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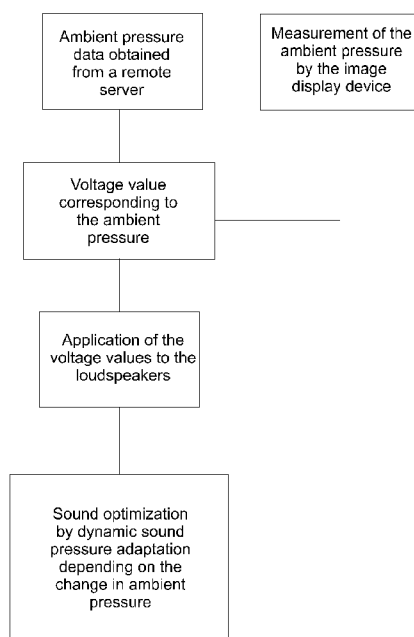
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(54) Title: IMAGE DISPLAY DEVICE WITH ADAPTIVE SOUND PRESSURE LEVEL ADJUSTMENT FUNCTION

Fig. 1



(57) Abstract: The present invention relates to an image display device capable of adapting the sound pressure level based on the ambient pressure variance according to the specific environment of said image display device. More particularly, the present invention relates to an image display device comprising at least one loudspeaker and an adaptive sound pressure level adjustment system automatically effectuating sound optimization through sound pressure level adjustment by way of analyzing pressure deviances in the surrounding of said image display device.



Description**IMAGE DISPLAY DEVICE WITH ADAPTIVE SOUND PRESSURE LEVEL
ADJUSTMENT FUNCTION**

- [0001] The present invention relates to an image display device capable of adapting the sound pressure level based on the ambient pressure variance according to the specific environment of said image display device.
- [0002] In general, sound pressure level is associated with pressure variations caused by the sound waves in the air. The lowest sound pressure heard by humans is referred to as hearing threshold. In air, sound pressure can be measured by a microphone.
- [0003] Image display devices may be preconfigured to apply certain predefined sound enhancement blocks being presented to the user in order for increasing the sound quality by way of enabling the user to select a sound preset. This approach does not yield completely satisfactory results for the unique reason that each of these predefined enhancement blocks basically aim to increase the sound quality for only one type of audio content.
- [0004] It is to be noted that a variety of parameters play an important role in the audio performance of home based theatre systems such as location of the audio players, volume level, balance of the speakers and bass equalization.
- [0005] The audio systems typically allow the user to manually set up the above-mentioned parameters through a controller on a control unit of the audio system. However, such fine-tunings and adjustment of the parameters can be complex and difficult especially for the so-called technically non-competent people as well as older persons. A typical situation which affects the sound output quality is the case where an ambient sound generated from outside makes it harder to hear the sound of the TV set. In this case, the subsequent reaction of the user could be to increase the volume to compensate the generated noise. Therefore, noticeably improper sound quality may occur and manual adjustment of the settings may be needed for the optimal sound performance, which can

cause dissatisfaction for the user.

- [0006] An adaptive sound pressure level (SPL) system enables the user to hear the output sound better even when an external noise interferes with the broadcast program's sound. The adaptive sound pressure level system automatically adjusts the sound pressure level depending on the ambient pressure and background noise.
- [0007] A prior art publication in the technical field of the present invention may be referred to as US2014328506, which discloses methods and systems for automatic configuration of wireless speakers. A system is described whereby a wireless speaker is configured to use an audio tone to generate a sound wave. The sound wave is received by an audio input/output device, which uses the received sound wave to generate audio information. A processor is configured to use the audio information to determine a distance between the wireless speaker and the audio input/output device, and to configure an audio parameter of the wireless speaker as a function of the distance.
- [0008] The present invention provides an adaptive sound pressure level (SPL) system automatically adjusting sound performance parameters of the image display device based on ambient pressure deviations as defined by the characterizing features in Claim 1.
- [0009] Primary object of the present invention is to provide an adaptive sound pressure level system for automatic optimization of the sound pressure level to output an improved audio quality at different environmental conditions with different background pressure levels in the ambient pressure.
- [0010] The present invention proposes an image display device automatically effectuating sound optimization through sound pressure level adjustment by way of analyzing pressure deviances in the vicinity of said image display device.
- [0011] The image display device comprises an electronic control unit in communication with a pressure meter so that the sound pressure level of the loudspeakers are adjusted depending on the ambient pressure levels as measured by said pressure meter on a continuous or periodical basis.

- [0012] The pressure meter is a digital barometric pressure sensor whose readings are compared to reference values in a preloaded database in order for obtaining the corresponding voltage values to be applied to the loudspeakers.
- [0013] Alternatively, the image display device can retrieve the information as to the ambient pressure by connecting to a remote server through a wide-area network (WAN) connection on a periodical basis so as to obtain the most recent ambient pressure value information based on the altitude and weather conditions of the specific location. Information as to the altitude and specific location of the image display device can be inputted by the user to be recorded by the image display device.
- [0014] Accompanying drawings are given solely for the purpose of exemplifying an adaptive sound pressure level adjustment system for image display devices whose advantages over prior art were outlined above and will be explained in brief hereinafter.
- [0015] The drawings are not meant to delimit the scope of protection as identified in the claims nor should they be referred to alone in an effort to interpret the scope identified in said claims without recourse to the technical disclosure in the description of the present invention.
- [0016] Fig. 1 demonstrates a general flow diagram of an adaptive sound pressure level adjustment method as executed by the image display device according to the present invention.
- [0017] Fig. 2 demonstrates a general flow diagram of an adaptive sound pressure level measurement and calibration method according to the present invention.
- [0018] The present invention relates to an image display device such as for instance an LCD or LED TV, having an adaptive sound pressure level system (SPL) automatically effectuating sound performance optimization through sound pressure level adjustment by analyzing ambient pressure deviances in the specific environment in association with said image display device. Typically, at least one built-in loudspeaker being in electrical communication with said image display device outputs sound waves in association with the broadcast program received by the image

display device.

- [0019] The image display device of the invention comprises an adaptive SPL system with a pressure meter, for instance in the form of a digital barometric pressure sensor being available in the market under many trade names and finding widespread use in electronic household appliances. A digital barometric pressure sensor continuously or periodically effectuates measurement of the ambient pressure and accordingly monitors changes during regular operation of the image display device as will be delineated hereinafter.
- [0020] The image display device typically comprises an electronic control unit to adjust and control the sound pressure level of the loudspeakers. The pressure meter provides real-time data so as to be processed by the electronic control unit to drive said loudspeakers.
- [0021] An internal memory unit of the image display device stores operational data and includes a database of pressure levels. Said database comprises corresponding voltage values for individual pressure levels. The pressure value generally varies depending on the specific location and altitude of the image display device as well as the background noises in the environment. The pressure value measured by the pressure meter is compared to the reference values in the database in order for obtaining the corresponding voltage values to be applied on the loudspeakers for an optimized audio quality during operation of the image display device.
- [0022] In the case the ambient pressure level fluctuates during the day due to different atmospheric conditions, i.e. due to the ambient temperature or in certain cases humidity, different voltage values can be applied to the loudspeaker according to the preloaded database. The preloaded database contains various ambient pressure values associated with different voltage values to be used to drive the loudspeakers. Therefore, the preloaded internal database of the image display serves to the purpose of associating measured sound pressure levels by the image display device with different reference voltage values previously obtained during a measurement and calibration step by the manufacturer. The obtained voltage values as retrieved from the preloaded internal database

provide optimization of the loudspeakers' sound quality.

- [0023] The reference values in the preloaded database are typically measured in an acoustically isolated environment at 25°C and sound pressure levels outputted by the loudspeakers as optimized according to human ear sensitivity are associated with reference electrical values. The ideal frequency response of the loudspeakers is therefore maintained. In the subsequent steps, voltage values under different ambient pressure levels are determined so as to maintain the same sound pressure levels optimized according to human ear sensitivity. Accordingly, a lookup table or database of ambient sound pressure levels and associated voltage values is obtained.
- [0024] The preloaded internal database and associated data is stored in the memory unit of the image display device. The electronic control unit accordingly performs measurement of the ambient sound pressure by means of said pressure meter and retrieves from the database the necessary voltage value in order for driving the loudspeakers. The pressure measured by the pressure meter during the regular operation of the image display device is compared with the values in the database and the voltage corresponding to the specific pressure level being measured is applied to the loudspeaker in order to optimize the sound pressure level by way of decreasing or increasing the applied voltage.
- [0025] It is to be noted that the ambient pressure may fluctuate depending on the atmospheric conditions such that a first measurement and a second subsequent measurement by the pressure meter may present different results so as to influence the viewing experience of the user unless voltage calibration is performed. In order for obtaining a continuously comfortable sound level in terms of the quality of the viewing experience and without requiring any user intervention, the image display device therefore uses the internal database to dynamically recalibrate the driving voltage of the loudspeakers.
- [0026] Therefore, change of the TV set sound level by the user due to pressure variations in the surrounding of the image display device is avoided by dynamically adapting the applied voltage to the ambient pressure level. To

this end, the image display device takes measurements, preferably each time it is turned on and on a continuous or periodical basis. Dynamically varied voltage values to obtain different loudspeaker sound pressure levels provide an automatically improved sound quality for the image display device during its operation.

- [0027] The information as to the ambient pressure may be alternatively or additionally obtained by the image display device through connecting to a remote server via Internet and retrieving the required information based on the altitude and weather conditions of the specific location. The obtained data may directly contain specific voltage values or may alternatively contain a look-up table of location-based pressure level values so that the image display device can itself determine the respective voltage values through the internal database. Information as to the altitude and specific location of the image display device can be inputted by the user to be recorded by the image display device.
- [0028] The present invention further provides adaptation of the sound volume (intensity) by adjusting audio output of said image display device conventionally by strengthening or weakening the energy of specific frequency bands. Additionally, it is possible to support the adaptation of the sound level by changing equalizer presets, typically altering the frequency response of the audio system, in which case the image display device's audio system adjusts the gain at a certain frequency band.
- [0029] In summary, the present invention proposes an image display device comprising at least one loudspeaker and an adaptive sound pressure level adjustment system automatically effectuating sound optimization through sound pressure level adjustment by way of analyzing pressure deviances in the surrounding of said image display device
- [0030] In one embodiment of the invention, said adaptive sound pressure level adjustment system comprises an electronic control unit to adjust and control the sound pressure level of said at least one loudspeaker in accordance with ambient pressure level measured by a pressure meter of the image display device.
- [0031] In a further embodiment of the invention, the pressure meter provides

real-time data so as to be processed by the electronic control unit to drive said at least one loudspeaker.

- [0032] In a further embodiment of the invention, an internal memory unit of the image display device stores operational data in the form of a database of pressure levels associated with corresponding voltage values.
- [0033] In a further embodiment of the invention, the pressure meter is a digital barometric pressure sensor.
- [0034] In a further embodiment of the invention, the digital barometric pressure sensor continuously or periodically effectuates measurement of the ambient pressure.
- [0035] In a further embodiment of the invention, the pressure value measured by the digital barometric pressure sensor is compared to the reference values in the database in order for obtaining the corresponding voltage values to be applied to the at least one loudspeaker.
- [0036] In a further embodiment of the invention, the electronic control unit of the image display device provides that the digital barometric pressure sensor takes pressure measurements each time the image display device is turned on.
- [0037] In a further embodiment of the invention, the information as to the ambient pressure is obtained by the image display device through connecting to a remote server via a network connection/computer network.
- [0038] In a further embodiment of the invention, the image display device retrieves the ambient pressure value information based on the altitude and weather conditions of the specific location.
- [0039] In a further embodiment of the invention, the image display device updates the location-based ambient pressure value information on a periodical basis.
- [0040] The automatic adjustment of the sound pressure level by way of increasing and decreasing the applied voltage through the adaptive SPL system ensures a more pleasant viewing experience on the part of users due to the improved sound quality. The adaptive SPL system eliminates the adverse effects of pressure fluctuations on the sound quality and ensures that the sound level set by the user remains constant, thereby

preventing the user from turning the volume up or down during television viewing.

Claims

1. An image display device comprising at least one loudspeaker and an adaptive sound pressure level adjustment system automatically effectuating sound optimization through sound pressure level adjustment by way of analyzing pressure deviances in the surrounding of said image display device,
characterized in that
said adaptive sound pressure level adjustment system comprises an electronic control unit to adjust and control the sound pressure level of at least one loudspeaker in accordance with ambient pressure level measured by a pressure meter of the image display device.
2. An image display device as in Claim 1, **characterized in that** the pressure meter provides real-time data so as to be processed by the electronic control unit to drive at least one loudspeaker.
3. An image display device as in Claim 2, **characterized in that** an internal memory unit of the image display device stores operational data in the form of a database of pressure levels associated with corresponding voltage values.
4. An image display device as in Claim 1, 2 or 3, **characterized in that** the pressure meter is a digital barometric pressure sensor.
5. An image display device as in Claim 4, **characterized in that** the digital barometric pressure sensor continuously or periodically effectuates measurement of the ambient pressure.
6. An image display device as in Claim 3 or 5, **characterized in that** the pressure value measured by the digital barometric pressure sensor is compared to the reference values in the database in order for obtaining the corresponding voltage values to be applied to the at least one loudspeaker.
7. An image display device as in Claim 5, **characterized in that** the electronic control unit of the image display device provides that the digital barometric pressure sensor takes pressure measurements each time the image display device is turned on.
8. An image display device as in Claim 1, **characterized in that** the information as to the ambient pressure is obtained by the image display device through connecting to a remote server via a network connection.
9. An image display device as in Claim 8, **characterized in that** the image display

device retrieves the ambient pressure value information based on the altitude and weather conditions of the specific location.

10. An image display device as in Claim 9, **characterized in that** the image display device updates the location-based ambient pressure value information on a periodical basis.

Fig. 1

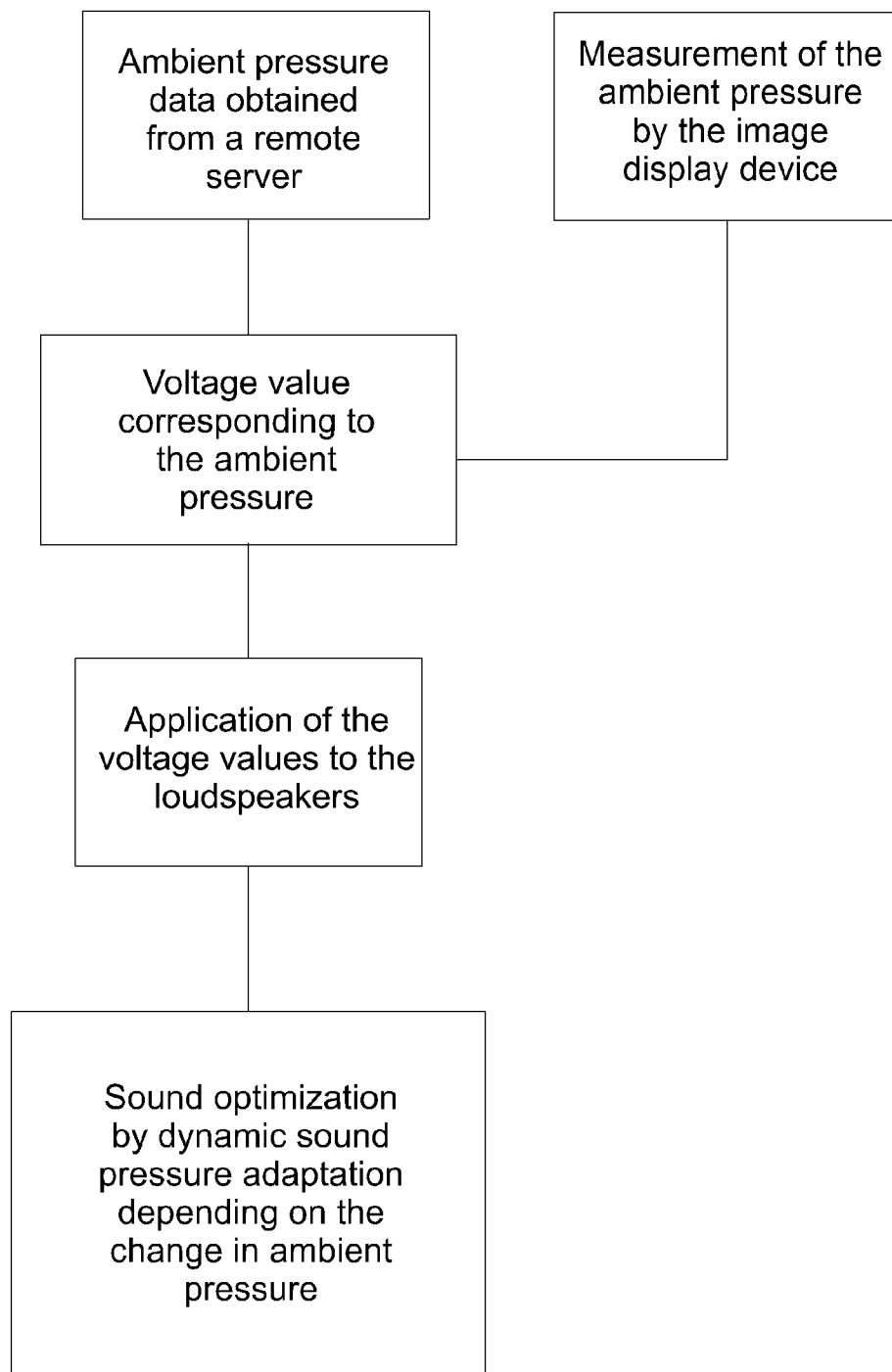
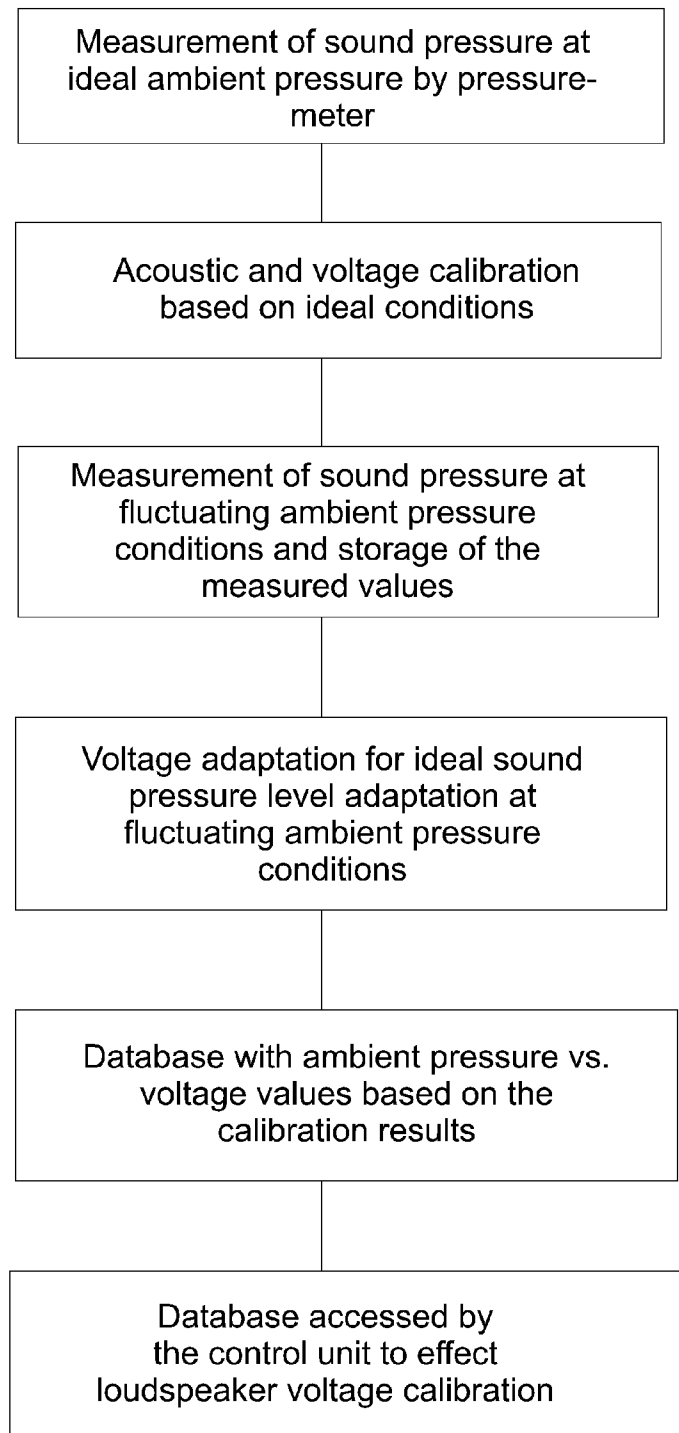


Fig. 2



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

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H04R

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8 588 432 B1 (SIMON JEFFREY FRANKLIN [US]) 19 November 2013 (2013-11-19) column 7, line 17 - column 10, line 16; claims 1-28; figures 2-7 column 17, line 20 - column 34, line 9 -----	1-10
A	US 2013/195299 A1 (ISEBERG STEVE [US] ET AL) 1 August 2013 (2013-08-01) paragraphs [0011], [0035] - paragraph [0065]; claims 1-13; figures 1-9 -----	1-10
A	US 2004/240698 A1 (EATON WILLIAM CHRIS [US]) 2 December 2004 (2004-12-02) the whole document -----	1-10



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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2013195299	A1	01-08-2013	NONE

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		EP 1629686 A1 01-03-2006	
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