

MULTIPLE CAMERA CONTROL SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. application Ser. No. 09/962,612, filed Sep. 26, 2001, titled MULTIPLE CAMERA CONTROL SYSTEM, which claims priority from U.S. Provisional Application No. 60/237,187, filed Oct. 3, 2000, titled DUAL CAMERA CONTROL SYSTEM, all of which are incorporated by reference.

TECHNICAL FIELD

[0002] This invention relates to an object tracking system, and more particularly to a video camera based object tracking and interface control system.

BACKGROUND

[0003] A variety of operating systems are currently available for interacting with and controlling a computer system. Many of these operating systems use standardized interface functions based on commonly accepted graphical user interface (GUI) functions and control techniques. As a result, different computer platforms and user applications can be easily controlled by a user who is relatively unfamiliar with the platform and/or application, as the functions and control techniques are generally common from one GUI to another.

[0004] One commonly accepted control technique is the use of a mouse or trackball style pointing device to move a cursor over screen objects. An action, such as clicking (single or double) on the object, executes a GUI function. However, for someone who is unfamiliar with operating a computer mouse, selecting GUI functions may present a challenge that prevents them from interfacing with the computer system. There also exist situations where it becomes impractical to provide access to a computer mouse or trackball, such as in front of a department store display window on a city street, or while standing in front of a large presentation screen to lecture before a group of people.

SUMMARY

[0005] In one general aspect, a method of tracking an object of interest is disclosed. The method includes acquiring a first image and a second image representing different viewpoints of the object of interest, and processing the first image into a first image data set and the second image into a second image data set. The method further includes processing the first image data set and the second image data set to generate a background data set associated with a background, and generating a first difference map by determining differences between the first image data set and the background data set, and a second difference map by determining differences between the second image data set and the background data set. The method also includes detecting a first relative position of the object of interest in the first difference map and a second relative position of the object of interest in the second difference map, and producing an absolute position of the object of interest from the first and second relative positions of the object of interest.

[0006] The step of processing the first image into the first image data set and the second image into the second image data set may include determining an active image region for each of the first and second images, and extracting an active

image data set from the first and second images contained within the active image region. The step of extracting the active image data set may include one or more techniques of cropping the first and second images, rotating the first and second images, or shearing the first and second images.

[0007] In one implementation, the step of extracting the active image data set may include arranging the active image data set into an image pixel array having rows and columns. The step of extracting further may include identifying the maximum pixel value within each column of the image pixel array, and generating data sets having one row wherein the identified maximum pixel value for each column represents that column.

[0008] Processing the first image into a first image data set and the second image into a second image data set also may include filtering the first and second images. Filtering may include extracting the edges in the first and second images. Filtering further may include processing the first image data set and the second image data set to emphasize differences between the first image data set and the background data set, and to emphasize differences between the second image data set and the background data set.

[0009] Processing the first image data set and the second image data set to generate the background data set may include generating a first set of one or more background data sets associated with the first image data set, and generating a second set of one or more background data sets associated with the second image data set.

[0010] Generating the first set of one or more background data sets may include generating a first background set representing a maximum value of data within the first image data set representative of the background, and generating the second set of one or more background data sets includes generating a second background set representing a maximum value of data within the second image data set representative of the background. Generating further may include, for the first and second background sets representing the maximum value of data representative of the background, increasing the values contained within the first and second background sets by a predetermined value.

[0011] Generating the first set of one or more background data sets may include generating a first background set representing a minimum value of data within the first image data set representative of the background, and generating the second set of one or more background data sets may include generating a second background set representing a minimum value of data within the second image data set representative of the background. Generating further may include, for the first and second background sets representing the minimum value of data representative of the background, decreasing the values contained within the first and second background sets by a predetermined value.

[0012] Generating the first set of background data sets may include sampling the first image data set, and generating the second set of background data sets may include sampling the second image data set. Sampling may occur automatically at predefined time intervals, where each sample may include data that is not associated with the background.

[0013] Generating the first set of one or more background data sets may include maintaining multiple samples of the