APPARATUS AND METHOD FOR VERIFYING AUDIO OUTPUT AT A CLIENT DEVICE

BACKGROUND OF THE INVENTION

Technical Field:

The present invention is directed to an apparatus and method for verifying audio output at a client device. More specifically, the present invention is directed to a mechanism for verifying that audio output at a client device matches audio data sent to the client device and that the audio output at the client device is at a volume level desired by the sender of the audio data.

Description of Related Art:

Advertising via the Internet has fast become a principle mechanism by which manufacturers and providers of goods and services are able to make the public aware of their offerings. Such advertising may take the form of pop-up ads, banner ads, and the like, which are associated with a web page that is accessed by a user of a client device having a web browser application. More often, these web based advertisements have associated sound that may convey additional advertisement information to the user of the web browser application, i.e. the potential customer.

The problem with advertisements having an audio component to them is that there is no guarantee that the user of the web browser on the client device has the audio output volume, i.e. speaker volume, turned to a sufficient level that the user is able to hear the audio component to the advertisement. This problem exists because the user of the client device has control over the speaker volume and thus, may intentionally or unintentionally have the speaker volume turned low or off so that the audio component of the advertisement is not heard by the user. As a result, the advertisement is not as effective as it would have been had the speaker volume been turned to a sufficient level to allow the user to experience the entire advertisement.

This may especially be a problem when a user is provided with access to resources in exchange for agreeing to view/listen to advertising. For example, a user may choose to not pay a monthly services fee for Internet access from an Internet Service Provider and as a result, agree to viewing/listening to advertising while browsing the World Wide Web. In such cases, the user may be able to circumvent his/her duty to listen to

the advertisement by turning the speaker volume down or off and yet still be provided with access to the resources.

Thus, it would be beneficial to have an apparatus and method for verifying the audio output at a client device.

SUMMARY OF THE INVENTION

The present invention provides an apparatus and method for verifying the audio output at a client device. With the apparatus and method of the present invention, when a user requests access to resources, such as during a log-on process, a profile for the user is retrieved. The profile is then used to determine whether the user is to be presented with audio advertisements. If so, a test audio advertisement is sent to the client device.

An agent application present on the client device receives the test audio advertisement and outputs the audio advertisement to the user via an audio adapter and speaker. During the output of the audio advertisement, the client device agent application records the audio that is being output by the speaker using a microphone or other recording device. The recording of the audio output is then sent back to the server that sent the original test audio advertisement for comparison.

The server then compares the recording of the audio output to the original test audio advertisement. This may be done, for example, using pattern matching or the like. If the recording matches the original test audio advertisement, then it is determined that the user of the client device has the speakers turned on and the volume of the audio output is sufficient to hear the audio advertisement. In addition, characteristics of the audio output may be extracted from the recording data to determine how to adjust the parameters of future audio advertisements sent to the client device. For example, a volume level may be identified in the recording of the audio output and compared to a desired volume level for an audio advertisement. If the volume level is too low, the volume parameters sent with the original audio advertisement may be adjusted to compensate and thereby increase the volume of the audio output at the client device.

If there is a match between the recording of the audio output and the original test audio advertisement, then access to the resources is granted. While the user accesses the resources, additional audio

advertisements may be sent to the client device and output via the speakers of the client device. As mentioned above, these additional audio advertisements may have their output parameters adjusted based on the comparison of characteristics of the recorded audio output to desired output characteristics for the particular audio advertisement.

If there is not a match between the recording of the audio output and the original test audio advertisement, then access to the resources is denied. In addition, a message may be sent to the client device informing the user of the denial of access as well as a request that the user turn up the volume of their speakers in order to obtain access.

The above process may be performed each time the user requests access to resources wherein the access is tied to the user listening to audio advertisements. Such instances may include logging on to an Internet Service Provider, accessing a particular web page, logging on to a web based service, requesting access to a particular data file, downloading of a data file, or the like. In addition, the above test may be performed periodically during the user's accessing of resources in order to verify that the user has not turned down his/her speakers to avoid listening to the audio advertisements.

These and other features and advantages will be described in, or will become apparent to those of ordinary skill in the art in view of, the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an exemplary diagram of a distributed data processing system in which the present invention may be implemented;

Figure 2 is an exemplary block diagram of a server computing device according to the present invention;

Figure 3 is an exemplary block diagram of a client computing device according to the present invention;

Figure 4 is an exemplary block diagram illustrating the primary operational components of the present invention;

Figure 5 is an exemplary diagram illustrating the manner by which the present invention operates with a client device; and

Figure 6 is a flowchart outlining an exemplary operation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As mentioned above, the present invention provides an apparatus and method for verifying audio output at a client device. The present invention is preferably implemented in a distributed data processing system, such as a local area network, wide area network, the Internet, or the like. Therefore, the following figures will provide a brief overview of a distributed data processing environment, a server computing device, and a client computing device, in order to provide a context in which the present invention will be described.

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented. Network data processing system **100** is a network of computers in which the present invention may be implemented. Network data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables.

In the depicted example, server **104** is connected to network **102** along with storage unit **106**. In addition, clients **108**, **110**, and **112** are connected to network **102**. These clients **108**, **110**, and **112** may be, for example, personal computers or network computers. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **108-112**. Clients **108**, **110**, and **112** are clients to server **104**. Network data processing system **100** may include additional servers, clients, and other devices not shown. In the depicted example, network data processing system **100** is the Internet with network **102**

representing a worldwide collection of networks and gateways that use the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI local bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to clients **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI local buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in

place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM eServer pSeries system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system or LINUX operating system.

With reference now to **Figure 3**, a block diagram illustrating a data processing system is depicted in which the present invention may be implemented. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface (SCSI) host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The operating system may be a commercially available operating system, such as Windows XP, which is available from Microsoft Corporation. An object oriented programming system such as Java may run in conjunction with the operating system and provide calls to the operating system from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk

drive **326**, and may be loaded into main memory **304** for execution by processor **302.**

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash read-only memory (ROM), equivalent nonvolatile memory, or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interfaces As a further example, data processing system **300** may be a personal digital assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations. For example, data processing system **300** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **300** also may be a kiosk or a Web appliance.

As illustrated in **Figure 3**, the data processing system **300** further includes a speaker **380** and an audio recording device **390**. These components of the data processing system **300** are utilized with the present invention to verify that the data processing system **300** is outputting audio via the speaker **380** at a volume level that is sufficient for the user to hear audio data being sent to the data processing system **300** from the server, e.g. server **104**. Such verification may be used to control access to resources of the server **104**, for example.

With reference again to **Figure 1**, with the present invention, a user of a client device **108**, for example, may request access to resources on server **104**. The server **104** may then retrieve a user profile for the user or the client device **108** requesting the access to the resources. This user profile may be stored on the server **104**, in a separate database, such as database **106**, or the like.

The server **104** determines from parameters included in the user profile, whether the user is to be provided with audio advertising as a requirement for obtaining access to the resources requested. For example, if the user has elected to pay a subscription fee for access to the resources, the user may be provided with access without having to listen to audio advertising. However, if the user has elected to not pay a subscription fee, the user may be provided with access only if the user agrees to listen to audio advertising. The user profile includes information identifying whether the user is a paying subscriber or a non-paying subscriber in such a case.

Based on the user profile information, the server **104** determines whether audio advertisements are to be provided to the user of the client device **108**. If audio advertisements are to be provided, the server **104** may perform one or more tests to first determine the presence of an audio adapter in the client device **108**. For example, a transport protocol check of the client device **108** configuration information may be performed to determine if a sound card driver is installed and operational in the client device **108**. This indicates that the client device **108** has a sound card that is used to output audio via one or more speakers. Such sound cards will also typically include a recorder input for coupling to a microphone or other audio signal pickup device. If the client device **108** does not have an audio adapter and audio advertisements are to be provided to the client device **108**, then the requested access may be denied with a message being sent to the client device **108** for display to the user that indicates the reason for denying access to the resources.

If the client device **108** includes an audio adapter, the server **104** then initiates a test of the audio output of the client device **108**. This test may include, for example, sending audio data to an agent application resident on the client device **108**. This agent application may receive the audio data and output the audio data as sound via the audio adapter and speakers associated with the client device **108**. In addition, the agent application may initiate recording of the sound that is output from the speakers using a recording device, such as a microphone, and a recording application or functionality within the client device agent associated with the client device **108**. For example, the WinADR™ application may be used to record the audio output by the speakers in an MP3 format.

The recording of the audio output from the speakers is stored in a data file which is then uploaded to the server **104**. The server **104** receives the data file and compares the recorded data to the test audio

data to determine if the sound output by the speakers was the same sound that is generated by the test audio data. This comparison, in a preferred embodiment, is performed by using pattern matching to determine if the patterns between the two data files match. Other mechanisms may be used for comparing the data files to determine if they match without departing from the spirit and scope of the present invention.

If the two data files match, then it is determined that the client device **108** is outputting the audio data that was sent to it from the server **104**. Thus, access to the resources may be granted to the user of the client device **108**. In addition, the server **104** may analyze the characteristics of the recorded data to determine if the output of the audio data has the characteristics desired by the supplier of the audio data. That is, the characteristics of the recorded data may be analyzed and future audio data parameters adjusted based on the analyzed characteristics of the recorded data. For example, the recorded data may be analyzed to determine the volume at which the audio data is output, the amount of bass in the audio output, the amount of tone in the audio output, and the like.

Based on the results of this analysis, the output parameters of future audio data sent to the client device **108** may be adjusted so that a desired output is achieved. For example, the volume may be increased or decreased, the amount of tone may be increased or decrease, the amount of bass may be increased or decreased, and the like.

If it is determined that the client device **108** is outputting the audio data sent to it by the server **104**, access to the system resources is granted. Thereafter, audio advertising may be output to the client device **108** while the user is accessing the system resources. This audio advertising will be sent to the client device **108** as data files along with output parameter data for adjusting the output of the audio via the audio adapter of the client device **108**. The agent application receives this audio advertisement data and the output parameters, adjusts the output of the audio adapter, via software settings, based on the output parameters and outputs the audio advertisement via the audio adapter and the speakers of the client device **108**.

During the access to system resources by the user of the client device **108**, the above process for testing that audio being sent to the client device **108** is actually being output by the speakers of the client device **108** may be periodically performed. In this way, it can be

determined whether the user has turned off his/her speakers or otherwise turned the volume of the speakers to a low level at which the audio advertising is not heard by the user. Thus, by periodically testing the audio output at the client device **108**, the present invention may ensure that users cannot circumvent their duty to listen to audio advertising in exchange for free access to system resources.

If during the comparison of the recorded data with the original test audio data it is determined that there is not a match, access to the system resources is denied. In addition, a message may be sent to the client device **108** indicating that the access has been denied and the reason why access has been denied. This message may prompt the user to turn on their speakers or turn up the volume of their speakers and attempt the access again.

Thus, with the present invention, a verification is made that the client device is presently outputting audio via the client device speakers in order to ensure that the user is listening to audio data sent to the client device. While the present invention is described in terms of sending audio advertisements, the present invention is not limited to such. Rather, any application of the present invention may be made in which it is desirable to verify that the client device currently is outputting audio data sent to it. For example, the present invention may be utilized in a testing application where it is desirable to verify that test instructions in an audio format are being output by the client device. Other applications of the present invention will be apparent to those of ordinary skill in the art in view of the present description.

In addition, while the present invention is described with regard to the server **104** performing the comparison of test audio data to recorded data, the present invention is not limited to such. Rather, the present invention may be implemented such that the comparison is performed within the agent application on the client device. Moreover, the present invention may be implemented such that all functions are performed within the client device and a server is not necessary. In such a case, the verification is to ensure that audio data generated by an application on the client device that should be output via the speakers of the client device is in actuality being output by the speakers.

Figure 4 is an exemplary block diagram of an audio output verification mechanism according to the present invention. The elements shown in **Figure 4** may be implemented in hardware, software, or any

combination of hardware and software. In a preferred embodiment, the elements in **Figure 4** are implemented as software instructions executed by one or more processing devices in a computing system.

As shown in **Figure 4**, the audio output verification mechanism includes a controller **410**, a network interface **420**, an audio advertisement engine **430**, a client audio verification device **450**, an audio advertisement database interface **440**, and a user profile engine **460**. The elements **410-460** are in communication with one another via the control/data signal bus **470**. While a bus architecture is shown in **Figure 4**, the present invention is not limited to such and any architecture that facilitates the communication of control/data signals between the elements **410-460** may be used without departing from the spirit and scope of the present invention.

The controller **410** controls the overall operation of the audio output verification mechanism and orchestrates the operation of the other elements **420-460**. The network interface **420** provides a communication interface for communicating with client devices. The audio advertisement engine **430** generates advertisement data for sending to the client devices via the interface **420** based on audio advertisements retrieved from an audio advertisement database via the audio advertisement database interface **440**. The client audio verification device **450** verifies that audio data sent to the client device is actually being output via speakers associated with the client device. The user profile engine **460** retrieves user profiles to determine if audio advertisements are to be sent to the users' client devices.

The operation of these elements will now be described with reference to the message flow diagram of **Figure 5**. As shown in **Figure 5**, when the controller **410** receives a request for access to system resources via the network interface **420**, the controller **410** instructs the user profile engine **460** to retrieve the user profile for the user requesting access and determine if audio advertisements are to be sent to the user's client device. The user profile engine **460** retrieves the user's profile and determines if audio advertisements are to be sent to the user's client device and returns the result to the controller **410**. It is assumed in the depicted message flow that it is determined that audio advertisements are to be sent to the client device via the client device agent **510**.

The controller **410** then sends a command to the audio advertisement engine **430** to send test audio data to the client device. The audio

advertisement engine **430** sends a request for a test audio advertisement to the audio advertisement database interface **440** which retrieves a test audio advertisement and forwards it to the audio advertisement engine **430**. The audio advertisement engine **430** then transmits the test audio advertisement data to the client device agent **510** which outputs the audio advertisement and records the sound output by the speakers of the client device.

The recorded audio output data is then transmitted by the client device agent **510** to the client audio verification device **450**. The client audio verification device **450** compares the recorded data with the original test audio advertisement data to determine if there is a match. The client audio verification device **450** then transmits the results of verification to the controller **410**. Based on the results from the client audio verification device **450**, the controller **410** either permits or denies access to the resources.

In addition, the client audio verification device may analyze the characteristics of the recorded data and send the results of the analysis to the controller **410**. The controller **410** may make use of this analysis when outputting future audio advertisement data for to the client device agent **510**. In this way, the controller **410** may adjust output parameters of the audio advertisement data so that the audio advertisement is output in a preferred manner on the client device.

Figure 6 is a flowchart outlining an exemplary operation of the present invention. As shown in **Figure 6**, the operation starts with receiving an access request (step **610**). A user profile is then retrieved (step **615**) and a determination is made as to whether audio advertisements are to be sent to the client device (step **620**). If not, access is permitted without the sending of audio advertisements (step **665**) and the operation terminates. If audio advertisements are to be sent to the client device, a test audio message is sent to the client device (step **625**). A client device agent then outputs the test audio message and records the sound emitted by the speakers of the client device.

The recorded data from the client device is then received (step **630**) and is compared to the original test audio data (step **635**). A determination is made as to whether there is a match (step **640**). If not, access is denied (step **670**). Otherwise, a determination is made as to whether the output parameters for future audio advertisements should be

modified (step **645**). If so, the output parameters are modified according to an analysis of the recorded data (step **675**).

Thereafter, or if no modifications to output parameters is necessary, access to the system resources is permitted and audio advertisements are sent (step **650**). Thereafter, a determination is made as to whether it is time to monitor the audio output again (step **655**), i.e. has a predetermined period of time elapsed for periodic checking of the sound output at the client device. If so, the operation returns to step **625**. Otherwise a determination is made as to whether a termination condition has occurred (step **660**). Such a termination condition may include, for example, logging off of the server, the web browser application accessing a different web page, or the like. If no termination condition has occurred, the operation returns to step **650**. Otherwise, if a termination condition has occurred, the operation is terminated.

Thus, the present invention provides a mechanism for monitoring the sound output at a client device to ensure that the user of the client device is listening to audio data sent to the client device. In this way, a supplier of a service or resources may be assured that a user that has not paid for access to such services or resources is listening to audio advertisements in exchange for non-paid access to such services and resources.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be

exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS

1. A method of verifying audio output at a client device, comprising:

receiving a request for access to a system resource;

sending audio data to the client device;

receiving recorded data from the client device, wherein the recorded data is data recorded from sound output at the client device;

comparing the recorded data to the audio data;

determining if the recorded data matches the audio data; and

permitting access to the system resource if the recorded data matches the audio data.

2. The method of claim 1, wherein the audio data is an audio advertisement.

3. The method of claim 1, wherein comparing the recorded data to the audio data includes performing pattern matching on the recorded data and the audio data.

4. The method of claim 1, further comprising:

determining if the client device has an audio adapter prior to sending audio data to the client device.

5. The method of claim 4, wherein determining if the client device has an audio adapter includes performing a transport protocol based check of a configuration of the client device.

6. The method of claim 1, further comprising:

analyzing a value of at least one characteristic of the recorded data;

comparing the value of the at least one characteristic of the recorded data to a desired value of the at least one characteristic for the audio data; and

generating at least one adjustment parameter for adjusting the value of the at least one characteristic to achieve the desired value of the at least one characteristic.

7. The method of claim 6, further comprising:

adjusting at least one parameter of the audio data based on the at least one adjustment parameter.

8. The method of claim 7, wherein the at least one characteristic is at least one of volume, tone, and bass.

9. The method of claim 1, further comprising:

denying access to the system resource if the recorded data does not match the audio data; and

transmitting a message indicating a reason for denial of access to the system resource.

10. The method of claim 1, further comprising:

outputting one or more audio advertisements following permitting the access to the system resource.

11. A computer program product in a computer readable medium for verifying audio output at a client device, comprising:

first instructions for receiving a request for access to a system resource;

second instructions for sending audio data to the client device;

third instructions for receiving recorded data from the client device, wherein the recorded data is data recorded from sound output at the client device;

fourth instructions for comparing the recorded data to the audio data;

fifth instructions for determining if the recorded data matches the audio data; and

sixth instructions for permitting access to the system resource if the recorded data matches the audio data.

12. An apparatus for verifying audio output at a client device, comprising:

means for receiving a request for access to a system resource;

means for sending audio data to the client device;

means for receiving recorded data from the client device, wherein the recorded data is data recorded from sound output at the client device;

means for comparing the recorded data to the audio data;

means for determining if the recorded data matches the audio data; and

means for permitting access to the system resource if the recorded data matches the audio data.