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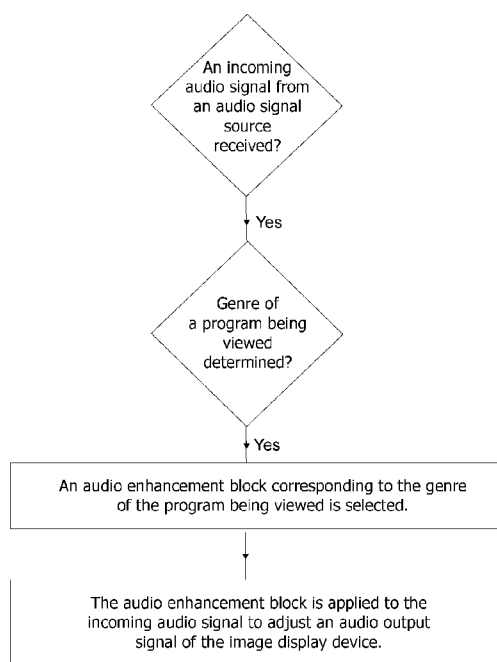
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(54) **Title:** IMAGE DISPLAY DEVICE WITH AUTOMATIC SOUND ENHANCEMENT FUNCTION

Fig. 1



(57) **Abstract:** The present invention relates to an image display device having an automatic sound enhancement function depending on the specific source as well as analyzing an incoming audio signal irrespective of the specific setting predefined for the specific source. The present invention more specifically proposes a method for operating an image display device, said image display device receiving a plurality of broadcasting services and a plurality of audio signal sources being accessible by the image display device, said method for operating the image display device comprising the steps of, receiving an incoming audio signal from an audio signal source, determining genre of a program being viewed and selecting an audio enhancement block corresponding to the genre of the program being viewed.

Description**IMAGE DISPLAY DEVICE WITH AUTOMATIC SOUND ENHANCEMENT
FUNCTION**

- [0001] The present invention relates to an image display device having an automatic sound enhancement function depending on the specific source as well as analyzing an incoming audio signal irrespective of the special setting predefined for the specific source.
- [0002] An image display device may receive audio signal from a plurality of sources such as set-top box, digital multimedia player, game console etc. Further, a smart TV application accessing a variety of Internet sites may present the user with multimedia content perceived as having different sound qualities. To this end, automatic sound enhancement in relation with various audio source devices should be applied to ensure a satisfactory listening experience irrespective of the specific source device.
- [0003] It is also known that digital and interactive TV systems provide a comprehensive amount of TV channels and programs leading to the general outcome that a user may need to review the received acoustic sound quality depending on the TV channel. Assuming that a TV service may have hundreds of channels, which might almost take one hour before every single channel is viewed at least once, such a manual attempt would prove unmanageable while surfing such a vast number of channels.
- [0004] Image display devices may be preconfigured to apply certain predefined sound enhancement blocks being presented to the user to increase received acoustic sound quality by enabling user to select a preset. This approach does not yield completely satisfactory results for the reason that each of these predefined enhancement blocks aim to increase the acoustic quality for only one type of audio content. For example music equalizer mode works well with musical content but it will suffer when audio signal is switched to speech. Bearing this in mind, if the user wants to keep the perceived sound quality in a satisfying level, he/she should again select correct audio preset in view of the playing audio content. In many cases this is not preferred; the user gives up at some point and tries to content himself with what is available to him. Therefore, common

behavior of the users is just to select a predefined sound enhancement block and leave the image display device in this setting for a prolonged period of time, like years. As a result, the received acoustical sound quality is decreased once the type of the playing audio content on the image display device is altered.

- [0005] Among others, one of the prior art disclosures in the technical field of the present invention may be referred to as KR20020054623, which discloses a method of setting a mode according to a program genre to automatically set an optimum image and a sound in an instrument according to a contents genre of a program, thereby supplying an optimum TV environment to users. To this end, an event information table section (EIT) is filtered from a transport stream in EIT information of program guide information and ID information of a program. A section number is retrieved among filtered EITs, to detect genre information for a corresponding program. A video processor and a sound processor are controlled according to the detected genre information, to set the program with a corresponding genre. The step of detecting the genre information is performed by detecting a section number of an EIT table by using a source ID selected by a user.
- [0006] The present invention provides a system and a method by which an image display device is operated such that an automatic sound enhancement function is performed either depending on the specific source or by analyzing the incoming audio signal irrespective of the special setting predefined for the specific source.
- [0007] The present invention therefore provides a system and method by which an image display device is operable to automatically perform a sound enhancement function regarding the audio source as well as the incoming audio signal as provided by the characterizing features defined in Claim 1.
- [0008] Primary object of the present invention is to provide a system and method by which an image display device automatically enhances an incoming audio signal based on the source device as well as the specific character of the audio signal.
- [0009] The present invention proposes a method by which an incoming audio

signal from an audio signal source is received and genre of a program being viewed is determined. An audio enhancement block in association with the determined program genre is accordingly applied to the incoming audio signal so as to adjust an audio output signal of the image display device conventionally by strengthening or weakening the energy of specific frequency bands.

- [0010] The program genre information can be obtained by means of a content identifier indicative of the genre and/or from a media player playing a medium such as for instance a Blu-ray disc. Smart TV applications may also connect to a remote database to retrieve the required information.
- [0011] Alternatively, the genre of a program being viewed can be defined by analyzing the power spectrum of the incoming audio signal and the magnitude and frequency and corresponding frequency band for each sound input can be determined. The results can then be processed by an audio evaluation unit to obtain a percentage distribution of different sound profiles in the incoming sound. This information is in turn used to specify a particular audio enhancement block or preset to be effective.
- [0012] In an alternative embodiment, a rate comparison unit periodically analyzes results obtained by the audio evaluation unit and investigates whether the selected preset is still appropriate in view of the present scene in the program being watched.
- [0013] Accompanying drawings are given solely for the purpose of exemplifying a system and method by which an image display device is operable, whose advantages over prior art were outlined above and will be explained in brief hereinafter.
- [0014] 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.
- [0015] Fig. 1 demonstrates a general diagram according to which the image display device of the invention executes the method of operation according to the present invention.
- [0016] The present invention relates to an image display device having an

automatic sound enhancement function depending on the specific source. The present invention further relates to an image display device performing sound enhancement function by analyzing an incoming audio signal irrespective of the special setting predefined for the specific source.

- [0017] According to the present invention, the image display device may be connected to various audio source devices such as set-top box, digital multimedia player, game console etc., with numerous connection options, such as for instance HDMI, Scart and USB connections. In case a set-top box is connected to the image display device through an HDMI cable and the program being watched is a sport event, the image display device determines the genre of the program and adjusts the audio frequency settings such that one of the equalizer predefined settings (presets) corresponding to the sport event is selected. By changing the equalizer preset, one typically alters the frequency response of the audio system, in this case the image display device's audio system and adjusts the gain at a frequency band.
- [0018] In accordance with the invention, content identifiers in association with different programs as provided by the broadcaster can be used in order for determining the genre of a program. In case a media player such as for instance a DVD player is connected through an HDMI cable and a movie is being watched, the image display device obtains the information as to the genre of the program from the media player and selects the appropriate audio preset accordingly. And if the user watches a music video on a website using a smart TV application, the application may convey the information as to the genre of the program being viewed and a new preset may be applied. The audio signal source can therefore be an external device or an internal component such as a built-in DVB receiver or a remote source accessed by the image display device, for instance through an application.
- [0019] In an alternative embodiment of the present invention, the information obtained from an audio signal source device as to the genre of the program being viewed is confirmed by the image display device, by way analyzing the incoming audio content. It is also possible that the image

display device cannot retrieve such information and defines the genre of the program being watched itself. To this end, the image display device monitors the incoming audio signal and its content is determined by analyzing the power spectrum thereof. A power spectrum analyzer in this respect provides that the character of the incoming sound is determined.

- [0020] It is to be noted that the incoming sound may include some musical content along with speech content. The image display device input sound signal may contain several audible components at the same time. For a movie scene that includes a couple of people talking to each other (speech), while they are walking outside (natural sound) and a music is playing at the background (musical content), the power spectrum analyzer may detect individually all of these audio components by analyzing frequency bands.
- [0021] As each individual sound has its specific frequency characteristics, i.e. its own specific trace in the frequency band and if a certain sound is analyzed in terms of frequency, a flute sound or female voice, there shall be signals within a certain frequency range and the source of the sound can be determined in the frequency band. The power spectrum analyzer determines the incoming audio signal's magnitude and frequency and corresponding frequency band for each sound input in a time interval is calculated by using signal processing techniques such as Fourier Transform. The power spectrum analyzer therefore calculates and generates meaningful outputs for an audio evaluation unit by analyzing the frequency band.
- [0022] Received audio content is then processed such that the outputs of the power spectrum analyzer are evaluated by said audio evaluation unit in a categorical format with a percentage distribution such as for instance 75% music, 13% speech and 12% environmental sound. This simple yet very efficient categorical approach is advantageous in that it provides directly practical results without overloading the respective processor. After rating the outputs of the power spectrum analyzer in the form of music, speech, environment sound and so on, a preset selection unit selects a corresponding preset or audio enhancement block from among a plurality

predefined presets, for example as in the case of a look-up table, based on the results obtained by the audio evaluation unit. The preset selection unit may have numerous predefined audio blocks like music, speech, environment sound with varying percentages.

- [0023] In an alternative embodiment of the present invention, a rate comparison unit is proposed to periodically compare the actual output of the audio evaluation unit with the previous output thereof such that the audio enhancement function can be performed dynamically on a real-time basis. In this respect, the rate comparison unit communicates with a data memory to retrieve the previous output of the audio evaluation unit in a predetermined frequency and decides whether the deviation of the actual output from the previous output requires an update of the currently effective audio enhancement block or preset. If needed, the preset selection unit applies the new corresponding preset. For example an actual incoming audio signal may consist of 75% music, 15% environment sound and 5% speech during a concert record and all of a sudden turn into a rate distribution of 75% speech and 25% environmental sound when the orchestra's chief conductor gives a short speech to the audience.
- [0024] In sum, if it is evaluated that the previously applied audio enhancement block or preset is no longer appropriate in view of the actual audio content, the preset selection unit determines the new preset to be effective. The data memory stores the outputs of the audio evaluation unit to be used by said rate comparison unit.
- [0025] In an alternative embodiment of the present invention, if it is evaluated that the previously applied preset is no longer appropriate in view of the actual audio content, a preset parameters computing unit can alternatively calculate a new parameter set to be applied to the selected sound preset. In other words, instead of selecting the most appropriate preset from among a plurality of existing presets, the preset selection unit can directly receive from said preset parameters computing unit a specially generated preset to which a computed parameter set is applied.
- [0026] Said preset parameters computing unit generates a new preset based on the outputs of the rate comparison unit. This unit creates a parameter set

to be applied to the current audio enhancement block. By this way, the current selected audio enhancement block is updated with a new parameter set.

- [0027] In a nutshell, the present invention proposes a method for operating an image display device, said image display device receiving a plurality of broadcasting services and a plurality of audio signal sources being accessible by said image display device, said method for operating said image display device comprising the steps of: a) receiving an incoming audio signal from an audio signal source, b) determining genre of a program being viewed, c) selecting an audio enhancement block corresponding to the genre of the program being viewed and d) applying the selected audio enhancement block to the incoming audio signal to adjust an audio output signal of said image display device.
- [0028] The step of determining the genre of a program being viewed comprises the step of receiving a content identifier indicative of the genre of the program and/or the step of obtaining information as to the genre of the program from a media player. The information as to the genre of the program is alternatively obtained by an application accessing Internet.
- [0029] In an embodiment of the present invention, the step of determining the genre of a program being viewed comprises the step of monitoring the incoming audio signal and analyzing the power spectrum thereof by a power spectrum analyzer so as to individually detect audio components in the incoming audio signal.
- [0030] In a further embodiment of the present invention, the magnitude and frequency and corresponding frequency band for each sound input in a time interval in the incoming audio signal is determined by the power spectrum analyzer.
- [0031] In a still further embodiment of the present invention, the outputs generated by said power spectrum analyzer are evaluated by an audio evaluation unit so as to obtain a categorical format percentage distribution of the incoming audio signal.
- [0032] In a yet still further embodiment of the present invention, a preset selection unit selects an audio enhancement block from among a plurality

predefined audio enhancement blocks, said selected audio enhancement block corresponding to the categorical format percentage distribution of the incoming audio signal as determined by said audio evaluation unit.

- [0033] In a yet still further embodiment of the present invention, a rate comparison unit periodically compares an actual output of the audio evaluation unit with the previous output thereof whereby audio enhancement function is dynamically performed on a real-time basis.
- [0034] In a yet still further embodiment of the present invention, the rate comparison unit communicates with a data memory to retrieve the previous output of the audio evaluation unit in a predetermined frequency and decides whether the deviation of the actual output from the previous output requires an update of the currently effective audio enhancement block.
- [0035] In a yet still further embodiment of the present invention, a preset selection unit selects an audio enhancement block from among a plurality of predefined audio enhancement blocks, said selected audio enhancement block corresponding to the actual output of said audio evaluation unit.
- [0036] In a yet still further embodiment of the present invention, a preset parameters computing unit calculates a new parameter set to be applied to the selected audio enhancement block based on the outputs of said rate comparison unit.
- [0037] Therefore, in accordance with the present invention, a new audio enhancement block is automatically selectable or current audio enhancement block is updatable in view of the playing audio content on a real-time basis so that the perceived acoustical sound quality is continually kept at a desirable maximum level without requiring any user intervention.

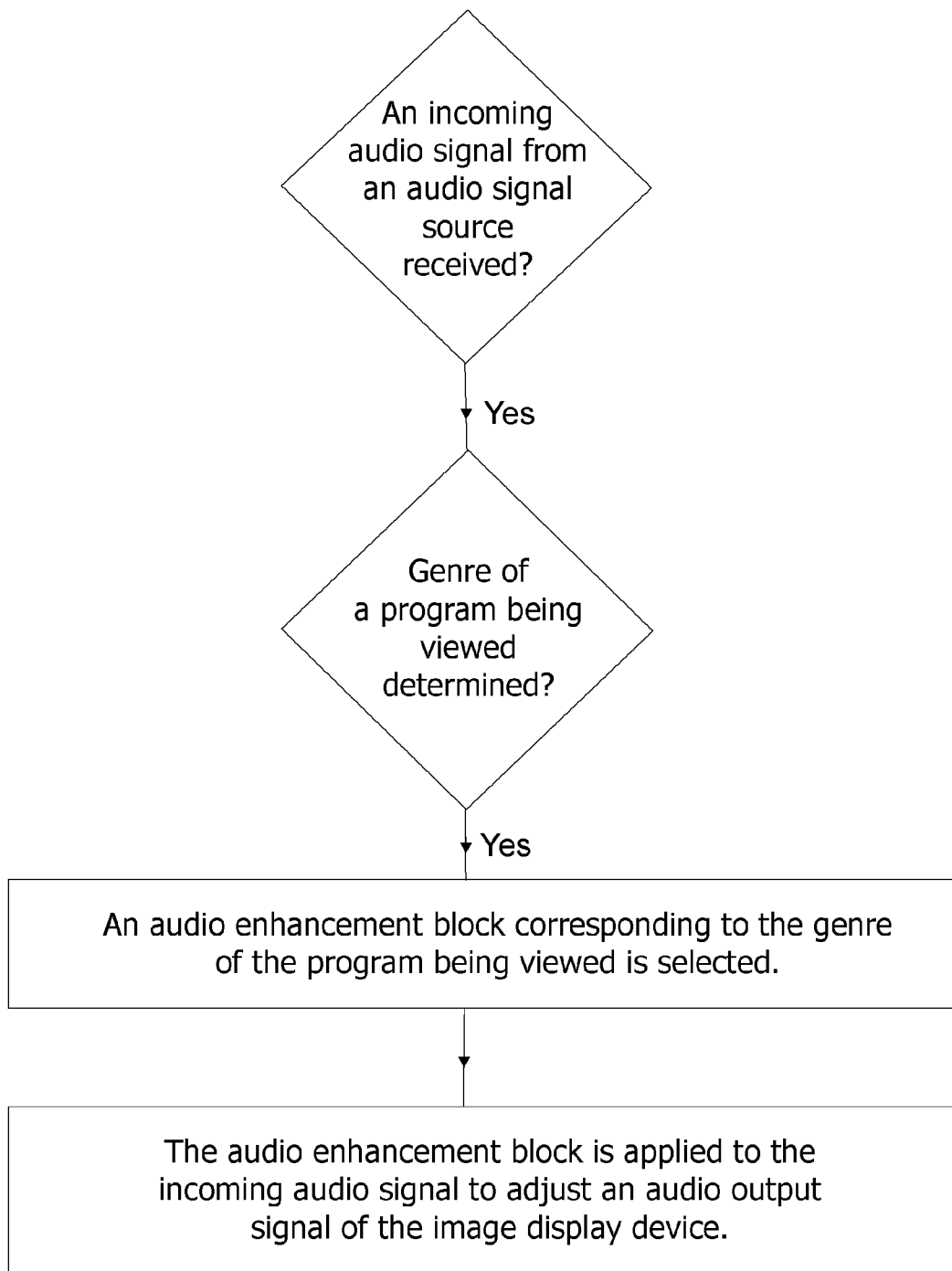
Claims

1. A method for operating an image display device, said image display device receiving a plurality of broadcasting services and a plurality of audio signal sources being accessible by said image display device, said method for operating said image display device comprising the steps of:
 - receiving an incoming audio signal from an audio signal source,
 - determining genre of a program being viewed,
 - selecting an audio enhancement block corresponding to the genre of the program being viewed and
 - applying the selected audio enhancement block to the incoming audio signal to adjust an audio output signal of the image display device.
2. A method for operating an image display device as in Claim 1, **characterized in that** the step of determining the genre of a program being viewed comprises the step of receiving a content identifier indicative of the genre of the program.
3. A method for operating an image display device as in Claim 1, **characterized in that** the step of determining the genre of a program being viewed comprises the step of obtaining information as to the program genre from a media player.
4. A method for operating an image display device as in Claim 1, **characterized in that** the step of determining the genre of a program being viewed comprises the step of obtaining information as to the program genre by an application accessing Internet.
5. A method for operating an image display device as in Claim 1, 2, 3 or 4 **characterized in that** the step of determining the genre of a program being viewed comprises the step of monitoring the incoming audio signal and analyzing the power spectrum thereof by a power spectrum analyzer so as to individually detect audio components in the incoming audio signal.
6. A method for operating an image display device as in Claim 5, **characterized in that** magnitude and frequency and corresponding frequency band for each sound input in a time interval in the incoming audio signal is determined by the power spectrum analyzer.
7. A method for operating an image display device as in Claim 6, **characterized in that** outputs generated by the power spectrum analyzer are evaluated by an audio evaluation unit so as to obtain a categorical format percentage

distribution of the incoming audio signal.

8. A method for operating an image display device as in Claim 7, **characterized in that** a preset selection unit selects an audio enhancement block from among a plurality predefined audio enhancement blocks, the selected audio enhancement block corresponding to the categorical format percentage distribution of the incoming audio signal as determined by the audio evaluation unit.
9. A method for operating an image display device as in Claim 7, **characterized in that** a rate comparison unit periodically compares an actual output of the audio evaluation unit with the previous output thereof whereby audio enhancement function is dynamically performed on a real-time basis.
10. A method for operating an image display device as in Claim 9, **characterized in that** the rate comparison unit communicates with a data memory to retrieve the previous output of the audio evaluation unit in a predetermined frequency and decides whether the deviation of the actual output from the previous output requires an update of the currently effective audio enhancement block.
11. A method for operating an image display device as in Claim 10, **characterized in that** a preset selection unit selects an audio enhancement block from among a plurality of predefined audio enhancement blocks, the selected audio enhancement block corresponding to the actual output of the audio evaluation unit.
12. A method for operating an image display device as in Claim 8 and 10, **characterized in that** a preset parameters computing unit calculates a new parameter set to be applied to the selected audio enhancement block based on outputs of the rate comparison unit.

Fig. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/056324

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04N21/439 H04N21/434 H04N21/84
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N

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 2009/281643 A1 (HIGUCHI SATOSHI [JP] ET AL) 12 November 2009 (2009-11-12) paragraphs [0073], [0089], [0090], [0091], [0092], [0096], [0097]; figures 1,3, 4	1-3
X	US 2009/064267 A1 (LEE HWA-KYUNG [KR]) 5 March 2009 (2009-03-05) paragraphs [0034] - [0036], [0040] - [0041], [0049]; figures 1-3 ----- -/--	1,2,4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HAN K-P ET AL: "GENRE CLASSIFICATION SYSTEM OF TV SOUND SIGNALS BASED ON A SPECTROGRAM ANALYSIS", IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, IEEE SERVICE CENTER, NEW YORK, NY, US, vol. 44, no. 1, 1 February 1998 (1998-02-01), pages 33-42, XP000779248, ISSN: 0098-3063, DOI: 10.1109/30.663728	1,5,6
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Information on patent family members

International application No

PCT/EP2014/056324

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