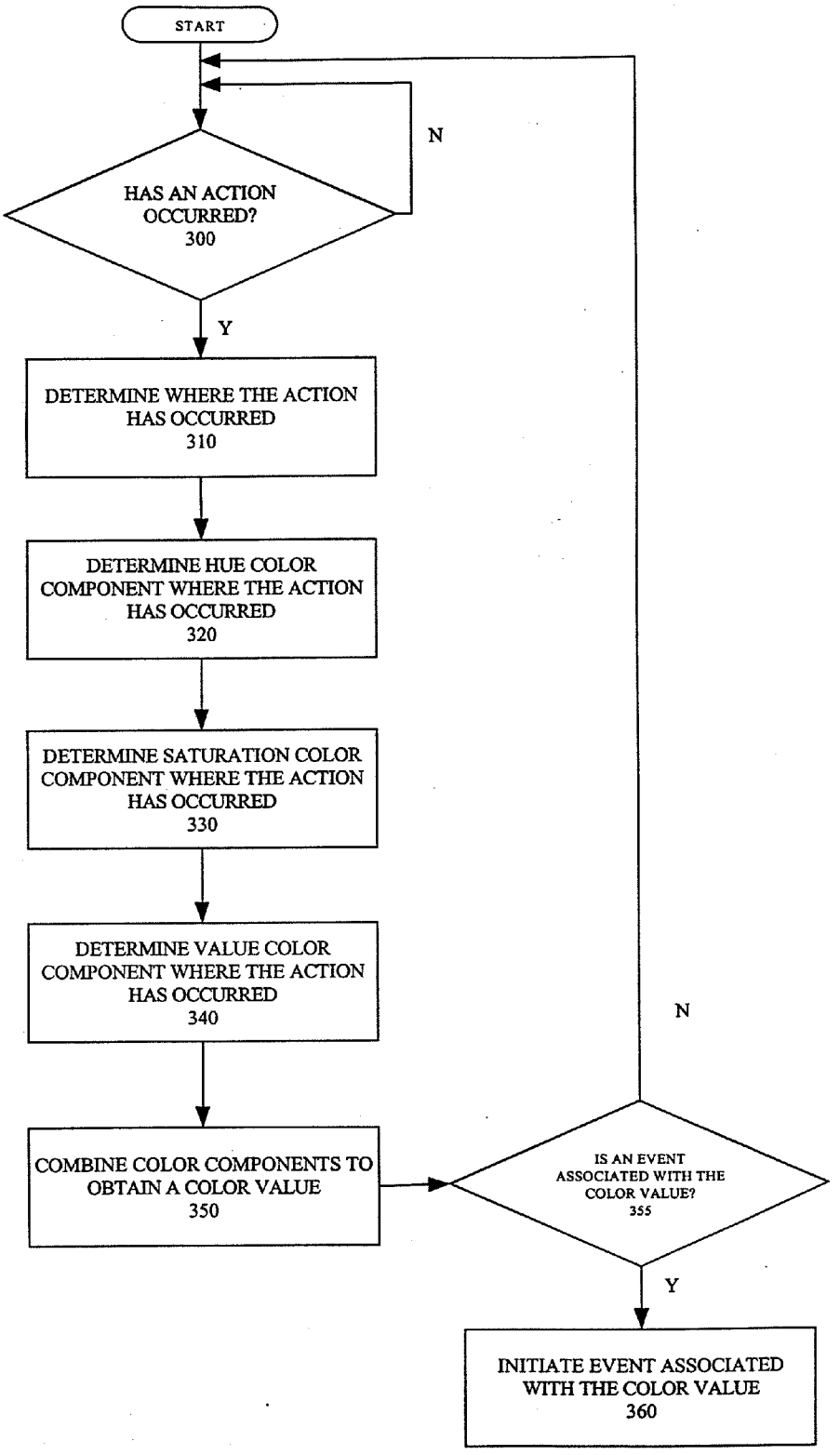

START
HAS AN ACTION OCCURRED? 200
N
Y
DETERMINE WHERE THE ACTION HAS OCCURRED 210
DETERMINE RED COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 220
DETERMINE GREEN COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 230
DETERMINE BLUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 240
COMBINE COLOR COMPONENTS TO OBTAIN A COLOR VALUE 250
IS AN EVENT ASSOCIATED WITH THE COLOR VALUE? 255
N
Y
INITIATE EVENT ASSOCIATED WITH THE COLOR VALUE 260

FIGURE 3


START
HAS AN ACTION OCCURRED? 300
N
Y
DETERMINE WHERE THE ACTION HAS OCCURRED 310
DETERMINE HUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 320
DETERMINE SATURATION COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 330
DETERMINE VALUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 340
COMBINE COLOR COMPONENTS TO OBTAIN A COLOR VALUE 350
IS AN EVENT ASSOCIATED WITH THE COLOR VALUE? 355
N
Y
INITIATE EVENT ASSOCIATED WITH THE COLOR VALUE 360

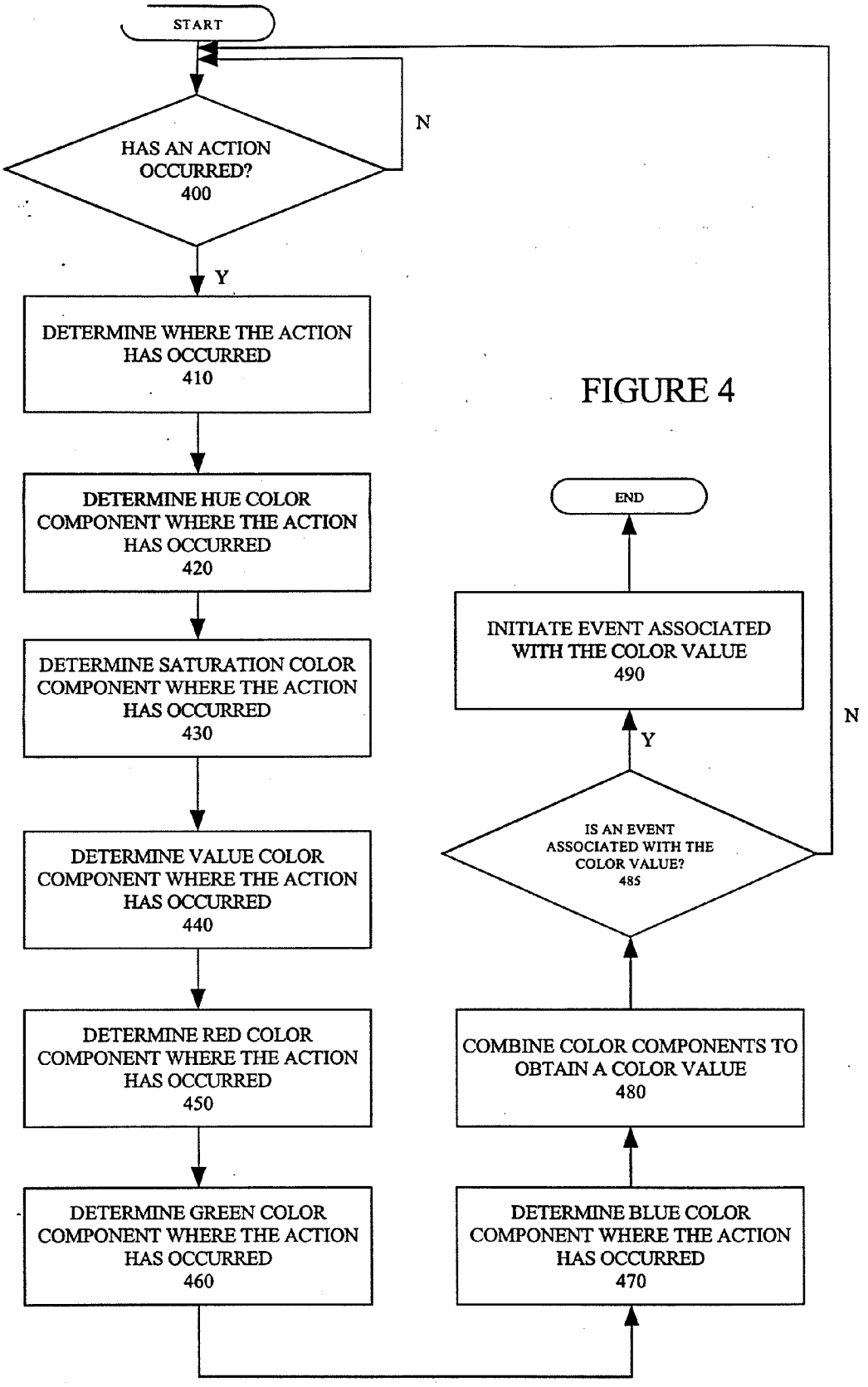

START
HAS AN ACTION OCCURRED? 400
N
Y
DETERMINE WHERE THE ACTION HAS OCCURRED 410
DETERMINE HUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 420
DETERMINE SATURATION COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 430
DETERMINE VALUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 440
DETERMINE RED COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 450
DETERMINE GREEN COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 460
DETERMINE BLUE COLOR COMPONENT WHERE THE ACTION HAS OCCURRED 470
COMBINE COLOR COMPONENTS TO OBTAIN A COLOR VALUE 480
IS AN EVENT ASSOCIATED WITH THE COLOR VALUE? 485
Y
N
INITIATE EVENT ASSOCIATED WITH THE COLOR VALUE 490
END

FIGURE 4

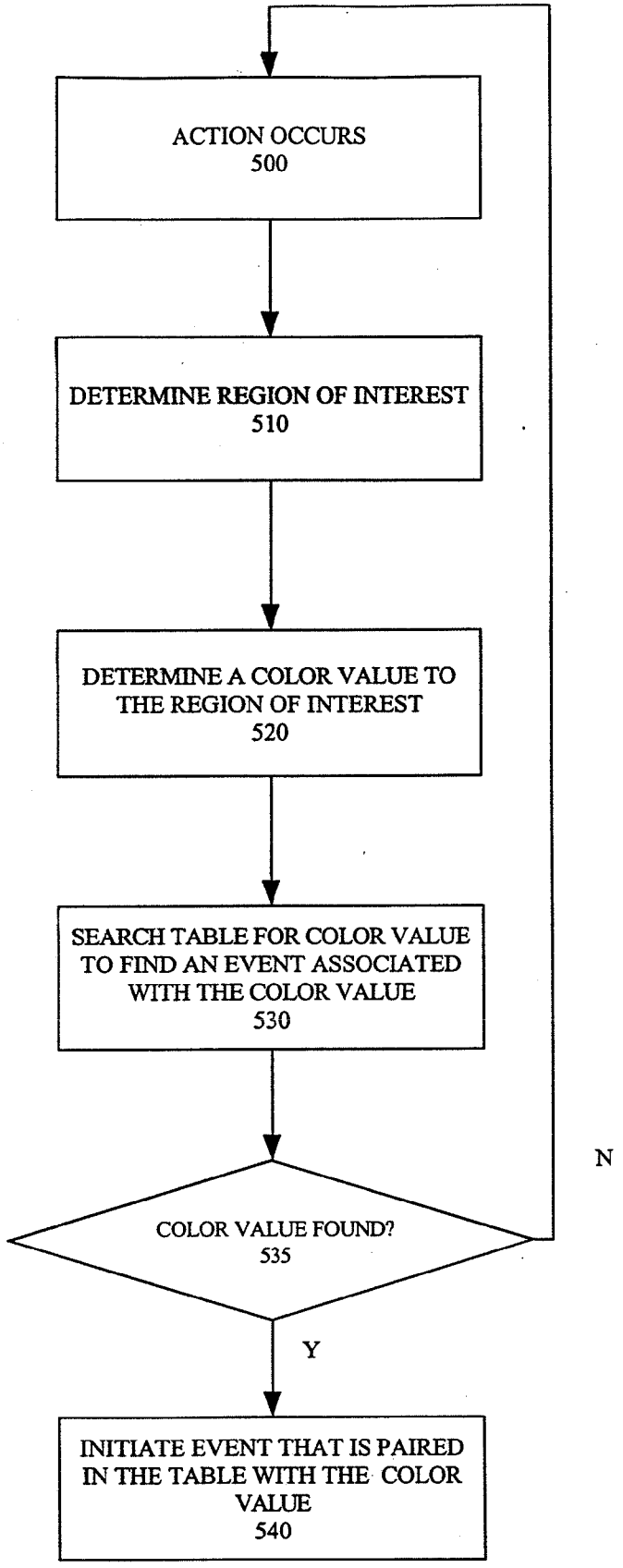

ACTION OCCURS
500
DETERMINE REGION OF INTEREST
510
DETERMINE A COLOR VALUE TO THE REGION OF INTEREST
520
SEARCH TABLE FOR COLOR VALUE TO FIND AN EVENT ASSOCIATED WITH THE COLOR VALUE
530
COLOR VALUE FOUND?
535
N
Y
INITIATE EVENT THAT IS PAIRED IN THE TABLE WITH THE COLOR VALUE
540

FIGURE 5

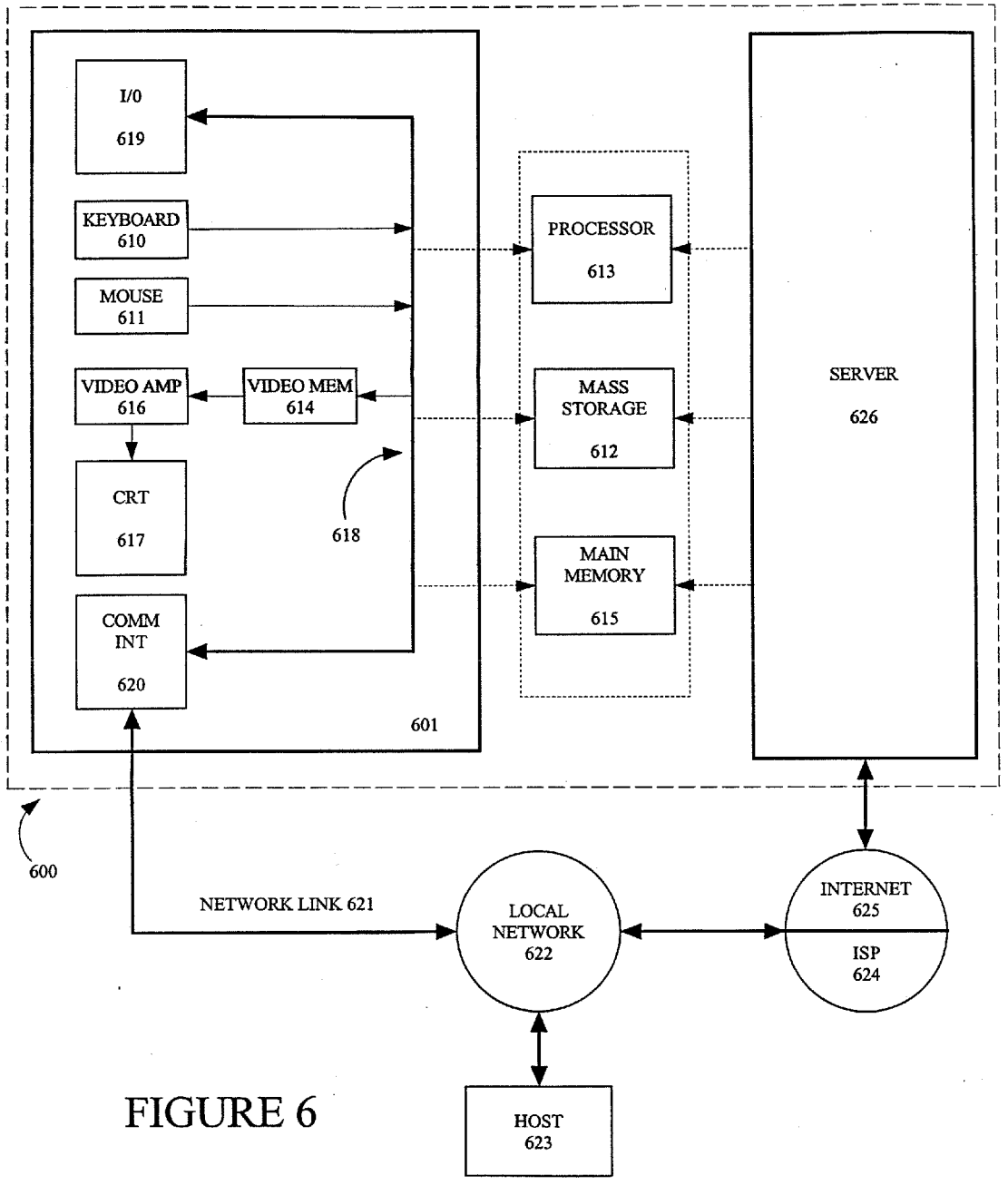

I/O
619
KEYBOARD
610
MOUSE
611
VIDEO AMP
616
VIDEO MEM
614
CRT
617
618
COMM
INT
620
601
PROCESSOR
613
MASS
STORAGE
612
MAIN
MEMORY
615
SERVER
626
600
NETWORK LINK 621
LOCAL
NETWORK
622
INTERNET
625
ISP
624
HOST
623

FIGURE 6

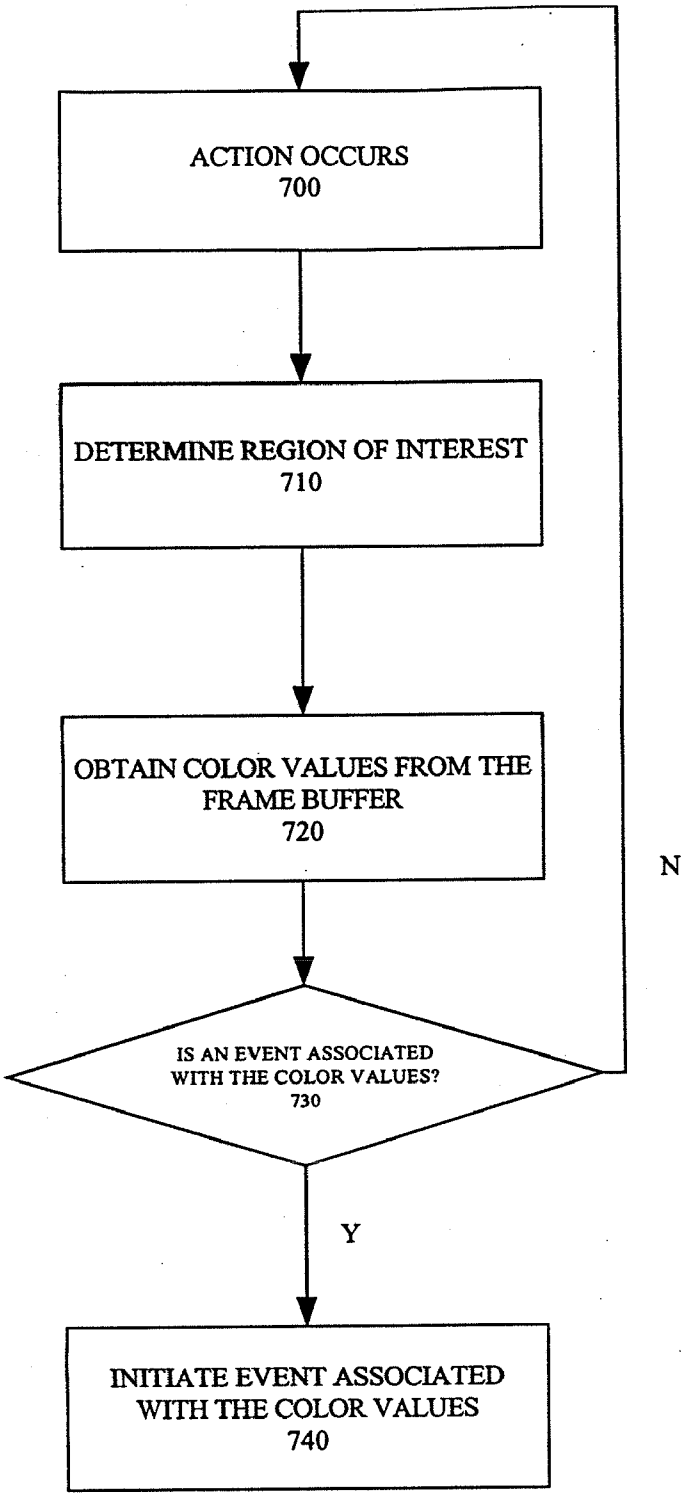

ACTION OCCURS
700
DETERMINE REGION OF INTEREST
710
OBTAIN COLOR VALUES FROM THE FRAME BUFFER
720
IS AN EVENT ASSOCIATED WITH THE COLOR VALUES?
730
N
Y
INITIATE EVENT ASSOCIATED WITH THE COLOR VALUES
740

FIGURE 7

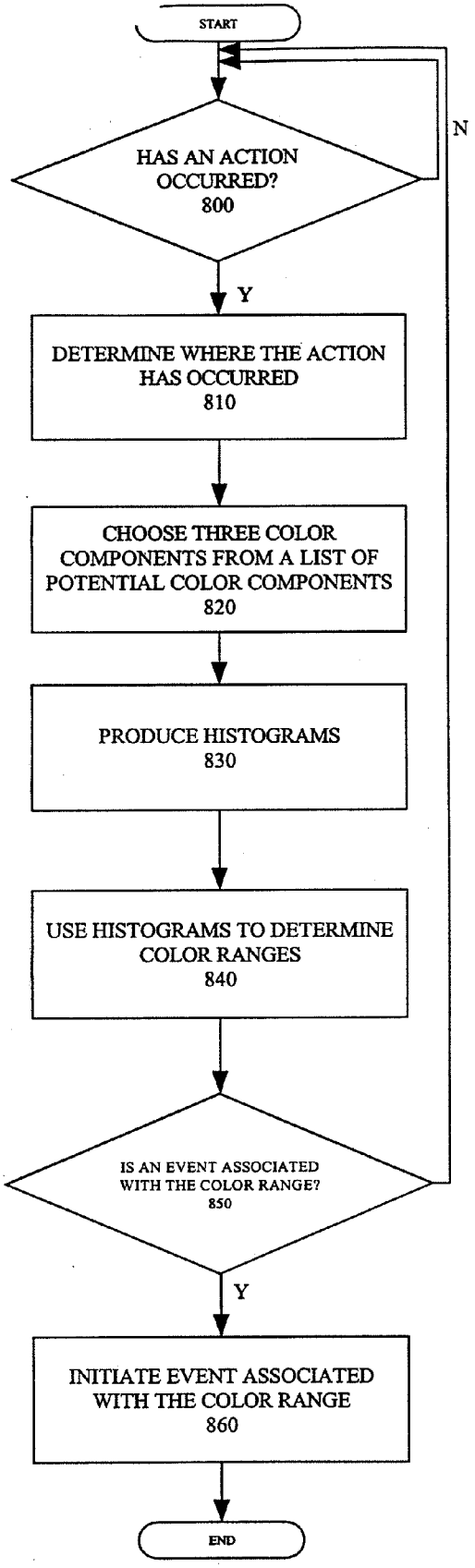

START
HAS AN ACTION OCCURRED? 800
N
Y
DETERMINE WHERE THE ACTION HAS OCCURRED 810
CHOOSE THREE COLOR COMPONENTS FROM A LIST OF POTENTIAL COLOR COMPONENTS 820
PRODUCE HISTOGRAMS 830
USE HISTOGRAMS TO DETERMINE COLOR RANGES 840
IS AN EVENT ASSOCIATED WITH THE COLOR RANGE? 850
Y
INITIATE EVENT ASSOCIATED WITH THE COLOR RANGE 860
END

FIGURE 8

METHOD AND APPARATUS FOR ASSOCIATING THE COLOR OF AN OBJECT WITH AN EVENT

[0001] This is a continuation of U.S. patent application Ser. No. 09/679,391, filed Oct. 3, 2000 (abandoned), the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates generally to event processing, and in particular to associating the color of an object with an event. Portions of the disclosure of this patent document contain material that is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure as it appears in the Patent and Trademark Office file or records, but otherwise reserves all copyright rights whatsoever.

[0004] 2. Background Art

[0005] When using a computer or other interactive devices a user can interact with the device in various ways. One way is to use a mouse. The user utilizes the mouse to position a pointer somewhere on a screen. The user then depresses a mouse button and depending on where the pointer is, something pre-programmed will happen if that area of the screen is "hot". In the context of the Internet, the user can position the mouse pointer over a hot spot "hyperlinked" to a web page and depress the mouse button. This will cause the computer, set-top box, or other device to send a signal to a server to retrieve that web page and display it on the computer screen.

[0006] We foresee the desirability to interact in this manner in many different contexts, not only linking with web pages. Current schemes are limited in the contexts that a user may interact. Before further describing the limitations of current schemes, a discussion of event processing is instructive.

[0007] Event Processing. "Event processing" refers to the association between some type of "action" and the occurrence of an "event". Such a term is used herein in the context of a user's computing experience. The user performs an action followed by an event, followed by a series of other actions followed by other events.

[0008] An action occurs when a user positions a cursor in a specified location on a computer screen, for instance using a mouse, and depressing one of the mouse buttons. This example shows a common type of action, but many other actions exist as well within the context of computer event processing, including the input of text, a voice command, or any other type of action. The example action may take place in any computing environment, but one common environment that the action occurs is in a web browser. A web browser is a graphical user interface that enables users to utilize the Internet, for instance by viewing web pages. Normally the user will position the mouse pointer over a "hyperlink" and depress the mouse button there. This, in turn, triggers an event. The event in this example is to cause a server to retrieve another web page. Thus, in this example, the user interacts with the Internet by a series of actions followed by events.

[0009] Current event processing is disadvantageous, in part, because the types of actions available and the events initiated by the actions are limited. Before further discussing the drawbacks of current event processing, an overview of the Internet is provided below.

[0010] Internet. The information network known as the "Internet" has become increasingly popular. The Internet provides a body of information which may be accessed by users via computers for such purposes as business, education, and entertainment. In particular, the Internet includes a large collection of interconnected documents, images, sounds, videos, and other forms of media which are stored in computers in a system known as the World Wide Web or simply "the web".

[0011] Internet resources are typically accessed in a two-way environment via a network connection. For example, connectivity to the network may be via a conventional twisted-pair telephone line which has a relatively low data-carrying capacity (e.g., bandwidth), or via a higher bandwidth path, which may comprise optical fiber, coaxial cable, ISDN, DSL, wireless connections, or other transmission mechanisms. To retrieve data from a network destination (e.g., an Internet site), a user sends a message to the network destination to request the transfer of information to the user's computer, referred to as a client. The network destination typically includes a computer known as a server. The server then sends a request signal to a source function, which may be a memory which is coupled to the server. The source function includes the user-requested information which may comprise, for example, text, graphics, audio and/or video data. In response to the request signal from the server, the source function provides the requested information to the client.

[0012] HTML. Source information which is stored in the source function is often stored in a format known as "Hypertext Markup Language (HTML)". This file or script format allows the display of text, graphics and audio information, and provides links to other pages of information through "hyperlinks." Hyperlinks are strings of characters in a particular format that specify the address of the desired page of information.

[0013] HTML is a system for marking documents to indicate how the document should be displayed, and how various documents should be linked together. HTML is a form of Standard Generalized Markup Language (SGML), defined by the International Standards Organization. HTML specifies the grammar and syntax of markup tags which are inserted into a data file to define how the data will be presented when read by a computer program known as a "web browser". Conventional web browsers include Internet Explorer, Netscape Navigator, and others.

[0014] The data file, which is typically stored on a server, includes one or more web pages which are visited by users who have computers which may ran different browsers. When a page is visited, HTML data output from the server is downloaded to the client computer. The client computer's browser processes the data to format a layout for the page so the page may be viewed by the user on a computer screen. Generally, HTML tags provide text formatting, hypertext links to other pages, and links to sound and image elements. HTML tags also define input fields for interactive web pages.

[0015] An HTML application is made available to users on the web by storing the HTML file in a directory that is accessible to a server. Such a server is typically a web server which conforms to a web browser-supported protocol known as Hypertext Transfer Protocol (HTTP). Servers that conform to

other protocols such as the File Transfer Protocol (FTP) or GOPHER may also be used, but do not support interactive HTML files.

[0016] HTTP defines a set of rules that servers and browsers follow when communicating with each other. Typically, the process begins when a user accesses an icon in an HTML page which is the anchor of a hyperlink, (for instance, by positioning a cursor on the icon and depressing a mouse button), or the user inputs a Uniform Resource Locator (URL) to his or her web browser, described below. A connection is then made to the server at the address and port number specified by the URL. Next, the browser sends a request to retrieve an object from the server, or to post data to an object on the server. The server sends a response to the browser including a status code and the response data. The connection between the browser and server is then closed. A URL is a unique address which identifies virtually all files and resources on the Internet. A URL has the form: method:// server:port/path/file# anchor. The "method" of accessing the resource is the web browser-supported protocol, and may include, for example, HTTP, FTP, GOPHER, TELNET, NEWS, or MAILTO. The "server:port" indicates the name of the server which is providing the resource, and is alternatively known as the Internet domain name. For example, many businesses will use their business name as part of the server field. The port designation is the port number on the server, but is usually not used since a default port is assumed. The "path" indicates the directory path to the resource. The file indicates the file name of the resource. The "anchor" indicates the named element in the HTML document. Not all fields are required.

[0017] Consider the following URL, for example: http:// www.business.com/information/profits.html# section_1. The access method is HTTP, the server is www.business.com. there is no port specified, the path is information, the file is profits.html, and the anchor is section_1. Thus, it may be seen that web browsers operate in a two-way communication environment to access information by sending a request signal defined by a URL command to a server, and receiving information in return.

[0018] Current Event Processing Schemes. In the context of the Internet, event processing has been limited by the nature of the web. Originally, the web was largely a textual body of interconnected information. Actions were limited to depressing a mouse button on a text link which initiated the event of retrieving another web page from a specified URL. These methods are disadvantageous because they are static. Such events have no application in an active environment, for instance where streaming video or television signals are involved, and such events have no application outside of a web browser (i.e., where a GUI is translating HTML commands into actions).

[0019] As the web evolved, other types of event processing have emerged. In particular, the web evolved to have a more active nature. First, the text-based web became merged with images. The images resided in various formats and could also be used to associate an action with an event. The images, however, suffered the same drawback as the text and essentially performed the same function. For instance, the images were used in the same event context (e.g., depressing a mouse button on the image) and the same actions resulted (e.g., the image caused a server to send another web page to the user).

[0020] After images came more active web environments. One example came in the form of animation where a sequential series of images are displayed in the web browser which cause the image to appear to move on the screen. To allow the user to act upon an animated image, one scheme takes each frame of the animated image and pre-determines where on that individual frame a potential action should be associated with an event.

[0021] For instance, imagine an animation of a runner holding a baton where the runner is moving horizontally across the screen and the desired action is to depress a mouse button when the pointer is over the baton. In this example, assume the animation consists of 100 images. Using one scheme, the 100 images are each individually stored in a computer and each image is analyzed to find where the baton was on the screen.

[0022] Along with each of the 100 images is an image map specifying that in frame **1** the boundary of the baton is in a first position and in frame **2**, the boundary of the baton is in a second position. To map to these positions, the prior art essentially draws a wire frame around the baton in each frame. Therefore, 100 wire frames must be drawn in varying locations. The baton in a moving image varies in position and angle. This in turn varies the shape of the wire frame in each frame of the image.

[0023] The prior scheme is extremely disadvantageous because it requires a tremendous amount of manual preprocessing to draw **100** varied size wire frames. Such preprocessing contains a large lag on overhead. This scheme also must store each and every potential action in a computer and then wait for the action to occur. This technique uses a large amount of the computer's storage space and a large amount of time to create the wire frames. This scheme, in addition, is bound to a web browser implementation and may only trigger events relating to the accessing of a web page at a specified URL.

[0024] As the web has developed more recently, such schemes have become even less advantageous. Specifically, the web has expanded away from a static model and now incorporates other technologies, such as television and other signals. The web through this expansion has also moved to other media forms, such as "set-top boxes" and interactive television sets where the user interacts with the web using a conventional television set as an output device. With these other media forms and other environments, other types of GUIs (not only web browsers) and other types of actions (not only the retrieval of a web page from a specific URL) are desired. However, there is currently no efficient way to process events in such environments.

SUMMARY OF THE INVENTION

[0025] The present invention provides a method and apparatus for associating the color of an object with an event. In one or more embodiments, the invention takes a streaming or static digital image frames and associates an active, dynamic, or static object with an event by its color.

[0026] In one embodiment, an event is the retrieval of a document at a specified URL and the display of the document in a web browser. In another embodiment, an event includes the retrieval of textual or audio information associated with the object. In another embodiment, the event comprises switching to a separate video stream in an environment using streaming media, such as a digital video disc (DVD) player or recorder, or other suitable video environment.

[0027] The invention defines the color in a location (termed a region of interest) by its digital color mathematical proper-

ties. For instance, one embodiment uses the RGB standard which separates the red, green, and blue properties of the color as numerical values. Another embodiment also uses the HSV characteristics of the color, which define hue, saturation, and value as components of color. Another embodiment uses both RGB and HSV characteristics. In one embodiment, the color characteristics are obtained from a digital RGB frame buffer

[0028] As described above, the event links to another URL (i.e., to facilitate a transaction over the Internet) or in the case of a DVD or other video environment, the event causes the video stream to transition to a different data track (i.e., to pull up different information) or to a different video stream

[0029] In one embodiment the invention uses an edge detection scheme to help define the boundaries for the colors in a digital RGB frame. The algorithm developed gives those pixels an "edge" which is not visible to the user, nor drawn on the screen, nor pre-processed prior to the user viewing the images formed by the pixels. The values of the pixels defines an edge rather than the actual drawing of a wire frame on the screen.

[0030] Thus, one or more embodiments of the present invention create the associations between objects and events dynamically in that the data which creates the association is a property of the image itself (i.e., its color values). The present invention requires no alteration or pre-processing of the image to create the associations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims and accompanying drawings where:

[0032] FIG. **1** is a flowchart showing how to associate the color of an object with an event according to an embodiment of the present invention.

[0033] FIG. **2** is a flowchart showing how to define the color characteristics of an object according to an embodiment of the present invention.

[0034] FIG. **3** is a flowchart showing how to define the color characteristics of an object according to another embodiment of the present invention.

[0035] FIG. **4** is a flowchart showing how to define the color characteristics of an object according to another embodiment of the present invention.

[0036] FIG. **5** is a flowchart showing how to associate the color of an object with an event using a table according to an embodiment of the present invention.

[0037] FIG. **6** is a computer execution environment where one or more embodiments of the present invention may be implemented.

[0038] FIG. **7** shows an embodiment of the present invention where the frame buffer is utilized.

[0039] FIG. **8** shows an embodiment of the present invention where color ranges are utilized.

DETAILED DESCRIPTION OF THE INVENTION

[0040] The invention is a method and apparatus for associating the color of an object with an event. In the following description, numerous specific details are set forth to provide a more thorough description of embodiments of the invention. It is apparent, however, to one skilled in the art, that the invention may be practiced without these specific details. In other instances, well known features have not been described in detail so as not to obscure the invention.

[0041] One or more embodiments of the present invention are directed to enhancing a user's ability to interact with a computer, set-top box, interactive television set, or other processing device. According to embodiments of the present invention, the user provides input on some area of a display device, for instance by depressing a mouse button at a specified location. The invention then determines where the user has depressed the mouse button and what color value appears on the display device at the time the user has depressed the mouse button. Then, the invention initiates an event that corresponds to that color value.

[0042] Event Processing. In one or more embodiments, the invention takes a streaming or static media and associates an active, dynamic, or static object with an event by its given color. The event may be, for instance, the retrieval of a document at a specified URL in a web browser or the retrieval of other information in non-web browser implementations. Other implementations include, for instance, the viewing of media, via a television, DVD or other media player, set-top devices, web-TV, interactive TV, and video-games.

[0043] Take, for example, a web page implementing streaming video. In the example, a game show host is wearing a green shirt. If a user provides input to the screen by depressing a mouse with the cursor in a location where the green shirt is located, the invention links to a URL associated with the green shirt. Thus, the moving color may substitute for a conventional, static, text link. In another embodiment, the game show host with the green shirt may be in a television show. In this embodiment, providing input on the moving green shirt may initiate a different event, such as providing information about the shirt or the game show host.

[0044] One embodiment of the present invention is shown in FIG. **1**. At step **100**, an action occurs. At step **110**, the location of the action (a region of interest) is determined. Locating a region of interest is well known in the art.

[0045] One method to locate a region of interest is to obtain an ordered pair corresponding to the location of the cursor at the moment of the action. For instance, a computer screen may be represented as a two-dimensional graph wherein the axis of the graph resides in the lower left hand corner of the computer screen. Thus all ordered pairs will correspond to positive values of x,y pairs on the graph.

[0046] After defining the region of interest, the value associated with a color in the region of interest is determined at step **120**. Thereafter, at step **130**, an event associated with that color is initiated.

[0047] Color Characteristics. In one embodiment, the invention defines the color by its mathematical properties. For instance, one embodiment uses the RGB standard which separates the red, green, and blue properties of the color as numerical values. Another embodiment also uses the HSV characteristics of the color, which define hue, saturation, and value as components of color. HSV characteristics further define the properties of a color, for instance V represents an analog of the intensity of a color or how bright the color appears. Another embodiment of the present invention uses both RGB and HSV characteristics.

[0048] One embodiment defines color characteristics as shown in FIG. **2**. At step **200**, it is determined whether an action has occurred. If no action occurred, step **200** repeats until an action occurs. If the action has occurred, it is determined where the action has occurred at step **210**.

[0049] The location is shown herein with respect to a single pixel, "pixel N'. At step **220**, a red component of a color for pixel A is determined. Then, at step **230**, a green component of the color for pixel A is determined. Next, at step **240**, a blue component of the color for pixel A is determined. Thereafter, at step **250**, the color characteristics are combined to form a color value for pixel A

[0050] After step **250**, it is determined whether any event is associated with the color value at step **255**. If no event is associated with that color value, no event is initiated and the process repeats at step **200**. If an event is associated with the color value, then at step **260** an event associated with the color value is initiated.

[0051] Another embodiment defines color characteristics as shown in FIG. **3**. At step **300**, it is determined whether an action has occurred. If no action occurred, step **300** repeats until an action occurs. If the action has occurred, it is determined where the action has occurred at step **310**. The location is shown herein with respect to a single pixel, "pixel B". At step **320**, a hue component of a color for pixel B is determined. Then, at step **330**, a saturation component of the color for pixel B is determined. Next, at step **340**, a value component of the color for pixel B is determined.

[0052] Thereafter, at step **350**, the color characteristics are combined to form a color value for pixel B. After step **350**, it is determined whether any event is associated with the color value at step **355**. If no event is associated with that color value, no event is initiated and the process repeats at step **300**. If an event is associated with the color value, then at step **360** an event associated with the color value is initiated.

[0053] Another embodiment defines color characteristics as shown in FIG. **4**. At step **400**, it is determined whether an action has occurred. If no action occurred, step **400** repeats until an action occurs. If the action has occurred, it is determined where the action has occurred at step **410**. The location is shown herein with respect to a single pixel, "pixel C'. At step **420**, a hue component of a color for pixel C is determined. Then, at step **430**, a saturation component of the color for pixel C is determined. Next, at step **440**, a value component of the color for pixel C is determined. At step **450**, a red component of a color for pixel C is determined. Then, at step **460**, a green component of the color for pixel C is determined. Next, at step **470**, a blue component of the color for pixel C is determined.

[0054] Thereafter, at step **480**, the color characteristics are combined to form a color value for pixel B. After step **480**, it is determined whether any event is associated with the color value at step **485**. If no event is associated with that color value, no event is initiated and the process repeats at step **400**. If an event is associated with the color value, then at step **490** an event associated with the color value is initiated.

[0055] Frame Buffer. In a computer or other comparable device, images are often used as a form of output. A common way that such devices handle images or streams of images (e.g., video) is by using a "frame buffer". For offline preprocessing or for real-time processing using high speed computers, the RGB frame buffers reside in memory. Alternatively, a special high speed video board can be used to process an RGB frame buffer for real-time processing.

[0056] A video signal, for instance, comprises a series of still images shown sequentially where the series of images appears so quickly that a user perceives the series of pictures to be a continuous stream of motion. As the computer processes each image, data relating to the image is stored in the frame buffer. Such data includes, for instance, the color values associated with each pixel at each location on the screen.

[0057] As a new image is displayed, new data about the image is stored in the frame buffer. Depending on the size of the frame buffer, many sequential images may be stored there before it fills up and old image data must be overwritten.

[0058] One embodiment of the present invention takes advantage of the data already existing in the frame buffer, for instance to perform step **120** of FIG. **1**. FIG. **7** shows an embodiment of the present invention where the frame buffer is utilized.

[0059] At step **700**, an action occurs. At step **710**, the location of the action (a region of interest) is determined. Next, at step **720**, the invention access the frame buffer to obtain color values at the location of the action when it occurred. Then, it is determined whether any event is associated with the color value at step **730**. If no event is associated with that color value, no event is initiated and the process repeats at step **700**. If an event is associated with the color value, then at step **740** an event associated with the color value is initiated.

[0060] Events. As described above, one event is a link to another URL (i.e., to facilitate a transaction over the Internet). Thus, one event may comprise the retrieval of a web page from a server computer connected to the Internet.

[0061] In the context of streaming media, an event may be the retrieval of a text page. For instance, assume the user is watching a DVD program showing several of the great pyramids of Egypt. If the user causes an event to occur in a region of interest defined by a specific pyramid, then the event may comprise the retrieval of a text page telling the user exactly which pyramid this is, when it was built, the history associated with this particular pyramid, and any other pertinent information. Thus, the event would cause the DVD to move to a different data track (i.e., to pull up different information).

[0062] In the same great pyramid example, another event may comprise the retrieval of audio information, for instance a narrator providing information similar to that given in the text track in the above example. Furthermore, the event may comprise the retrieval of a new media stream, such as the close up of the pyramid, alternate angles showing different views of the same pyramid, or views from inside the pyramid, for example.

[0063] In one embodiment an event comprises the retrieval of a data track. A data track comprises information associated with the color acted upon. Assume for instance, that this embodiment of the present invention takes place using an interactive television set. While the interactive television set is operating, a game show host appears wearing a green shirt. Then assume, for instance, that a user caused an action to occur at the location of the green shirt. In this instance, the data track may be information about the shirt, the game show host, or any other relevant information.

[0064] Whether an event is associated with a color value may be determined in a plurality of ways. One such way is to use a table. An example of one embodiment of a table is shown in Table 1.

TABLE 1

Color Value	Event
100	retrieve document at URL www.info.comltest
300	obtain data track at a specified location
200	initiate media stream at specified location
288	initiate audio track at specified location

[0065] The table may be arranged in a plurality of ways and may be accessed in methods well known to those skilled in the art, including hash tables, hash functions, pointers, indices, or any other suitable form of table lookup. In addition, different

color values may initiate the same event. Alternatively, every color value on an output device may be associated with the same event.

[0066] FIG. **5** shows an embodiment of the present invention where a table is implemented. At step **500**, an action occurs. At step **510**, the location of the action (a region of interest) is determined. Then at step **520**, the value associated with a color in the region of interest is determined. Next, a table is searched to locate the color value to obtain an event that is paired with the color value at step **530**. Then, at step **535**, it is determined whether the color value is in the table. If it is not, then that color value is not linked to an event and no event is initiated. In that case the process repeats at step **500**. Otherwise, at step **540**, the event is initiated.

[0067] Color Ranges. In another embodiment of the present invention regions of interest (i.e., those regions where a user has performed an action) are associated with events based on color ranges. A color range, for instance, includes those shades of blue that correspond to the body of a bluebird in a video stream. Realistic image and video streams will not have a uniform shade of blue at all areas of the bluebird's body since light and other factors will cause natural variations in the perceived color reflected from an object. In this embodiment, this reality is accounted for, which gives this embodiment specific application in dynamic and high-quality video streams.

[0068] Color ranges are defined by color characteristics. For instance, a color range may translate into values on an RGB or HSV scale, or could be combinations of both. Typically, in a computer system such values range from 0-255. Thus, the bluebird's body may be defined as a region of interest where the color range includes a B value on the RGB scale of 50-75, for instance.

[0069] Thus, whether the action occurred at an upper left or lower right portion of the bluebird's body, the same event is initiated, despite the potential that at these corners of the regions of interest, the color values differed. All that is required in this embodiment is that both differing color values fall within the defined color range.

[0070] In many images, the colors may be very similar, yet they may be aspects of different components of the image and associated with different events. In one embodiment, the ranges are defined with respect to a plurality of color characteristics including RGB and HSV.

[0071] For instance, a range may be defined where the R is selected to have a range of 50-80, the G is selected to have a range of 150-160, and the B is selected to have a range of 200-220. An example color is selected by the user where the example color has RGB characteristics of 60, 155, and 205 respectively. Another color on the screen that is associated with a different event may appear to be substantially identical to the example color but has RGB characteristics of 190, 100,33. Since the ranges have been defined by a plurality of characteristics, however, such minute differences in color shading are accounted for by this embodiment of the present invention.

[0072] In one embodiment, the characteristics of the color are defined by R, G, B, H, S, V, and R-G, and G-B, where R-G and G-B have red and green and green and blue components respectively. In this embodiment, any three of these variables is sufficient to uniquely define all colors displayed on an output device or stored in a frame buffer. To determine whether the variables are within the color range for the purpose of determining whether an event will be associated with the area of interest, the following algorithm is used (shown in FIG. **8**).

[0073] At step **800**, it is determined whether an action has occurred. If no action occurred, step **800** repeats until an action occurs. If the action has occurred, it is determined where the action has occurred at step **810**. Then at step **820**, three variables are chosen from a list of possible color components, for instance, R, G, B, H, S, V, R-G, or G-B. For the chosen variables, histograms are produced at step **830**

[0074] A histogram is a graphical method for describing data. It is a presentation of quantitative data (i.e., color components) that have been summarized in a frequency distribution. The values of the quantitative variable are shown on the horizontal axis. A rectangle is drawn above each class such that the base of the rectangle is equal to the width of the class interval and its height is proportional to the number of data values in the class.

[0075] Using the histogram, the color ranges are determined at step **840**, for instance by determining the variable peak on the histogram + or − three times its variance. After step **840**, it is determined whether any event is associated with the color range at step **850**. If no event is associated with that color range, no event is initiated and the process repeats at step **800**. If an event, is associated with that color range, then at step **860** an event associated with the color range is initiated.

[0076] Color Patterns. It is often beneficial to define a regions of interest that is not uniform in color. A region of interest, for instance, may be a plaid tablecloth. In this case, it is not adequate to use a single color value, nor a color range to define the region of interest. To account for this, one embodiment of the present invention uses color patterns to define the region of interest.

[0077] A color pattern comprises a representation of the colors in the region of interest, for instance a graphical representation, defined by a plot on an x,y axis. The varying colors in the region of interest create peaks and valleys in the color pattern, graph representation. By locating patterns of peaks and valleys in such a color pattern, multi-color patterns, such as the plaid tablecloth, are used to associate actions with events.

[0078] Edge Detection. One embodiment of the present invention uses an edge detection scheme to define the boundaries for the colors. The color component of an object is described by its pixels. An algorithm gives those pixels an "edge" which is not visible to the user, nor drawn on the screen, nor pre-processed prior to the user viewing the images formed by the pixels. For instance, an invisible wire frame is created to describe the shape of the given colored object to associate with the event. But the value of the pixels defines the wire frame rather than actually drawing a wire frame on the screen.

[0079] One embodiment of the present invention uses Quicktime, a software package available from Apple Computers™. In this embodiment, Quicktime is used to support the use of "sprites". A sprite is a clickable element within a video stream Using Quicktime, a sprite is modified to be defined by its color component. Thus, one or more embodiments of the present invention create the associations between objects and events dynamically, in that the data which creates the association is a property of the image itself

(i.e., its color values). The present invention requires no alteration or pre-processing of the image to create the associations.

[0080] Embodiment of Computer Execution Environment (Hardware). An embodiment of the invention may be implemented as computer software in the form of computer readable program code executed in a general purpose computing environment such as environment **600** illustrated in FIG. **6**, or in the form of byte code class files executable within a Java runtime Environment™ running in such an environment, or in the form of byte codes running on a processor (or devices enabled to process byte codes) existing in a distributed environment (e.g., one or more processors on a network). A keyboard **610** and mouse **611** are coupled to a system bus **618**. The keyboard and mouse are for introducing user input to the computer system and communicating that user input to central processing unit (CPU) **613**. Other suitable input devices may be used in addition to, or in place of, the mouse **611** and keyboard **610**. I/O (input/output) unit **619** coupled to bidirectional system bus **618** represents such I/O elements as a printer, A/V (audio/video) I/O, etc.

[0081] Computer **601** may include a communication interface **620** coupled to bus **618**. Communication interface **620** provides a two-way data communication coupling via a network link **621** to a local network **622**. For example, if communication interface **620** is an integrated services digital network (ISDN) card or a modem, communication interface **620** provides a data communication connection to the corresponding type of telephone line, which comprises part of network link **621**. If communication interface **620** is a local area network (LAN) card, communication interface **620** provides a data communication connection via network link **621** to a compatible LAN. Wireless links are also possible. In any such implementation, communication interface **620** sends and receives electrical, electromagnetic or optical signals which carry digital data streams representing various types of information.

[0082] Network link **621** typically provides data communication through one or more networks to other data devices. For example, network link **621** may provide a connection through local network to local server computer **623** or to data equipment operated by ISP **624**. ISP **624** in turn provides data communication services through the world wide packet data communication network now commonly referred to as the "Internet" **625**. Local network **622** and Internet **625** both use electrical, electromagnetic or optical signals which carry digital data streams. The signals through the various networks and the signals on network link **621** and through communication interface **620**, which carry the digital data to and from computer **600**, are exemplary forms of carrier waves transporting the information.

[0083] Processor **613** may reside wholly on client computer **601** or wholly on server **626** or processor **613** may have its computational power distributed between computer **601** and server **626**. Server **626** symbolically is represented in FIG. **6** as one unit, but server **626** may also be distributed between multiple "tiers". In one embodiment, server **626** comprises a middle and back tier where application logic executes in the middle tier and persistent data is obtained in the back tier. In the case where processor **613** resides wholly on server **626**, the results of the computations performed by processor **613** are transmitted to computer **601** via Internet **625**, Internet Service Provider (ISP) **624**, local network **622** and communication interface **620**. In this way, computer **601** is able to display the results of the computation to a user in the form of output.

[0084] Computer **601** includes a video memory **614**, main memory **615** and mass storage **612**, all coupled to bidirectional system bus **618** along with keyboard **610**, mouse **611** and processor **613**. As with processor **613**, in various computing environments, main memory **615** and mass storage **612**, may reside wholly on server **626** or computer **601**, or they may be distributed between the two. Examples of systems where processor **613**, main memory **615**, and mass storage **612** are distributed between computer **601** and server **626** include the thin-client computing architecture developed by Sun Microsystems, Inc., the palm pilot computing device and other personal digital assistants, Internet ready cellular phones and other Internet computing devices, and in platform independent computing environments, such as those which utilize the Java technologies also developed by Sun Microsystems, Inc.

[0085] The mass storage **612** may include both fixed and removable media, such as magnetic, optical or magnetic optical storage systems or any other available mass storage technology. Bus **618** may contain, for example, thirty-two address lines for addressing video memory **614** or main memory **615**. The system bus **618** also includes, for example, a 32-bit data bus for transferring data between and among the components; such as processor **613**, main memory **615**, video memory **614** and mass storage **612**. Alternatively, multiplex data/address lines may be used instead of separate data and address lines.

[0086] In one. embodiment of the invention, the processor **613** is a microprocessor manufactured by Motorola, such as the 680×0 processor or a microprocessor manufactured by Intel, such as the 80×86, or Pentium processor, or a SPARC microprocessor from Sun Microsystems, Inc. However, any other suitable microprocessor or microcomputer may be utilized. Main memory **615** is comprised of dynamic random access memory (DRAM). Video memory **614** is a dual-ported video random access memory. One port of the video memory **614** is coupled to video amplifier **616**. The video amplifier **616** is used to drive the cathode ray tube (CR 1) raster monitor **617**. Video amplifier **616** is well known in the art and may be implemented by any suitable apparatus. This circuitry converts pixel data stored in video memory **614** to a raster signal suitable for use by monitor **617**. Monitor **617** is a type of monitor suitable for displaying graphic images.

[0087] Computer **601** may send messages and receive data, including program code, through the network(s), network link **621**, and communication interface **620**. In the Internet example, remote server computer **626** might transmit a requested code for an application program through Internet **625**, ISP **624**, local network **622** and communication interface **620**. The received code may be executed by processor **613** as it is received, and/or stored in mass storage **612**, or other non-volatile storage for later execution. In this manner, computer **600** may obtain application code in the form of a carrier wave. Alternatively, remote server computer **626** may execute applications using processor **613**, and utilize mass storage **612**, and/or video main memory **615**. The results of the execution at server **626** are then transmitted through Internet **625**, ISP **624**, local network **622** and communication interface **620**. In this example, computer **601** performs only input and output functions.

[0088] Application code maybe embodied in any form of computer program product. A computer program product

comprises a medium configured to, store or transport computer readable code, or in which computer readable code may be embedded. Some examples of computer program products are CD-ROM disks, ROM cards, floppy disks, magnetic tapes, computer hard drives, servers on a network, and carrier waves.

[0089] The computer systems described above are for purposes of example only. An embodiment of the invention may be implemented in any type of computer system or programming or processing environment.

[0090] Thus, a method and apparatus for associating the color of an object with an event is described in conjunction with one or more specific embodiments. The invention is defined by the claims and their full scope of equivalents.

What is claimed is:

1. A method for automatically identifying an object in a plurality of video frames and associating the object with a link action, comprising:

determining a location in one of said video frames where an action by a pointing device on the object has occurred;

determining a color value of the determined location on the object; and

automatically associating a link action with said color value of said determined location on the object in said one video frame, and automatically associating said link action with said color value on the object in succeeding video frames.

2. A method for automatically identifying an object in a plurality of video frames and associating the object with a URL, comprising:

determining the x-y coordinates of the object in a video frame that is selected by a pointing device;

determining a color value range for the determined object; and

automatically associating a URL with said color value range of said determined object in said one video frame, and automatically associating the URL with said color value range of said determined object in succeeding video frames.

3. A method for automatically identifying an object in a plurality of video frames and associating the object with an link decision, comprising:

determining the coordinates of an object in one of said video frames selected by a pointing device;

determining a color value pattern for the selected object; and

automatically associating the link decision with said color value pattern of the selected object in said one video frame, and automatically associating the link decision with said color value pattern in succeeding video frames.

4. A method for providing linked information for an object in any one of a plurality of succeeding video frames based only on the color value of the object, comprising:

using a pointing device to identify coordinates of the object in a first video frame;

determining the color values of the identified object in the first video frame;

storing the color values of the identified object in the first video frame;

detecting an action of the object being selected in any one of the plurality of video frames succeeding the first video frame;

determining the color values of the selected object in the any one of the plurality of video frames succeeding the first video frame;

determining whether the determined color values correspond to the stored color values; and

automatically providing the linked information only when the determined color values correspond to the stored color values.

5. Apparatus for automatically identifying an object in a plurality of video frames and associating the object with a link action, comprising:

a graphical user interface (GUI);

user pointing structure; and

at least one computer coupled to the graphical user interface and to said user pointing structure, said at least one computer being configured to:

(i) determine a location in one of said video frames displayed on said GUI where said user pointing structure has identified the object;

(ii) determine a color value of the object in said one video frame displayed on said GUI;

(iii) automatically associate a link action with said color value of said determined location on the object in said one video frame; and

(iv) automatically associate said link action with said color value on the object in succeeding video frames.

6. Apparatus for automatically identifying an object in a plurality of video frames and associating the object with a URL, comprising:

a graphical user interface (GUI);

user pointing structure; and

at least one computer coupled to the graphical user interface and to said user pointing structure, said at least one computer being configured to:

(i) determine the x-y coordinates of the object in a video frame displayed on said GUI that is selected by said user pointing structure;

(ii) determine a color value range for the determined object;

(iii) automatically associate a URL with said color value range of said determined object in said one video frame; and

(iv) automatically associate the URL with said color value range of said determined object in succeeding video frames.

7. Apparatus for automatically identifying an object in a plurality of video frames and associating the object with an link decision, comprising:

a graphical user interface (GUI);

user pointing structure; and

at least one computer coupled to the graphical user interface and to said user pointing structure, said at least one computer being configured to:

(i) determine the coordinates of an object in one of said video frames displayed on said GUI selected by said user pointing structure;

(ii) determining a color value pattern for the selected object;

(iii) automatically associate the link decision with said color value pattern of the selected object in said one video frame; and

(iv) automatically associate the link decision with said color value pattern in succeeding video frames.

8. Apparatus for providing linked information for an object in any one of a plurality of succeeding video frames based only on the color value of the object, comprising:

a graphical user interface (GUI);

user pointing structure; and

at least one computer coupled to the graphical user interface and to said user pointing structure, said at least one computer being configured to:

(i) identify coordinates of the object in a first video frame displayed on said GUI where said pointing structure has pointed;

(ii) determine the color values of the identified object in the first video frame displayed on said GUI;

(iii) store the color values of the identified object in the first video frame displayed on said GUI;

(iv) detect an action of the object being selected by said pointing structure in any one of the plurality of video frames displayed on said GUI succeeding the first video frame;

(v) determine the color values of the selected object in the any one of the plurality of video frames succeeding the first video frame;

(vi) determine whether the determined color values correspond to the stored color values; and

(vii) automatically provide the linked information to said GUI only when the determined color values correspond to the stored color values.

* * * * *