Advantage is taken of the fact that as a player becomes uncomfortable, visually observable aspects of the player’s physiological state, such as the frequency of eye blinks, may change. By analyzing such changes and/or other image changes, as obtained from signals generated by an input device, the system is able to determine changes in a player’s comfort level and change the game accordingly.
FIG. 1

INPUT DEVICE

PROCESSOR

DISPLAY

GAME ALGORITHM

FIG. 2A

20

22

201

12, 14
FIG. 2B

FIG. 3

IMAGE PROCESSING CIRCUIT

FILTER

SIGNAL CONDITION

A/D CONVERTER

TO PROCESSOR 12

AMPLIFIER

SIGNAL FROM VISUAL SENSOR 22
**FIG. 4**

1. Acquire signal from user interface (402)
2. Process received visual signal (403)
3. Perform visual image analysis on processed visual signal (404)
4. Has visual image signal changed? (405)
   - No (406)
   - Yes (407)
5. Determine player's response level (407)
6. Adjust program skill level based on changes of player's response level (407)
SYSTEM AND METHOD FOR USING IMAGE ANALYSIS OF USER INTERFACE SIGNALS FOR PROGRAM CONTROL

CROSS-REFERENCE TO RELATED APPLICATIONS


TECHNICAL FIELD

[0002] The present invention relates generally to interactive computer systems and methods, and more particularly to systems and methods for using image analysis of a user interface signal to control a program.

BACKGROUND OF THE INVENTION

[0003] Electronic games using computers, game consoles or handheld consoles typically employ an input device, a processor, and a visual display. The input device can be a mouse, joystick, or other form of controller which allow the player to input responses into the processor. The processor can be a part of a computer system or it can be a dedicated game system, such as XBOX® and PLAYSTATION® game systems. The processor communicates with the display to show visual and/or audio images of the game.

[0004] These electronic games typically have different levels of play in order to provide a level of play which is entertaining for the player. For many games, the level of play is selected by the user prior to playing the game, and changing the level of play will require the user to restart the game. A player will often have to try out a variety of levels before finding a level which is suitable for his/her level of play.

[0005] Games typically place the player in situations where quick and/or agile response is required and a player’s score is typically reflective of his/her ability to respond quickly to the challenges presented by the game. In many situations, a mouse, joystick or a controller is used to relay positional information which is used by the game to move an object on the display.

[0006] Playing at an appropriate level of play will ensure that the player is challenged by the game, and minimizes the risk of overwhelming or boring the player. However, when user skill levels must be set before a game is started there is not a convenient way in which the user can adjust the skill level short of restarting the game. Often, the user does not even know that the skill level is wrong for that user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] For a more complete understanding of the present invention, reference is now made to the following description taken in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 is a diagram of one embodiment of the present invention;
[0011] FIGS. 2A and 2B are overviews of embodiments of the invention;
[0012] FIG. 3 shows one example of image processing used in the invention; and
[0013] FIG. 4 illustrates a block diagram of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] As shown in FIG. 1, one embodiment of the present invention includes a user visual interface, such as device 22, which communicates with processor 12 via processing circuit 30. The program code or algorithm for a game program may be stored in a memory device, such as memory 14, and executed by processor 12. The processing shown in circuit 30 (as will be discussed with respect to FIG. 3) can be accomplished in circuitry, in software as part of an algorithm, or partially in each. The processing or circuitry can be separate from, or integral to, processor 12.

[0015] User interface 22 may be a stand alone device as shown in FIG. 2 where the visual input device is shown marked on top of display 201, or it can be incorporated into a computer mouse, a game controller, a joystick, or any other device, such as keyboard 202, through which the player is able to input his/her actions into processor 12. Device 22 can be an analog or digital camera or an LED display for capturing images, such as eye blinks, head movements, frequency of face touches, swinging motion of arms or legs, head nods, etc. Processor 12 may include memory devices, microprocessors, and any components which are utilized to execute the program code for a game program. The processor system may be a part of a computer system, a video game console, or a handheld gaming device.

[0016] The visual image, for example, eye blinks, head nods, changes in facial images, etc., can be used as an
indicator of a player’s response level. For example, fast eye blinks may suggest a player becoming frustrated or confused. Changes of a player’s response level during game play can be used to change a game program aspect, for example the play difficulty could be adjusted.

As shown in FIG. 3, in one embodiment, amplifier 31 of image processing circuit 30 receives the image signal, for example, from device 22 shown in FIGS. 2A and 2B. This signal would typically, but not always, be in analog form and would be amplified by amplifier 31 and filtered by filter 32. The filtering would remove signals outside certain ranges as desired. This filtered signal would be conditioned by circuit 33 and, if necessary, converted to digital format by A/D converter 34. This signal would then be presented to processor 12.

Note that as part of the filtering and/or conditioning, changes of the image could be detected and signaled to the processor, or, if desired, the entire conditioned signal could be presented to the processor for a determination of image change and a determination of what such an image change means in terms of user discomfort, etc.

Once the player’s response level is determined, processor 12 may modify the system, for example by adjusting the difficulty level of the game being played. In one embodiment of the invention, this includes switching between preset difficulty levels defined in the game or to use a difficulty level that is indicated by a database or algorithm to be appropriate with the determined response level. In another embodiment, the processing system may increase or decrease the speed with which it executes the game algorithm. In a still further embodiment, the difficulty can be continuously adjusted until the user response moves within a defined range.

FIG. 4 represents a flowchart of one embodiment 40 of the system used to adjust skill level of a game, or other application, based on received visual images. Process 402 acquires a signal from user interface 22 and by image analysis of the signal as discussed with respect to FIG. 3, as performed by process 403 and process 404, a determination is made by process 405 if some significant feature of the image has changed. If it has changed from a previous reading (or a previous set of readings as stored in memory), then process 406 determines the response level of the player based on the nature of the received visual images. Process 402 then adjusts the skill level of the game or other parameters based on the received visual image data. Images can be stored for a period of time in a memory (not shown) and an image can be compared against the previous image, or against a composite (or average) of previous images to determine of the user is agitated, bored, wondering, intense, etc. Rapid eye changes could, for example, mean the user is agitated. If desired, data can be maintained on a user by user basis such that for a particular user a correlation can be made between visual image changes and action (poor, good, etc.) taken by that user. This correlation then can be the foundation of changes made to the program upon future detection of similar visual changes.

Note that there could be a table established of user levels such that the received visual images are averaged (or otherwise saved) over a period of time can be used to determine an actual graded level of user comfort. Based on the gradation at any point in time the same (or other) program can be adjusted harder or easier.

Note that while a game system has been described, the concepts taught herein can be used to control the operation aspects of any program running on any processor. For example, a spreadsheet program can have different instructions presented based on the frequency of eye movement or other visual image.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods, and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, process, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same results as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such process, machines, manufacture, composition of matter, means, methods or steps.

What is claimed is:

1. A method of controlling a program running on a processor comprising:
   using visual image analysis on a signal from a user interface;
   determining a user’s response level;
   and adjusting said program in response to a determined user response.

2. The method of claim 1 wherein said user comprises:
   matching a received image against a previously received image.

3. The method of claim 1 wherein said determined response is based on a change in received images.

4. The method of claim 2 wherein the determination is based on a rapid change in received images.

5. The method of claim 1 wherein said program is a game program and said adjusting results in a change of a skill level presented to said user.

6. A system comprising:
   a user interface to a program running on a processor;
   means for performing visual image processing on a signal from said user interface during execution of a program on said processor; and
   means for adjusting at least one operational aspect of said program in response to performed visual image analysis.

7. The system of claim 6 wherein said program is a game and said input interface is a camera.

8. The system of claim 6 wherein said operational aspect is selected from the list of:
   difficulty level;
   instructional level; and
   amount of information displayed.

9. The system of claim 6 wherein said signal is a series of visual images.

10. The system of claim 9 wherein said visual images are selected from the list of:
    eye blinks; face touches; leg movement; arm movement; and head movement.

11. The system of claim 6 wherein said image processing means comprises means for measuring the present video
images from said user interface against at least one previous video image from said user interface.

12. The system of claim 6 wherein said visual image processing means comprises:
circuitry for amplifying and filtering analog signals.
13. The system of claim 12 wherein said analog signals are from a camera.

14. The system of claim 6 wherein said visual image performing means comprises:
an algorithm for processing input signals from a digital camera.

15. A method of using a program comprising:
setting a program level;
determining changes in a user response level during program use by monitoring visual images of said user as obtained from a user interface signal; and adjusting said program level based on determined changes in said user's video images over time.

16. The method of claim 15 wherein said determining comprises using differences between visual images as received from said user interface signal.

17. The method of claim 16 wherein said user interface signal represents user image changes while said user is operating a program input device of a game controller component.

18. The method of claim 17 wherein said program level is a difficulty level of said game program.

19. The method of claim 18 wherein said difficulty level is decreased when said visual image monitoring indicates an increase in the rate of visual image change between interface signals.

20. The method of claim 18 wherein said difficulty level is increased when said visual image monitoring indicates substantially no changes between user interface signals.

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