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(71) Applicant (for all designated States except US): **WMS GAMING INC.** [US/US]; 800 South Northpoint Blvd., Waukegan, Illinois 60085 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PRYZBY, Eric, M.** [US/US]; 5119 Greenleaf St., Skokie, Illinois 60077 (US). **RADEK, Paul** [US/US]; 1939 Spice Circle, Naperville, Illinois 60565 (US). **THOMAS, Alfred** [US/US]; 2385 E. Windmill #247, Las Vegas, Nevada 89123 (US).

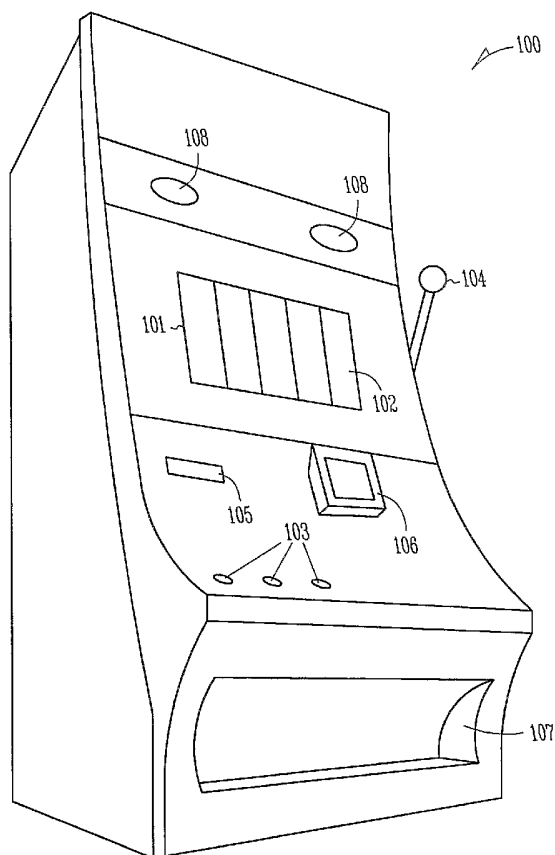
(74) Agents: **STEFFEY, Charles, E.** et al.; Schwegman, Lundberg, Woessner & Kluth, P.A., P.O. Box 2938, Minneapolis, Minnesota 55402 (US).

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(54) Title: AUDIO OBJECT LOCATION IN A COMPUTERIZED WAGERING GAME



(57) Abstract: A computerized wagering game system (100) has a gaming module comprising a processor and gaming code which is operable when executed on the processor to conduct a wagering game on which monetary value can be wagered. An audio module comprising part of the computerized wagering game system (100) is operable to play sound through two or more speakers (108), and is further operable to apply audio object location processing to the sound so that it appears to come from a specific location.

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AUDIO OBJECT LOCATION IN A COMPUTERIZED WAGERING GAME

5

Related Application

This application claims the priority benefit of U.S. Provisional Application Serial No. 60/614,922, filed 30 September 2004, the contents of which are incorporated herein by reference.

10

Field of the Invention

The invention relates generally to audio in wagering gaming systems, and more specifically to audio object location in a computerized wagering game system.

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Background of the Invention

A wide variety of gaming devices are now available to gamers and to casino operators in computerized form, from slot machines to games that are traditionally played live such as poker and blackjack. These computerized
5 games provide many benefits to the game owner and to the gambler, including greater reliability than can be achieved with a mechanical game or human dealer, more variety, sound, and animation in presentation of a game, and a lower overall cost of production and management.

Computerized video game systems must be designed with many of the
10 same concerns as their mechanical and table game ancestors - they must be fair, they must provide sufficient feedback to the gamer to make the game fun to play, and they must meet a variety of gaming regulations to ensure that both the machine owner and gamer are honest and fairly treated in implementing the game. Further, they must provide a gaming experience that is at least as
15 attractive as the older mechanical gaming machine experience to the gamer, to ensure success in a competitive gaming market.

Many computerized wagering game systems have a variety of sound and graphical elements designed to attract and keep a game player's attention, such as sound effects, music, and animation. These game presentation features often
20 include a variety of music, sound effects, and voices presented to complement a video presentation of the wagering game on a display.

Wagering game players typically stand or sit on one side of a wagering game, and interact with the game such as by pushing buttons, pulling levers, and operating a touchscreen. The wagering game system in turn provides feedback

to the game player via the display and one or more speakers. Use of multiple speakers in some wagering games allow playback of stereo audio in which each of the two stereo audio channels plays a different signal.

5 In some wagering game machines, sound is played in conjunction with a video object's motion or presentation, such as a sound accompanying reel spin in a reel slot machine, or credit bang-up sounds played as credits are counted up in a game player's credit counter. Such sounds can help call the game player's attention to the screen and can audibly indicate the occurrence of particular events, enhancing presentation of the game to the wagering game player.

10 But, some sounds can become repetitive and lose meaning to a game player, and a game player may not associate a certain sound with a particular game element or activity as is desired by the wagering game designers. It is therefore desirable to more strongly associate sounds presented in a wagering game system with their associated wagering game objects.

15

Summary of the Invention

The present invention provides in one embodiment a computerized wagering game system has a gaming module comprising a processor and gaming code which is operable when executed on the processor to play a wagering game on which monetary value can be wagered. An audio module comprising part of
20 the computerized wagering game system is operable to play sound through two or more speakers, and is further operable to apply audio object location processing to the sound so that it appears to come from a specific location.

Brief Description of the Figures

Figure 1 shows a computerized reel slot gaming system operable to play a sound processed with audio object location processing, consistent with an example embodiment of the present invention.

5 Figure 2 is a top view display diagram of a software application to facilitate audio object location specification, consistent with an example embodiment of the present invention.

 Figure 3 is a side view display diagram of a software application to facilitate audio object location specification, consistent with an example
10 embodiment of the present invention.

 Figure 4 is a wagering game system employing a surround sound speaker system and audio object location processing, consistent with an example embodiment of the present invention.

 Figure 5 is a diagram of a head and torso model as is used to derive a
15 head-related transfer function in some example embodiments of the present invention.

Detailed Description

 In the following detailed description of sample embodiments of the
20 invention, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific sample embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and

that logical, mechanical, electrical, and other changes may be made without departing from the spirit or scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the invention is defined only by the appended claims.

5 The present invention provides in one embodiment a computerized wagering game system having a gaming module comprising a processor and gaming code which is operable when executed on the processor to present or conduct a wagering game on which monetary value can be wagered. An audio module comprising part of the computerized wagering game system is operable
10 to play sound through two or more speakers, and is further operable to apply audio object location processing to the sound so that it appears to come from a specific location.

 Figure 1 illustrates a computerized wagering game machine, as may be used in an embodiment of the present invention. The computerized gaming
15 system shown generally at 100 is a video wagering game system, which displays information for at least one wagering game upon which monetary value can be wagered on video display 101. Video display 101 is in various embodiments a CRT display, an LCD display, a surface conducting electron emitter display, or any other type of display suitable for displaying electronically provided display
20 information. Alternate embodiments of the invention will have other game indicators, such as mechanical reels instead of the video graphics reels shown at 102 that comprise a part of a video slot machine wagering game.

 A game of chance is implemented as software within the wagering game, such as via instructions stored on a machine-readable medium such as a hard

disk drive or nonvolatile memory. In some further example embodiments, some or all of the software stored in the wagering game machine is encrypted or is verified using a hash algorithm or encryption algorithm to ensure its authenticity and to verify that it has not been altered. The game of chance takes various forms in different wagering game machines, and includes such well-known wagering games as reel slots, video poker, blackjack, craps, roulette, or hold 'em games. The wagering game is played and controlled with inputs such as various buttons 103 or via a touchscreen overlay to video screen 101. In some alternate examples, other devices such as pull arm 104 used to initiate reel spin in this reel slot machine example are employed to provide other input interfaces to the game player.

Monetary value is typically wagered on the outcome of the games, such as with tokens, coins, bills, or cards that hold monetary value. The wagered value is conveyed to the machine through a changer 105 or a secure user identification module interface 106, and winnings are returned via the returned value card or through the coin tray 107. Sound is also provided through speakers 108. In some further embodiments, the wagering game machine is coupled to a network, and is operable to use its network connection to receive wagering game data, track players and monetary value associated with a player, and to perform other such functions.

The wagering game in one example embodiment of the present invention uses audio object location processing applied to sound played through speakers 108 to make it sound to a game player as though the sound were coming from a specific location. In some embodiments, the location is based on the screen

location of an object associated with the sound, while in some other embodiments the specific location is selected to provide a broader soundstage of sounds or for special effects purposes.

The sounds are processed in one embodiment by application of what is
5 known as a head-related transfer function to the sounds that are intended to sound as though they come from specified directions or locations. The head related transfer function, or HTRF, is derived from the way a listener's head, ear, and torso affect the sound that is eventually heard. These head, ear, and torso effects are largely responsible for the listener's ability to determine the direction
10 from which a sound is coming, and can be characterized and applied to sounds to make them sound as though they are coming from directions other than their true source.

The head-related transfer function is determined such as by use of preexisting models, or by measuring a dummy head designed to mimic the
15 acoustic behavior of a human head. This function is then applied to a sound signal by use of filters such as digital signal processing filters that shape the frequency response of the sound signal before the signal is routed to a speaker and converted to an acoustic or audible sound signal. The game player then hears a filtered version of the sound having frequency response filtering applied
20 such that the sound appears to come from a location specific to the applied filtering process.

Figure 2 illustrates one method of applying such filter processing to a sound to make it appear to a game player as though it comes from a specified direction. A screen diagram is shown generally at 201 of a computer program

designed to allow a game's creator to specify the apparent position of sound in a horizontal plane relative to a game player 202. The screen shot shows a sequence of positions such as 203, each of which are connected and have various attributes that can be specified. In one example, the sound starts at position 203, and progresses second by second to the other positions shown in Figure 2. Time in between seconds is interpolated, such that motion of the sound is smooth and appears to follow the approximate paths shown in Figure 2 linking points rather than jumping second-by-second. In other embodiments, the period of time and the change between positions is further customizable or can be specified in other ways, such as by specifying the amount of time a sound takes to travel from one specified position to the next or the amount of time a sound spends stationary at one point before proceeding on.

In some embodiments, the elevation of the sound is a parameter that can be set along with other parameters for a particular point such as point 203 of Figure 2, while other systems will use other methods of further specifying position such as the screen diagram of Figure 3. The screen shot 301 shown generally in Figure 3 shows a top view of a computer program screen designed to allow a game creator to specify a sound's location in a vertical plane, along with various points such as point 303 corresponding to the points such as 203 of Figure 2. This alternate view enables visualization and configuration of the apparent elevation or height of a sound relative to the head of a listener 302, enabling a creator to fully visualize the position of a sound at a given time when viewed in conjunction with the position view of Figure 2.

In some embodiments of the invention, the specified sound location is achieved not only with a head-related transfer function, but by using a multichannel speaker system, or what is commonly known as a surround sound system. Such a system is shown in Figure 4, adapted to the two-speaker wagering game system shown in Figure 1. The speakers 108 of Figure 1 are replaced with left, center, and right channel speakers 401, 402, and 403. Additional surround channel speakers are added, including left rear channel speaker 404 and right rear channel speaker 405. The use of multiple speakers means that less head-related transfer function processing is needed to make sound come from a certain direction or elevation. In some example embodiments, simply directing sound to the appropriate speakers can in a surround sound system having three or more speakers located in different positions such as are shown in Figure 4 can create the illusion of a sound being placed in a specific location, and the audio processing involves specifying which speakers are to play a sound, what volume each speaker is to play the sound, or the like.

Sound having more than the traditional two stereo channels can be encoded and decoded in many ways, including a few example commercial embodiments discussed here in greater detail (all names are trademarked property of their respective owners). Examples include Dolby formats such as Dolby ProLogic and Dolby Digital, Logic 7, and various embodiments of DTS such as DTS-ES and DTS-NEO6.

Dolby ProLogic was one of the first commercially available surround sound formats, and enabled analog derivation of a center channel and two

surround channels from a two-channel encoded signal. Dolby Digital is a digitally encoded format, providing for encoding and decoding of five full-range channels and a low frequency channel (5.1 channels) from an encoded digital signal.

5 Similarly, a variety of digital surround sound formats from DTS, including DTS, DTS-ES, and DTS-NEO6 derive five or six channels plus a low frequency effects channel from a digitally encoded signal. DTS is a five channel discrete encoded signal that also has an encoded low frequency effects channel. DTS-ES adds a sixth channel, plus the ability to matrix encode a 5.1 channel
10 surround signal in addition to discrete channel encoding. DTS-NEO6 is a six channel matrix encoded format, incorporating a low-frequency effects channel to provide a 6.1 channel matrix encoded digital surround format.

Logic 7, also known as L7, is a proprietary seven-channel decoding process developed by Lexicon, a subsidiary of Harman International. Logic 7 in
15 various embodiments is able to derive seven channel surround sound from a two channel stereo or matrix encoded source, and has various parameters optimized for film, broadcast, reverberant environment, and other modes. It is further able to derive up to seven channels of surround information from other surround encoded formats, including matrix and discrete multichannel surround formats
20 such as Dolby Digital or DTS.

The Logic 7, Dolby Digital, DTS, and other surround sound formats presented here are examples of ways in which various audio processing can be applied to implement different surround sound formats in an audio system having three or more discrete audio channels and speakers.

Systems employing only two speakers will in many embodiments rely on implementation of a head-related transfer function (HRTF) as described earlier to provide the audio object location function that causes an audible sound to sound to a game player like it's coming from a specific location. Figure 5 shows
5 a typical example of a dummy head as is often used to derive a head-related transfer function.

The head and torso 501 are a three-dimensional model of a human head and torso, made with materials having acoustic absorptive and reflective properties similar to that of an actual human. The head and torso 501 are also
10 typically clothed with a shirt work on the torso, to reflect the damping effect that audio striking the clothed areas of a real person who is clothed would experience. The ears of the head and torso model similarly are designed to reflect a typical human ear, except that they contain microphones 502 that are
coupled to measurement equipment. The head and torso of Figure 5 is further
15 mounted on a turntable apparatus 503 that is operable to turn the head and torso assembly during measurement, so that a sound source at a particular elevation can be measured from a variety of angles relative to the head in a horizontal plane.

Measurements are typically conducted in an anechoic chamber to
20 minimize the effects of reflected and reverberation of sound. Characterization of a head-related transfer function in three dimensions will typically involve placing a sound source at various heights and various distances from the head and torso assembly 501, and rotating the head and torso assembly about a complete rotation while taking measurements for each sound source position. The

resulting changes in frequency response observed characterize the head-related transfer function, and can be applied to sounds reproduced through speakers to make the sounds appear to come from specific locations other than the speaker or speakers playing the sound.

- 5 The examples shown herein have illustrated how audio processing can be employed in a wagering game system to apply audio object location processing to sound so that the sound appears to come from a specific location. Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement which is
- 10 calculated to achieve the same purpose may be substituted for the specific embodiments shown. This application is intended to cover any adaptations or variations of the invention. It is intended that this invention be limited only by the claims, and the full scope of equivalents thereof.

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Claims

1. A computerized wagering game system, comprising:

a gaming module comprising a processor and gaming code which is operable when executed on the processor to present a wagering game on which monetary value can be wagered;

an audio module operable to play sound through two or more speakers, and further operable to apply audio object location processing to the sound so that it appears to come from a specific location.
2. The computerized wagering game system of claim 1, wherein the audio module is further operable to apply crosstalk cancellation to the sound.
3. The computerized wagering game system of claim 1, wherein the audio object location comprises application of a head-related transfer function (HRTF).
4. The computerized wagering game system of claim 3, wherein application of the head-related transfer function is operable to change the perceived elevation of a sound.
5. The computerized wagering game system of claim 1, wherein the two or more speakers comprise a surround sound speaker configuration.

6. The computerized wagering game system of claim 1, wherein the specific audio location the sound appears to come from moves during presentation of the sound.
7. The computerized wagering game system of claim 1, wherein the specific location from which the sound appears to come is determined by receiving video object location data from a video module, and applying the video object location to an associated audio sound via the audio object location processing.
8. The computerized wagering game system of claim 1, wherein the audio object location processing is applied based on object location data provided to the audio module and associated with a particular sound.
9. The computerized wagering game system of claim 1, wherein the audio object location processing comprises panning an object between two or more speakers of a surround sound speaker system comprising three or more independent sound channels and associated speakers.
10. The computerized wagering game of claim 1, wherein the audio object location processing further comprises encoding the audio in at least one of Dolby Digital, DTS, Qsound, CircleSurround, or Logic 7.

11. A method of operating a computerized wagering game system, comprising:
 - presenting a wagering game on which monetary value can be wagered;
 - applying audio object location processing to the sound so that it appears to come from a specific location; and
 - playing the sound through two or more speakers.
12. The method of claim 11, further comprising applying crosstalk cancellation to the sound.
13. The method of claim 11, wherein the audio object location comprises application of a head-related transfer function (HRTF).
14. The method of claim 13, wherein application of the head-related transfer function is operable to change the perceived elevation of a sound.
15. The method of claim 11, wherein the two or more speakers comprise a surround sound speaker configuration.
16. The method of claim 11, wherein the specific audio location the sound appears to come from moves during presentation of the sound.

17. The method of claim 11, wherein the specific location from which the sound appears to come is determined by receiving video object location data from a video module, and applying the video object location to an associated audio sound via the audio object location processing.

18. The method of claim 11, wherein the audio object location processing is applied based on object location data provided to the audio module and associated with a particular sound.

19. The method of claim 11, wherein the audio object location processing comprises panning an object between two or more speakers of a surround sound speaker system comprising three or more independent sound channels and associated speakers.

20. A machine-readable medium with instructions coded thereon, the instructions when executed operable to cause a computerized wagering game system operable to:

present a wagering game on which monetary value can be wagered;

apply audio object location processing to the sound so that it appears to come from a specific location; and

play the sound through two or more speakers.

21. The machine-readable medium of claim 20, the instructions when executed further operable to cause the computerized wagering game system to apply crosstalk cancellation to the sound.
22. The machine-readable medium of claim 20, wherein the audio object location comprises application of a head-related transfer function (HRTF).
23. The machine-readable medium of claim 22, wherein application of the head-related transfer function is operable to change the perceived elevation of a sound.
24. The machine-readable medium of claim 20, wherein the two or more speakers comprise a surround sound speaker configuration.
25. The machine-readable medium of claim 20, wherein the specific audio location the sound appears to come from moves during presentation of the sound.
26. The machine-readable medium of claim 20, wherein the specific location from which the sound appears to come is determined by receiving video object location data from a video module, and applying the video object location to an associated audio sound via the audio object location processing.

27. The machine-readable medium of claim 20, wherein the audio object location processing is applied based on object location data provided to the audio module and associated with a particular sound.

28. The machine-readable medium of claim 20, wherein the audio object location processing comprises panning an object between two or more speakers of a surround sound speaker system comprising three or more independent sound channels and associated speakers.

29. A computerized wagering game system, comprising:

a gaming module comprising a processor and gaming code which is operable when executed on the processor to present a wagering game on which monetary value can be wagered; and

an audio module operable to play sound through two or more speakers, the sound comprising object location information such that it appears to come from a specific location.

30. The computerized wagering game system of claim 29, wherein the object location information comprises application of crosstalk cancellation to the sound.

31. The computerized wagering game system of claim 29, wherein the object location information comprises application of a head-related transfer function (HRTF) to the sound.

32. The computerized wagering game system of claim 31, wherein application of the head-related transfer function is operable to change the perceived elevation of a sound.

33. The computerized wagering game system of claim 29, wherein the two or more speakers comprise a surround sound speaker configuration.

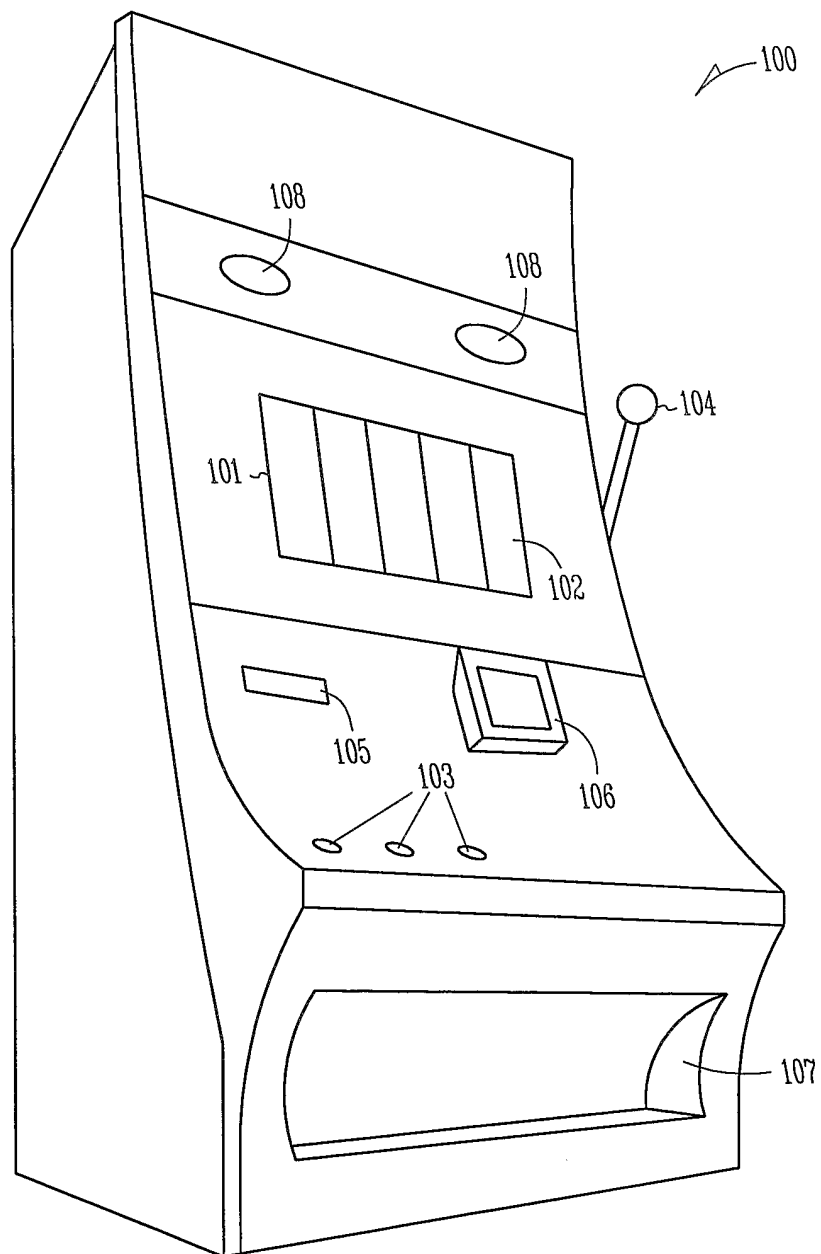
34. The computerized wagering game system of claim 29, wherein the specific location from which the sound appears to come is determined by receiving video object location data from a video module, and applying the video object location to an associated audio sound via the audio object location processing.

35. The computerized wagering game system of claim 29, wherein the audio object location information is based on object location data provided to the audio module and associated with a particular sound.

36. The computerized wagering game system of claim 29, wherein the audio object location information comprises panning an object between two or more speakers of a surround sound speaker system comprising three or more independent sound channels and associated speakers.

37. The computerized wagering game of claim 29, wherein the audio object location information comprises audio information decoded via at least one of Dolby Digital, DTS, Qsound, CircleSurround, or Logic 7.

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*FIG. 1*

2/4

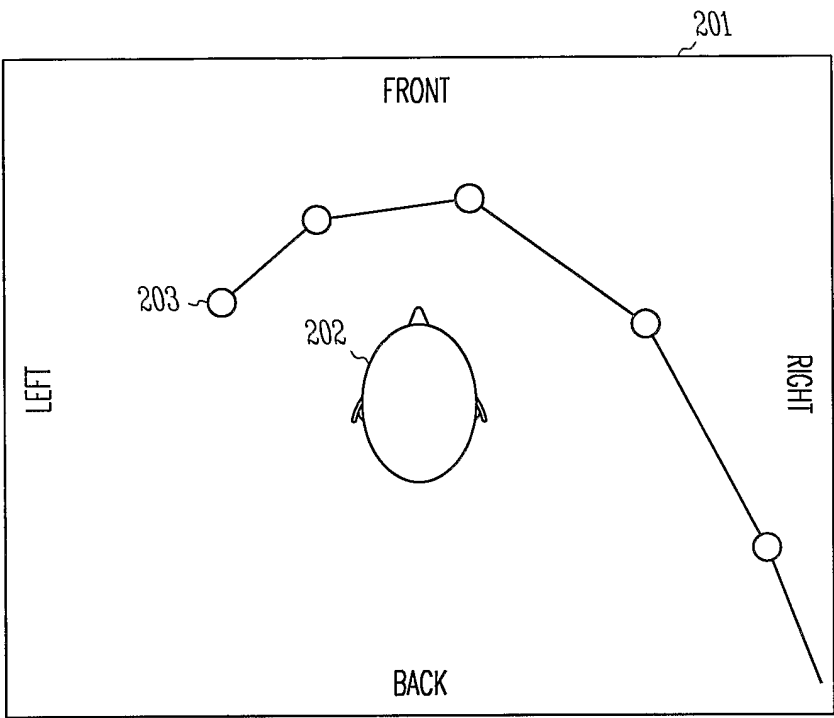


FIG. 2

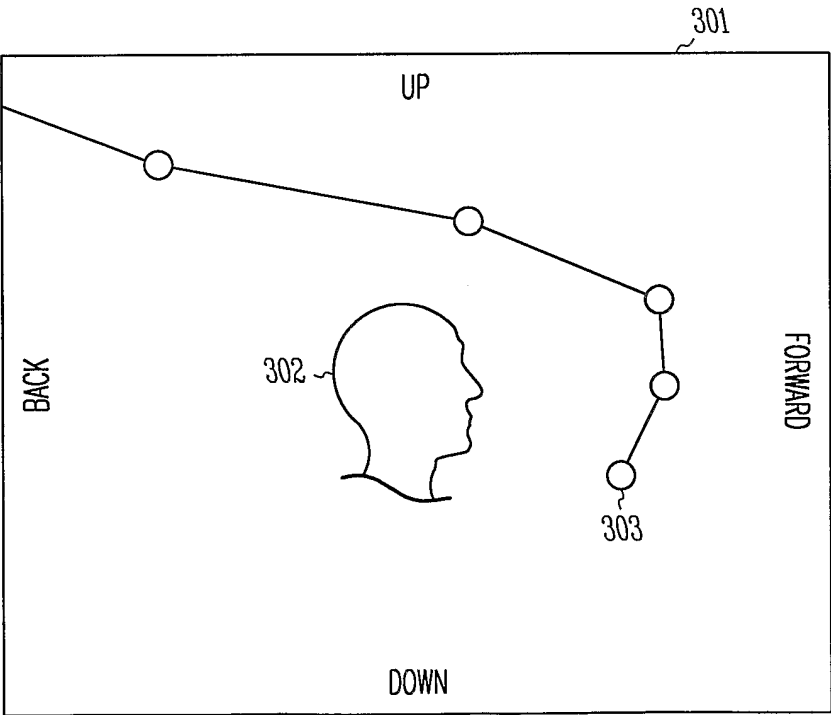


FIG. 3

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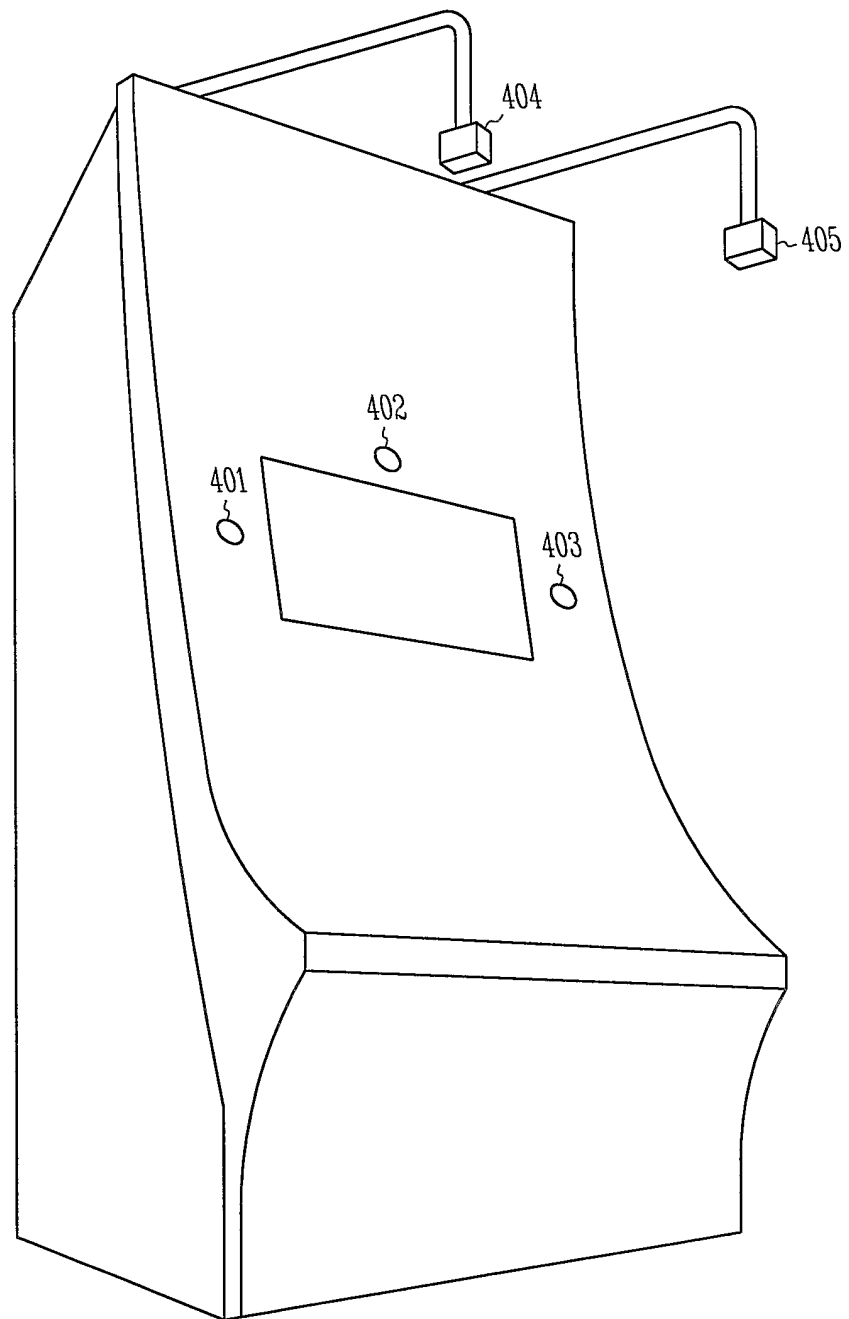
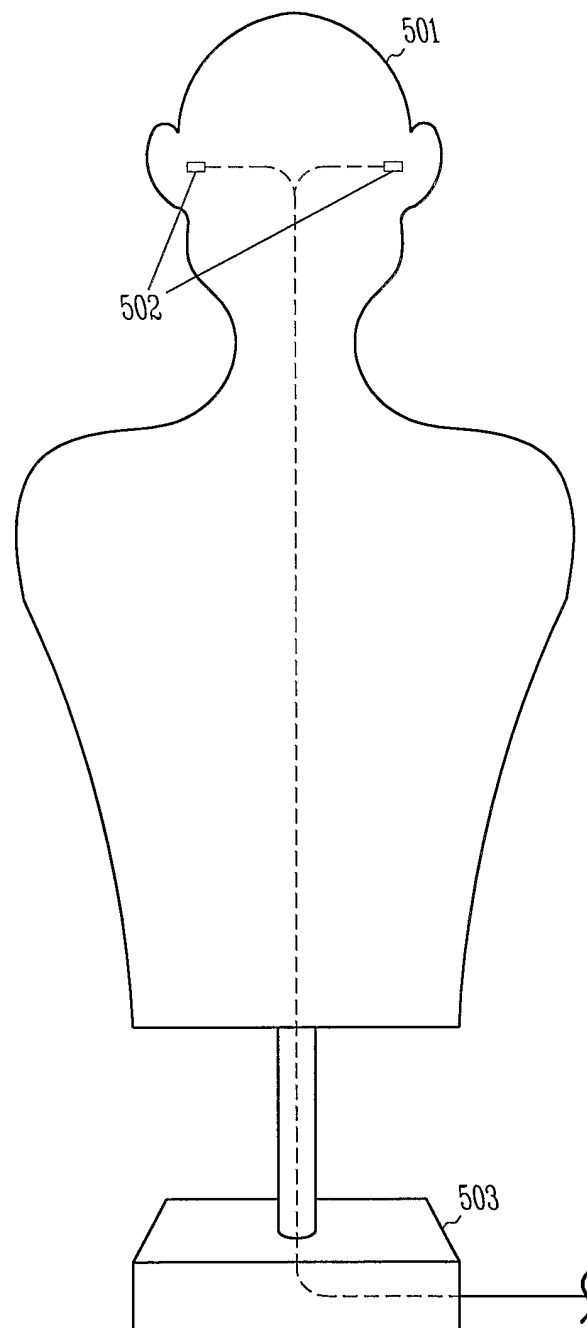


FIG. 4

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*FIG. 5*

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) : A63F 13/00

US CL : 463/34

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 463/34,20; 273/143R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0142747 A1 (PRYZBY) 22 July 2004 (22.07.2004), See entire document.	1-37

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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Facsimile No. (571) 273-3201

Authorized officer

Kim T. Nguyen

Telephone No. (703)308-1148

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/34770

Continuation of B. FIELDS SEARCHED Item 3:

EAST

search terms: wagering gaming system, audio module, surround sound speaker configuration.