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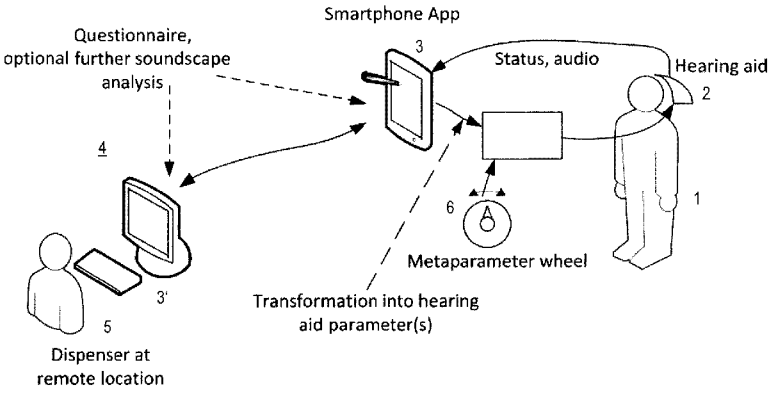


Fig. 1

(57) Abstract: The present invention pertains to a method for adjusting a hearing device 2 to personal preferences and needs of a user 1. The proposed method comprises receiving from the user 1 a request for improving a processed sound signal provided to the user 1 by the hearing device 2, presenting one or more questions to the user 1, receiving at least one response from the user 1 to the one or more questions, configuring a user control element 6 to adjust one or more signal processing parameters, and the user 1 operating the user control element 6 to provide a user control signal for adjusting the one or more signal processing parameters so as to meet the personal preferences and needs of the user 1. Configuring the user control element 6 comprises automatically selecting the one or more signal processing parameters and automatically providing a mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters, both being based on the at least one user response as well as for instance information related to the current listening situation. Moreover, the present invention provides a system structured and configured to carry out the proposed method.

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METHOD AND SYSTEM FOR ADJUSTING A HEARING DEVICE TO PERSONAL PREFERENCES AND NEEDS OF A USER

TECHNICAL FIELD

The present invention pertains to a method and system for adjusting a hearing device to personal preferences and needs of a user of the hearing device.

BACKGROUND OF THE INVENTION

In the context of the present invention the term "hearing device" refers to hearing aids (alternatively called hearing instruments or hearing prostheses) used to compensate hearing impairments of hard of hearing persons as well as to audio and communication devices used to provide sound signals to persons with normal hearing capability, e.g. in order to improve hearing in harsh acoustic surroundings. Such hearing devices are able to process a received input sound signal and then provide the processed sound signal to the user, e.g. into his ear canal. The processing is for instance automatically adapted to the prevailing listening situation. Furthermore, it is adapted according to the individual preferences and needs of the user, for instance in dependence of the user's specific hearing capability/

deficiency, e.g. hearing loss. The process of adjusting hearing device settings, such as hearing programs, for a specific user is commonly referred to as fitting and is usually performed by a trained fitter such as a hearing device or hear care professional, e.g. an audiologist or a hearing device dispenser, at his office. Despite carefully fitting the hearing device the user will subsequently often encounter listening situations in which he is unable to achieve satisfactory hearing performance. It would therefore be advantageous to improve the settings of the hearing device for these specific listening situations. However, this is a difficult undertaking, because the user has to return to the fitter's office and explain the problem to him in detail. Oftentimes the user is unable to identify the problematic listening situation, i.e. he is unable to describe the acoustic environment in which he experiences difficulties, nor is he able to say in which respect the hearing perception was unsatisfactory, e.g. to describe what it sounded like. In such cases it is usually beneficial to allow the user to adjust the hearing device settings himself under those conditions where problems arise. This process is commonly referred to as self-fitting. However, the user typically has difficulties with adjusting the settings such that an improved hearing performance is achieved. Frequently, the user will be overwhelmed by this task. Hence, there exists a need for improved self-fitting techniques and means.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved method for allowing a user to adjust a hearing device to his personal preferences and needs. This object is achieved by the method according to claim 1.

Moreover, it is a further goal of the present invention to provide an improved system for adjusting a hearing device to the personal preferences and needs of a user. This aim is achieved by the system according to claim 9.

Specific embodiments of the method and system according to the present invention are given in the dependent claims.

The present invention provides a method for adjusting a hearing device to personal preferences and needs of a user of the hearing device, the method comprising the steps of:

a) receiving an input sound signal;

b) automatically identifying a listening situation based on the input sound signal, for instance by means of sound classification;

c) processing the input sound signal dependent on the identified listening situation;

d) providing the processed sound signal to the user;

e) receiving a request from the user for improving the processed sound signal;

f) presenting one or more questions to the user;

g) receiving at least one response from the user to the one or more questions;

h) configuring a user control element to adjust one or more signal processing parameters; and

i) the user operating the user control element to provide a user control signal for adjusting the one or more signal processing parameters so as to meet the personal preferences and needs of the user,

wherein configuring the user control element comprises:

h1) automatically selecting the one or more signal processing parameters; and

h2) automatically providing a mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein steps h1) and h2) are based on the at least one user response and at least one of the following:

- the identified listening situation, in particular a sound class, a sound level, a signal-to-noise ratio (SNR), a mean reverberation time, a frequency distribution, direction of arrival information, all of which being associated with the input sound signal;
- currently selected signal processing parameters;
- currently selected mode of operation;

- current user location/position data;
- current time;
- image data associated with a current surroundings of the user.

In a situation where the user is not satisfied with the processed sound signal currently being provided by the hearing device he is able to issue a request for improving the processing of the sound signal. Upon receiving the user's request questions are posed to the user in order to determine the possible cause of the problem the user is having. Based upon the user's answers a user control element is automatically configured such that the user is able to adjust one or more signal processing parameters which are most likely able to provide an improved processing of the sound signal that will result a better hearing performance of the user. By operating this user control element the user can then adjust the hearing device such that it meets his needs in the present listening situation. In this way help is provided to the user and he can be guided to optimally adjust the hearing device himself. As a result the task of self-fitting the hearing device is made much easier and more successful for the user.

In an embodiment the method further comprises:

- establishing a connection, such as a wireless connection, between the hearing device and a second

device, such as a smartphone or a computer, for instance remotely located at a call centre or at a hearing device dispenser;

- providing from the hearing device to the second device at least one of the following:
  - the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio (SNR), the mean reverberation time, the frequency distribution, the direction of arrival information;
  - the currently selected signal processing parameters;
  - the currently selected mode of operation;
  - the current user location/position data;
  - the current time;
  - the image data associated with the current surroundings of the user;
  - an audio signal dependent on the input sound signal.

In this way part of the workload of the fitting process can be carried out by the second device in order to relieve the hearing device from certain tasks and to allow more complex processing not possible with the limited resources of the hearing device. Furthermore, the self-fitting procedure can be supported from a remote location, thereby allowing to benefit from the advantages of remote fitting schemes, in particular the help, expertise and guidance of a person

specialised in fitting hearing devices, such as a hearing device or hear care professional.

In a further embodiment of the method the step b) of automatically identifying the listening situation is performed by the second device, in particular remotely from the hearing device. In this way more complex and elaborate sound classification can be applied than possible with the hearing device's limited processing power.

In a further embodiment of the method selecting the one or more signal processing parameters to be adjusted and determining the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters is performed by the second device. In this way more complex and elaborate schemes can be employed than possible with the hearing device alone. Moreover, such schemes are not required during normal operation of the hearing device and are not well supported by the resources necessary for normal operation (e.g. audio processing, such as frequency-dependent amplification) of the hearing device. It is therefore more economical to provide the fitting related resources in a separate second device, which is more suited to carry out the necessary tasks.

In a further embodiment of the method the one or more questions are presented to the user by means of the second

device or are provided to the user by a remote person assisting the user, such as a person located at the call centre, a hearing dispenser or a hearing device / hear care professional, for instance an audiologist. The second device can especially comprise an appropriate display for presenting the questions as well as input means which allows to the user to conveniently provide a response to the questions.

In a further embodiment of the method the one or more questions are selected from a plurality of questions based on at least one of the following:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio (SNR), the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user;
- information regarding the user's experience with utilising the hearing device or other users' experience with utilising the hearing device, in particular in listening situations similar to the presently identified listening situation, e.g. where at least one of the mode

of operation, sound type, location or time were the same as in the present listening situation, or where at least one of the sound level, SNR, mean reverberation time, frequency distribution, direction of arrival information or signal processing parameters was within a predetermined range of that in the present listening situation.

In this way the questions can be precisely directed to the specific situation the user in presently in and to the manner in which the hearing device is currently working. Furthermore, the questions can be tailored to how much experience the user has with using the hearing device, e.g. to provide more basic questions to a novice user and more complex ones to an advanced user. Moreover, those questions can be selected that previously proved to be useful when helping other hearing device users, e.g. in similar listening situations.

In a further embodiment of the method at least one further question is selected from the plurality of questions based on one or more prior responses received from the user. In this way the user's responses help select a suitable subsequent question in order to help gather the information necessary to resolve the user's listening problem more quickly and efficiently.

In a further embodiment of the method at least part of the information received by the second device and optionally further information, in particular derived from the information received by the second device, is provided to an expert system, wherein the expert system performs at least one of the following:

- select the one or more questions to be presented to the user from a plurality of questions;
- determine the sequence in which two or more questions are presented to the user;
- evaluate one or more responses received from the user;
- select the one or more signal processing parameters to be adjusted;
- determine the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein the expert system is in particular located at the second device or remotely located from the hearing device and the second device. In this way a complex problem analysis can be performed and possible solutions are automatically proposed by the expert system, which is coupled with an extensive and continuously expanding knowledge base.

Furthermore, the present invention is directed to a system for adjusting a hearing device to personal preferences and needs of a user, comprising:

- the hearing device with an input transducer for receiving an input sound signal, a classifier adapted to automatically classify the input sound signal, an audio signal processing unit adapted to process the input sound signal dependent on the identified listening situation, and an output transducer for providing the processed sound signal to the user;
- an input means adapted to receive a request from the user for improving the processed sound signal;
- an output unit adapted to present one or more questions to the user, for instance a display unit or a loudspeaker, such as the output transducer;
- an input unit adapted to receive at least one response from the user to the one or more questions;
- a configurable user control element, such as a wheel, rocker, slider, touch sensitive element or motion sensor, operable by the user and adapted to provide a user control signal for adjusting one or more signal processing parameters;
- a selection and configuration unit adapted to select the one or more signal processing parameters and to determine a mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters based on the at least one response and at least one of the following:
  - the identified listening situation, in particular a sound class, a sound level, a signal-to-noise ratio (SNR), a mean reverberation time, a frequency

distribution, direction of arrival information, all of which being associated with the input sound signal;

- currently selected signal processing parameters;
- currently selected mode of operation;
- current user location/position data;
- current time;
- image data associated with a current surroundings of the user.

In an embodiment the system comprises a second device, such as a smartphone or a computer, for instance remotely located at a call centre or at a hearing device dispenser, the second device being operationally connected to the hearing device, the second device being adapted to receive at least one of the following from the hearing device:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio (SNR), the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user;

- an audio signal dependent on the input sound signal.

In a further embodiment of the system the second device is further adapted to automatically identify the listening situation, in particular based on the received audio signal.

In a further embodiment of the system at least one of the input means, output unit, input unit, configurable user control element, and the selection and configuration unit is located at the second device.

In a further embodiment the system further comprises an expert system adapted to perform at least one of the following:

- select the one or more questions to be presented to the user from a plurality of questions;
- determine the sequence in which two or more questions are presented to the user;
- evaluate one or more responses received from the user;
- select the one or more signal processing parameters to be adjusted;
- determine the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein the expert system is in particular located at the second device or remotely located from the hearing device and the second device.

In a further embodiment of the system the expert system is adapted to select the one or more questions from a plurality of questions based on at least one of the following:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio (SNR), the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user;
- information regarding the user's experience with utilising the hearing device or other users' experience with utilising the hearing device (e.g. the same model of hearing device or a similar hearing device), in particular in listening situations similar to the presently identified listening situation, e.g. where at least one of the mode of operation, sound type, location or time were the same as in the present listening situation, or where at least one of the sound level,

SNR, mean reverberation time, frequency distribution, direction of arrival information or signal processing parameters was within a predetermined range of that in the present listening situation.

In a further embodiment of the system the expert system is further adapted to select the at least one further question from the plurality of questions based on one or more prior responses received from the user.

In is specifically pointed out that combinations of the embodiments described above can result in even further more specific embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is further explained below by means of non-limiting specific embodiments and with reference to the accompanying drawings, which show:

Fig. 1 depicts a conceptual diagram of a hearing device user interacting with a smartphone and/or a remote dispenser according to the method and system of the present invention;

Fig. 2 depicts an exemplary flow diagram with questions, diagnostic blocks and action requests according to the method of the present invention;

Fig. 3 depicts a detailed view of the diagnostic block A from Fig. 2;

Fig. 4 depicts a detailed view of the diagnostic blocks B & C from Fig. 2;

Fig. 5 depicts a detailed view of the diagnostic blocks D & E from Fig. 2; and

Fig. 6 depicts a detailed view of the diagnostic blocks F & G from Fig. 2.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows an exemplary conceptual setup of a fitting system according to the present invention, based upon which the proposed method of fitting a hearing device according to the present invention will be described in the following. The user 1 is wearing a hearing device 2 at or in one of his ears. When in a situation where the user 1 is not satisfied with the processed sound signal currently being provided by the hearing device 2 he issues a request for improving the processing of the sound signal, e.g. by pressing a (help) button on the hearing device 2.

In the case depicted in Fig. 1 the hearing device 2 is operationally connected with a smartphone 3. This can for instance be achieved directly by means of a Bluetooth link or via a communication relay (not shown) where the hearing device 2 is e.g. part of an inductive body area network

(BAN) for intra-body communication which includes a hub or relay for off-body communication e.g. via Bluetooth, wireless LAN or mobile cellular link. The smartphone 3 is executing a special mobile application program, subsequently referred to as an "app", that is triggered by the request of the user 1. Instead of pressing a (help) button at the hearing device 2, the user can alternatively activate a corresponding button or icon on the screen of the smartphone 3. The hearing device 2 then sends information for instance regarding the current listening situation (e.g. sound class, sound level, signal-to-noise ratio, mean reverberation time, frequency distribution, direction of arrival information), the currently selected signal processing parameters and mode of operation of the hearing device 2 to the smartphone 3. Additionally or alternatively an audio signal based on the sound picked up by the hearing device 2 may be sent to the smartphone 3, where e.g. the information regarding the current listening situation is determined. The app may receive further information such as current time and location as well as a picture of the present environment from the smartphone 3 itself.

The information received by the smartphone 3 or information determined by the smartphone 3 therefrom may then be sent to a remote location 4 such as a support or service centre where it is evaluated to get a detailed understanding of the problematic listening situation and how the hearing device 2 is currently dealing with it. This may be done

automatically, e.g. by an expert system, or by a person specialised in fitting hearing devices, e.g. a hearing device dispenser.

A structured questionnaire is then compiled to determine the exact problem the user 1 is experiencing in the current environment. The questions are automatically determined by an expert system based on the information provided by the hearing device 2 and/or smartphone 3, e.g. based selecting appropriate questions from an extensive list of possible questions. Additionally, information regarding the user's experience with utilising the hearing device 2 or other users' experience with utilising the same model or a similar hearing device, in particular in listening situations similar to the presently identified listening situation, e.g. where at least one of the mode of operation, sound type, location or time were the same as in the present listening situation, or where at least one of the sound level, SNR, mean reverberation time, frequency distribution, direction of arrival information or signal processing parameters was within a predetermined range of that in the present listening situation, can also be used to compile the questionnaire.

An exemplary flow diagram with questions, diagnostic blocks and action requests according to the method of the present invention is depicted in Fig. 2, with more detailed views of block A, blocks B & C, blocks D & E, and blocks F & G provided in Figs. 3, 4, 5, & 6, respectively.

The questionnaire may be used by the dispenser 5, who then reads individual questions to the user 1, or the questions may be presented to the user 1 by the smartphone app. The user 1 then provides his response(s) to these questions either by means of the hearing device 2 directly or via the smartphone 3 by entering them into the app, whereby subsequent questions can be selected by the expert system dependent in the user's previous response(s).

Based on the user's response(s) and the available determined information regarding the current listening situation and the hearing device's present settings and mode of operation the expert system selects or defines a most sensitive "meta-parameter" (i.e. one or more signal processing parameters) to act upon in order to resolve the problem at hand. For example, if the sound environment has been determined to be reverberant and the user has intelligibility problems, then a meta-parameter is chosen that acts on the reverberation canceller, the beamformer and some gain model time constants. If the analysis shows that the T-coil is switched on and the user complains about it being too loud (or quiet), then the input sensitivity for this input channel is assigned to the meta-parameter. If the user 1 complains about a boomy own voice, then the occlusion cancelling settings are assigned to the meta-parameter. If the analysis needs more information, the system launches a questionnaire in similar acoustic

situations or in situations, which need to be clarified so that the possible causes can be narrow down further.

Furthermore, the expert system automatically determines a mapping or transformation of a user control signal to an adjustment of the meta-parameter, i.e. the one or more signal processing parameters. The user control signal can then be adjusted by the user operating a configurable user control element 6 (either at the smartphone 3 or the hearing device 2), such as a wheel, rocker, slider, touch sensitive interface (e.g. a touch screen) or motion sensor.

By operating the user control element 6 (e.g. the meta-parameter wheel depicted in Fig. 1) the user 1 adjusts the user control signal and thereby (via the transformation/ mapping) the one or more signal processing parameters (i.e. the meta-parameter) to adapt the signal processing of the hearing device 2 in such a way that has been determined to be the most effective to resolve the problem at hand. The user 1 can thus find optimal settings for his perception in the current problematic listening situation. Once the user 1 is satisfied with the performance of the hearing device 2 the new optimal settings are stored persistently in the hearing device 2 and associated with this listening situation. If the user 1 is unable to adjust the hearing device 2 such that satisfactory hearing performance is achieve, he can issue a further request, in response to which the expert system provides an alternate meta-parameter for the user 1 to try out.

In a specific embodiment the smartphone 3 can execute all the functions provided at the remote location 4, in particular the app can include the expert system so that no remote location 4 is involved to perform the proposed method according to the present invention. Alternatively, the expert system implemented in the app executed by the smartphone can access a knowledge base hosted by a remote server.

In a further embodiment, if the user 1 is unable to solve the problem with the aid of the app (implementing the expert system) alone, the app can additionally contact the remote support/service centre 4 which provides further, in particular more expansive help, e.g. by means for more complex processing and/or a more elaborate expert system.

In a further embodiment user 1 may also start processing the questionnaire locally using his smartphone 3, and proceed in case of problems by connecting with e.g. a dispenser 5, who gets the current status of the questionnaire as well as all other information regarding the analysis of the present situation (e.g. type of listening environment and settings of the hearing device 2) to continue the process. The dispenser 5 might then also approve and save the changes made by the user 1 or propose another solution.

Alternatively, the user 1 may store the proposals (e.g. the determined meta-parameter) together with the questionnaire and analysis data and discusses them during the next visit to e.g. an audiologist.

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LIST OF REFERENCE SYMBOLS AND ABBREVIATIONS

1	user
2	hearing device
3	smartphone
3′	remote computer
4	remote location, call centre
5	fitter/dispenser
6	user control element, meta-parameter wheel
AAS	alternative audio source
BF	beamformer
BTE	behind the ear
EOL	end of life
GM	gain model
HCP	health/hear care professional
HI	hearing instrument
HL	hearing loss
HRTF	head related transfer function
MPO	maximum power output
NC	noise canceller
RIC	receiver in canal
VC	volume control
UI	user interface

CLAIMS

1. A method for adjusting a hearing device (2) to personal preferences and needs of a user (1) of the hearing device (2), the method comprising the steps of:

a) receiving an input sound signal;

b) automatically identifying a listening situation based on the input sound signal, for instance by means of sound classification;

c) processing the input sound signal dependent on the identified listening situation;

d) providing the processed sound signal to the user (1);

e) receiving a request from the user (1) for improving the processed sound signal;

f) presenting one or more questions to the user (1);

g) receiving at least one response from the user (1) to the one or more questions;

h) configuring a user control element (6) to adjust one or more signal processing parameters; and

i) the user (1) operating the user control element (6) to provide a user control signal for adjusting the one or more signal processing parameters so as to meet the personal preferences and needs of the user (1),

wherein configuring the user control element (6) comprises:

h1) automatically selecting the one or more signal processing parameters; and

h2) automatically providing a mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein steps h1) and h2) are based on the at least one user response and at least one of the following:

- the identified listening situation, in particular a sound class, a sound level, a signal-to-noise ratio, a mean reverberation time, a frequency distribution, direction of arrival information, all of which being associated with the input sound signal;
- currently selected signal processing parameters;
- currently selected mode of operation;
- current user location/position data;
- current time;
- image data associated with a current surroundings of the user (1).

2. The method of claim 1, further comprising:

- establishing a connection, such as a wireless connection, between the hearing device (2) and a second device (3, 3'), such as a smartphone (3) or a computer (3'), for instance remotely located at a call centre (4) or at a hearing device dispenser (5);
- providing from the hearing device (2) to the second device (3, 3') at least one of the following:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio, the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user (1);
- an audio signal dependent on the input sound signal.

3. The method of claim 2, wherein step b) of automatically identifying the listening situation is performed by the second device (3, 3'), in particular remotely from the hearing device (2).

4. The method of claim 2 or 3, wherein selecting the one or more signal processing parameters to be adjusted and determining the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters is performed by the second device (3, 3').

5. The method of one of claims 2 to 4, wherein the one or more questions are presented to the user (1) by means of

the second device (3, 3') or are provided to the user (1) by a remote person (5) assisting the user (1), such as a person (5) located at the call centre (4), a hearing dispenser or a hearing device professional, for instance an audiologist or dispenser (5).

6. The method of one of claims 1 to 5, wherein the one or more questions are selected from a plurality of questions based on at least one of the following:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio, the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user (1);
- information regarding the user's experience with utilising the hearing device or other users' experience with utilising the hearing device (1), in particular in listening situations similar to the presently identified listening situation, e.g. where at least one of the mode of operation, sound type, location or time were the same as in the present listening situation, or where at least one of the sound level, SNR, mean reverberation time,

frequency distribution, direction of arrival information or signal processing parameters was within a predetermined range of that in the present listening situation.

7. The method of claim 6, wherein at least one further question is selected from the plurality of questions based on one or more prior responses received from the user (1).

8. The method of one of claims 2 to 7, wherein at least part of the information received by the second device (3, 3') and optionally further information, in particular derived from the information received by the second device (3, 3'), is provided to an expert system, wherein the expert system performs at least one of the following:

- select the one or more questions to be presented to the user (1) from a plurality of questions;
- determine the sequence in which two or more questions are presented to the user (1);
- evaluate one or more responses received from the user (1);
- select the one or more signal processing parameters to be adjusted;
- determine the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein the expert system is in particular located at the second device (3, 3') or remotely located from the hearing device (2) and the second device (3).

9. A system for adjusting a hearing device (2) to personal preferences and needs of a user (1) of the hearing device (2), comprising:

- the hearing device (2) with an input transducer for receiving an input sound signal, a classifier adapted to automatically classify the input sound signal, an audio signal processing unit adapted to process the input sound signal dependent on the identified listening situation, and an output transducer for providing the processed sound signal to the user (1);
- an input means adapted to receive a request from the user (1) for improving the processed sound signal;
- an output unit adapted to present one or more questions to the user (1), for instance a display unit or a loudspeaker, such as the output transducer;
- an input unit adapted to receive at least one response from the user (1) to the one or more questions;
- a configurable user control element (6), such as a wheel, rocker, slider, touch sensitive element or motion sensor, operable by the user (1) and adapted to provide a user control signal for adjusting one or more signal processing parameters;

- a selection and configuration unit adapted to select the one or more signal processing parameters and to determine a mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters based on the at least one response and at least one of the following:
  - the identified listening situation, in particular a sound class, a sound level, a signal-to-noise ratio, a mean reverberation time, a frequency distribution, direction of arrival information, all of which being associated with the input sound signal;
  - currently selected signal processing parameters;
  - currently selected mode of operation;
  - current user location/position data;
  - current time;
  - image data associated with a current surroundings of the user (1).

10. The system of claim 9, comprising a second device (3, 3'), such as a smartphone (3) or a computer (3'), for instance remotely located at a call centre (4) or at a hearing device dispenser (5), the second device (3, 3') being operationally connected to the hearing device (2), the second device (3, 3') being adapted to receive at least one of the following from the hearing device (2):

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio,

the mean reverberation time, the frequency distribution, the direction of arrival information;

- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;
- the image data associated with the current surroundings of the user (1);
- an audio signal dependent on the input sound signal.

11. The system of claim 10, the second device (3, 3') being further adapted to automatically identify the listening situation, in particular based on the received audio signal.

12. The system of claim 10 or 11, wherein at least one of the input means, output unit, input unit, configurable user control element (6), and the selection and configuration unit is located at the second device (3, 3').

13. The system of one of claims 9 to 12, further comprising an expert system adapted to perform at least one of the following:

- select the one or more questions to be presented to the user (1) from a plurality of questions;

- determine the sequence in which two or more questions are presented to the user (1);
- evaluate one or more responses received from the user (1);
- select the one or more signal processing parameters to be adjusted;
- determine the mapping or transformation of the user control signal to an adjustment of the one or more signal processing parameters,

wherein the expert system is in particular located at the second device (3, 3') or remotely located from the hearing device (2) and the second device (3).

14. The system of claim 13, wherein the expert system is adapted to select the one or more questions from a plurality of questions based on at least one of the following:

- the identified listening situation, in particular the sound class, the sound level, the signal-to-noise ratio, the mean reverberation time, the frequency distribution, the direction of arrival information;
- the currently selected signal processing parameters;
- the currently selected mode of operation;
- the current user location/position data;
- the current time;

- the image data associated with the current surroundings of the user (1);

- information regarding the user's experience with utilising the hearing device (2) or other users' experience with utilising the hearing device, in particular in listening situations similar to the presently identified listening situation, e.g. where at least one of the mode of operation, sound type, location or time were the same as in the present listening situation, or where at least one of the sound level, SNR, mean reverberation time, frequency distribution, direction of arrival information or signal processing parameters was within a predetermined range of that in the present listening situation.

15. The system of claim 14, wherein the expert system is further adapted to select the at least one further question from the plurality of questions based on one or more prior responses received from the user (1).

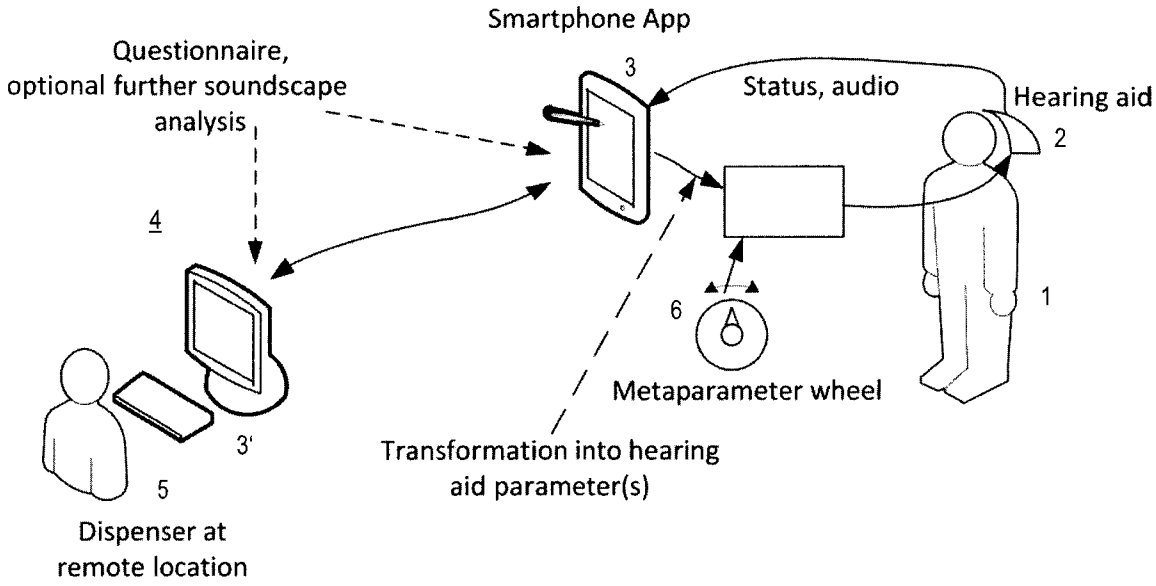

Smartphone App
Questionnaire,
optional further soundscape
analysis
3
Status, audio
Hearing aid
2
4
6
1
Metaparameter wheel
3'
Transformation into hearing
aid parameter(s)
5
Dispenser at
remote location

Fig. 1

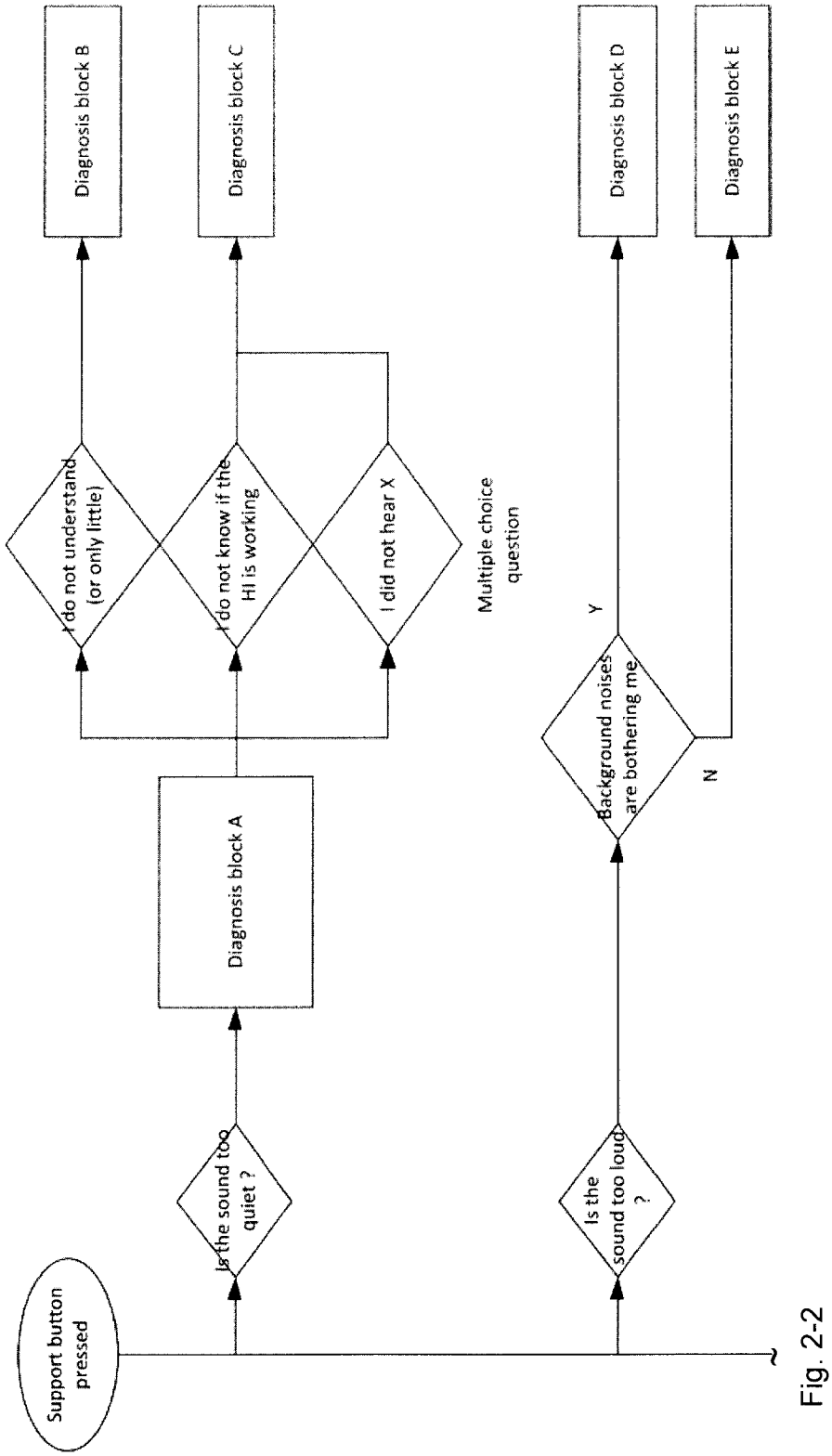

Diagnosis block B
Diagnosis block C
Diagnosis block D
Diagnosis block E
I do not understand (or only little)
I do not know if the HI is working
I did not hear X
Multiple choice question
Y
N
Background noises are bothering me
Diagnosis block A
Is the sound too quiet ?
Is the sound too loud ?
Support button pressed

Fig. 2-2

Fig. 2-1

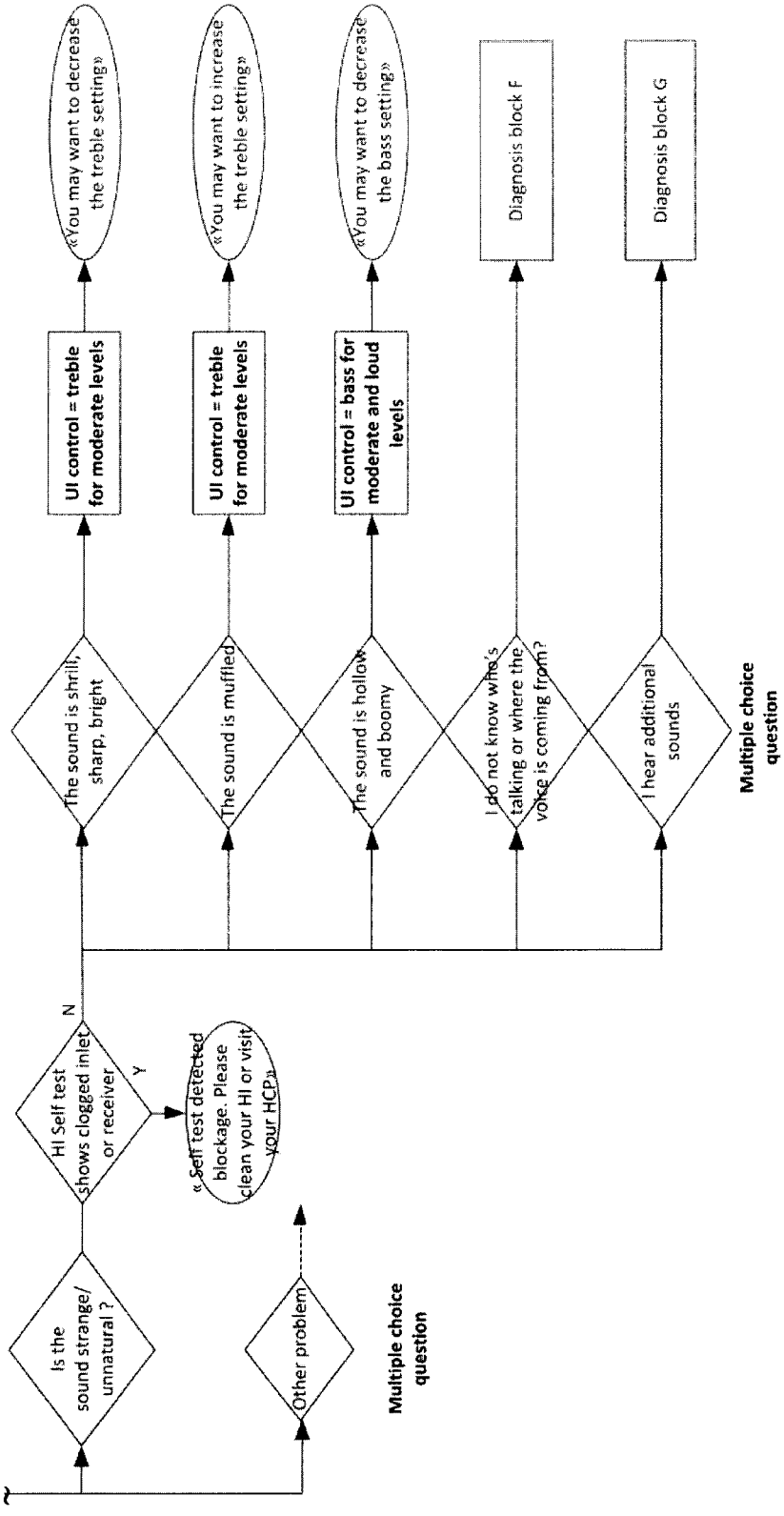

Is the sound strange/ unnatural ?
Other problem
Multiple choice question
HI Self test shows clogged inlet or receiver
N
Y
« Self test detected blockage. Please clean your HI or visit your HCP »
The sound is shrill, sharp, bright
The sound is muffled
The sound is hollow and boomy
I do not know who's talking or where the voice is coming from?
I hear additional sounds
Multiple choice question
UI control = treble for moderate levels
UI control = treble for moderate levels
UI control = bass for moderate and loud levels
Diagnosis block F
Diagnosis block G
«You may want to decrease the treble setting»
«You may want to increase the treble setting»
«You may want to decrease the bass setting»

Fig. 2-1

Fig. 2-2

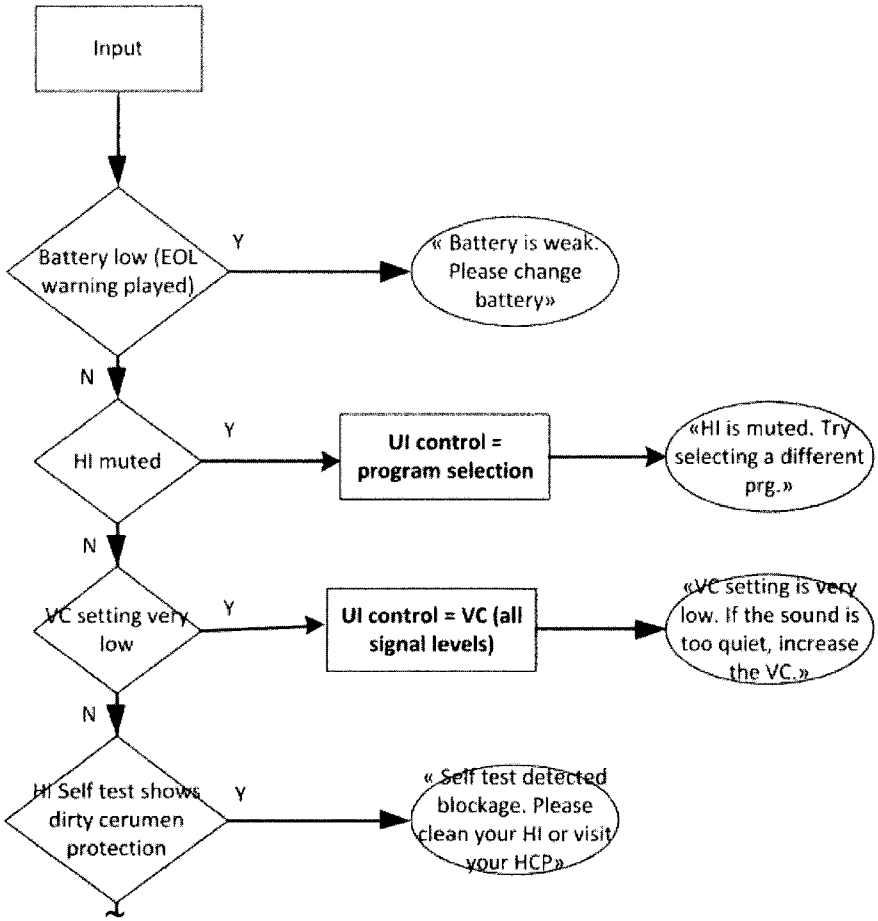

Input
Battery low (EOL warning played)
Y
« Battery is weak. Please change battery»
N
HI muted
Y
UI control = program selection
«HI is muted. Try selecting a different prg.»
N
VC setting very low
Y
UI control = VC (all signal levels)
«VC setting is very low. If the sound is too quiet, increase the VC.»
N
HI Self test shows dirty cerumen protection
Y
« Self test detected blockage. Please clean your HI or visit your HCP»

Fig. 3-2

Fig. 3-1

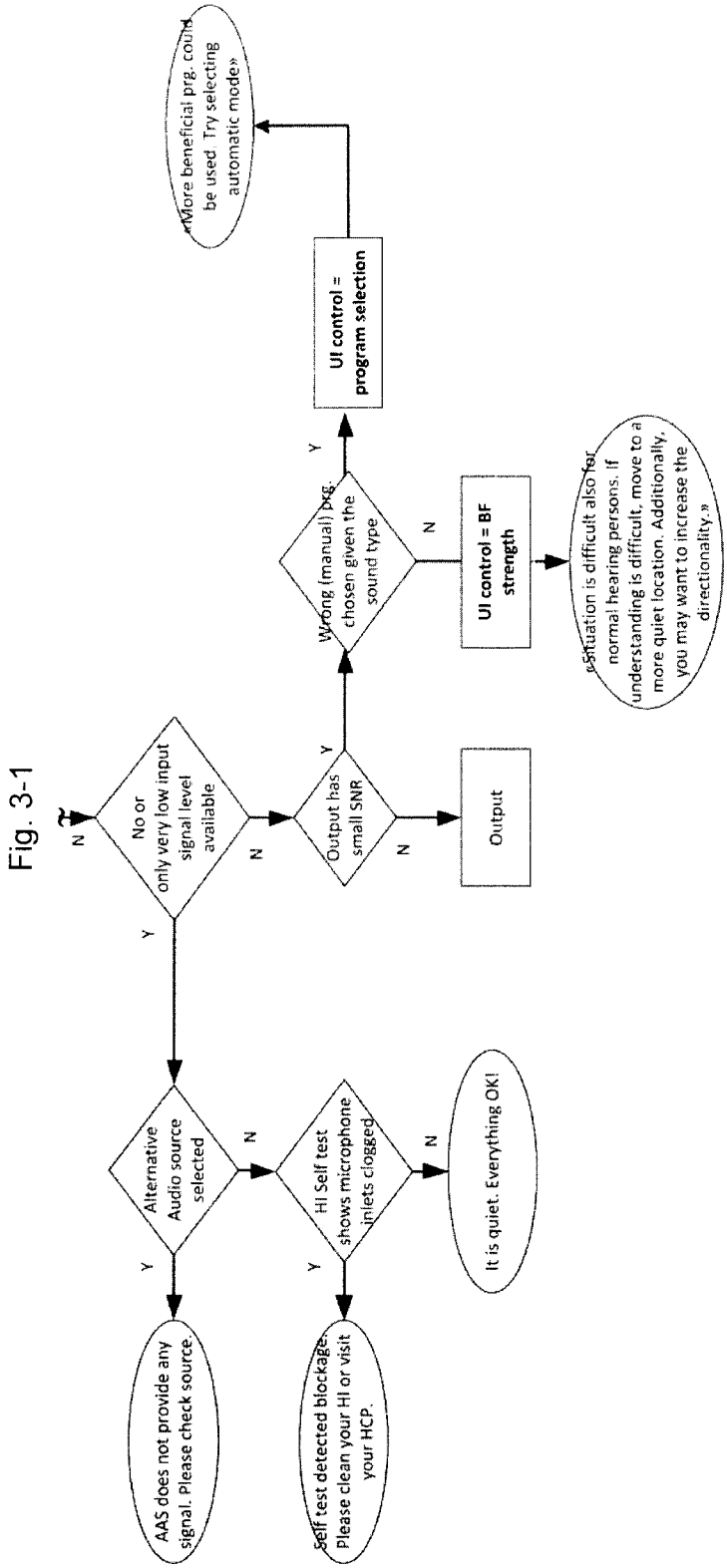

No or only very low input signal level available
Output has small SNR
Output
Wrong (manual) prg. chosen given the sound type
UI control = BF strength
Situation is difficult also for normal hearing persons. If understanding is difficult, move to a more quiet location. Additionally, you may want to increase the directionality.»
UI control = program selection
«More beneficial prg. could be used. Try selecting automatic mode»
Alternative Audio source selected
AAS does not provide any signal. Please check source.
HI Self test shows microphone inlets clogged
Self test detected blockage. Please clean your HI or visit your HCP.
It is quiet. Everything OK!
Y
N

Fig. 3-1

Fig. 3-2

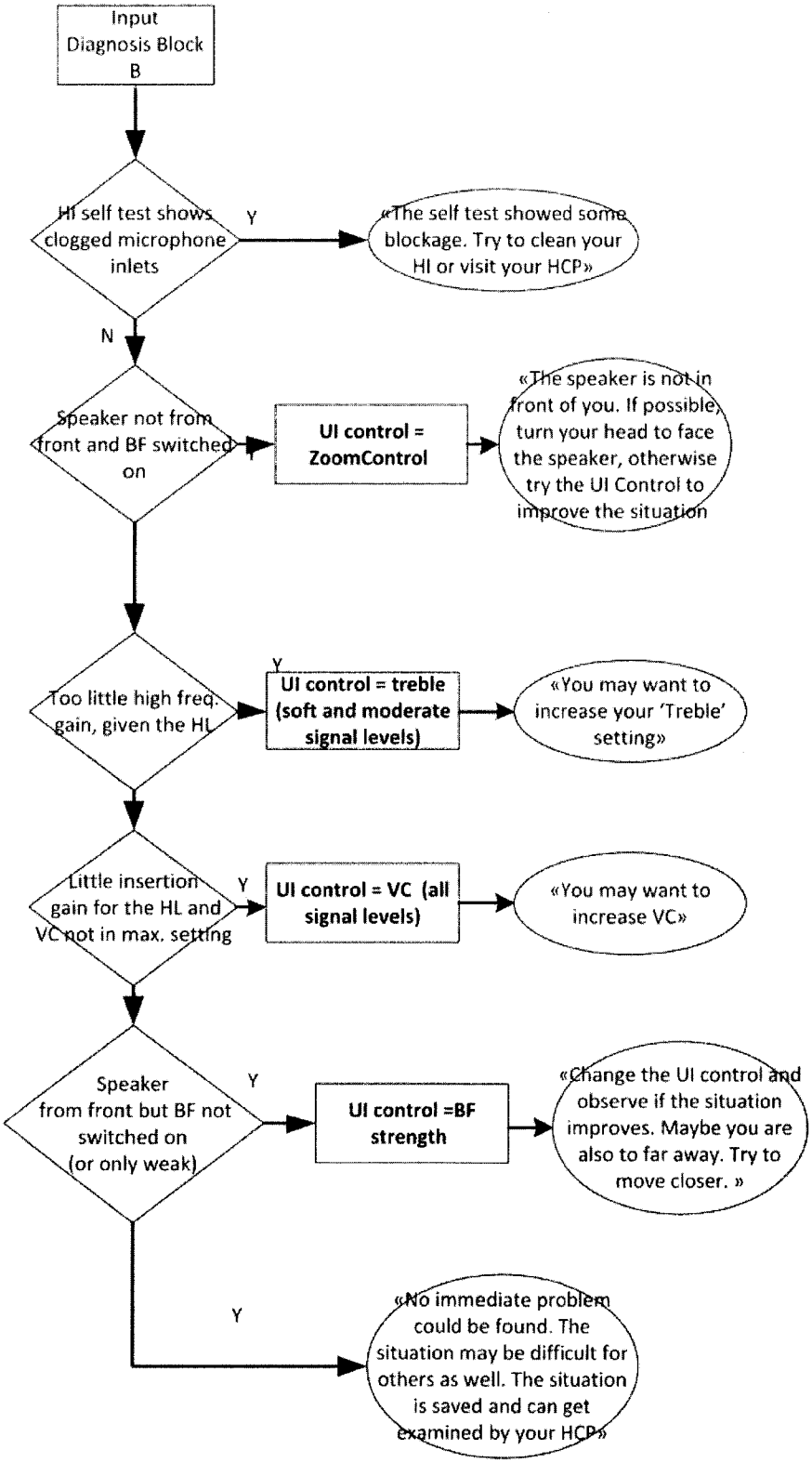

Input Diagnosis Block B
HI self test shows clogged microphone inlets
Y
«The self test showed some blockage. Try to clean your HI or visit your HCP»
N
Speaker not from front and BF switched on
Y
UI control = ZoomControl
«The speaker is not in front of you. If possible, turn your head to face the speaker, otherwise try the UI Control to improve the situation
Too little high freq. gain, given the HL
Y
UI control = treble (soft and moderate signal levels)
«You may want to increase your 'Treble' setting»
Little insertion gain for the HL and VC not in max. setting
Y
UI control = VC (all signal levels)
«You may want to increase VC»
Speaker from front but BF not switched on (or only weak)
Y
UI control =BF strength
«Change the UI control and observe if the situation improves. Maybe you are also to far away. Try to move closer. »
Y
«No immediate problem could be found. The situation may be difficult for others as well. The situation is saved and can get examined by your HCP»

Fig. 4-1

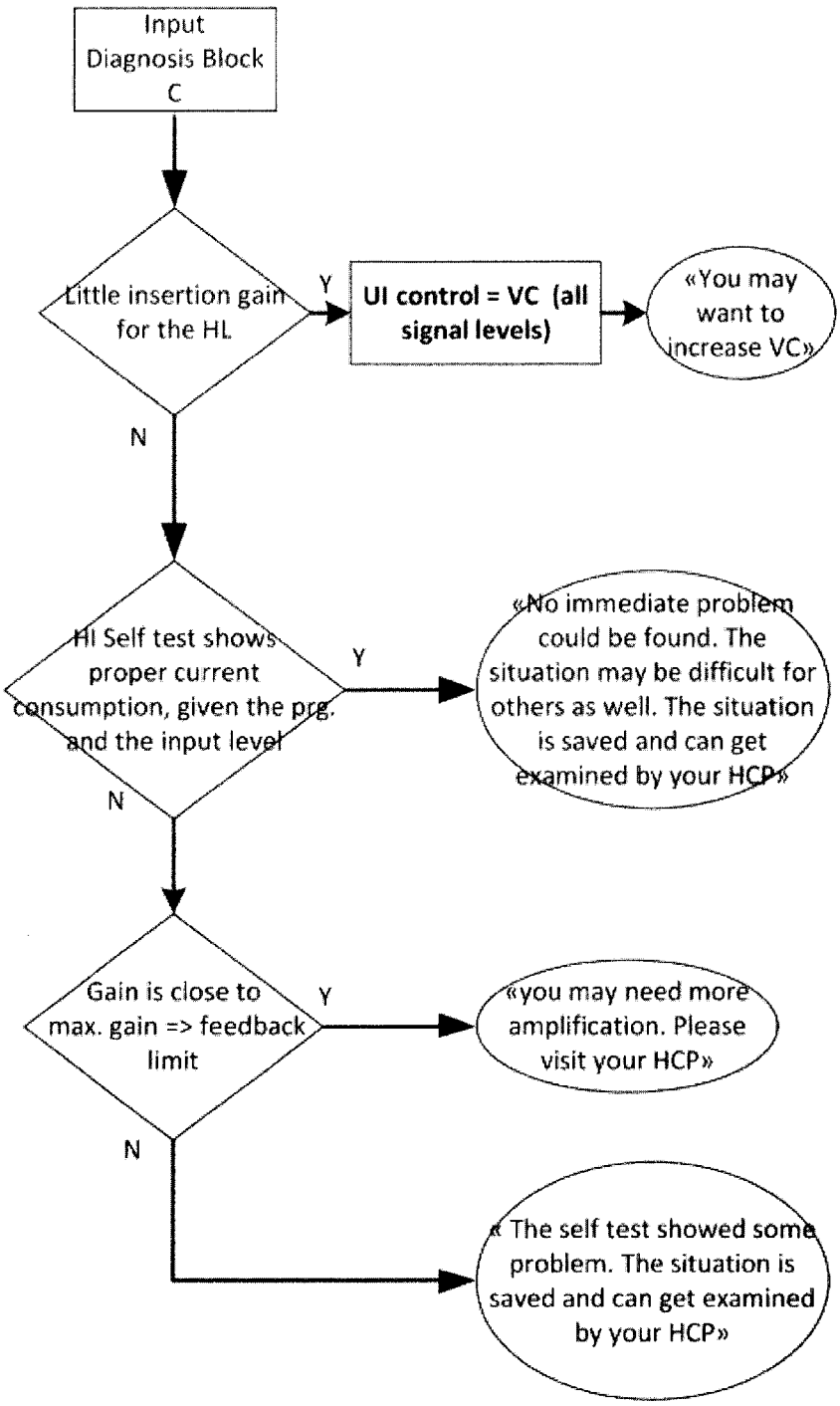

Input Diagnosis Block C
Little insertion gain for the HL
Y
UI control = VC (all signal levels)
«You may want to increase VC»
N
HI Self test shows proper current consumption, given the prg. and the input level
Y
«No immediate problem could be found. The situation may be difficult for others as well. The situation is saved and can get examined by your HCP»
N
Gain is close to max. gain => feedback limit
Y
«you may need more amplification. Please visit your HCP»
N
« The self test showed some problem. The situation is saved and can get examined by your HCP»

Fig. 4-2

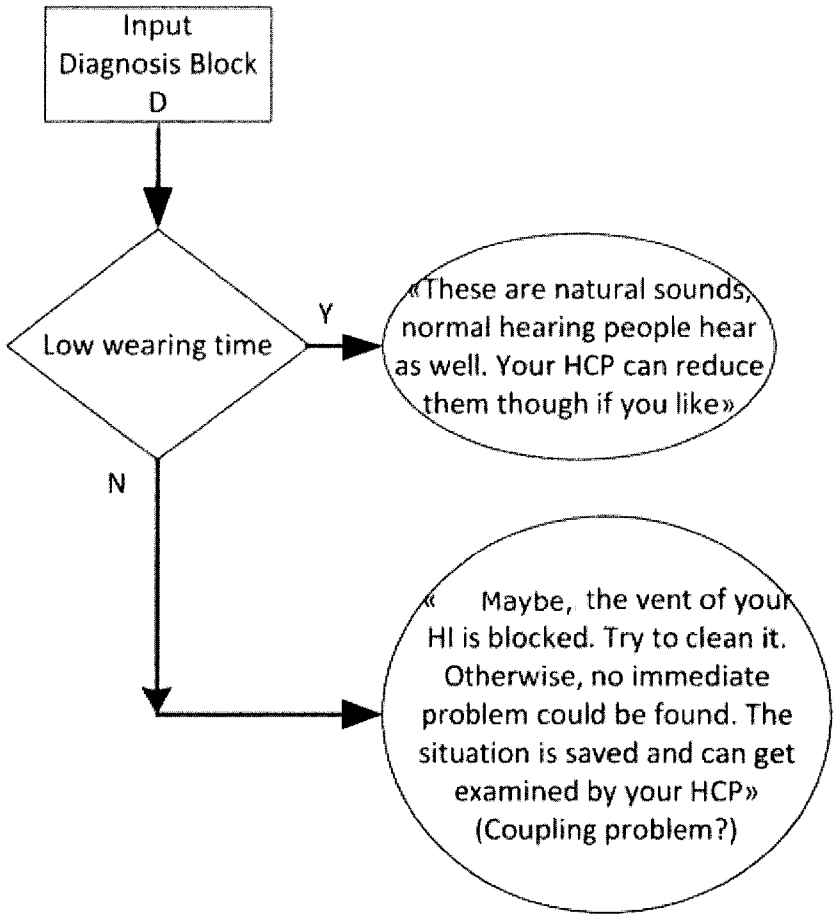

Input Diagnosis Block D
Low wearing time
Y
«These are natural sounds, normal hearing people hear as well. Your HCP can reduce them though if you like»
N
« Maybe, the vent of your HI is blocked. Try to clean it. Otherwise, no immediate problem could be found. The situation is saved and can get examined by your HCP» (Coupling problem?)

Fig. 5-1

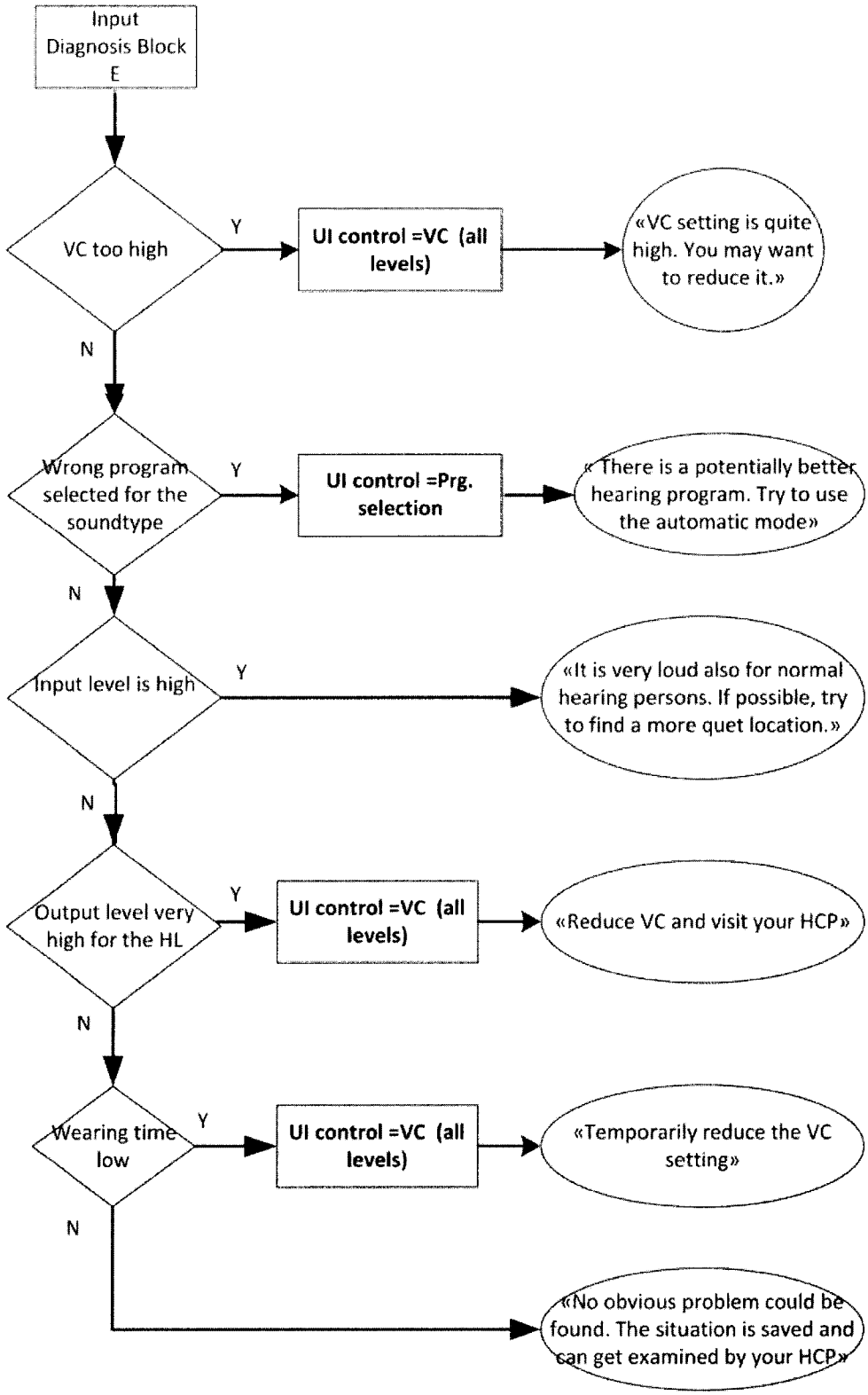

Input Diagnosis Block E
VC too high
Y
UI control =VC (all levels)
«VC setting is quite high. You may want to reduce it.»
N
Wrong program selected for the soundtype
Y
UI control =Prg. selection
« There is a potentially better hearing program. Try to use the automatic mode»
N
Input level is high
Y
«It is very loud also for normal hearing persons. If possible, try to find a more quet location.»
N
Output level very high for the HL
Y
UI control =VC (all levels)
«Reduce VC and visit your HCP»
N
Wearing time low
Y
UI control =VC (all levels)
«Temporarily reduce the VC setting»
N
«No obvious problem could be found. The situation is saved and can get examined by your HCP»

Fig. 5-2

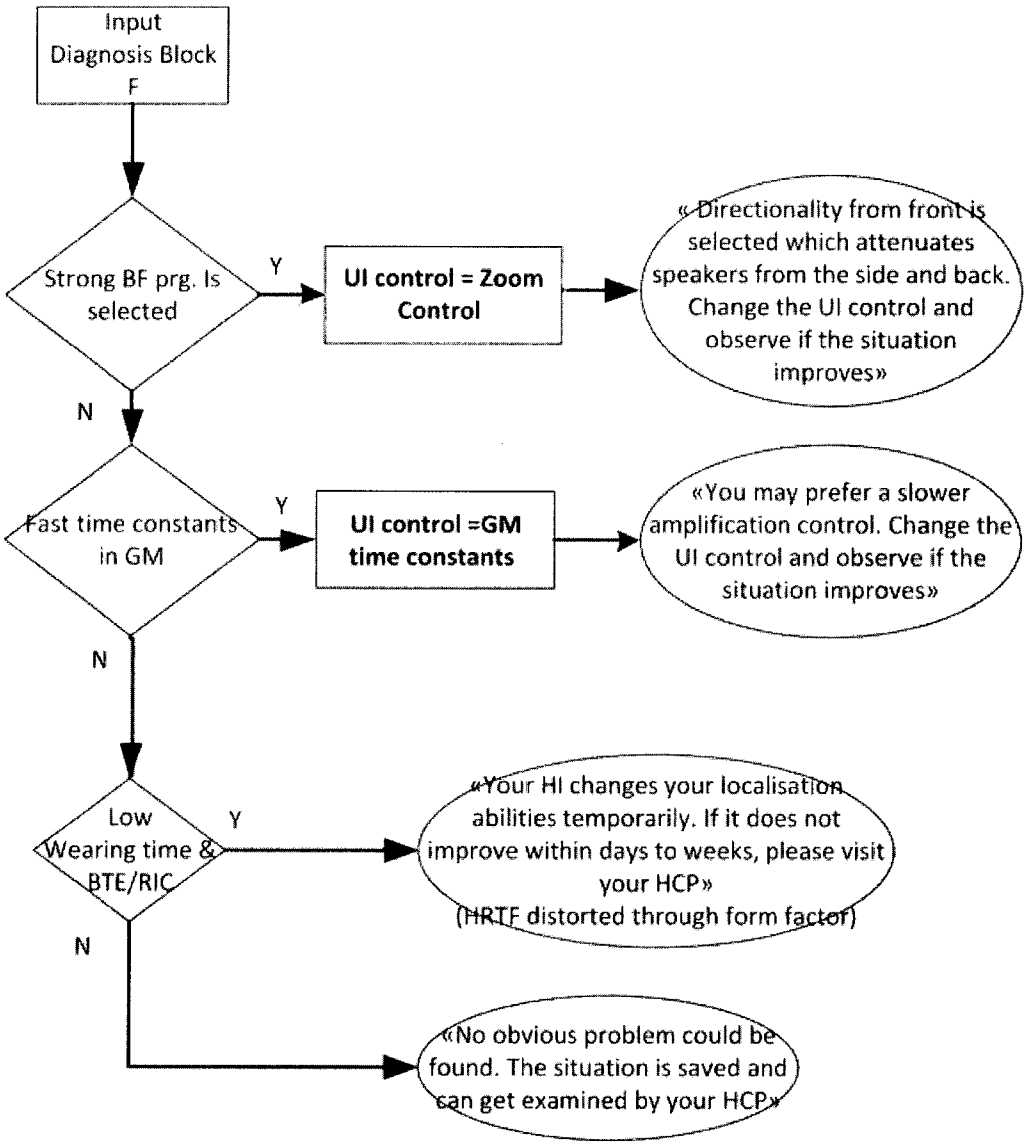

Input Diagnosis Block F
Strong BF prg. Is selected
Y
UI control = Zoom Control
«Directionality from front is selected which attenuates speakers from the side and back. Change the UI control and observe if the situation improves»
N
Fast time constants in GM
Y
UI control =GM time constants
«You may prefer a slower amplification control. Change the UI control and observe if the situation improves»
N
Low Wearing time & BTE/RIC
Y
«Your HI changes your localisation abilities temporarily. If it does not improve within days to weeks, please visit your HCP»
(HRTF distorted through form factor)
N
«No obvious problem could be found. The situation is saved and can get examined by your HCP»

Fig. 6-1

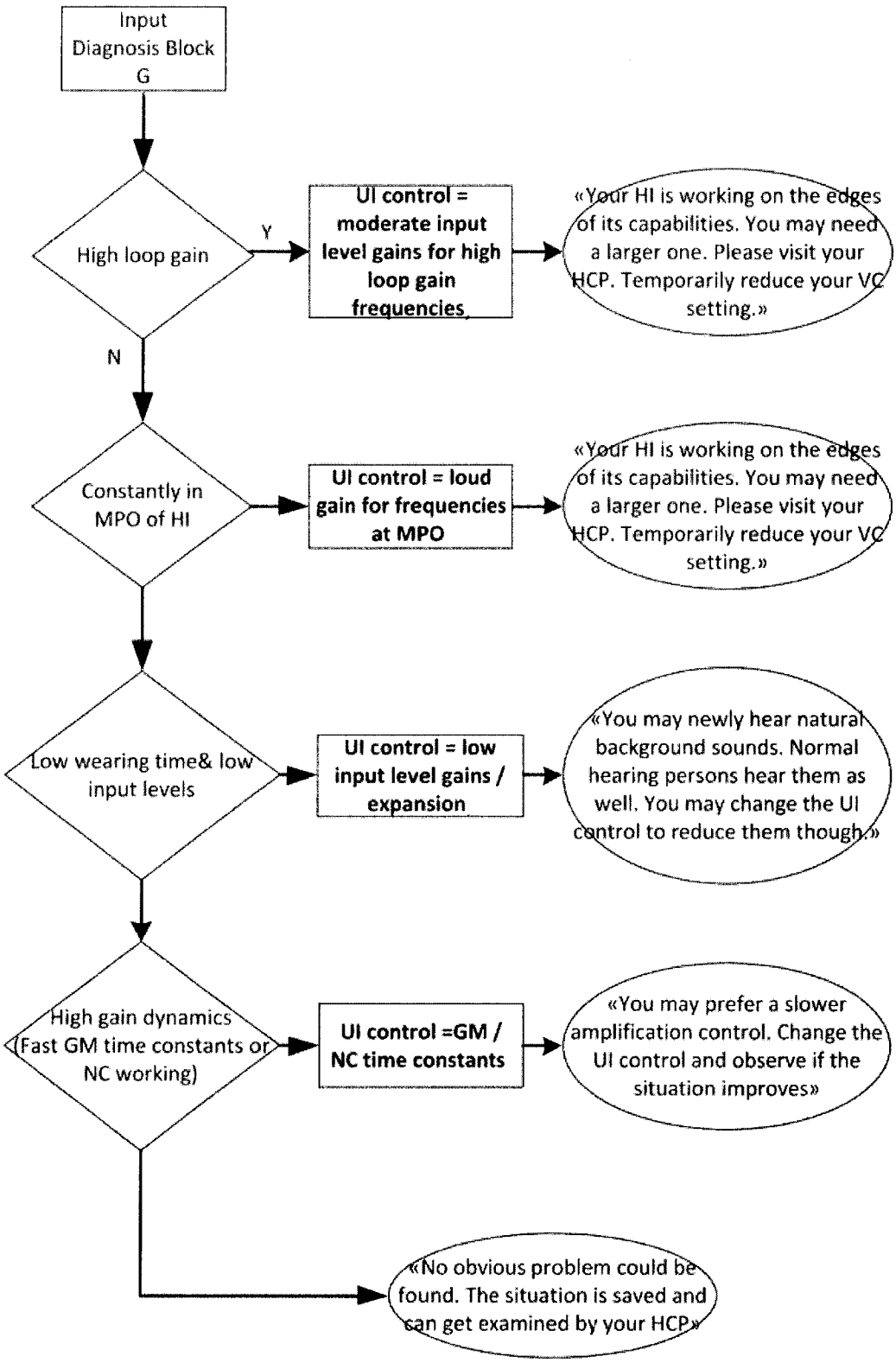

Input Diagnosis Block G
High loop gain
Y
UI control = moderate input level gains for high loop gain frequencies
«Your HI is working on the edges of its capabilities. You may need a larger one. Please visit your HCP. Temporarily reduce your VC setting.»
N
Constantly in MPO of HI
UI control = loud gain for frequencies at MPO
«Your HI is working on the edges of its capabilities. You may need a larger one. Please visit your HCP. Temporarily reduce your VC setting.»
Low wearing time& low input levels
UI control = low input level gains / expansion
«You may newly hear natural background sounds. Normal hearing persons hear them as well. You may change the UI control to reduce them though.»
High gain dynamics (Fast GM time constants or NC working)
UI control =GM / NC time constants
«You may prefer a slower amplification control. Change the UI control and observe if the situation improves»
«No obvious problem could be found. The situation is saved and can get examined by your HCP»

Fig. 6-2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/050101

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/00
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)
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 2013/202131 A1 (KEMMOCHI CHISATO [JP] ET AL) 8 August 2013 (2013-08-08) the whole document	1-15
Y	EP 2 306 756 A1 (SIEMENS MEDICAL INSTR PTE LTD [SG]) 6 April 2011 (2011-04-06) the whole document	1-15
Y	US 2005/281424 A1 (RASS UWE [DE]) 22 December 2005 (2005-12-22) the whole document	1-15
A	US 2010/272297 A1 (BORETZKI MICHAEL [CH]) 28 October 2010 (2010-10-28) the whole document	1-15
A	US 2015/023512 A1 (SHENNIB ADNAN [US]) 22 January 2015 (2015-01-22) the whole document	1-15

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

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 September 2016	22/09/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bücker, Martin

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/050101

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