PTO/AIA/15 (10-17)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	0503-0636
First Named Inventor	Abhinav GABA
Title	A METHOD AND SYSTEM ...
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☐ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 29] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 11]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☑ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
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ACCOMPANYING APPLICATION PAPERS

10. ☐ **Assignment Papers** (cover sheet & document(s)) Name of Assignee _____
11. ☐ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☑ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☑ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☑ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☐ **Other:** _____

*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

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Zophonos EX2001
Samsung v. Zophonos
IPR2026-00085

A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is based on and claims priority under 35 U.S.C. § 119(a) of an Indian patent application number 202111061923, filed on December 30, 2021, in the Indian Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

[0002] The disclosure relates to a method and system for mitigating unwanted audio noise. More particularly, the disclosure relates to a method and system for mitigating unwanted audio noise in a voice assistant-based communication environment.

2. Description of Related Art

[0003] With the rapid growth in speech recognition and speech response-based systems, an exploration into human interaction with Artificial Intelligence (AI) based voice systems has become an integral part of livelihood and has drawn significant consideration of the users for a better interactive experience. For example, voice assistants have become an integral part of home and office environments nowadays. There are many reasons due to which speech recognition or the speech response by the AI-based voice systems fail in the case of a noisy environment.

[0004] In an ideal scenario, in a room or hall with no activity, the voice responses from the voice assistants would be clearly audible to users. However, it is very rare to have an interaction with a voice assistant that doesn't have some form of background noise. For example, the user could be in a home with multiple noise elements present in the background, or the user could be at a quick-service restaurant with other customers' chatter, etc. whatever the background noise is, a voice assistant needs to be able to filter

through it and focus on the person asking the question and respond that accordingly. Otherwise, the voice assistant will lose its accuracy. For example, the voice assistant might provide false positives and negative responses, and might create frustration for the user. Generally, the voice assistant brings a whole new hands-free experience of asking questions, requests, or giving tasks and that is why it needs to be accurate. Therefore, the voice responses from these devices need to be loud and clear.

[0005] Elements of the noisy environment like additive noise, convolutional noise, nonlinear distortion, etc. in the AI-based voice systems are not easy to correct and not all solutions work for each type of noise interference. For example, there is noise or some background sound in rooms and offices where different kinds of activities are ongoing. An example of such an environment is also shown in FIG. 1 of the drawings. These noises and the background sound in the room and offices make it difficult for the user of the voice assistant to be able to understand or listen to the audio response provided by the voice assistant. In general, noise is very difficult for AI-based voice systems to handle and requires various reduction methods.

[0006] Therefore, there lies a need for a method and system that can mitigate unwanted audio noise in such environments as discussed above. Accordingly, the disclosure describes the method and the system for mitigating unwanted audio noise in a voice assistant-based communication environment to provide loud and clear voice responses to the user.

[0007] The above information is presented as background information only to assist with an understanding of the disclosure. No determination has been made, and no assertion is made, as to whether any of the above might be applicable as prior art with regard to the disclosure.

SUMMARY

[0008] This summary is provided to introduce a selection of concepts in a simplified format that are further described in the detailed description of the disclosure. This summary is not intended to identify key or essential inventive concepts of the disclosure, nor is it intended for determining the scope of the disclosure.

[0009] Aspects of the disclosure are to address at least the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the disclosure is to provide a method and system for mitigating unwanted audio noise in a voice assistant-based communication environment.

[0010] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

[0011] In accordance with an aspect of the disclosure, a method for mitigating unwanted audio noise in the Internet of things (IoT) based communication environment is provided. The method includes identifying and pairing one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. The method further comprises dividing, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. Furthermore, the method comprises detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. Subsequent to the detection of the user's location, the method furthermore comprises determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location and then using a recurrent neural networks (RNN) model predicting an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data that includes information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices. At last, after the prediction of the optimal sound output of the voice assistance device, the method furthermore comprises correcting the predicted optimal sound output of the

voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT devices of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

[0012] In accordance with another aspect of the disclosure, a system for mitigating unwanted audio noise in IoT based communication environment is provided. The system includes a pairing module, a clustering module, a prediction module, and a correction module. The pairing module is configured to identify and pair one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. The clustering module is configured to divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. The clustering module is further configured to detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. Furthermore, the clustering module is configured to determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. The prediction module is configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data that includes information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise information associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.. After the prediction of the optimal sound output, the correction module is configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT devices of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

[0013] Other aspects, advantages, and salient features of the disclosure will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses various embodiments of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The above and other, aspects, features, and advantages of certain embodiments of the disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0015] FIG. 1 illustrates an example illustration of problems indicating unwanted noise present in a voice assistance based communication environment, according to the related art;

[0016] FIG. 2 illustrates a flowchart of method operations for mitigating unwanted audio noise in the IoT based communication environment, according to an embodiment of the disclosure;

[0017] FIG. 3 illustrates a system architecture for mitigating unwanted audio noise in the IoT based communication environment, according to an embodiment of the disclosure;

[0018] FIG. 4 illustrates an example illustration of the gaussian mixture model (GMM), according to an embodiment of the disclosure;

[0019] FIG. 5 illustrates a graphical representation indicating maximum silhouette score for the selection of the number of clusters, according to an embodiment of the disclosure;

[0020] FIG. 6 illustrates an example illustration of sonar technology using the ultrasonic wave and the echo signal for the detection of the user's location with respect to the voice assistant device, according to an embodiment of the disclosure;

[0021] FIG. 7 illustrates a prediction method involved in the prediction of the optimal sound at the detected user's location, according to an embodiment of the disclosure;

[0022] FIG. 8 illustrates a process of comparison for the selection of the target IoT node, according to an embodiment of the disclosure;

[0023] FIG. 9 illustrates a phase shift network for shifting the phase of the predicted optimal sound output, according to an embodiment of the disclosure;

[0024] FIG. 10 illustrates a representative architecture to provide tools and development environment described herein for a technical realization of the system 300, according to an embodiment of the disclosure; and

[0025] FIG. 11 illustrates another implementation in accordance with the embodiment of the disclosure, and yet another typical hardware configuration of the system 1000 in the form of a computer system 1100, according to an embodiment of the disclosure.

[0026] Further, skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and may not have necessarily been drawn to scale. For example, the flow charts illustrate the method in terms of the most prominent operations involved to help to improve understanding of aspects of the disclosure. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by symbols, according to the related art, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the disclosure so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

[0027] Throughout the drawings, like reference numerals will be understood to refer to like parts, components, and structures.

DETAILED DESCRIPTION

[0028] The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of various embodiments of the disclosure as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and

modifications of the various embodiments described herein can be made without departing from the scope and spirit of the disclosure. In addition, descriptions of well-known functions and constructions may be omitted for clarity and conciseness.

[0029] The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the disclosure. Accordingly, it should be apparent to those skilled in the art that the following description of various embodiments of the disclosure is provided for illustration purpose only and not for the purpose of limiting the disclosure as defined by the appended claims and their equivalents.

[0030] It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a component surface" includes reference to one or more of such surfaces.

[0031] The term "some" as used herein is defined as "none, or one, or more than one, or all." Accordingly, the terms "none," "one," "more than one," "more than one, but not all" or "all" would all fall under the definition of "some." The term "some embodiments" may refer to no embodiments or one embodiment or several embodiments or all embodiments. Accordingly, the term "some embodiments" is defined as meaning "no embodiment, or one embodiment, or more than one embodiment, or all embodiments."

[0032] The terminology and structure employed herein is for describing, teaching, and illuminating some embodiments and their specific features and elements and does not limit, restrict, or reduce the spirit and scope of the claims or their equivalents.

[0033] More specifically, any terms used herein such as but not limited to "includes," "comprises," "has," "consists," and grammatical variants thereof do NOT specify an exact limitation or restriction and certainly do NOT exclude the possible addition of one or more features or elements, unless otherwise stated, and must NOT be taken to exclude the possible removal of one or more of the listed features and elements, unless otherwise stated with the limiting language "MUST comprise" or "NEEDS TO include."

[0034] Whether or not a certain feature or element was limited to being used only once, either way, it may still be referred to as "one or more features" or "one or more elements" or "at least one feature" or "at least one element." Furthermore, the use of the terms "one or more" or "at least one" feature or element do NOT preclude there being none of that feature or element unless otherwise specified by limiting language such as "there NEEDS to be one or more..." or "one or more element is REQUIRED."

[0035] Unless otherwise defined, all terms, and especially any technical and/or scientific terms, used herein may be taken to have the same meaning as commonly understood by one having ordinary skill in the art.

[0036] Embodiments of the disclosure will be described below in detail with reference to the accompanying drawings.

[0037] FIG. 2 illustrates a flowchart of method operations for mitigating unwanted audio noise in the Internet of Things (IoT)-based communication environment, according to an embodiment of the disclosure.

[0038] Referring to FIG. 2, it depicts a method 200 that is executed by components of the system 300 of FIG. 3 of the drawings. FIG. 3 illustrates a system architecture for mitigating unwanted audio noise in the IoT-based communication environment, according to an embodiment of the disclosure.

[0039] Referring to FIG. 3, the system 300 includes a pairing module 302, a clustering module 304, a prediction module 306, a correction module 308, a rendering module 310, IoT devices 312 including sensor module 314, a voice assistant device 316, and a processing module 318. The aforementioned components of the system 300 are coupled with each other for transfer of information from one component to the other component in the system 300. It will be understood to a person of ordinary skill in the art that the disclosure is not limited to the architecture described above, the concept of the proposed architecture can be applied to any kind of IoT communication-based architecture supporting the voice assistance feature.

[0040] The IoT devices 312 are intended to represent devices with wired or wireless interfaces through which the IoT devices 312 can send and receive data over wired and wireless connections. Examples of IoT devices include, but are not limited to, mobile devices, smart electronic devices, biological managers, sensory devices,

functionality performing devices, and the like. The IoT devices 312 can include unique identifiers which can be used in the transmission of data through a network. Unique identifiers of the IoT devices 312 can include identifiers created in accordance with Internet Protocol version 4 (hereinafter referred to as "IPv4") or identifiers created in accordance with Internet Protocol version 6 (hereinafter referred to as "IPv6"), of which both protocol versions are hereby incorporated by reference. Depending upon implementation-specific or other considerations, the IoT devices 312 can include applicable communication interfaces for receiving and sending data according to an applicable wireless device protocol. Examples of applicable wireless device protocols include, but are not limited to, Wi-Fi, ZigBee®, Bluetooth®, and other applicable low-power communication standards.

[0041] The sensor module 314 included in the IoT devices 312 may include but is not limited to, accelerometer sensor, ultrasonic sensors, gyro sensor, proximity sensor, infrared (IR) sensor, humidity sensor, pressure sensor, level sensor, gas sensor, temperature sensor, motion detection sensor, and the like.

[0042] Here a detailed description of the flow of method of the method 200 and functionalities of the components of the system 300 will be made by referring to the voice assistant device 316. However, other smart IoT devices supporting voice assistant features and the like can also be used as reference.

[0043] Referring to FIG. 2, the method 200 comprises at operation 202 identifying and pairing one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. As an example, the pairing module 302 identifies the IoT devices 312 in the IoT-based communication environment when the voice assistant device 316 triggers an input event to the pairing module 302 as soon as the voice assistant device is ready in a wireless connection state and operation mode. After the identification of the IoT devices 312, the pairing module 302 pairs the identified IoT devices with the voice assistant device 316 based on an exchange of information between the IoT devices 312 and the voice assistant device 316.

[0044] In particular, the pairing module 302 exchanges the information between the IoT devices 312 and the voice assistant device 316 in a pairing mode based on approval of a respective connection request by the IoT devices 312 that is being transmitted by the voice assistant device 316 to the respective IoT devices 312. The exchanged information may include but is not limited to, the location information of the IoT devices 312, the information associated with environmental noise around each IoT device of the IoT devices 312, and the information associated with the perceived sound of the voice assistant device 316 at each IoT device of the IoT devices 312. The pairing module 302 may also update the exchanged information periodically based on a change in the wireless connection states of the IoT devices 312 with the voice assistant device 316. The flow of the method 200 now proceeds to operation 204.

[0045] At operation 204, subsequent to the pairing of the IoT devices 312 with the voice assistant device 316, the method 200 comprises dividing, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. For ease of explanation, an example illustration of the gaussian mixture model is also shown in FIG. 4 of the drawings, according to an embodiment of the disclosure. As an example, the clustering module 304 divides the IoT devices 312 that are paired with the voice assistant device 316 into a plurality of clusters based on the location information of the IoT devices 312. Initially, the clustering module 304 applies the gaussian mixture model on a dataset for a different range of cluster count and then further selects a number of clusters for which silhouette score is maximum. A graphical representation indicating maximum silhouette score for the selection of the number of clusters is illustrated in FIG. 5 of the drawings, according an embodiment of the disclosure. Here, each cluster of the plurality of clusters includes at least one IoT device. The flow of the method 200 now proceeds to operation 206.

[0046] At operation 206, after the division of the one or more paired IoT devices into the plurality of clusters, the method 200 comprises detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the

user's body in response to the transmitted ultrasonic wave. As an example, after dividing the IoT devices 312 into the plurality of clusters, the clustering module 304 further detects a location of the user with respect to a location of the voice assistant device 316 based on at least one of sensors data collected by the respective sensor modules 314 of the IoT devices 312 or the time difference between the ultrasonic wave 602 transmitted by the voice assistance device 316 and an echo signal 604 reflected from the user's body 606 in response to the transmitted ultrasonic wave 602. In particular, the clustering module 304 identifies the user's location with the help of sonar technology and classify the user as part of one of the clusters among the plurality of cluster. An example illustration of the sonar technology using the ultrasonic wave and the echo signal is shown in FIG. 6 of the drawings, according to an embodiment of the disclosure. The flow of the method 200 now proceeds to operation 208.

[0047] At operation 208, after the detection of the user's location, the method 200 comprises determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. As an example, after detecting the user's location, the clustering module 304 furthermore determines a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. The flow of the method 200 now proceeds to operation 210.

[0048] Once the process of clustering module 304 is completed and the output generated by clustering module 304 acts as an input to the prediction module 306, and accordingly at operation 210, the method 200 comprises predicting, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data. As an example, the prediction module 306 predicts, using the RNN model, an optimal sound output of the voice assistance device 316 that is audible at the detected user's location based on the sound information data. The sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices. In particular, the sound information data includes an original sound output of the voice assistant device 316, the

environmental noise information associated with the determined cluster in which the user is present, and the information related to the perceived sound of the voice assistant device 316 at each IoT device among the IoT devices 312. Further, the predicted optimal sound output of the voice assistance device 316 includes a plurality of acoustic parameters (Frequency parameters and intensity parameters). The first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level (f_{min}, f_{max}, and f_{mid}) of the predicted optimal sound output, and the second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level (I_{min}, I_{max}, and I_{mid}) of the predicted optimal sound output.

[0049] In particular, the output of the RNN is the predicted sound at the detected user's location, which can be denoted as 6 acoustic parameters such as:

Frequency parameters: f_{min}, f_{max}, f_{mid}

Intensity parameters: I_{min}, I_{max}, I_{mid}

[0050] For ease of explanation, the operations involved in the prediction of the optimal sound at the detected user's location is shown in FIG. 7 of the drawings, according to an embodiment of the disclosure. The Output Y as shown in FIG. 7 denotes the predicted optimal sound at the detected user's location that can be denoted as 6 acoustic parameters as described above. The flow of the method 200 now proceeds to operation 212.

[0051] Once the process of the prediction module 306 is completed, the output generated by the prediction module 306 acts as an input to the correction module 308, and accordingly at operation 212, the method 200 comprises correcting the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value. As an example, the correction module 308 corrects the predicted optimal sound output of the voice assistance device 316. For correcting the predicted optimal sound

output of the voice assistance device 316, the correction module 308 performs a series of operations described below.

[0052] Initially, the correction module 308 calculates the sound parameter value (Δ) corresponding to each of the IoT devices of the determined cluster in which the user is present. In order to calculate the sound parameter value, the correction module 308 performs a series of sub-operations such as, combining the first set of acoustic parameters ($\Delta_f = f_{min}, f_{max}, f_{mid}$) with the second set of acoustic parameters ($\Delta_I = I_{min}, I_{max}, I_{mid}$) based on frequency bands of an audible range (for example, 20Hz – 20kHz) and then calculates the sound parameter value ($\Delta = \Delta_f + \Delta_I$) by adding or combining the parameter values of the first set of acoustic parameters with the parameter values of the second set of acoustic parameters. Here, both parameter values Δ_f and Δ_I correspond to independent variables.

[0053] Once the sound parameter value is calculated by the correction module 308 then the correction module 308 selects, as a target IoT device, an IoT device that has a minimum sound parameter value from the determined cluster in which the user is present. In particular, the correction module 308 compares the functional values (comparison function 800) of the combinations of the acoustic parameters for each neighboring IoT node with the current IoT node (i.e., the IoT node with the Ideal sound which needs to be heard in the user cluster) and selects a target IoT Node 802 on the basis of a result of the comparison indicating an IoT node with the minimum difference. Here, during the comparison, mid-range frequencies have been given a higher priority because they are most audible by humans and then the minimum range frequencies have been prioritized because they are most susceptible to loss. Accordingly, the target IoT node 802 is selected on the basis of least delta (i.e., sound parameter value Δ) from it to the determined cluster in which the user is present. An example illustration of the basis of comparison for the selection of the target IoT node is shown in FIG. 8 of the drawings, according to an embodiment of the disclosure.

[0054] Once the target IoT node (Target IoT device among the determined user cluster) is selected by the correction module 308 then the correction module 308 perform a shifting operation for shifting a phase of the predicted optimal sound output based on the sound parameter value (Δ) and the sound parameters of the selected IoT

device (i.e., sound parameters of the target IoT device). As an example, the correction module 308 shifts the phase of the predicted optimal sound output by 180° based on Δ parameters (acoustic parameters) of the selected target IoT device using a phase shift network 806 as shown in FIG. 9 of the drawings, according to an embodiment of the disclosure. The shifting in the phase of the predicted optimal sound output ensures destructive interference with noise.

[0055] Furthermore, in the final operation, after shifting the phase of the predicted optimal sound output, the correction module 308 generates a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with the desired sound of the voice assistant device 316. As an example, the correction module 308 generates a corrected sound or the ideal sound to be heard at the user's location by merging the shifted phase optimal sound output with the desired sound of the voice assistant device 316.

[0056] When the new optimal sound or the corrected sound is generated by the correction module 308, then the rendering module 310 of the system 300 emits or outputs the generated new optimal sound from the selected target IoT device that can be heard clearly at the user location despite the adverse effect of the unwanted noise in the environment or surroundings around the user.

[0057] According to one embodiment of the disclosure, the processing module 318 of the system 300 determines, based on the corrected optimal sound output of the voice assistance device 316, an optimal region in the determined cluster in which the user is present or around the determined cluster where the generated new optimal sound is audible and accordingly updates settings of the voice assistance device 316 based on the determined optimal region in order to accurately provide loud and clear voice response to the user.

[0058] Now some specific use case examples of the disclosure will be described in accordance with an embodiment of the disclosure.

[0059] The method 200 and the system 300 of the disclosure can be used in IoT-based Home Automation solutions. Many times, in an event-triggered communication between the voice assistant device and a human, when the voice assistant (VA) device utters some message for the user but due to the noisy environment there is no feedback

if the user gets the message uttered by the voice assistant device or not. In other words, since the user is not aware that the voice assistant device is speaking information to the user, the user never gets that information. In view of such a situation, the method 200 and the system 300 of the disclosure can generate an enhanced modulated sound which if transmitted from IoT devices will reach to the user with minimized signal to noise ratio (SNR). Those skilled in the art will appreciate that the aforementioned example is merely exemplary and is not intended to limit the scope of the invention.

[0060] The method 400 and the system 500 of the disclosure can also be used in the case of industrial automation based IoT solutions to mitigate the unwanted noise from a noisy environment and in order to generate the enhanced modulated sound which if transmitted from IoT devices will reach to the user or other IoT devices with minimized SNR. Those skilled in the art will appreciate that the aforementioned example is merely exemplary and is not intended to limit the scope of the invention.

[0061] Referring now to FIG. 10 of the drawings, it illustrates a representative architecture to provide tools and development environment described herein for a technical realization of the system 300, according to an embodiment of the disclosure. FIG. 10 is merely a non-limiting example, and it will be appreciated that many other architectures may be implemented to facilitate the functionality described herein. The architecture may be executing on hardware such as a computing machine (or system) 1000 of FIG. 10 that includes, among other things, processors, memory, and various application-specific hardware components.

[0062] The architecture (or system) 1000 may include an operating system, libraries, frameworks, or middleware. The operating system may manage hardware resources and provide common services. The operating system may include, for example, a kernel, services, and drivers defining a hardware interface layer. The drivers may be responsible for controlling or interfacing with the underlying hardware. For instance, the drivers may include display drivers, camera drivers, Bluetooth® drivers, flash memory drivers, serial communication drivers (e.g., Universal Serial Bus (USB) drivers), Wi-Fi® drivers, audio drivers, power management drivers, and so forth depending on the hardware configuration.

[0063] A hardware interface layer includes libraries which may include system libraries such as file-system (e.g., C standard library) that may provide functions such as memory allocation functions, string manipulation functions, mathematic functions, and the like. In addition, the libraries may include application programming interface (API) libraries such as audio-visual media libraries (e.g., multimedia data libraries to support presentation and manipulation of various media formats such as moving picture experts group 4 (MPEG4), H.264, MPEG audio layer 3 (MP3), advanced audio coding (AAC), adaptive multi rate (AMR), joint photographic expert group (JPG), portable network graphic (PNG)), database libraries (e.g., SQLite that may provide various relational database functions), web libraries (e.g., WebKit that may provide web browsing functionality), and the like.

[0064] A middleware may provide a higher-level common infrastructure such as various graphic user interface (GUI) functions, high-level resource management, high-level location services, and so forth. The middleware may provide a broad spectrum of other APIs that may be utilized by the applications or other software components/modules, some of which may be specific to a particular operating system or platform.

[0065] The term “module” or “unit” used in this disclosure may refer to a certain unit that includes one of hardware, software, and firmware or any combination thereof. The module may be interchangeably used with unit, logic, logical block, component, or circuit, for example. The module may be the minimum unit, or part thereof, which performs one or more particular functions. The module may be formed mechanically or electronically. For example, the module or the unit disclosed herein may include at least one Application-Specific Integrated Circuit (ASIC) chip, Field-Programmable Gate Arrays (FPGAs), and programmable-logic device, which have been known or are to be developed.

[0066] Further, the architecture 1000 depicts an aggregation of audio/video processing device-based mechanisms and machine learning/natural language processing (ML/NLP)-based mechanisms in accordance with an embodiment of the subject matter. A user interface is defined as input and interaction 1001 refers to overall input. It can include one or more of the following –touch screen, microphone, camera,

etc. A first hardware module 1002 depicts specialized hardware for ML/NLP based mechanisms. As an example, the first hardware module 1002 comprises one or more neural processors, FPGA, digital signal processor (DSP), graphics processing unit (GPU), etc.

[0067] A second hardware module 1012 depicts specialized hardware for executing the data splitting and transfer. ML/NLP based frameworks and APIs 1004 correspond to the hardware interface layer for executing the ML/NLP logic 1006 based on the underlying hardware. In an example, the frameworks may be one or more or the following – Tensorflow, Café, NLTK, GenSim, ARM Compute, etc. Simulation frameworks 1016 and APIs 1014 may include one or more of – Audio Core, Audio Kit, Unity, Unreal etc.

[0068] A multimedia database (DB) 1008 depicts a pre-trained database. The database 1008 may be remotely accessible through cloud by the ML/NLP logic 1006. In other example, the database 1008 may partly reside on cloud and partly on-device based on usage statistics.

[0069] Another database (e.g., an objects DB) 1018 refers the memory. The database 1018 may be remotely accessible through a cloud. In other example, the database 1018 may partly reside on the cloud and partly on-device based on usage statistics.

[0070] A rendering module 1005 is provided for rendering audio output and triggering further utility operations. The rendering module 1005 may be manifested as a display cum touch screen, monitor, speaker, projection screen, etc.

[0071] A general-purpose hardware and driver module 1003 corresponds to the computing device 1100 as referred in FIG. 11 and instantiates drivers for the general-purpose hardware units as well as the application-specific units (1002, 1012).

[0072] In an example, the ML mechanism underlying the architecture 1000 may be remotely accessible and cloud-based, thereby being remotely accessible through a network connection. An audio/video processing device may be configured for remotely accessing the NLP/ML modules and simulation modules may comprise skeleton elements such as a microphone, a camera a screen/monitor, a speaker, etc.

[0073] Further, at least one of the plurality of modules of the mesh network may be implemented through AI based on an ML/NLP logic 1006. A function associated with AI may be performed through the non-volatile memory, the volatile memory, and the processor constituting the first hardware module 1002, i.e., specialized hardware for ML/NLP based mechanisms. The processor may include one or a plurality of processors. At this time, one or a plurality of processors may be a general-purpose processor, such as a central processing unit (CPU), an application processor (AP), or the like, a graphics-only processing unit such as a graphics processing unit (GPU), a visual processing unit (VPU), and/or an AI-dedicated processor such as a neural processing unit (NPU). The aforesaid processors collectively correspond to the processor 1102 of FIG. 11.

[0074] One or a plurality of processors control the processing of the input data in accordance with a predefined operating rule or artificial intelligence (AI) model stored in the non-volatile memory and the volatile memory. The predefined operating rule or artificial intelligence model is provided through training or learning.

[0075] Here, being provided through learning means that, by applying a learning logic/technique to a plurality of learning data, a predefined operating rule or AI model of the desired characteristic is made. “Obtained by training" means that a predefined operation rule or artificial intelligence model configured to perform the desired feature (or purpose) is obtained by training a basic artificial intelligence model with multiple pieces of training data by a training technique. The learning may be performed in a device (i.e., the architecture 1000 or the device 1000) itself in which AI according to an embodiment is performed, and/or may be implemented through a separate server/system. "

[0076] The AI model may consist of a plurality of neural network layers. Each layer has a plurality of weight values and performs a neural network layer operation through calculation between a result of computation of a previous layer and an operation of a plurality of weights. Examples of neural networks include, but are not limited to, convolutional neural network (CNN), deep neural network (DNN), recurrent neural network (RNN), restricted Boltzmann Machine (RBM), deep belief network (DBN),

bidirectional recurrent deep neural network (BRDNN), generative adversarial networks (GAN), and deep Q-networks.

[0077] The ML/NLP logic 1006 is a method for training a predetermined target device (for example, a robot) using a plurality of learning data to cause, allow, or control the target device to make a determination or prediction. Examples of learning techniques include, but are not limited to, supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning.

[0078] Referring to FIG. 11, it illustrates another implementation according to an embodiment of the disclosure, and yet another typical hardware configuration of the system 1000 in the form of a computer system 1100, according to an embodiment of the disclosure. The computer system 1100 can include a set of instructions that can be executed to cause the computer system 1100 to perform any one or more of the methods disclosed. The computer system 1100 may operate as a standalone device or may be connected, e.g., using a network, to other computer systems or peripheral devices.

[0079] In a networked deployment, the computer system 1100 may operate in the capacity of a server or as a client user computer in a server-client user network environment, or as a peer computer system in a peer-to-peer (or distributed) network environment. The computer system 1100 can also be implemented as or incorporated across various devices, such as a personal computer (PC), a tablet PC, a personal digital assistant (PDA), a mobile device, a palmtop computer, a laptop computer, a desktop computer, a communications device, a wireless telephone, a land-line telephone, a web appliance, a network router, switch or bridge, or any other machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while a single computer system 1100 is illustrated, the term "system" shall also be taken to include any collection of systems or sub-systems that individually or jointly execute a set, or multiple sets, of instructions to perform one or more computer functions.

[0080] The computer system 1100 may include a processor 1102 e.g., a central processing unit (CPU), a graphics processing unit (GPU), or both. The processor 1102 may be a component in a variety of systems. For example, the processor 1102 may be part of a standard personal computer or a workstation. The processor 1102 may be one

or more general processors, digital signal processors, application-specific integrated circuits, field-programmable gate arrays, servers, networks, digital circuits, analog circuits, combinations thereof, or other now known or later developed devices for analyzing and processing data. The processor 1102 may implement a software program, such as code generated manually (i.e., programmed).

[0081] The computer system 1100 may include a memory 1104, such as a memory 1104 that can communicate via a bus 1108. The memory 1104 may include, but is not limited to computer-readable storage media such as various types of volatile and non-volatile storage media, including but not limited to random access memory, read-only memory, programmable read-only memory, electrically programmable read-only memory, electrically erasable read-only memory, flash memory, magnetic tape or disk, optical media and the like. In one example, memory 1104 includes a cache or random access memory for the processor 1102. In alternative examples, the memory 1104 is separate from the processor 1102, such as a cache memory of a processor, the system memory, or other memory. The memory 1104 may be an external storage device or database for storing data. The memory 1104 is operable to store instructions executable by the processor 1102. The functions, acts or tasks illustrated in the figures or described may be performed by the programmed processor 1102 for executing the instructions stored in the memory 1104. The functions, acts or tasks are independent of the particular type of instructions set, storage media, processor or processing strategy and may be performed by software, hardware, integrated circuits, firmware, micro-code and the like, operating alone or in combination. Likewise, processing strategies may include multiprocessing, multitasking, parallel processing and the like.

[0082] As shown, the computer system 1100 may or may not further include a display unit 1110, such as a liquid crystal display (LCD), an organic light-emitting diode (OLED), a flat panel display, a solid-state display, a projector, a printer or other now known or later developed display device for outputting determined information. The display 1110 may act as an interface for the user to see the functioning of the processor 1102, or specifically as an interface with the software stored in the memory 1104 or the drive unit 1116.

[0083] Additionally, the computer system 1100 may include an input device 1112 configured to allow a user to interact with any of the components of system 1100. The computer system 1100 may also include a disk or optical drive unit 1116. The disk drive unit 1116 may include a computer-readable medium 1122 in which one or more sets of instructions 1124, e.g., software, can be embedded. Further, the instructions 1124 may embody one or more of the methods or logic as described. In a particular example, the instructions 1124 may reside completely, or at least partially, within the memory 1104 or within the processor 1102 during execution by the computer system 1100.

[0084] The disclosure contemplates a computer-readable medium that includes instructions 1124 or receives and executes instructions 1124 responsive to a propagated signal so that a device connected to a network 1126 can communicate voice, video, audio, images, or any other data over the network 1126. Further, instructions 1124 may be transmitted or received over the network 1126 via a communication port or interface 1120 or using a bus 1108. The communication port or interface 1120 may be a part of the processor 1102 or maybe a separate component. The communication port 1120 may be created in software or maybe a physical connection in hardware. The communication port 1120 may be configured to connect with a network 1126, external media, the display 1110, or any other components in system 1100, or combinations thereof. The connection with the network 1126 may be a physical connection, such as a wired Ethernet connection or may be established wirelessly as discussed later. Likewise, the additional connections with other components of the system 1100 may be physical or may be established wirelessly. The network 1126 may alternatively be directly connected to the bus 1108.

[0085] The network 1126 may include wired networks, wireless networks, Ethernet audio video bridging (AVB) networks, or combinations thereof. The wireless network may be a cellular telephone network, an 802.11, 802.16, 802.20, 802.1Q or WiMax network. Further, the network 1126 may be a public network, such as the Internet, a private network, such as an intranet, or combinations thereof, and may utilize a variety of networking protocols now available or later developed including, but not limited to transmission control protocol/internet protocol (TCP/IP) based networking protocols. The system is not limited to operation with any particular standards and

protocols. For example, standards for Internet and other packet-switched network transmissions (e.g., TCP/IP, user date protocol/internet protocol (UDP/IP), hypertext markup language (HTML), and hypertext transfer protocol (HTTP)) may be used.

[0086] While specific language has been used to describe the disclosure, any limitations arising on account of the same are not intended. As would be apparent to a person in the art, various working modifications may be made to the method in order to implement the inventive concept as taught herein.

[0087] The drawings and the forgoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment. For example, orders of processes described herein may be changed and are not limited to the manner described herein.

[0088] Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts necessarily need to be performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples. Numerous variations, whether explicitly given in the specification or not, such as differences in structure, dimension, and use of material, are possible. The scope of embodiments is at least as broad as given by the following claims.

[0089] While the disclosure has been shown and described with reference to various embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising:

identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;

determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

2. The method of claim 1,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level,

maximum frequency level, and mean frequency level of the predicted optimal sound output, and

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

3. The method of claim 2, wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises:

combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters.

4. The method of claim 2, wherein correcting the predicted optimal sound output comprises:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value;

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device;

generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device; and

outputting, by a rendering module, the generated new optimal sound from the target IoT device.

5. The method of claim 4,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

6. The method of claim 4, further comprising:

determining, by a processing module based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

updating, by the processing module, settings of the voice assistance device based on the determined optimal region.

7. The method of claim 1, further comprising:

exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pairing, by the pairing module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

8. The method of claim 1, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

9. A system for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the system comprising:

a pairing module configured to identify and pair one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

a clustering module configured to:

divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device,

detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave, and

determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

a prediction module configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

a correction module configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

10. The system of claim 9,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level,

maximum frequency level, and mean frequency level of the predicted optimal sound output, and

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

11. The system of claim 10, wherein, to calculate the sound parameter value corresponding to each IoT device of the determined cluster, the correction module is further configured to:

combine the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and

calculate the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters.

12. The system of claim 10,

wherein to correct the predicted optimal sound output, the correction module is further configured to:

select, as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shift a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generate a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device, and

wherein the system further comprises a rendering module configured to output the generated new optimal sound from the target IoT device.

13. The system of claim 12,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

14. The system of claim 12, further comprising a processing module configured to:

determine, based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

update settings of the voice assistance device based on the determined optimal region.

15. The system of claim 9, wherein the pairing module is further configured to:

exchange, in a pairing mode, the information between the one or more IoT devices and the voice assistant device, the exchanged information including location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pair the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

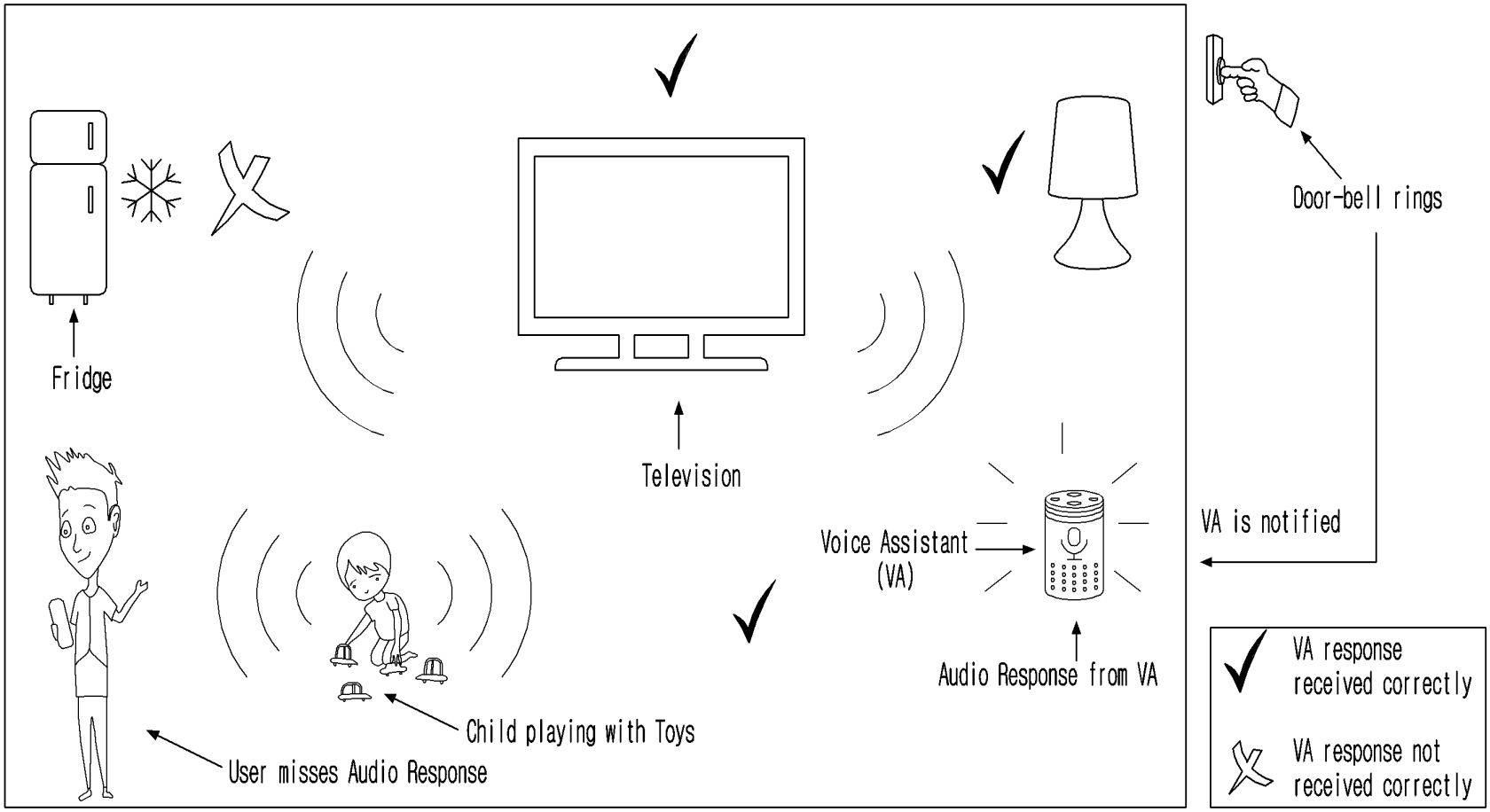
update the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

16. The system of claim 9, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

ABSTRACT

A method for mitigating unwanted audio noise in internet of things (IoT) based communication environment is provided. The method includes identifying and pairing one or more IoT devices with a voice assistant device, and then dividing the one or more paired IoT devices into a plurality of clusters. The method further includes detecting a user's location with respect to a location of the voice assistant device and then determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location and thereafter using a recurrent neural networks (RNN) model, predicting an optimal sound output of the voice assistance device that is audible at the detected user's location. The method furthermore includes correcting the predicted optimal sound output of the voice assistance device using a sound parameter value associated with the determined cluster and a phase shift of the predicted optimal sound output.

FIG. 1


Fridge
Television
Door-bell rings
VA is notified
Voice Assistant
(VA)
Audio Response from VA
Child playing with Toys
User misses Audio Response
VA response received correctly
VA response not received correctly

0031

FIG. 2

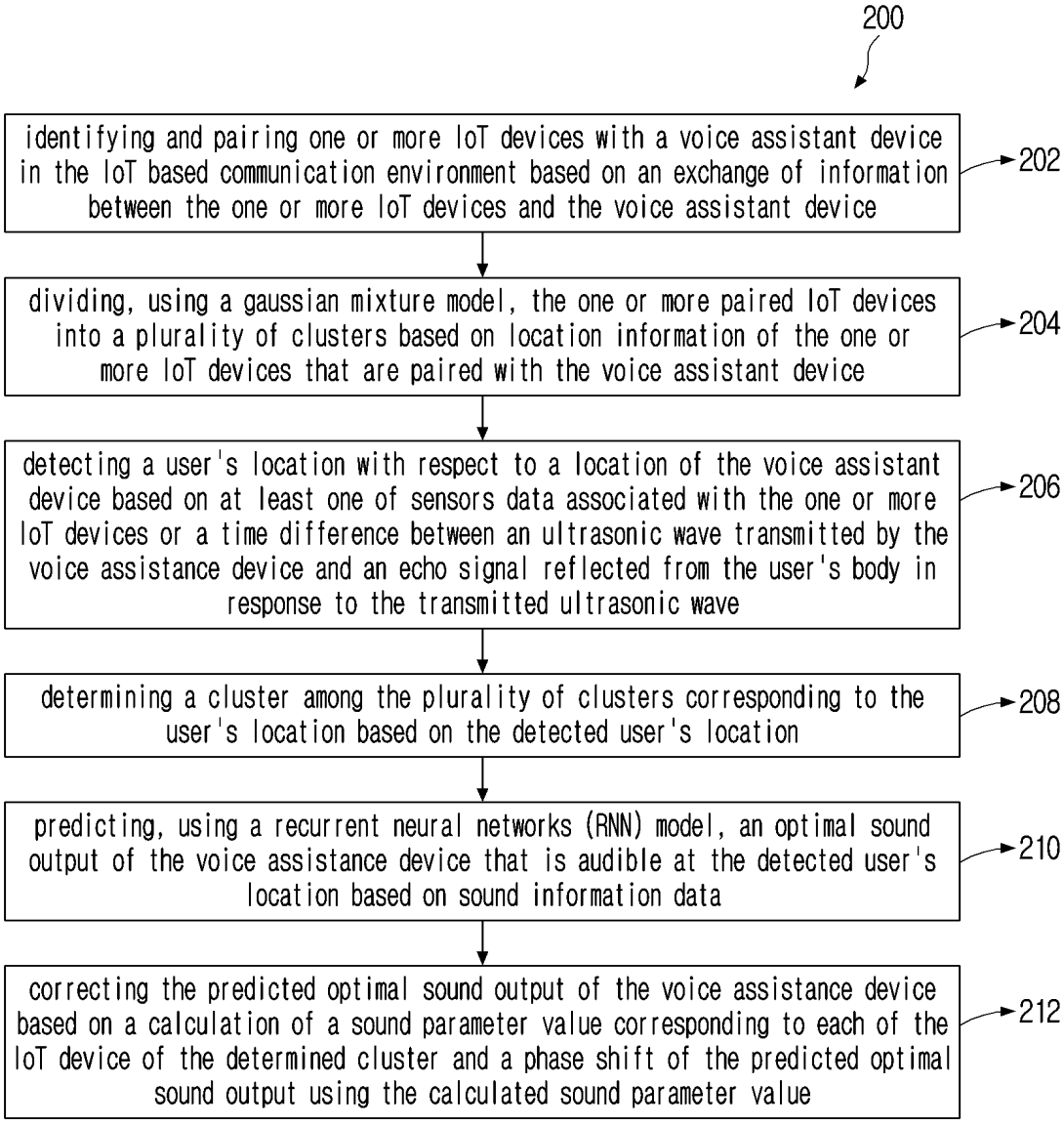

200
identifying and pairing one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device
202
dividing, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device
204
detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave
206
determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location
208
predicting, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data
210
correcting the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value
212

FIG. 3

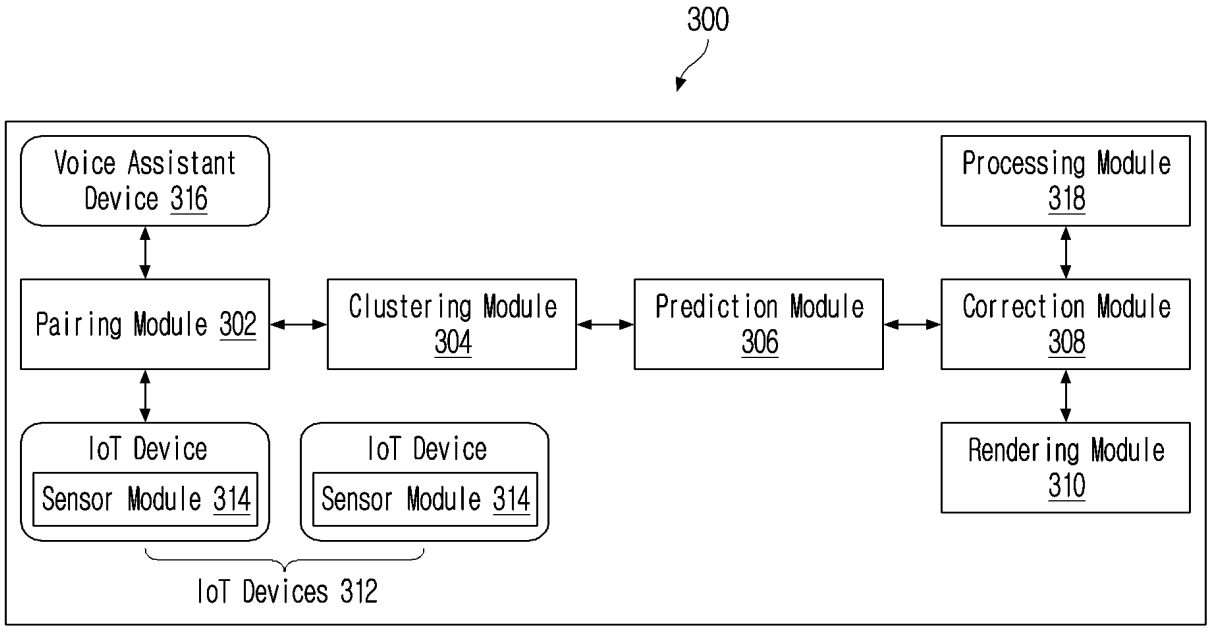
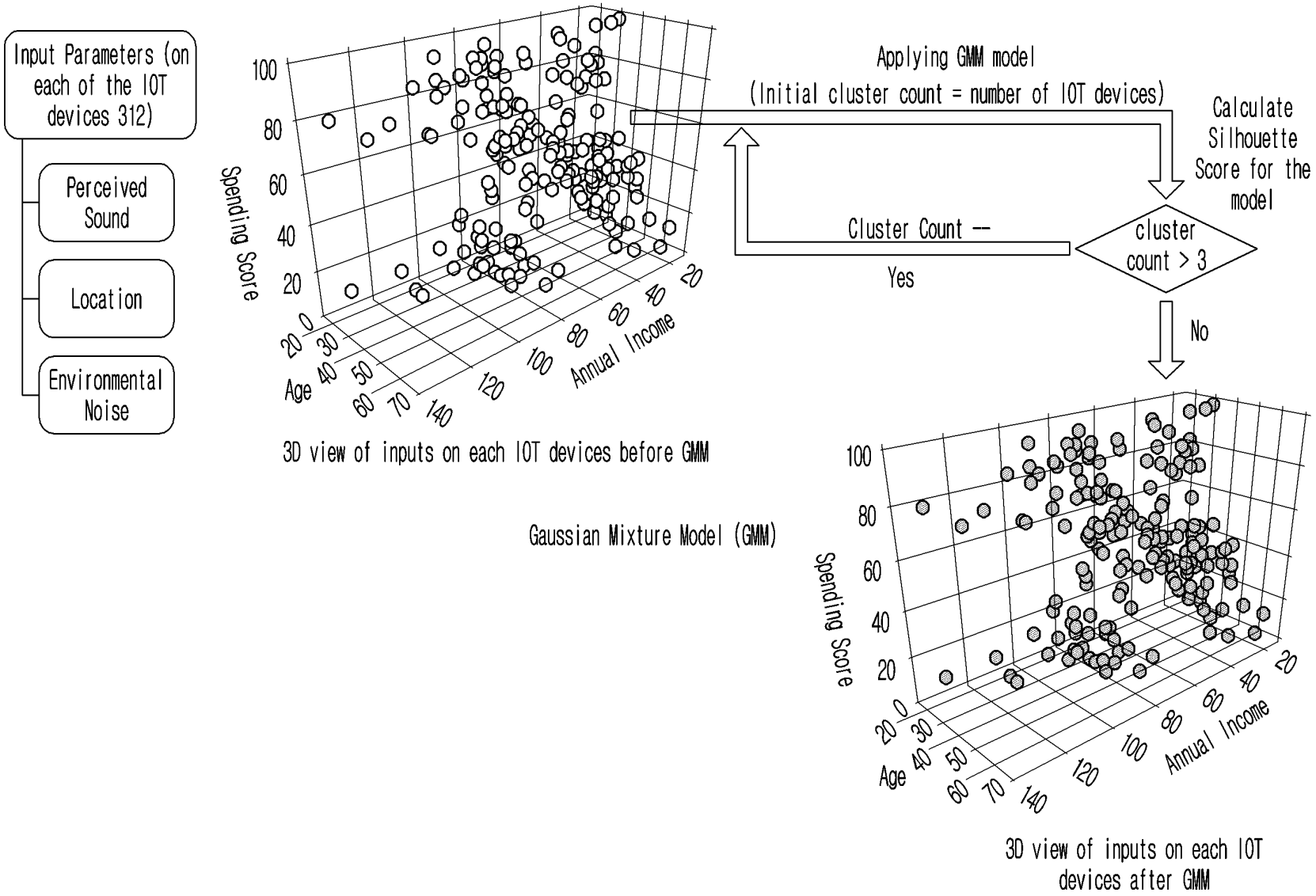

300
Voice Assistant Device 316
Processing Module 318
Pairing Module 302
Clustering Module 304
Prediction Module 306
Correction Module 308
IoT Device
Sensor Module 314
IoT Device
Sensor Module 314
Rendering Module 310
IoT Devices 312

FIG. 4


Input Parameters (on each of the IOT devices 312)
Perceived Sound
Location
Environmental Noise
Spending Score
Age
Annual Income
3D view of inputs on each IOT devices before GMM
Applying GMM model
(Initial cluster count = number of IOT devices)
Calculate Silhouette Score for the model
cluster count > 3
Cluster Count --
Yes
No
Gaussian Mixture Model (GMM)
3D view of inputs on each IOT devices after GMM

0034

FIG. 5

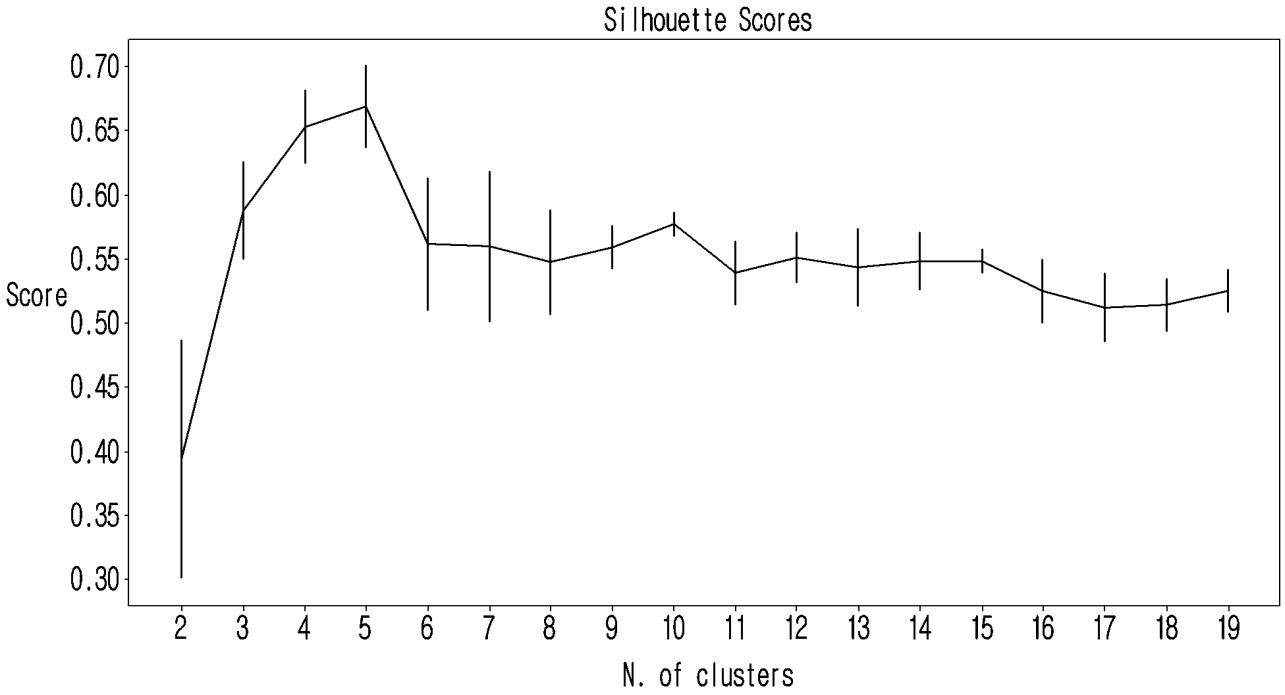

Silhouette Scores
Score
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
N. of clusters

FIG. 6

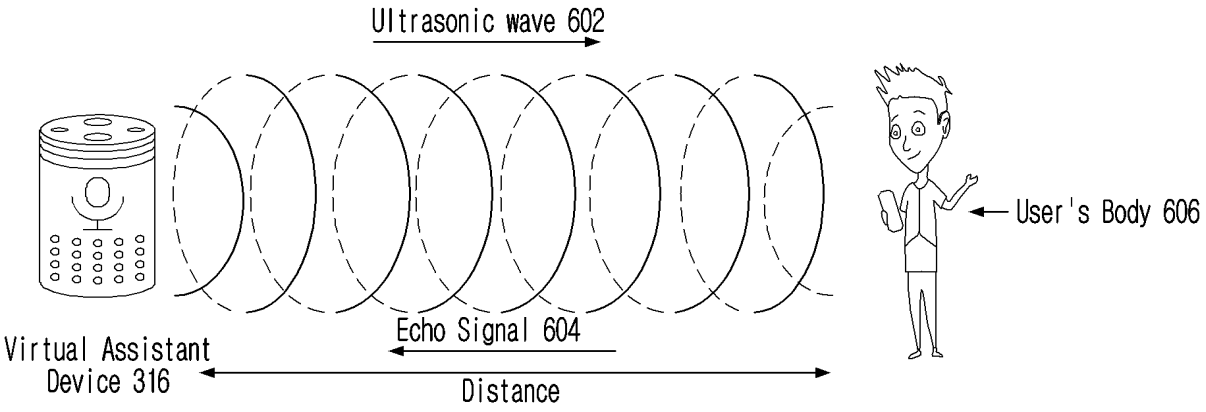
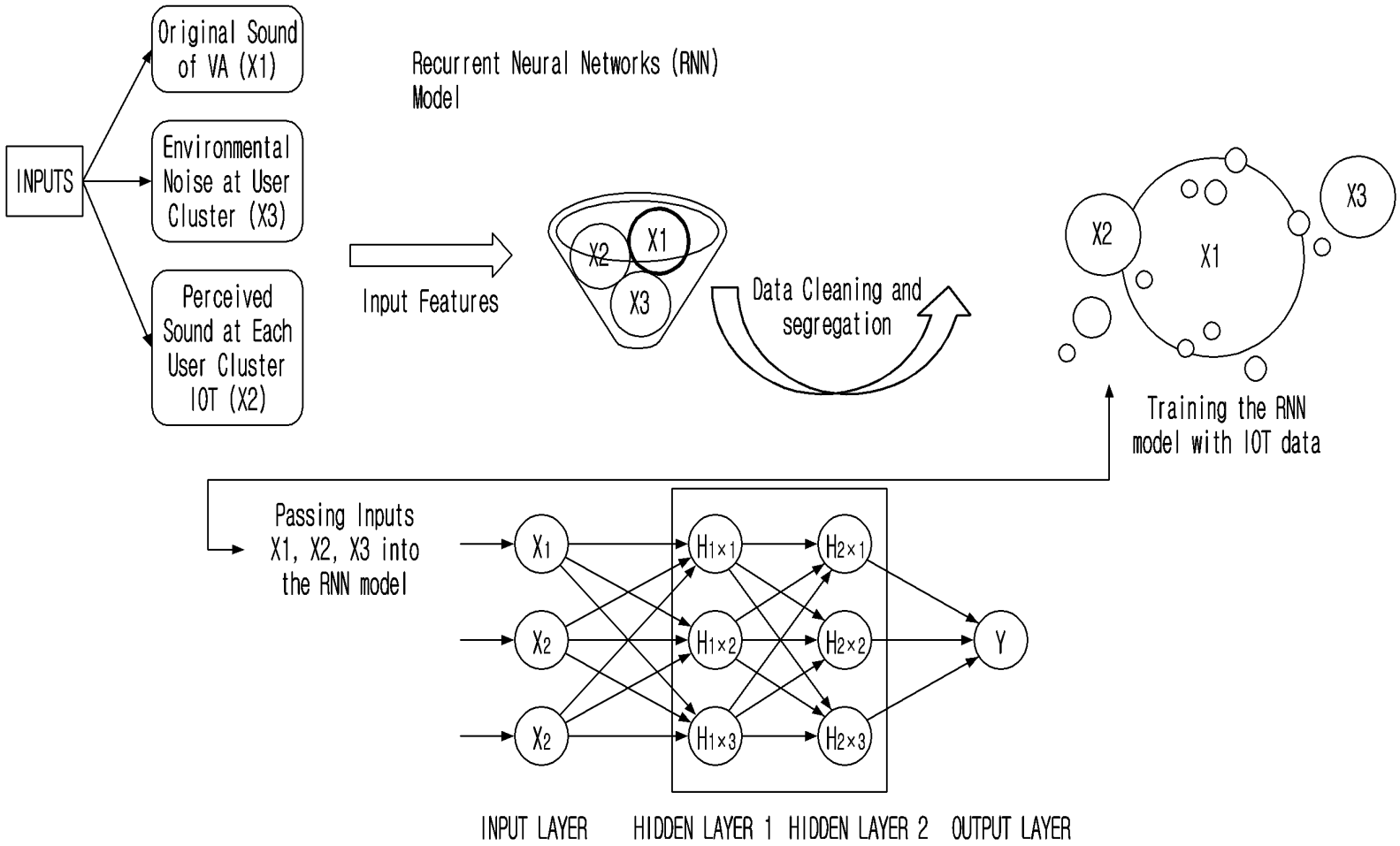

Ultrasonic wave 602
User's Body 606
Echo Signal 604
Virtual Assistant Device 316
Distance

FIG. 7


INPUTS
Original Sound of VA (X1)
Environmental Noise at User Cluster (X3)
Perceived Sound at Each User Cluster IOT (X2)
Recurrent Neural Networks (RNN) Model
Input Features
X1
X2
X3
Data Cleaning and segregation
Training the RNN model with IOT data
Passing Inputs X1, X2, X3 into the RNN model
X1
X2
X2
H1×1
H1×2
H1×3
H2×1
H2×2
H2×3
Y
INPUT LAYER
HIDDEN LAYER 1
HIDDEN LAYER 2
OUTPUT LAYER

0037

FIG. 8

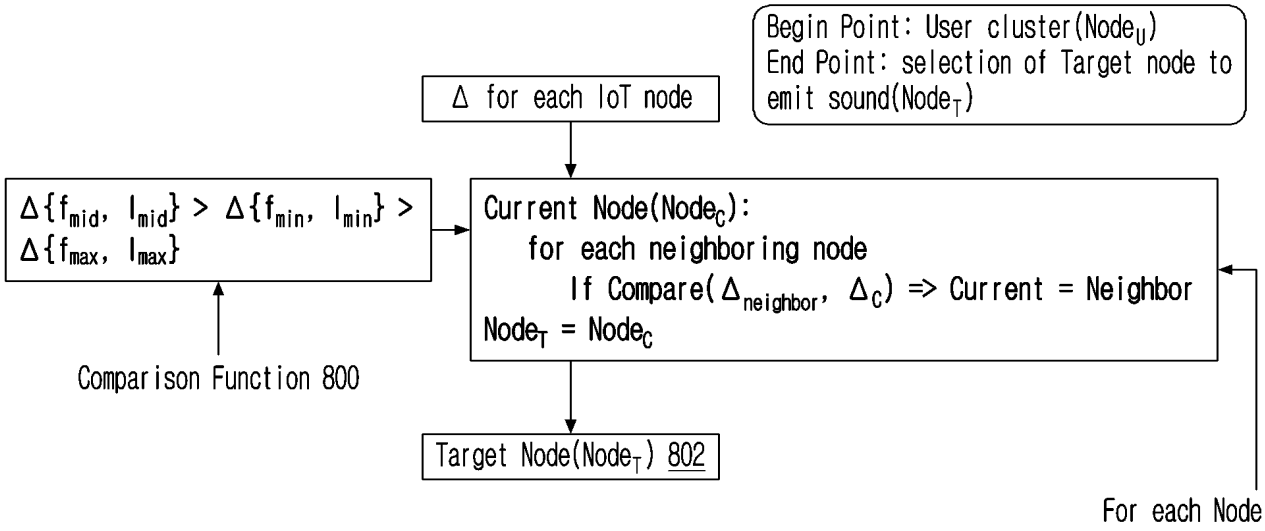
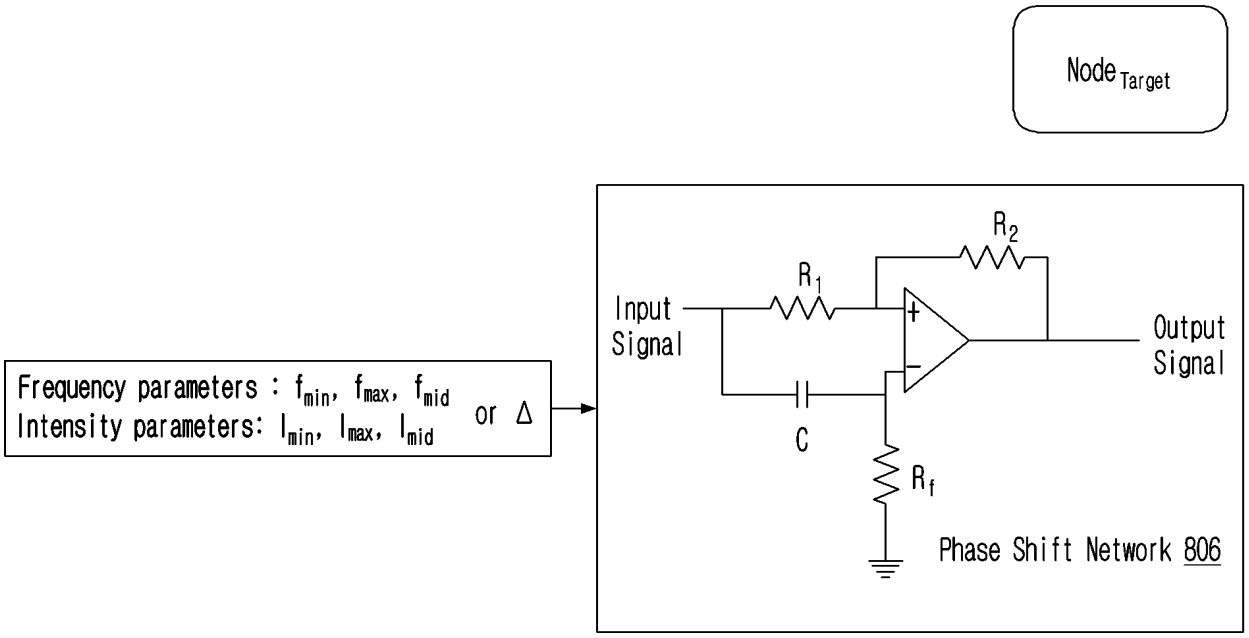

Begin Point: User cluster($Node_U$)
End Point: selection of Target node to emit sound($Node_T$)
Δ for each IoT node
$\Delta\{f_{mid}, I_{mid}\} > \Delta\{f_{min}, I_{min}\} > \Delta\{f_{max}, I_{max}\}$
Comparison Function 800
Current Node($Node_C$):
for each neighboring node
If Compare($\Delta_{neighbor}$, Δ_C) => Current = Neighbor
$Node_T = Node_C$
Target Node($Node_T$) 802
For each Node

FIG. 9



180° phase shift of sound parameters

FIG. 10

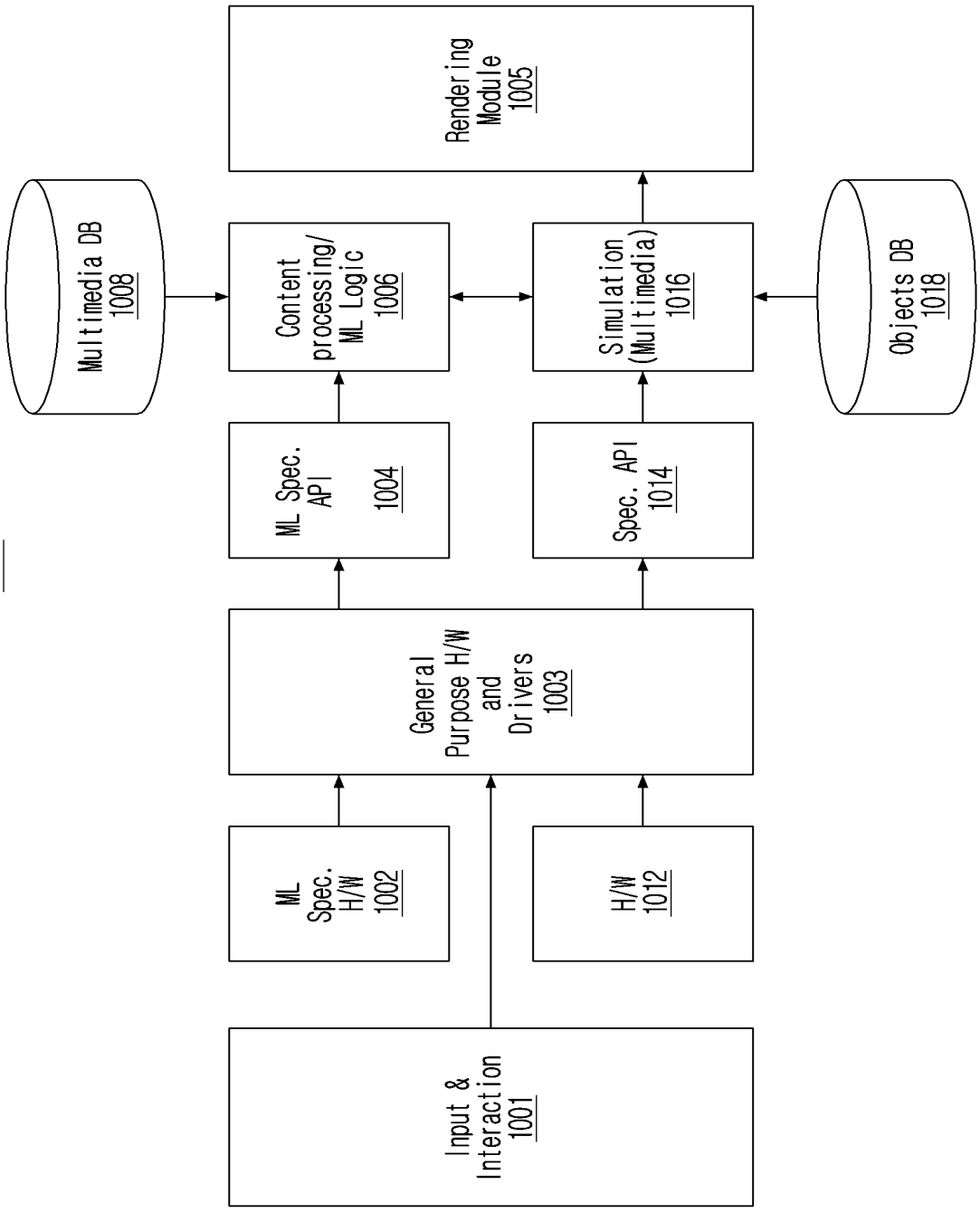
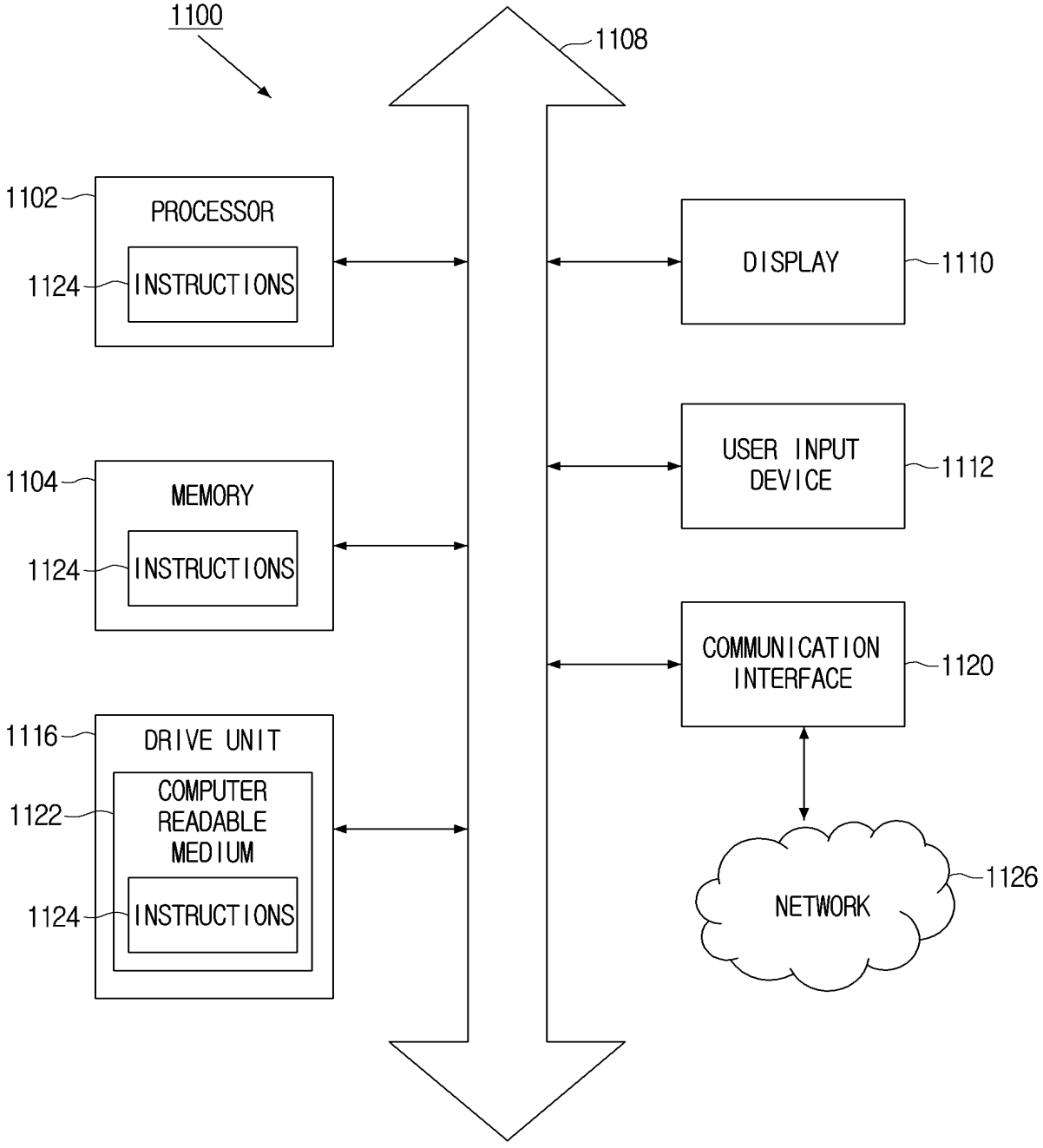

1000
Input & Interaction 1001
ML Spec. H/W 1002
H/W 1012
General Purpose H/W and Drivers 1003
ML Spec. API 1004
Spec. API 1014
Rendering Module 1005
Multimedia DB 1008
Content processing/ ML Logic 1006
Simulation (Multimedia) 1016
Objects DB 1018

FIG. 11


1100
1108
1102
PROCESSOR
1124
INSTRUCTIONS
1104
MEMORY
1124
INSTRUCTIONS
1116
DRIVE UNIT
1122
COMPUTER READABLE MEDIUM
1124
INSTRUCTIONS
DISPLAY
1110
USER INPUT DEVICE
1112
COMMUNICATION INTERFACE
1120
NETWORK
1126

DOCKET NO.: **0503-0636**
CLIENT REF.: **OEC/14548/US**
SAMSUNG REF.: **WI-202109-035-1-US0**

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

TITLE: **A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT**

As the below named inventor, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

☐ United States application or PCT international application number _____ filed on _____.

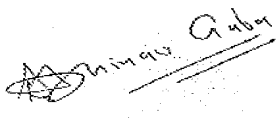
The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable u nder 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: **Abhinav GABA** Date: August 2, 2022



Signature: _____

DOCKET NO.: **0503-0636**
CLIENT REF.: **OEC/14548/US**
SAMSUNG REF.: **WI-202109-035-1-US0**

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

TITLE: **A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT**

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I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable u nder 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: **Akul TANEJA** Date: August 2, 2022

Signature: _____

DOCKET NO.: **0503-0636**
CLIENT REF.: **OEC/14548/US**
SAMSUNG REF.: **WI-202109-035-1-US0**

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

TITLE: **A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT**

As the below named inventor, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

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The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable u nder 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: **Deepak SHARMA** Date: August 2, 2022

Signature: _____

DOCKET NO.: **0503-0636**
CLIENT REF.: **OEC/14548/US**
SAMSUNG REF.: **WI-202109-035-1-US0**

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

TITLE: **A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT**

As the below named inventor, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

☐ United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable u nder 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: **Raja SINGHAL** Date: August 2, 2022

Signature: _____

Doc Code: PA..
Document Description: Power of Attorney

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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	December 19, 2022
First Named Inventor	Abhinav GABA
Title	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

SIGNATURE of Applicant or Patent Practitioner

Signature	/Donald A. DIPAULA/	Date (Optional)	December 19, 2022
Name	Donald A. DiPaula	Registration Number	58,115
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 68103

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Samsung Electronics Co., Ltd.

☐ Inventor or Joint Inventor (title not required below)

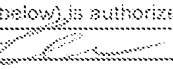
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Sunghyuk Shin		
Title	Corporate SVP, Samsung Electronics Co., Ltd.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Abhinav		GABA	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Noida	Country of Residence i	IN

Mailing Address of Inventor:

Address 1	Logix Cyber Pk, Plot No. C 28-29, Tower D, Ground
Address 2	to 10th Fl., Twr. C - 3rd and 7th Floor, Sector 62
City	Noida, (U.P.)
State/Province	
Postal Code	201301
Country i	IN

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Akul		TANEJA	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Noida	Country of Residence i	IN

Mailing Address of Inventor:

Address 1	Logix Cyber Pk, Plot No. C 28-29, Tower D, Ground
Address 2	to 10th Fl., Twr. C - 3rd and 7th Floor, Sector 62
City	Noida, (U.P.)
State/Province	
Postal Code	201301
Country i	IN

Inventor 3 Remove

Legal Name

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Deepak		SHARMA	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Noida	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	Logix Cyber Pk, Plot No. C 28-29, Tower D, Ground
Address 2	to 10th Fl., Twr. C - 3rd and 7th Floor, Sector 62
City	Noida, (U.P.) **State/Province**
Postal Code	201301 **Country** [i] IN

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Raja		SINGHAL	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Noida	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	Logix Cyber Pk, Plot No. C 28-29, Tower D, Ground
Address 2	to 10th Fl., Twr. C - 3rd and 7th Floor, Sector 62
City	Noida, (U.P.) **State/Province**
Postal Code	201301 **Country** [i] IN

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	68103		
Email Address	usdocketing@jeffersonip.com	Add Email	Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Application Information:

Title of the Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT		
Attorney Docket Number	0503-0636	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	11	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	68103		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
202111061923	IN	2021-12-30	1ED1

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Samsung Electronics Co., Ltd.		
Mailing Address Information For Applicant:			
Address 1	129, Samsung-ro, Yeongtong-gu		
Address 2			
City	Suwon-si, Gyeonggi-do	**State/Province**	
Country	KR	Postal Code	16677
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Donald A. DIPAULA/			Date (YYYY-MM-DD)	2022-12-19
First Name	Donald A.	Last Name	DiPaula	Registration Number	58115

Additional Signature may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0503-0636
	Application Number	
Title of Invention	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10325585	B2	2019-06-18	BAKER et al.	
	2	10878812	B1	2020-12-29	HELWANI et al.	

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	1	20210110826	A1	2021-04-15	LAMBOURNE et al.	
	2	20190273996	A1	2019-09-05	STAROBIN et al.	
	3	20170372725	A1	2017-12-28	KHOURY et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2022-12-19
	First Named Inventor	Abhinav GABA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0503-0636

	1	10-2254522	KR	B1	2021-05-24	LEE et al.		X

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2022-12-19
	First Named Inventor	Abhinav GABA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0503-0636

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Donald A. DIPAULA/	Date (YYYY-MM-DD)	2022-12-19
Name/Print	Donald A. DiPaula	Registration Number	58115

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Espacenet

KR102254522B1 CONTROL METHOD DEVICE AND PROGRAM OF PARAMETRIC EQUALIZING SOUND TUNING SYSTEM USING ARTIFICIAL INTELLIGENCE

Applicants: GV KOREA CO LTD [KR]

Inventors: LEE KI MAN [KR],HWANG YOUN SEUNG [KR],AN TAE SOO [KR]

Classifications:
IPC ***H04R3/04; H04R3/12;***

CPC **H04R3/04 (KR); H04R3/12 (KR);**

Priorities: KR20190151022A 2019-11-22

Application: KR20190151022A·2019-11-22

Publication: KR102254522B1·2021-05-24

Published as: KR102254522B1

CONTROL METHOD DEVICE AND PROGRAM OF PARAMETRIC EQUALIZING SOUND TUNING SYSTEM USING ARTIFICIAL INTELLIGENCE

Abstract

Disclosed is a method for controlling a parametric equalizing sound tuning system by using artificial intelligence. The method for controlling a parametric equalizing sound tuning system by using artificial intelligence comprises the steps in which: a speaker outputs a test audio signal; an electronic device receives the output test audio signal to obtain test frequency response characteristic data; the electronic device obtains target frequency response characteristic data for the received test audio signal; the electronic device inputs the test frequency response characteristic data and the target frequency response characteristic data as input values for an artificial intelligence model to obtain equalizing parameters for correcting the test audio signal, as output values for the artificial intelligence model; an equalizer corrects an audio signal output from the speaker based on the obtained equalizing parameters; and the speaker outputs an output audio signal. The equalizing parameters include at least one among a center frequency, a frequency band, and a gain value.

(19) 대한민국특허청(KR)
(12) 등록특허공보(B1)

(45) 공고일자 2021년05월24일
(11) 등록번호 10-2254522
(24) 등록일자 2021년05월14일

(51) 국제특허분류(Int. Cl.)
H04R 3/04 (2006.01) *H04R 3/12* (2006.01)
(52) CPC특허분류
H04R 3/04 (2013.01)
H04R 3/12 (2013.01)
(21) 출원번호 10-2019-0151022
(22) 출원일자 2019년11월22일
심사청구일자 2019년11월22일
(56) 선행기술조사문헌
JP2004159037 A*
KR101764274 B1*
KR1020180087782 A*
*는 심사관에 의하여 인용된 문헌

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(74) 대리인
김남혁

전체 청구항 수 : 총 6 항 심사관 : 강석재

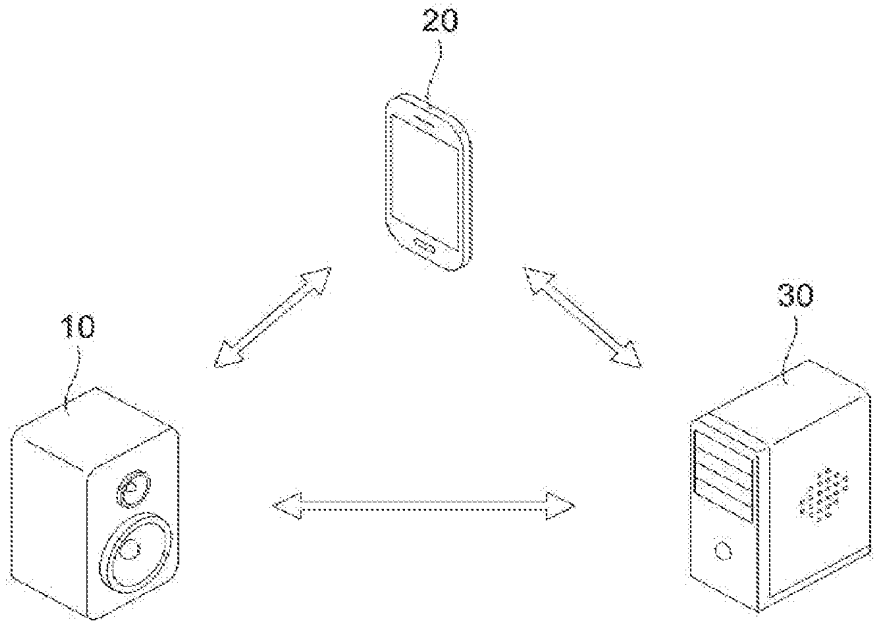
(54) 발명의 명칭 **인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법, 장치 및 프로그램**

(57) 요 약

인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법이 제공된다. 상기 인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법은, 스피커가, 테스트 오디오 신호를 출력하는 단계; 전자장치가, 상기 출력된 테스트 오디오 신호를 수신하여 테스트 주파수 응답 특성 데이터를 획득하는 단계; 상기 전

(뒷면에 계속)

대 표 도 - 도1



자 장치가, 상기 수신한 테스트 오디오 신호에 대한 목표 주파수 응답 특성 데이터를 획득하는 단계; 상기 전자 장치가, 상기 테스트 주파수 응답 특성 데이터 및 상기 목표 주파수 응답 특성 데이터를 인공지능 모델의 입력값으로 입력하여, 상기 테스트 오디오 신호를 보정하기 위한 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계; 이퀄라이저가, 상기 획득된 이퀄라이징 파라미터를 바탕으로 상기 스피커에서 출력되는 오디오 신호를 보정하는 단계; 및 상기 스피커가, 출력 오디오 신호를 출력하는 단계; 를 포함하고, 상기 이퀄라이징 파라미터는, 중심 주파수, 주파수 대역 및 이득값 중 적어도 하나를 포함한다.

명 세 서

청구범위

청구항 1

인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법에 있어서,

스피커가, 테스트 오디오 신호를 출력하는 단계;

전자 장치가, 상기 출력된 테스트 오디오 신호를 수신하여 테스트 주파수 응답 특성 데이터를 획득하는 단계;

상기 전자 장치가, 상기 수신한 테스트 오디오 신호에 대한 목표 주파수 응답 특성 데이터를 획득하는 단계;

상기 전자 장치가, 상기 테스트 주파수 응답 특성 데이터 및 상기 목표 주파수 응답 특성 데이터를 인공지능 모델의 입력값으로 입력하여, 상기 테스트 오디오 신호를 보정하기 위한 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계;

이퀄라이저가, 상기 획득된 이퀄라이징 파라미터를 바탕으로 상기 스피커에서 출력되는 오디오 신호를 보정하는 단계; 및

상기 스피커가, 출력 오디오 신호를 출력하는 단계; 를 포함하고,

상기 이퀄라이징 파라미터는, 중심 주파수, 주파수 대역 및 이득값 중 적어도 하나를 포함하고,

상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는,

단위 주파수 대역 정보를 획득하는 단계;

상기 단위 주파수 대역 정보를 바탕으로, 상기 이퀄라이징 파라미터 중 보정을 위한 제1 중심 주파수를 획득하는 단계;

상기 제1 중심 주파수를 바탕으로, 보정을 위한 제1 주파수 대역을 획득하는 단계; 및

상기 제1 주파수 대역에서의 테스트 주파수 응답 특성 데이터 및 상기 제1 주파수 대역에서의 목표 주파수 응답 특성 데이터를 바탕으로, 상기 제1 주파수 대역을 보정하기 위한 제1 이득값을 획득하는 단계; 를 포함하고,

상기 테스트 주파수 응답 특성 데이터를 획득하는 단계는,

상기 출력된 테스트 오디오 신호를 수신하여 잔향시간 데이터를 수신하는 단계; 를 더 포함하고,

상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는,

상기 전자 장치가, 음향 조율을 위한 인공지능 모델을 학습시키기 위한 학습 데이터를 수집하는 단계;

상기 전자 장치가, 상기 학습 데이터를 바탕으로 상기 인공지능 모델을 학습시키는 단계; 및

상기 전자 장치가, 상기 학습된 인공지능 모델에 상기 주파수 응답 특성 데이터 및 상기 잔향시간 데이터를 상기 인공지능 모델에 입력 데이터로 입력하여 상기 이퀄라이징 파라미터를 획득하는 단계; 를 포함하고,

상기 학습 데이터를 수집하는 단계는,

상기 테스트 오디오 신호의 이득값을 획득하는 단계;

제1 잔향시간, 제2 잔향시간, 제3 잔향시간 및 제4 잔향시간 중 적어도 하나의 잔향시간을 포함하는 잔향시간 데이터를 획득하는 단계;

학습용 오디오 신호를 획득하는 단계;

상기 학습용 오디오 신호로부터 학습용 오디오 데이터를 획득하는 단계; 및

상기 학습용 오디오 데이터를 복수의 주파수 밴드로 분류하고, 상기 학습용 오디오 데이터에 상기 복수의 주파수 밴드 각각에 대한 학습용 이퀄라이징 파라미터를 적용하여 측정된 상기 복수의 주파수 밴드 각각에 대한 이득값을 획득하는 단계;를 포함하고,

상기 인공지능 모델을 학습시키는 단계는,

상기 인공지능 모델에 상기 잔향시간 데이터 및 상기 학습용 오디오 데이터를 인공지능 모델에 입력하여 상기 출력 오디오 신호에 대한 목표 이득값이 출력되도록 상기 인공지능 모델의 가중치를 변경하는 단계; 및

상기 출력 오디오 신호에 대응되는 상기 이퀄라이징 파라미터를 획득하는 단계; 를 포함하고,

상기 학습용 오디오 신호는

동일한 이득값을 가지는 테스트 음원 및 옥타브마다 -3db씩 감쇄되는 크기의 테스트 음원 중 적어도 하나를 포함하고,

상기 제1 잔향시간은, 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -10db 감쇠되는 시점까지의 시간이고, 상기 제2 잔향시간은, 상기 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -30db 감쇠되는 시점까지의 시간이고, 상기 제3 잔향시간은, 상기 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -60db 감쇠되는 시점까지의 시간이고, 상기 제4 잔향시간은, 상기 테스트 오디오 신호를 복수의 주파수 밴드로 분류하고, 상기 복수의 주파수 밴드 각각에 대한 복수의 잔향시간이고,

상기 학습용 오디오 데이터는, 상기 복수의 주파수 밴드 각각에 대한 복수의 학습용 이퀄라이징 파라미터 및 상기 학습용 오디오 신호에 상기 복수의 주파수 밴드 각각에 대한 복수의 학습용 이퀄라이징 파라미터가 적용되어 출력된 상기 복수의 주파수 밴드 각각에 대한 복수의 이득값 데이터를 포함하는 것을 특징으로 하는 제어 방법.

청구항 2

삭제

청구항 3

제1항에 있어서,

상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는,

단위 주파수 대역 정보를 획득하는 단계;

상기 단위 주파수 대역 정보를 바탕으로, 상기 이퀄라이징 파라미터 중 보정을 위한 제2 주파수 대역을 획득하는 단계;

상기 제2 주파수 대역을 바탕으로, 보정을 위한 제2 중심 주파수를 획득하는 단계; 및

상기 제2 중심 주파수에서의 테스트 주파수 응답 특성 데이터 및 상기 제2 중심 주파수에서의 목표 주파수 응답 특성 데이터를 바탕으로, 상기 제2 주파수 대역을 보정하기 위한 제2 이득값을 획득하는 단계; 를 포함하는 제어 방법.

청구항 4

제1항 또는 제3항에 있어서,

상기 단위 주파수 대역은,

저음 대역에 대한 제1 단위 주파수 대역, 중저음 대역에 대한 제2 단위 주파수 대역, 중고음 대역에 대한 제3 단위 주파수 대역, 고음 대역에 대한 제4 단위 주파수 대역을 포함하는 것을 특징으로 하는 제어 방법.

청구항 5

제1항에 있어서,

상기 테스트 오디오 신호는 화이트 노이즈, 핑크 노이즈 및 스위프 시그널 중 적어도 하나의 테스트 오디오 신호인 것을 특징으로 하는 제어 방법.

청구항 6

삭제

청구항 7

삭제

청구항 8

삭제

청구항 9

하나 이상의 인스트럭션을 저장하는 메모리; 및

상기 메모리에 저장된 상기 하나 이상의 인스트럭션을 실행하는 프로세서를 포함하고,

상기 프로세서는 상기 하나 이상의 인스트럭션을 실행함으로써,

제1 항의 방법을 수행하는, 장치.

청구항 10

하드웨어인 컴퓨터와 결합되어, 제1 항의 방법을 수행할 수 있도록 컴퓨터에서 독출가능한 기록매체에 저장된 컴퓨터프로그램.

발명의 설명

기 술 분 야

[0001] 본 발명은 인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법, 장치 및 프로그램에 관한 것이다.

배 경 기 술

[0002] 4차 산업 혁명에 따른 신기술의 등장으로, 다양한 분야에 새로운 기술이 접목되고 있다. 구체적으로, 가상 현실 기술, 인공 지능 기술 등의 새로운 기술들이 다양한 산업 분야에 적용되고 있다.

[0003] 이러한 다양한 기술들 중, 인공지능(Artificial Intelligence, AI) 시스템은 인간 수준의 지능을 구현하는 컴퓨터 시스템이며, 기존 Rule 기반 스마트 시스템과 달리 기계가 스스로 학습하고 판단하며 똑똑해지는 시스템이다. 인공지능 시스템은 사용할수록 인식률이 향상되고 사용자 취향을 보다 정확하게 이해할 수 있게 되어, 기존 Rule 기반 스마트 시스템은 점차 딥러닝 기반 인공지능 시스템으로 대체되고 있다.

[0004] 인공지능 기술은 기계학습(딥러닝) 및 기계학습을 활용한 요소 기술들로 구성된다.

[0005] 기계학습은 입력 데이터들의 특징을 스스로 분류/학습하는 알고리즘 기술이며, 요소기술은 딥러닝 등의 기계학습 알고리즘을 활용하여 인간 두뇌의 인지, 판단 등의 기능을 모사하는 기술로서, 언어적 이해, 시각적 이해, 추론/예측, 지식 표현, 동작 제어 등의 기술 분야로 구성된다.

[0006] 인공지능 기술은 다양한 분야에서 응용되며, 특히 정보를 수집하고 수집된 정보에 기초하여 결론을 추론하거나, 빅데이터에 포함된 데이터 간의 연관성을 파악하여 새로운 정보를 도출해내는 것도 가능하다.

[0007] 한편, 종래 음향 공간의 음향 조율을 위한 이퀄라이징 기법으로, 그래픽 이퀄라이징 기법과 파라메트릭 이퀄라이징 기법이 존재한다. 그래픽 이퀄라이징 기법은 설정된 주파수 밴드별로 이득값을 조정하는 이퀄라이징 기법으로, 간편하게 이퀄라이징을 수행할 수 있다는 장점이 존재하나, 세밀한 이퀄라이징을 수행할 수 없다는 단점이 존재한다.

[0008] 한편, 파라메트릭 이퀄라이징 기법은 주파수 응답 그래프를 바탕으로 Q 팩터(주파수 대역)를 결정하고, 결정된 Q 팩터에 대응되도록 이득값을 조정하는 이퀄라이징 기법으로, 세밀한 이퀄라이징을 수행할 수 있다는 장점이 존재하나, Q 팩터를 어떻게 결정할 것인지를 음향 조율 전문가의 경험이나 노하우에 맡겨야 한다는 단점이 존재한다.

[0009] 따라서, 파라메트릭 이퀄라이징 기법은, 종래 오디오 음향의 최적화는 다년간 음향 장비를 설치하거나 운영한

경험이나 노하우가 풍부한 전문가의 주관적 판단에 의해 이뤄지는 경우가 많았으며, 이에 따라 전문가가 아니더라도 파라메트릭 이퀄라이징 기법을 통해 세밀하게 오디오 음향을 최적화 할 수 있는 방법에 대한 기술의 필요성이 존재하게 되었다.

선행기술문헌

특허문헌

[0011] (특허문헌 0001) 등록특허공보 제10-1764274호, 2017.07.27 등록

발명의 내용

해결하려는 과제

[0012] 본 발명이 해결하고자 하는 과제는 인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법, 장치 및 프로그램을 제공하는 것이다.

[0013] 본 발명이 해결하고자 하는 과제들은 이상에서 언급된 과제로 제한되지 않으며, 언급되지 않은 또 다른 과제들은 아래의 기재로부터 통상의 기술자에게 명확하게 이해될 수 있을 것이다.

과제의 해결 수단

[0014] 상술한 과제를 해결하기 위한 본 발명의 일 면에 따른 인공지능을 이용한 파라메트릭 이퀄라이징 음향 조율 시스템의 제어 방법은, 스피커가, 테스트 오디오 신호를 출력하는 단계; 전자 장치가, 상기 출력된 테스트 오디오 신호를 수신하여 테스트 주파수 응답 특성 데이터를 획득하는 단계; 상기 전자 장치가, 상기 수신한 테스트 오디오 신호에 대한 목표 주파수 응답 특성 데이터를 획득하는 단계; 상기 전자 장치가, 상기 테스트 주파수 응답 특성 데이터 및 상기 목표 주파수 응답 특성 데이터를 인공지능 모델의 입력값으로 입력하여, 상기 테스트 오디오 신호를 보정하기 위한 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계; 이퀄라이저가, 상기 획득된 이퀄라이징 파라미터를 바탕으로 상기 스피커에서 출력되는 오디오 신호를 보정하는 단계; 및 상기 스피커가, 출력 오디오 신호를 출력하는 단계; 를 포함하고, 상기 이퀄라이징 파라미터는, 중심 주파수, 주파수 대역 및 이득값 중 적어도 하나를 포함할 수 있다.

[0015] 이때, 상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는, 단위 주파수 대역 정보를 획득하는 단계; 상기 단위 주파수 대역 정보를 바탕으로, 상기 이퀄라이징 파라미터 중 보정을 위한 제1 중심 주파수를 획득하는 단계; 상기 제1 중심 주파수를 바탕으로, 보정을 위한 제1 주파수 대역을 획득하는 단계; 및 상기 제1 주파수 대역에서의 테스트 주파수 응답 특성 데이터 및 상기 제1 주파수 대역에서의 목표 주파수 응답 특성 데이터를 바탕으로, 상기 제1 주파수 대역을 보정하기 위한 제1 이득값을 획득하는 단계; 를 포함할 수 있다.

[0016] 이때, 상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는, 단위 주파수 대역 정보를 획득하는 단계; 상기 단위 주파수 대역 정보를 바탕으로, 상기 이퀄라이징 파라미터 중 보정을 위한 제2 주파수 대역을 획득하는 단계; 상기 제2 주파수 대역을 바탕으로, 보정을 위한 제2 중심 주파수를 획득하는 단계; 및 상기 제2 중심 주파수에서의 테스트 주파수 응답 특성 데이터 및 상기 제2 중심 주파수에서의 목표 주파수 응답 특성 데이터를 바탕으로, 상기 제2 주파수 대역을 보정하기 위한 제2 이득값을 획득하는 단계; 를 포함할 수 있다.

[0017] 이때, 상기 단위 주파수 대역은, 저음 대역에 대한 제1 단위 주파수 대역, 중저음 대역에 대한 제2 단위 주파수 대역, 중고음 대역에 대한 제3 단위 주파수 대역, 고음 대역에 대한 제4 단위 주파수 대역을 포함할 수 있다.

[0018] 이때, 상기 테스트 오디오 신호는 화이트 노이즈, 핑크 노이즈 및 스위프 시그널 중 적어도 하나의 테스트 오디오 신호일 수 있다.

[0019] 이때, 상기 테스트 주파수 응답 특성 데이터를 획득하는 단계는, 상기 출력된 테스트 오디오 신호를 수신하여 잔향시간 데이터를 수신하는 단계; 를 더 포함하고, 상기 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득하는 단계는, 상기 전자 장치가, 음향 조율을 위한 인공지능 모델을 학습시키기 위한 학습 데이터를 수집하는 단계; 상기 전자 장치가, 상기 학습 데이터를 바탕으로 상기 인공지능 모델을 학습시키는 단계; 및 상기 전

자 장치가, 상기 학습된 인공지능 모델에 상기 주파수 응답 특성 데이터 및 상기 잔향시간 데이터를 상기 인공지능 모델에 입력 데이터로 입력하여 상기 이퀄라이징 파라미터를 획득하는 단계; 를 포함할 수 있다.

[0020] 이때, 상기 학습 데이터를 수집하는 단계는, 상기 테스트 오디오 신호의 이득값을 획득하는 단계; 제1 잔향시간, 제2 잔향시간, 제3 잔향시간 및 제4 잔향시간 중 적어도 하나의 잔향시간을 포함하는 잔향시간 데이터를 획득하는 단계; 학습용 오디오 신호를 획득하는 단계; 상기 학습용 오디오 신호로부터 학습용 오디오 데이터를 획득하는 단계; 및 상기 학습용 오디오 데이터를 복수의 주파수 밴드로 분류하고, 상기 학습용 오디오 데이터에 상기 복수의 주파수 밴드 각각에 대한 학습용 이퀄라이징 파라미터를 적용하여 측정된 상기 복수의 주파수 밴드 각각에 대한 이득값을 획득하는 단계;를 포함하고, 상기 인공지능 모델을 학습시키는 단계는, 상기 인공지능 모델에 상기 잔향시간 데이터 및 상기 학습용 오디오 데이터를 인공지능 모델에 입력하여 상기 출력 오디오 신호에 대한 목표 이득값이 출력되도록 상기 인공지능 모델의 가중치를 변경하는 단계; 및 상기 출력 오디오 신호에 대응되는 상기 이퀄라이징 파라미터를 획득하는 단계; 를 포함할 수 있다.

[0021] 이때, 상기 학습용 오디오 신호는, 동일한 이득값을 가지는 테스트 음원 및 옥타브마다 -3db씩 감쇠되는 크기의 테스트 음원 중 적어도 하나를 포함하고, 상기 제1 잔향시간은, 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -10db 감쇠되는 시점까지의 시간이고, 상기 제2 잔향시간은, 상기 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -30db 감쇠되는 시점까지의 시간이고, 상기 제3 잔향시간은, 상기 테스트 오디오 신호의 이득값이 상기 테스트 오디오 신호의 정상상태 이득값으로부터 -60db 감쇠되는 시점까지의 시간이고, 상기 제4 잔향시간은, 상기 테스트 오디오 신호를 복수의 주파수 밴드로 분류하고, 상기 복수의 주파수 밴드 각각에 대한 복수의 잔향시간이고, 상기 학습용 오디오 데이터는, 상기 복수의 주파수 밴드 각각에 대한 복수의 학습용 이퀄라이징 파라미터 및 상기 학습용 오디오 신호에 상기 복수의 주파수 밴드 각각에 대한 복수의 학습용 이퀄라이징 파라미터가 적용되어 출력된 상기 복수의 주파수 밴드 각각에 대한 복수의 이득값 데이터를 포함할 수 있다.

[0022] 본 발명의 기타 구체적인 사항들은 상세한 설명 및 도면들에 포함되어 있다.

발명의 효과

[0023] 상술한 본 발명의 다양한 실시예에 따라, 전문가가 아닌 일반인도 Q 팩터(주파수 대역)값을 바탕으로 하는 파라메트릭 이퀄라이징 기법을 손쉽게 사용할 수 있는 효과가 존재한다.

[0024] 본 발명의 효과들은 이상에서 언급된 효과로 제한되지 않으며, 언급되지 않은 또 다른 효과들은 아래의 기재로부터 통상의 기술자에게 명확하게 이해될 수 있을 것이다.

도면의 간단한 설명

[0025] 도 1은 본 발명의 일 실시예에 따른 음향 조율 시스템을 설명하기 위한 시스템도이다.

도 2는 본 발명의 일 실시예에 따른 이퀄라이징 파라미터를 획득하여 오디오 신호를 보정하는 방법을 설명하기 위한 예시도이다.

도 3 내지 도 4e는 본 발명의 일 실시예에 따른 중심 주파수를 바탕으로 주파수 대역 및 이득값을 획득하는 방법을 설명하기 위한 예시도이다.

도 5 내지 도 6b는 본 발명의 일 실시예에 따른 주파수 대역을 바탕으로 중심 주파수 및 이득값을 획득하는 방법을 설명하기 위한 예시도이다.

도 7은 본 발명의 일 실시예에 따른 인공지능 모델을 이용하여 이퀄라이징 파라미터를 획득하는 방법을 설명하기 위한 예시도이다.

도 8은 본 발명의 또 다른 실시예에 따른 학습 데이터를 수집하는 방법을 설명하기 위한 예시도이다.

도 9는 본 발명의 일 실시예에 따른 장치의 구성도이다.

발명을 실시하기 위한 구체적인 내용

[0026] 본 발명의 이점 및 특징, 그리고 그것들을 달성하는 방법은 첨부되는 도면과 함께 상세하게 후술되어 있는 실시예들을 참조하면 명확해질 것이다. 그러나, 본 발명은 이하에서 개시되는 실시예들에 제한되는 것이 아니라 서로 다른 다양한 형태로 구현될 수 있으며, 단지 본 실시예들은 본 발명의 개시가 완전하도록 하고, 본 발명이

속하는 기술 분야의 통상의 기술자에게 본 발명의 범주를 완전하게 알려주기 위해 제공되는 것이며, 본 발명은 청구항의 범주에 의해 정의될 뿐이다.

[0027] 본 명세서에서 사용된 용어는 실시예들을 설명하기 위한 것이며 본 발명을 제한하고자 하는 것은 아니다. 본 명세서에서, 단수형은 문구에서 특별히 언급하지 않는 한 복수형도 포함한다. 명세서에서 사용되는 "포함한다(comprises)" 및/또는 "포함하는(comprising)"은 언급된 구성요소 외에 하나 이상의 다른 구성요소의 존재 또는 추가를 배제하지 않는다. 명세서 전체에 걸쳐 동일한 도면 부호는 동일한 구성 요소를 지칭하며, "및/또는"은 언급된 구성요소들의 각각 및 하나 이상의 모든 조합을 포함한다. 비록 "제1", "제2" 등이 다양한 구성요소들을 서술하기 위해서 사용되나, 이들 구성요소들은 이들 용어에 의해 제한되지 않음은 물론이다. 이들 용어들은 단지 하나의 구성요소를 다른 구성요소와 구별하기 위하여 사용하는 것이다. 따라서, 이하에서 언급되는 제1 구성요소는 본 발명의 기술적 사상 내에서 제2 구성요소일 수도 있음은 물론이다.

[0028] 다른 정의가 없다면, 본 명세서에서 사용되는 모든 용어(기술 및 과학적 용어를 포함)는 본 발명이 속하는 기술 분야의 통상의 기술자에게 공통적으로 이해될 수 있는 의미로 사용될 수 있을 것이다. 또한, 일반적으로 사용되는 사전에 정의되어 있는 용어들은 명백하게 특별히 정의되어 있지 않는 한 이상적으로 또는 과도하게 해석되지 않는다.

[0029] 명세서에서 사용되는 "부" 또는 "모듈"이라는 용어는 소프트웨어, FPGA 또는 ASIC과 같은 하드웨어 구성요소를 의미하며, "부" 또는 "모듈"은 어떤 역할들을 수행한다. 그렇지만 "부" 또는 "모듈"은 소프트웨어 또는 하드웨어에 한정되는 의미는 아니다. "부" 또는 "모듈"은 어드레싱할 수 있는 저장 매체에 있도록 구성될 수도 있고 하나 또는 그 이상의 프로세서들을 재생시키도록 구성될 수도 있다. 따라서, 일 예로서 "부" 또는 "모듈"은 소프트웨어 구성요소들, 객체지향 소프트웨어 구성요소들, 클래스 구성요소들 및 태스크 구성요소들과 같은 구성요소들과, 프로세스들, 함수들, 속성들, 프로시저들, 서브루틴들, 프로그램 코드의 세그먼트들, 드라이버들, 펌웨어, 마이크로 코드, 회로, 데이터, 데이터베이스, 데이터 구조들, 테이블들, 어레이들 및 변수들을 포함한다. 구성요소들과 "부" 또는 "모듈"들 안에서 제공되는 기능은 더 작은 수의 구성요소들 및 "부" 또는 "모듈"들로 결합되거나 추가적인 구성요소들과 "부" 또는 "모듈"들로 더 분리될 수 있다.

[0030] 공간적으로 상대적인 용어인 "아래(below)", "아래(beneath)", "하부(lower)", "위(above)", "상부(upper)" 등은 도면에 도시되어 있는 바와 같이 하나의 구성요소와 다른 구성요소들과의 상관관계를 용이하게 기술하기 위해 사용될 수 있다. 공간적으로 상대적인 용어는 도면에 도시되어 있는 방향에 더하여 사용시 또는 동작시 구성요소들의 서로 다른 방향을 포함하는 용어로 이해되어야 한다. 예를 들어, 도면에 도시되어 있는 구성요소를 뒤집을 경우, 다른 구성요소의 "아래(below)"또는 "아래(beneath)"로 기술된 구성요소는 다른 구성요소의 "위(above)"에 놓여질 수 있다. 따라서, 예시적인 용어인 "아래"는 아래와 위의 방향을 모두 포함할 수 있다. 구성요소는 다른 방향으로도 배향될 수 있으며, 이에 따라 공간적으로 상대적인 용어들은 배향에 따라 해석될 수 있다.

[0031] 본 명세서에서, 컴퓨터는 적어도 하나의 프로세서를 포함하는 모든 종류의 하드웨어 장치를 의미하는 것이고, 실시 예에 따라 해당 하드웨어 장치에서 동작하는 소프트웨어적 구성도 포괄하는 의미로서 이해될 수 있다. 예를 들어, 컴퓨터는 스마트폰, 태블릿 PC, 데스크톱, 노트북 및 각 장치에서 구동되는 사용자 클라이언트 및 애플리케이션을 모두 포함하는 의미로서 이해될 수 있으며, 또한 이에 제한되는 것은 아니다.

[0032] 이하, 첨부된 도면을 참조하여 본 발명의 실시예를 상세하게 설명한다.

[0033] 본 명세서에서 설명되는 각 단계들은 컴퓨터에 의하여 수행되는 것으로 설명되나, 각 단계의 주체는 이에 제한되는 것은 아니며, 실시 예에 따라 각 단계들의 적어도 일부가 서로 다른 장치에서 수행될 수도 있다.

[0034] 도 1은 본 발명의 일 실시예에 따른 음향 조율 시스템을 설명하기 위한 시스템도이다.

[0035] 도 1에 도시된 바와 같이, 음향 조율 시스템은 스피커(10), 전자 장치(20) 및 이퀄라이저(30)로 구현될 수 있다.

[0036] 스피커(10)는, 음향 조율을 위한 다양한 오디오 신호를 출력할 수 있다. 일 실시예로, 스피커(10)는 잔향시간에 대한 데이터를 획득하기 위한 테스트 오디오 신호 및 이퀄라이징 파라미터를 획득하기 위한 학습용 오디오 신호를 생성하여 출력할 수 있다.

[0037] 전자 장치(20)는, 스피커(10)로부터 오디오 신호를 수신하고, 수신한 오디오 신호를 바탕으로, 음향 조율을 위한 이퀄라이징 파라미터를 획득하기 위한 구성이다.

[0038] 일 실시예로, 전자 장치(20)는 스마트폰(smartphone), 태블릿 PC(tablet personal computer), 이동 전화기(mobile phone), 영상 전화기, 전자책 리더기(e-book reader), 데스크탑 PC (desktop PC), 랩탑 PC(laptop PC), 넷북 컴퓨터(netbook computer), 워크스테이션(workstation), 서버, PDA(personal digital assistant), PMP(portable multimedia player), MP3 플레이어, 모바일 의료기기, 카메라, 또는 웨어러블 장치(wearable device) 중 적어도 하나를 포함할 수 있다.

[0039] 또 다른 실시 예로, 전자 장치(20)는 가전 제품(home appliance)일 수 있다. 가전 제품은, 예를 들면, 텔레비전, DVD 플레이어(Digital Video Disk player), 오디오, 냉장고, 에어컨, 청소기, 오븐, 전자레인지, 세탁기, 공기 청정기, 셋톱 박스(set-top box), 홈 오토매이션 컨트롤 패널(home automation control panel), 보안 컨트롤 패널(security control panel), TV 박스(예: 삼성 HomeSync쳬, 애플TV쳬, 또는 구글 TV쳬), 게임 콘솔(예: Xbox쳬, PlayStation쳬), 전자 사전, 전자 키, 캠코더, 또는 전자 액자 중 적어도 하나를 포함할 수 있다.

[0040] 이퀄라이저(30)는, 전자 장치(20)로부터 수신한 이퀄라이징 파라미터를 바탕으로 오디오 신호를 보정하기 위한 구성이다. 일 실시예로, 이퀄라이저(30)는 다채널 오디오 믹서를 포함하는 개념으로 이해될 수 있다.

[0041] 도 2는 본 발명의 일 실시예에 따른 이퀄라이징 파라미터를 획득하여 오디오 신호를 보정하는 방법을 설명하기 위한 예시도이다.

[0042] 단계 S110에서, 스피커(10)는, 테스트 오디오 신호를 출력할 수 있다.

[0043] 본 발명의 일 실시예에 따라, 테스트 오디오 신호는 화이트 노이즈, 핑크 노이즈 및 스위프 시그널 중 적어도 하나의 테스트 오디오 신호일 수 있다. 나아가, 테스트 오디오 신호는 잔향시간 측정을 위한 테스트 오디오 신호일 수 있음은 물론이다.

[0044] 단계 S120에서, 전자 장치(20)는, 출력된 테스트 오디오 신호를 수신하여 테스트 주파수 응답 특성 데이터를 획득할 수 있다.

[0045] 이때, 테스트 주파수 응답 특성 데이터는, 주파수 대역별 이득값에 대한 데이터일 수 있으며, 도 4a, 도 4b, 도 6a 및 도 6b에 도시된 바와 같이 가로축을 주파수 대역 축으로, 세로축을 이득값 축으로 하는 그래프의 형태로 표시될 수 있다.

[0046] 단계 S130에서, 전자 장치(20)는, 수신한 테스트 오디오 신호에 대한 목표 주파수 응답 특성 데이터를 획득할 수 있다.

[0047] 이때, 목표 주파수 응답 특성 데이터는, 전 주파수 대역 또는 기 설정된 주파수 값 이상의 주파수 대역에서 일정한 이득값을 가지는 플랫한 응답특성 데이터일 수 있다. 그러나 이에 한정되는 것은 아니며, 목표 주파수 응답 특성 데이터는 상황에 따라 다양하게 설정될 수 있음은 물론이다.

[0048] 단계 S140에서, 전자 장치(20)는, 테스트 주파수 응답 특성 데이터 및 목표 주파수 응답 특성 데이터를 인공지능 모델의 입력값으로 입력하여, 테스트 오디오 신호를 보정하기 위한 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득할 수 있다.

[0049] 이때, 이퀄라이징 파라미터는, 중심 주파수, 주파수 대역 및 이득값 중 적어도 하나를 포함할 수 있다. 이때, 중심 주파수는 F값, 주파수 대역은 Q 값, 이득값은 K 값 등으로 표현될 수 있으나, 이에 한정되는 것은 아니다.

[0050] 일 실시예에 따라, 전자 장치(20)는 테스트 주파수 응답 특성 데이터 및 목표 주파수 응답 특성 데이터를 비교하여 이퀄라이징이 필요한 주파수 대역 및 이득값을 결정하고, 결정된 주파수 대역에서 결정된 이득값만큼 테스트 주파수 응답 특성을 부스트(boost) 또는 컷(cut) 할 수 있다.

[0051] 단계 S150에서, 이퀄라이저(30)는, 획득된 이퀄라이징 파라미터를 바탕으로 스피커에서 출력되는 오디오 신호를 보정할 수 있다.

[0052] 단계 S160에서, 스피커(10)는, 출력 오디오 신호를 출력할 수 있다.

[0053] 한편, 전자 장치(10)는, 중심 주파수, 주파수 대역 및 이득값을 획득하기 위하여, 단위 주파수 대역을 이용할 수 있다. 본 명세서에서 단위 주파수 대역이란, 단위 주파수 대역에 대응되는 주파수 대역에서의 중심 주파수, 주파수 대역 및 이득값 획득을 위한 주파수 대역의 범위로 이해될 수 있다. 일 실시예로, 이퀄라이징을 위한 주파수 대역은 단위 주파수 대역보다 작은 범위로 설정될 수 있다. 예를 들어, 단위 주파수 대역이 100hz 범위인

경우, 이퀄라이징을 위한 주파수 대역은 최대 100hz일 수 있다.

[0054] 일 실시예에 따라, 전자 장치(20)는 이퀄라이징에 대한 다양한 학습 데이터를 바탕으로 단위 주파수 대역의 결정할 수 있다. 단위 주파수 대역의 결정 방법에 대해서는 후술한다.

[0055] 도 3 내지 도 4e는 본 발명의 일 실시예에 따른 중심 주파수를 바탕으로 주파수 대역 및 이득값을 획득하는 방법을 설명하기 위한 예시도이다.

[0056] 단계 S210에서, 전자 장치(20)는, 단위 주파수 대역 정보를 획득할 수 있다.

[0057] 단계 S220에서, 전자 장치(20)는, 단위 주파수 대역 정보를 바탕으로, 이퀄라이징 파라미터 중 보정을 위한 제1 중심 주파수를 획득할 수 있다.

[0058] 일 실시예에 따라, 전자 장치(20)는 전체 주파수 대역 중 이득값이 가장 높거나 가장 낮은 주파수를 제1 중심 주파수로 획득할 수 있다.

[0059] 또 다른 실시예로, 전자 장치(20)는 단위 주파수 대역 내에서 이득값이 가장 높거나 가장 낮은 주파수를 제1 중심 주파수로 획득할 수 있다.

[0060] 또 다른 실시예로, 전자 장치(20)는 단위 주파수 대역 내의 각각의 주파수 값에 대한 각각의 이득값을 획득하고, 획득된 복수의 이득값 중 어느 두개의 이득값의 차이가 기 설정된 이득값 이상인 경우, 획득된 두개의 이득값 중 어느 하나를 제1 중심 주파수로 획득할 수 있다.

[0061] 일 실시예로, 도 4a 및 도 4b에 도시된 바와 같이, 전자 장치(20)는 제1 주파수값을 피크값인 F1으로 결정할 수 있다.

[0062] 단계 S230에서, 전자 장치(20)는, 제1 중심 주파수를 바탕으로, 보정을 위한 제1 주파수 대역을 획득할 수 있다.

[0063] 구체적으로, 전자 장치(20)는 제1 중심 주파수를 중심으로, 주파수 변화에 따른 이득값의 기울기 변화량을 판단할 수 있다. 전자 장치(20)는 주파수 변화에 따른 이득값의 기울기 변화량이 기 설정된 값 이상인 주파수 값이 주파수 대역에 포함되도록 제1 주파수 대역을 결정할 수 있다. 이때, 이득값의 기울기는, 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 1차 미분값을 의미할 수 있다.

[0064] 또 다른 실시예로, 전자 장치(20)는 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 2차 미분값을 바탕으로 제1 주파수 대역을 결정할 수 있다. 구체적으로, 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 2차 미분값은, 이득값의 기울기 변화량에 대한 기울기를 의미할 수 있으며, 이득값의 변화량이 급격히 증가하는 주파수 값은 제1 주파수 대역에 포함되고, 이득값의 변화량이 완만한 주파수 값은 제1 주파수 대역에 포함되지 않도록 주파수 대역을 결정할 수 있다.

[0065] 예를 들어, 도 4a에 도시된 바와 같이, 전자 장치(20)는 테스트 주파수 응답 그래프의 a1 주파수를 주파수 대역 결정을 위한 주파수로 판단할 수 있다. 이때, a1 주파수는 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 2차 미분값을 바탕으로 결정될 수 있음은 상술한 바와 같다, 이 경우, 제1 주파수 대역은 [a1, 2F1-a1]으로 결정될 수 있다.

[0066] 다만, 상술한 바와 같이, 제1 주파수 대역은 단위주파수 대역보다 작은 범위로 결정되는 경우를 가정할 수 있다. 예를 들어, 도 4b에 도시된 바와 같이, 실제 이상적인 제1 주파수 대역이 도 4a에 따른 주파수 대역이라고 하더라도, 단위 주파수 대역의 범위가 작은 경우, 전자 장치(20)는 a1 주파수 값을 찾아낼 수 없는 경우가 존재한다. 이 경우, 전자 장치(20)는 단위 주파수 대역을 제1 주파수 대역을 결정할 수 있다.

[0067] 도 4a의 경우와 같이, 단위 주파수 대역이 충분히 넓어 이상적인 제1 주파수 대역을 획득하는 것이 가능한 경우, 도 4c에 도시된 바와 같이, 효과적인 이퀄라이징이 가능할 수 있다. 다만, 단위 주파수 대역이 넓은 경우, 전자 장치(20)의 계산량이 증가하게되는 문제점이 존재할 수 있다. 또는, 테스트 주파수 응답 특성 그래프가 도 4e와 같이, 단위 주파수 대역 범위내에 복수개의 피크값을 포함하는 경우, 전자 장치(20)는 하나의 피크값에 대해서만 제1 주파수 대역을 결정하거나, 두개의 피크값을 모두 포함하는 제1 주파수 대역을 획득하게 되어, 효과적인 이퀄라이징이 불가능한 경우가 발생할 가능성이 존재한다.

[0068] 한편, 도 4b의 경우와 같이, 단위 주파수 대역의 범위가 이상적인 제1 주파수 대역의 범위보다 작은 경우, 이퀄라이징 후 테스트 주파수 응답 특성 그래프는 도 4d에 도시된 형태가 될 수 있다. 이 경우, 이퀄라이징 후 새로

운 피크값(F1' 및 F2'')가 발생하게 되므로, 상술한 도 3의 방법으로 이퀄라이징을 복수회 수행하여야 하는 단점이 존재하게 된다.

[0069] 따라서, 전자 장치(20)는 적절한 범위의 단위 주파수 대역을 결정할 필요성이 존재한다.

[0070] 일 실시예로, 전자 장치(20)는 단위 주파수 대역을, 저음 대역에 대한 제1 단위 주파수 대역, 중저음 대역에 대한 제2 단위 주파수 대역, 중고음 대역에 대한 제3 단위 주파수 대역, 고음 대역에 대한 제4 단위 주파수 대역으로 구분할 수 있다. 이때, 저음대역은 20hz~100hz, 중저음 대역은 100hz~1000hz, 중고음 대역은 1000hz~5000hz, 고음대역은 5000hz~20000hz로 설정될 수 있으나, 이에 한정되는 것은 아니다.

[0071] 예를 들어, 저음 대역에 대한 제1 단위 주파수 대역은 10hz, 중저음 대역에 대한 제2 단위 주파수 대역은 100hz, 제3 중고음 대역에 대한 단위 주파수 대역은 500hz, 고음 대역에 대한 제4 단위 주파수 대역은 2000hz 등으로 결정될 수 있다.

[0072] 한편, 상술한 경우, 단위 주파수 대역이 저음영역과 중저음 영역에 걸치거나, 중저음 영역과 중고음 영역에 걸치거나, 중고음 영역과 고음 영역에 걸치게 되는 경우가 존재할 수 있다. 이 경우, 전자 장치(20)는 제1 단위 주파수 대역이 저음 영역에 포함되는 비율 및 제2 단위 주파수 대역이 중저음 영역에 포함되는 비율을 바탕으로 단위 주파수 대역을 획득할 수 있다.

[0073] 구체적으로, 제1 단위 주파수 대역 범위를 a, 제2 단위 주파수 대역 범위를 b, 제1 단위 주파수 대역에 대응되는 저음 대역과 제2 단위 주파수 대역에 대응되는 중저음 대역의 경계 주파수를 A, 획득하고자 하는 단위 주파수 대역의 시작 주파수를 x, 단위 주파수 대역의 종료 주파수를 y라고 할 때, 단위 주파수 대역의 종료 주파수를 y는 하기 수학식을 통해 구해질 수 있다.

[0074] [수학식]

[0075] $$y = \frac{b(a + x - A)}{a}$$

[0076] 다만, 단위 주파수 대역을 결정하는 방법은 상술한 실시예에 한정되는 것은 아니며, 단위 주파수 대역은 기 설정된 주파수 밴드를 기초로 결정될 수 있다. 이때, 주파수 밴드는 밴드의 중심 주파수를 기초로 결정되는 주파수 대역일 수 있다. 예를 들어, BAND 1의 주파수 대역은 중심 주파수는 31.5hz를 바탕으로 0hz~60hz로 결정되고, BAND 2의 주파수 대역은 중심 주파수는 64hz를 바탕으로 40hz~120hz로 결정되고, BAND 3의 주파수 대역은 중심 주파수는 125hz를 바탕으로 100hz~200hz로 결정되고, BAND 4의 주파수 대역은 중심 주파수는 250hz를 바탕으로 150hz~400hz로 결정되고, BAND 5의 주파수 대역은 중심 주파수는 500hz를 바탕으로 350hz~900hz로 결정되고, BAND 6의 주파수 대역은 중심 주파수는 1000hz를 바탕으로 800hz~1700hz로 결정되고, BAND 7의 주파수 대역은 중심 주파수는 2000hz를 바탕으로 15000hz~3500hz로 결정되고, BAND 8의 주파수 대역은 중심 주파수는 4000hz를 바탕으로 3000hz~7000hz로 결정되고, BAND 9의 주파수 대역은 중심 주파수는 8000hz를 바탕으로 6000hz~14000hz로 결정되고, BAND 10의 주파수 대역은 중심 주파수는 16000hz를 바탕으로 12000hz~20000hz로 결정될 수 있다. 각각의 주파수 밴드의 주파수 대역은 위의 실시예에 한정되는 것은 아니고, 필요에 따라 10개의 밴드가 아닌 31개의 밴드, 64개의 밴드 등으로 다양하게 변경될 수 있다.

[0077] 한편, 전자 장치(20)는 상술한 다양한 단위 주파수 대역을 바탕으로 보정을 위한 중심 주파수, 주파수 대역 및 이득값을 결정하되, 결정된 중심 주파수, 주파수 대역 및 이득값을 바탕으로 보정된 신호의 주파수 응답 특성 데이터와 목표 주파수 응답 특성 데이터를 비교하고, 비교 결과를 바탕으로 단위 주파수 대역을 변경할 수 있다.

[0078] 구체적으로, 전자 장치(20)는 테스트 오디오 신호에 대한 주파수 응답 특성 데이터, 결정된 이퀄라이징 파라미터, 이퀄라이징 파라미터를 바탕으로 보정된 오디오 신호에 대한 주파수 응답 특성 데이터 및 목표 주파수 응답 특성 데이터를 입력값으로 인공지능 모델에 입력하여 새로운 단위 주파수 대역을 출력값으로 획득할 수 있다.

[0079] 일 실시예로, 전자 장치(20)는 보정 후 제1 중심 주파수(F1)에서 기 설정된 범위의 주파수 대역에서 새로운 중심 주파수가 (짝수개) 획득되면, 단위 주파수 대역의 범위를 증가시킬 수 있다. 또 다른 실시예로, 전자 장치(20)는 보정 후 제1 중심 주파수 대역(F1) 에서 기 설정된 범위의 주파수 대역에서 새로운 중심 주파수가 획득되지 않으면, 단위 주파수 대역의 범위를 감소 시킬 수 있다.

[0080] 상술한 방법을 바탕으로, 전자 장치(20)는 저음 대역, 중저음 대역, 중고음 대역 및 고음 대역 각각에 대한 최

적의 단위 주파수 대역을 획득할 수 있다.

[0081] 단계 S240에서, 전자 장치(20)는, 제1 주파수 대역에서의 테스트 주파수 응답 특성 데이터 및 제1 주파수 대역에서의 목표 주파수 응답 특성 데이터를 바탕으로, 제1 주파수 대역을 보정하기 위한 제1 이득값을 획득할 수 있다.

[0082] 즉, 전자 장치(20)는 결정된 제1 주파수 대역에서 결정된 제1 이득값만큼 테스트 주파수 응답 특성을 부스트(boost) 또는 컷(cut) 하기 위한 제어 신호를 이퀄라이저(30)로 전송할 수 있다.

[0083] 도 5 내지 도 6b는 본 발명의 일 실시예에 따른 주파수 대역을 바탕으로 중심 주파수 및 이득값을 획득하는 방법을 설명하기 위한 예시도이다.

[0084] 단계 S310에서, 전자 장치(20)는, 단위 주파수 대역 정보를 획득할 수 있다. 단위 주파수 대역에 대한 구체적인 내용은 상술한 바와 같다.

[0085] 단계 S320에서, 전자 장치(20)는, 단위 주파수 대역 정보를 바탕으로, 이퀄라이징 파라미터 중 보정을 위한 제2 주파수 대역을 획득할 수 있다.

[0086] 구체적으로, 전자 장치(20)는 단위 주파수 대역에 포함된 주파수별 이득값을 바탕으로, 주파수 변화에 따른 이득값의 기울기 변화량을 판단할 수 있다. 전자 장치(20)는 주파수 변화에 따른 이득값의 기울기 변화량이 기 설정된 값 이상인 주파수 값이 주파수 대역에 포함되도록 제2 주파수 대역을 결정할 수 있다. 이때, 이득값의 기울기는, 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 1차 미분값을 의미할 수 있다.

[0087] 또 다른 실시예로, 전자 장치(20)는 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 2차 미분값을 바탕으로 제2 주파수 대역을 결정할 수 있다. 구체적으로, 주파수 값을 입력값으로 하였을 때 출력되는 이득값에 대한 2차 미분값은, 이득값의 기울기 변화량에 대한 기울기를 의미할 수 있으며, 이득값의 변화량이 급격히 증가하는 주파수 값은 제2 주파수 대역에 포함되고, 이득값의 변화량이 완만한 주파수 값은 제2 주파수 대역에 포함되지 않도록 주파수 대역을 결정할 수 있다.

[0088] 이때, 도 4a 및 도 4b에서 설명한 것과 동일하게, 전자 장치(20)는 도 6a에 도시된 바와 같이, 제2 단위 주파수 대역(U2)보다 작은 범위의 제2 주파수 대역(Q2)을 획득하거나, 도 6b에 도시된 바와 같이, 제2 단위 주파수 대역(U2)과 동일한 범위의 제2 주파수 대역(Q2)을 획득할 수 있음은 물론이다.

[0089] 단계 S330에서, 전자 장치(20)는, 제2 주파수 대역을 바탕으로, 보정을 위한 제2 중심 주파수를 획득할 수 있다. 이때, 제2 중심 주파수는 제2 주파수 대역의 중간 주파수일 수 있다.

[0090] 단계 S340에서, 전자 장치(20)는, 제2 중심 주파수에서의 테스트 주파수 응답 특성 데이터 및 제2 중심 주파수에서의 목표 주파수 응답 특성 데이터를 바탕으로, 제2 주파수 대역을 보정하기 위한 제2 이득값을 획득할 수 있다.

[0091] 즉, 전자 장치(20)는 결정된 제2 주파수 대역에서 결정된 제2 이득값만큼 테스트 주파수 응답 특성을 부스트(boost) 또는 컷(cut) 하기 위한 제어 신호를 이퀄라이저(30)로 전송할 수 있다.

[0092] 도 7은 본 발명의 일 실시예에 따른 인공지능 모델을 이용하여 이퀄라이징 파라미터를 획득하는 방법을 설명하기 위한 예시도이다.

[0093] 단계 S410에서, 전자 장치(20)는, 출력된 테스트 오디오 신호를 수신하여 잔향시간 데이터를 수신할 수 있다.

[0094] 구체적으로, 전자 장치(20)는 수신한 오디오 신호를 분석하여 잔향시간에 대한 데이터를 획득할 수 있다. 주파수 응답 특성 데이터는 상술한 단위 주파수 대역별로 독립적으로 획득할 수 있음은 물론이다.

[0095] 단계 S420에서, 전자 장치(20)는, 음향 조율을 위한 인공지능 모델을 학습시키기 위한 학습 데이터를 수집할 수 있다.

[0096] 단계 S430에서, 전자 장치(20)는, 학습 데이터를 바탕으로 인공지능 모델을 학습시킬 수 있다.

[0097] 일 실시예로, 인공지능 모델이 데이터 학습부 및 데이터 인식부를 포함할 수 있다. 데이터 학습부는 인공지능 모델이 특정 목적에 따른 기준을 갖도록 인공지능 모델을 학습시킬 수 있다. 이때, 특정 목적이란 잔향시간 데이터를 바탕으로 학습용 오디오 데이터의 이퀄라이징 파라미터를 결정하기 위한 목적일 수 있다. 데이터 학습부는 상술한 목적에 따른 동작을 결정하기 위하여 학습 데이터를 데이터 인공지능 모델에 적용하여, 판단 기준을 갖는 인공지능 모델을 생성할 수 있다. 데이터 인식부는 입력 데이터에 기초하여 특정 목적에 대한 상황을 판단

할 수 있다. 데이터 인식부는 학습된 인공지능 모델을 이용하여, 소정의 입력 데이터로부터 상황을 판단할 수 있다. 데이터 인식부는 기 설정된 기준에 따라 소정의 입력 데이터를 획득하고, 획득된 입력 데이터를 입력 데이터로 하여 인공지능 모델에 적용함으로써, 소정의 입력 데이터에 기초한 소정의 상황을 판단할 수 있다(또는, 추정(estimate)할 수 있다). 또한, 획득된 입력 데이터를 입력 데이터로 인공지능 모델에 적용하여 출력된 결과값은, 인공지능 모델을 갱신하는데 이용될 수 있다.

[0098] 한편, 데이터 학습부의 적어도 일부 및 데이터 인식부의 적어도 일부는, 소프트웨어 모듈로 구현되거나 적어도 하나의 하드웨어 칩 형태로 제작되어 전자 장치에 탑재될 수 있다. 예를 들어, 데이터 학습부 및 데이터 인식부 중 적어도 하나는 인공 지능(AI; artificial intelligence)을 위한 전용 하드웨어 칩 형태로 제작될 수도 있고, 또는 기존의 범용 프로세서(예: CPU 또는 application processor) 또는 그래픽 전용 프로세서(예: GPU)의 일부로 제작되어 전술한 각종 전자 장치에 탑재될 수도 있다. 이 때, 인공 지능을 위한 전용 하드웨어 칩은 확률 연산에 특화된 전용 프로세서로서, 기존의 범용 프로세서보다 병렬처리 성능이 높아 기계 학습과 같은 인공 지능 분야의 연산 작업을 빠르게 처리할 수 있다. 데이터 학습부 및 데이터 인식부가 소프트웨어 모듈(또는, 인스트럭션(instruction) 포함하는 프로그램 모듈)로 구현되는 경우, 소프트웨어 모듈은 컴퓨터로 읽을 수 있는 판독 가능한 비일시적 판독 가능 기록 매체(non-transitory computer readable media)에 저장될 수 있다. 이 경우, 소프트웨어 모듈은 OS(Operating System)에 의해 제공되거나, 소정의 어플리케이션에 의해 제공될 수 있다. 또는, 소프트웨어 모듈 중 일부는 OS(Operating System)에 의해 제공되고, 나머지 일부는 소정의 어플리케이션에 의해 제공될 수 있다.

[0099] 한편, 데이터 학습부는 데이터 획득부, 전처리부, 학습 데이터 선택부, 모델 학습부 및 모델 평가부를 더 포함할 수 있다. 데이터 획득부는 특정 목적에 따른 학습 데이터를 획득하기 위한 구성이다. 전처리부는 획득부에서 획득된 데이터를 기 정의된 포맷으로 전처리하기 위한 구성이다. 학습 데이터 선택부는, 학습 데이터 획득부에서 획득된 데이터 또는 학습 데이터 전처리부에서 전처리된 데이터 중에서 학습에 필요한 데이터를 선택하기 위한 구성이다. 선택된 학습 데이터는 모델 학습부에 제공될 수 있다. 모델 학습부는 학습 데이터를 이용하여 인공지능 모델을 학습시키기 위한 구성이다. 모델 평가부는 인공지능 모델의 결과를 향상 시키기 위한 구성이다.

[0100] 또한, 데이터 인식부는 데이터 획득부, 전처리부, 입력 데이터 선택부, 인식 결과 제공부 및 모델 갱신부를 더 포함할 수 있다. 데이터 획득부는 입력 데이터를 획득하기 위한 구성이다. 전처리부는 획득부에서 획득된 데이터를 기 정의된 포맷으로 전처리하기 위한 구성이다. 입력 데이터 선택부는 전처리된 데이터 중 인식에 필요한 데이터를 선별하기 위한 구성이다. 인식 결과 제공부는 입력 데이터로부터 선택된 데이터를 수신할 수 있는 구성이다. 모델 갱신부는 인식 결과 제공부로부터 제공된 인식 결과에 대한 평가에 기초하여 인공지능 모델을 갱신하기 위한 구성이다.

[0101] 또한, 인공지능 모델은 인식 모델의 적용 분야, 학습의 목적 또는 장치의 컴퓨터 성능 등을 고려하여 구축될 수 있다. 인공지능 모델은, 예를 들어, 신경망(Neural Network)을 기반으로 하는 모델일 수 있다. 인공지능 모델은 인간의 뇌 구조를 컴퓨터 상에서 모의하도록 설계될 수 있다. 인공지능 모델은 인간의 신경망의 뉴런(neuron)을 모의하는, 가중치를 가지는 복수의 네트워크 노드들을 포함할 수 있다. 복수의 네트워크 노드들은 뉴런이 시냅스(synapse)를 통하여 신호를 주고 받는 시냅틱(synaptic) 활동을 모의하도록 각각 연결 관계를 형성할 수 있다. 인공지능 모델은, 일 예로, 신경망 모델, 또는 신경망 모델에서 발전한 딥 러닝 모델을 포함할 수 있다. 딥 러닝 모델에서 복수의 네트워크 노드들은 서로 다른 깊이(또는, 레이어)에 위치하면서 컨볼루션(convolution) 연결 관계에 따라 데이터를 주고 받을 수 있다.

[0102] 예컨대, DNN(Deep Neural Network), RNN(Recurrent Neural Network), BRDNN(Bidirectional Recurrent Deep Neural Network)과 같은 모델이 인공지능 모델로서 사용될 수 있으나, 이에 한정되지 않는다.

[0103] 단계 S440에서, 전자 장치(20)는, 학습된 인공지능 모델에 주파수 응답 특성 데이터 및 잔향시간 데이터를 인공지능 모델에 입력 데이터로 입력하여 이퀄라이징 파라미터를 획득할 수 있다.

[0105] 도 8은 본 발명의 또 다른 실시예에 따른 학습 데이터를 수집하는 방법을 설명하기 위한 예시도이다.

[0106] 단계 S510에서, 전자 장치(20)는, 테스트 오디오 신호의 이득값을 획득할 수 있다.

[0107] 단계 S520에서, 전자 장치(20)는, 제1 잔향시간, 제2 잔향시간, 제3 잔향시간 및 제4 잔향시간 중 적어도 하나의 잔향시간을 포함하는 잔향시간 데이터를 획득할 수 있다.

[0108] 즉, 전자 장치(20)는 잔향 측정용 이득값을 설정하고, 설정된 이득값을 가지는 측정용 오디오 신호를 재생하여 실내 공간의 잔향을 측정할 수 있다. 구체적으로, 전자 장치(20)는 전체 대역 및 단위 주파수 대역별 감쇠 시간

을 측정 및 계산하고, 측정 및 계산된 잔향시간을 파라미터로 저장할 수 있다.

[0109] 구체적으로, 제1 잔향시간은, 테스트 오디오 신호의 이득값이 테스트 오디오 신호의 정상상태 이득값으로부터 -10db 감쇠되는 시점까지의 시간이고, 제2 잔향시간은, 테스트 오디오 신호의 이득값이 테스트 오디오 신호의 정상상태 이득값으로부터 -30db 감쇠되는 시점까지의 시간이고, 제3 잔향시간은, 테스트 오디오 신호의 이득값이 테스트 오디오 신호의 정상상태 이득값으로부터 -60db 감쇠되는 시점까지의 시간이고, 제4 잔향시간은, 테스트 오디오 신호를 복수의 단위 주파수 대역으로 분류하고, 복수의 단위 주파수 대역 각각에 대한 복수의 잔향시간일 수 있다.

[0110] 이때, 본 발명의 다양한 실시예에 따라, -60db가 감쇠되는데 걸리는 잔향 시간은 노이즈 레벨로 인하여 측정이 어려운 경우가 존재할 수 있다. 이 경우, 전자 장치(20)는 -60db가 감쇠되는데 걸리는 잔향 시간 대신 -30db가 감쇠되는데 걸리는 잔향 시간을 사용할 수 있음은 물론이다.

[0111] 단계 S530에서, 전자 장치(20)는, 학습용 오디오 신호를 획득할 수 있다.

[0112] 단계 S540에서, 전자 장치(20)는, 학습용 오디오 신호로부터 학습용 오디오 데이터를 획득할 수 있다.

[0113] 즉, 전자 장치(20)는 이퀄라이징 파라미터를 설정하여 테스트 오디오 신호를 재생하고, 재생된 테스트 오디오 신호를 바탕으로 각 단위 주파수 대역 별 오디오 신호를 측정할 수 있다. 전자 장치(20)는 측정된 단위 주파수 대역 별 신호 및 측정된 단위 주파수 대역 별 신호에 대응되는 이퀄라이징 파라미터의 설정 상태를 수집할 수 있다. 전자 장치(20)는 상술한 방법을 통해 잔향시간 파라미터, 수집된 단위 주파수 대역 별 신호 및 이퀄라이징 파라미터를 포함하는 복수의 데이터를 수집할 수 있다.

[0114] 구체적으로, 학습용 오디오 데이터는, 복수의 단위 주파수 대역 각각에 대한 복수의 학습용 이퀄라이징 파라미터 및 학습용 오디오 신호에 복수의 단위 주파수 대역 각각에 대한 복수의 학습용 이퀄라이징 파라미터가 적용되어 출력된 복수의 단위 주파수 대역 각각에 대한 복수의 이득값 데이터를 포함할 수 있다.

[0115] 단계 S550에서, 전자 장치(20)는, 학습용 오디오 데이터를 복수의 주파수 밴드로 분류하고, 학습용 오디오 데이터에 복수의 주파수 밴드 각각에 대한 학습용 이퀄라이징 파라미터를 적용하여 측정된 복수의 주파수 밴드 각각에 대한 이득값을 획득할 수 있다.

[0116] 단계 S560에서, 전자 장치(20)는, 인공지능 모델에 잔향시간 데이터 및 학습용 오디오 데이터를 인공지능 모델에 입력하여 출력 오디오 신호에 대한 목표 이득값이 출력되도록 인공지능 모델의 가중치를 변경할 수 있다.

[0117] 전자 장치(20)는 획득된 잔향시간 데이터, 학습용 오디오 데이터 및 학습용 오디오 데이터에 복수의 단위 주파수 대역 각각에 대한 학습용 이퀄라이징 파라미터를 적용하여 측정된 복수의 단위 주파수 대역 각각에 대한 이득값에 대한 데이터를 하나의 학습 데이터로 저장할 수 있다.

[0118] 단계 S570에서, 전자 장치(20)는, 출력 오디오 신호에 대응되는 이퀄라이징 파라미터를 획득할 수 있다.

[0119] 한편, 본 발명의 다양한 실시예에 따라, 본 발명에서 적용되는 음향 조율 시스템은 음성인식장치, 중앙제어장치, 볼륨조절장치, CD플레이어, 스피커선택장치, 오디오 앰프, 순차전원공급 장치, 오디오 믹서 등 다양한 장치를 포함할 수 있음은 물론이다. 본 발명에 따른 음향 조율 시스템은 상술한 다양한 장치들과 연동되어 음향을 조율할 수 있다.

[0120] 한편, 상술한 다양한 실시예에서는, 전자 장치(20) 가 인공 지능 모델을 이용하여 음향을 조율하는 방법을 설명하였으나, 일반적인 전자 장치(20)에서 인공 지능 모델이 원활히 동작하기 위해서는 큰 저장 공간과 고성능의 GPU가 필요하다는 단점이 존재한다.

[0121] 따라서, 본 개시의 또 다른 실시예에 의해 동작하는 인공 지능 모델을 전자 장치(20)가 사용하기 위하여, 필요에 따라 인공지능 모델을 압축하여 사용할 수 있다. 예를 들어, 인공 지능 모델은 Pruning, Quantization, Decomposition 및 Knowledge Distillation 중 적어도 하나를 이용하여 압축될 수 있다. Pruning은 인공 지능 모델의 가중치 중 의미 없는 가중치 또는 출력값에 큰 영향을 주지 않는 가중치를 삭제하는 압축 기법 중 하나이다. Quantization은 각각의 가중치를 기 설정된 비트로 양자화 하는 압축 기법 중 하나이다. Decomposition은 가중치의 집합인 가중치 행렬 또는 텐서(tensor)를 선형 분해(approximated decomposition)하여 가중치의 크기를 줄이는 압축 기법 중 하나이다. Knowledge Distillation은 원본 모델을 Teacher 모델로 하여 원본 모델보다 작은 Student 모델을 생성하고 학습시키는 압축 기법 중 하나이다. 이때, Student 모델은 상술한 Pruning, Decomposition 또는 Quantization을 통해 생성될 수 있다.

[0122] 상술한 방법에 따라, 서버는 다양한 학습 데이터를 바탕으로 음향 조율을 위한 인공지능 모델을 학습시키고, 전자 장치(20)는 서버에 의해 학습된 모델을 압축하여 저장할 수 있다. 전자 장치(20)는 압축된 인공지능 모델을 이용하여 특정 장소에서의 음향 조율을 위한 이퀄라이징 파라미터를 획득할 수 있다.

[0123] 도 9는 일 실시 예에 따른 장치의 구성도이다.

[0124] 프로세서(102)는 하나 이상의 코어(core, 미도시) 및 그래픽 처리부(미도시) 및/또는 다른 구성 요소와 신호를 송수신하는 연결 통로(예를 들어, 버스(bus) 등)를 포함할 수 있다.

[0125] 일 실시예에 따른 프로세서(102)는 메모리(104)에 저장된 하나 이상의 인스트럭션을 실행함으로써, 도 1 내지 도 8과 관련하여 설명된 방법을 수행한다.

[0126] 예를 들어, 프로세서(102)는 메모리에 저장된 하나 이상의 인스트럭션을 실행함으로써 신규 학습용 데이터를 획득하고, 학습된 모델을 이용하여, 상기 획득된 신규 학습용 데이터에 대한 테스트를 수행하고, 상기 테스트 결과, 라벨링된 정보가 소정의 제1 기준값 이상의 정확도로 획득되는 제1 학습용 데이터를 추출하고, 상기 추출된 제1 학습용 데이터를 상기 신규 학습용 데이터로부터 삭제하고, 상기 추출된 학습용 데이터가 삭제된 상기 신규 학습용 데이터를 이용하여 상기 학습된 모델을 다시 학습시킬 수 있다.

[0127] 한편, 프로세서(102)는 프로세서(102) 내부에서 처리되는 신호(또는, 데이터)를 일시적 및/또는 영구적으로 저장하는 램(RAM: Random Access Memory, 미도시) 및 롬(ROM: Read-Only Memory, 미도시)을 더 포함할 수 있다. 또한, 프로세서(102)는 그래픽 처리부, 램 및 롬 중 적어도 하나를 포함하는 시스템온칩(SoC: system on chip) 형태로 구현될 수 있다.

[0128] 메모리(104)에는 프로세서(102)의 처리 및 제어를 위한 프로그램들(하나 이상의 인스트럭션들)을 저장할 수 있다. 메모리(104)에 저장된 프로그램들은 기능에 따라 복수 개의 모듈들로 구분될 수 있다.

[0129] 본 발명의 실시예와 관련하여 설명된 방법 또는 알고리즘의 단계들은 하드웨어로 직접 구현되거나, 하드웨어에 의해 실행되는 소프트웨어 모듈로 구현되거나, 또는 이들의 결합에 의해 구현될 수 있다. 소프트웨어 모듈은 RAM(Random Access Memory), ROM(Read Only Memory), EPROM(Erasable Programmable ROM), EEPROM(Electrically Erasable Programmable ROM), 플래시 메모리(Flash Memory), 하드 디스크, 착탈형 디스크, CD-ROM, 또는 본 발명이 속하는 기술 분야에서 잘 알려진 임의의 형태의 컴퓨터 판독가능 기록매체에 상주할 수도 있다.

[0130] 본 발명의 구성 요소들은 하드웨어인 컴퓨터와 결합되어 실행되기 위해 프로그램(또는 애플리케이션)으로 구현되어 매체에 저장될 수 있다. 본 발명의 구성 요소들은 소프트웨어 프로그래밍 또는 소프트웨어 요소들로 실행될 수 있으며, 이와 유사하게, 실시 예는 데이터 구조, 프로세스들, 루틴들 또는 다른 프로그래밍 구성들의 조합으로 구현되는 다양한 알고리즘을 포함하여, C, C++, 자바(Java), 어셈블러(assembler) 등과 같은 프로그래밍 또는 스크립팅 언어로 구현될 수 있다. 기능적인 측면들은 하나 이상의 프로세서들에서 실행되는 알고리즘으로 구현될 수 있다.

[0131] 이상, 첨부된 도면을 참조로 하여 본 발명의 실시예를 설명하였지만, 본 발명이 속하는 기술분야의 통상의 기술자는 본 발명이 그 기술적 사상이나 필수적인 특징을 변경하지 않고서 다른 구체적인 형태로 실시될 수 있다는 것을 이해할 수 있을 것이다. 그러므로, 이상에서 기술한 실시예들은 모든 면에서 예시적인 것이며, 제한적이 아닌 것으로 이해해야만 한다.

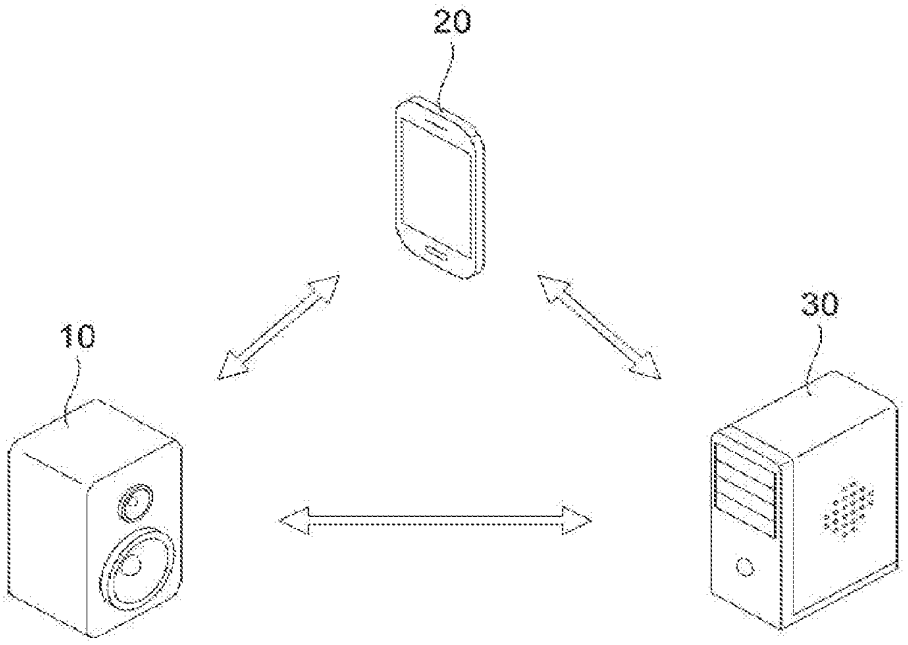
부호의 설명

[0132] 100 : 000

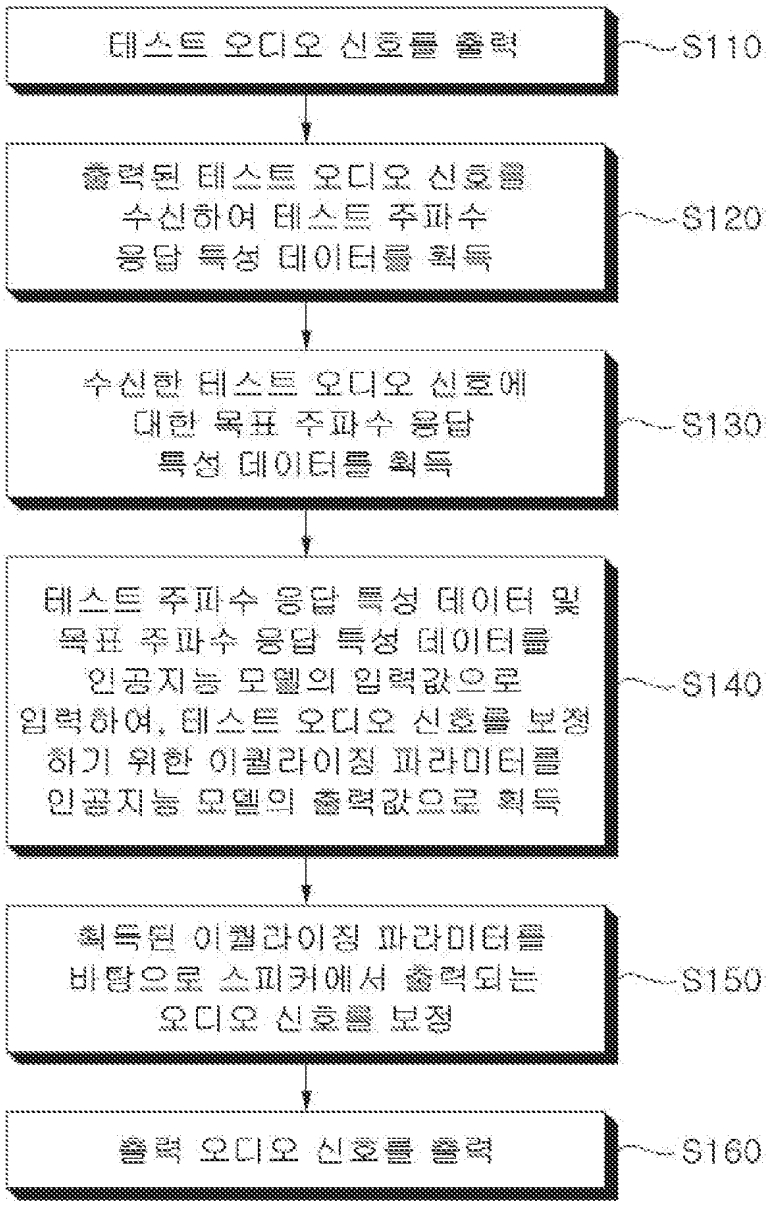
200 : 000

도면

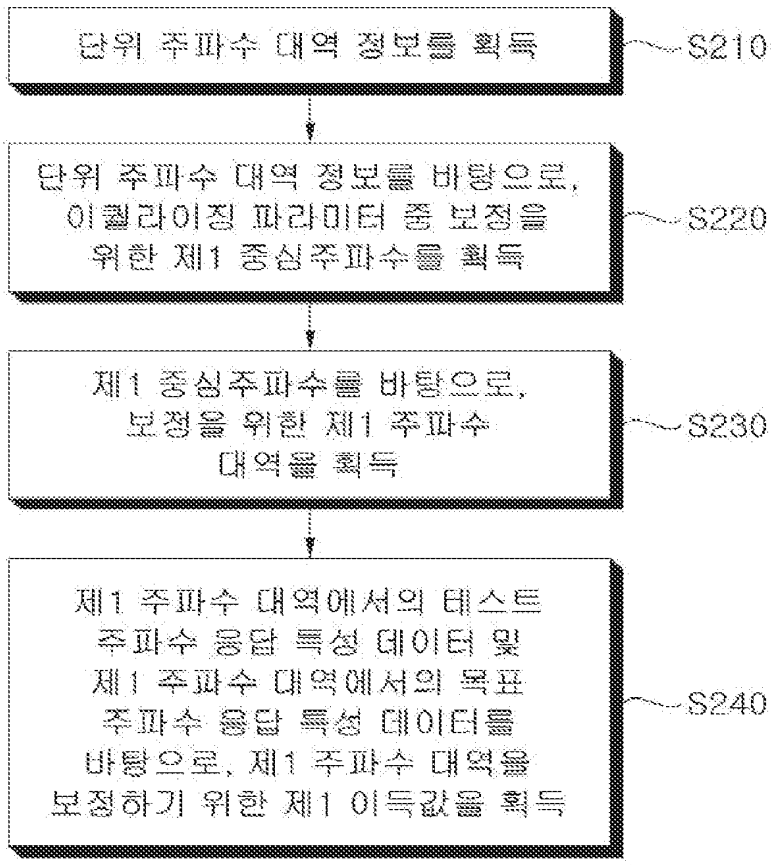
도면1



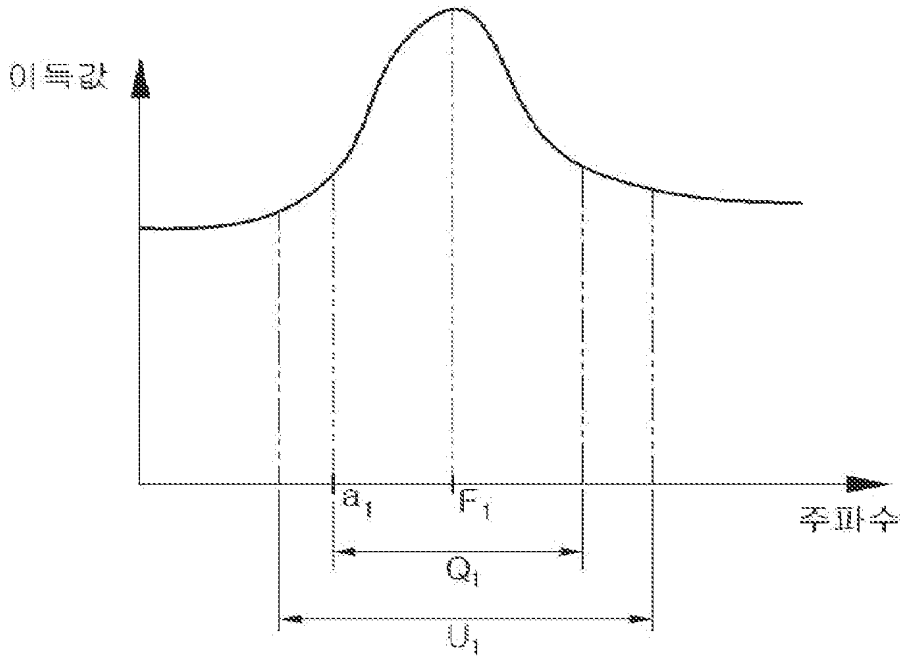
도면2


테스트 오디오 신호를 출력
S110
출력된 테스트 오디오 신호를 수신하여 테스트 주파수 응답 특성 데이터를 획득
S120
수신한 테스트 오디오 신호에 대한 목표 주파수 응답 특성 데이터를 획득
S130
테스트 주파수 응답 특성 데이터 및 목표 주파수 응답 특성 데이터를 인공지능 모델의 입력값으로 입력하여, 테스트 오디오 신호를 보정하기 위한 이퀄라이징 파라미터를 인공지능 모델의 출력값으로 획득
S140
획득된 이퀄라이징 파라미터를 바탕으로 스피커에서 출력되는 오디오 신호를 보정
S150
출력 오디오 신호를 출력
S160

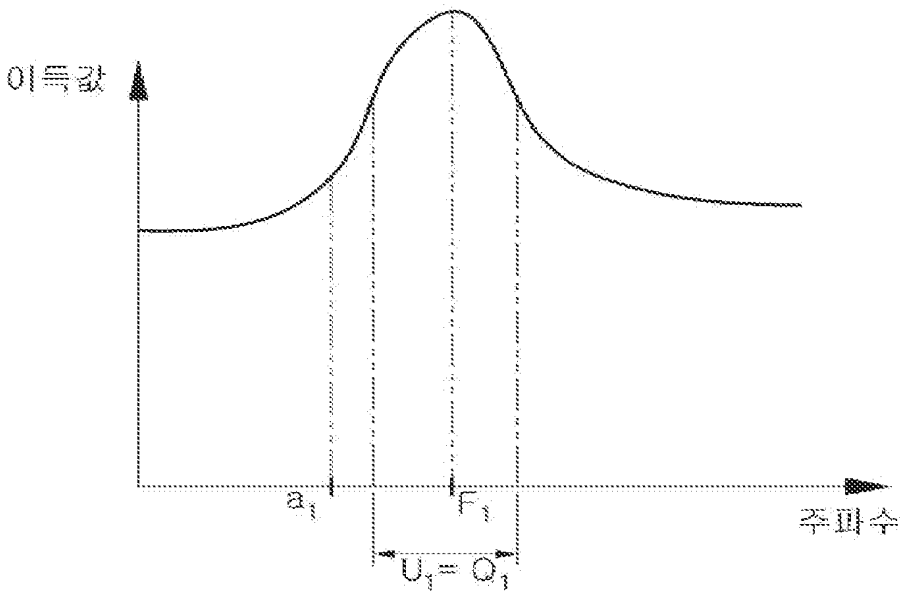
도면3


단위 주파수 대역 정보를 획득
S210
단위 주파수 대역 정보를 바탕으로, 이퀄라이징 파라미터 중 보정을 위한 제1 중심주파수를 획득
S220
제1 중심주파수를 바탕으로, 보정을 위한 제1 주파수 대역을 획득
S230
제1 주파수 대역에서의 테스트 주파수 응답 특성 데이터 및 제1 주파수 대역에서의 목표 주파수 응답 특성 데이터를 바탕으로, 제1 주파수 대역을 보정하기 위한 제1 이득값을 획득
S240

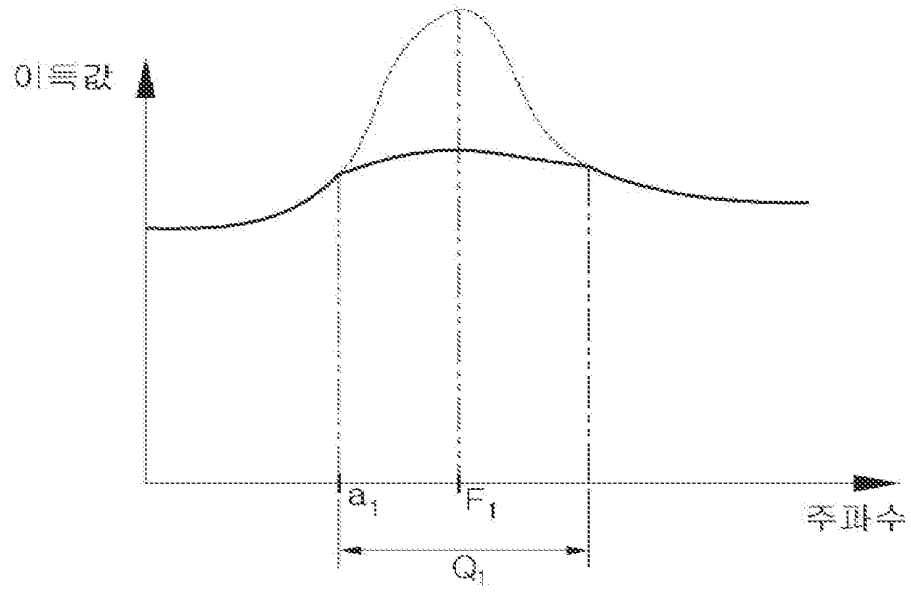
도면4a


이득값
주파수
a_1
F_1
Q_1
U_1

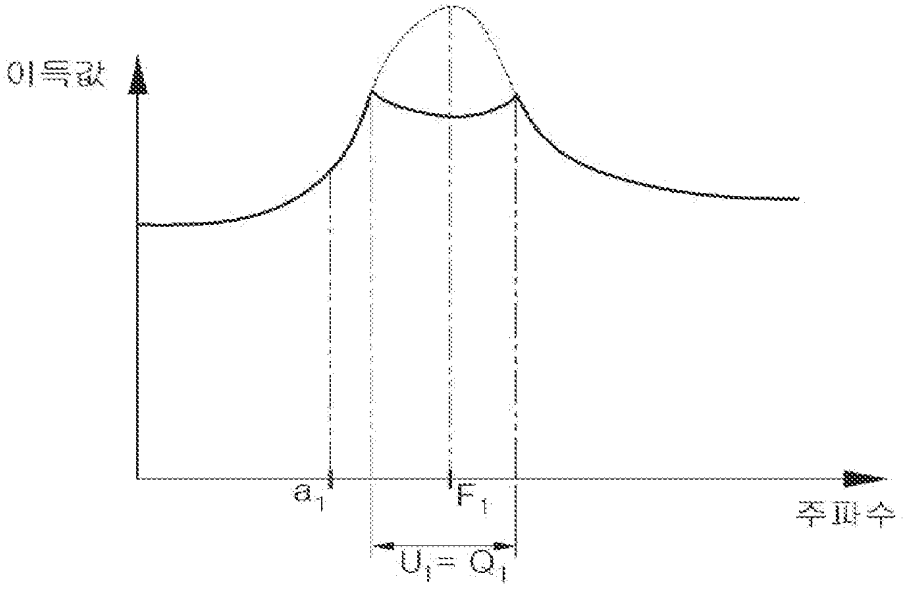
도면4b



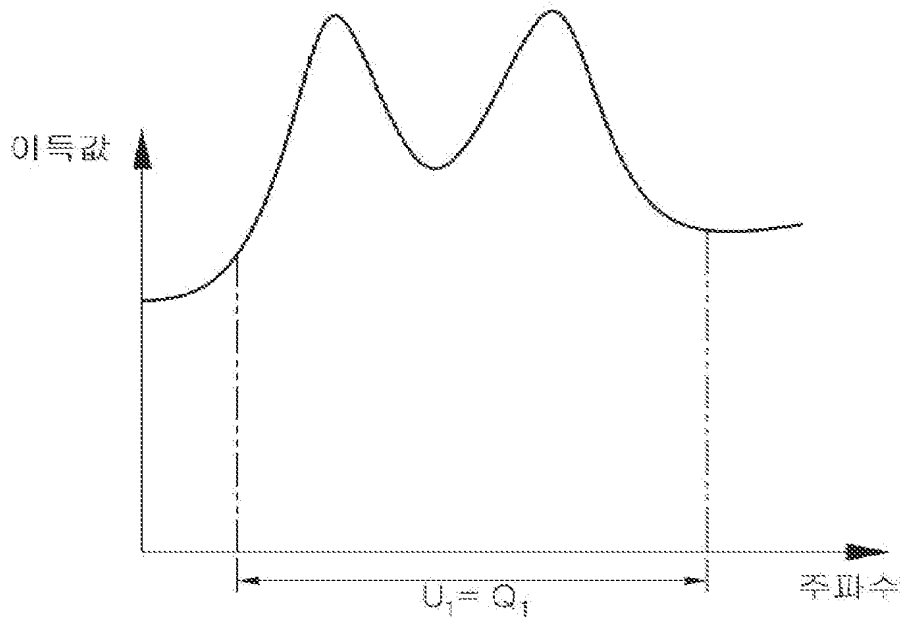
도면4c



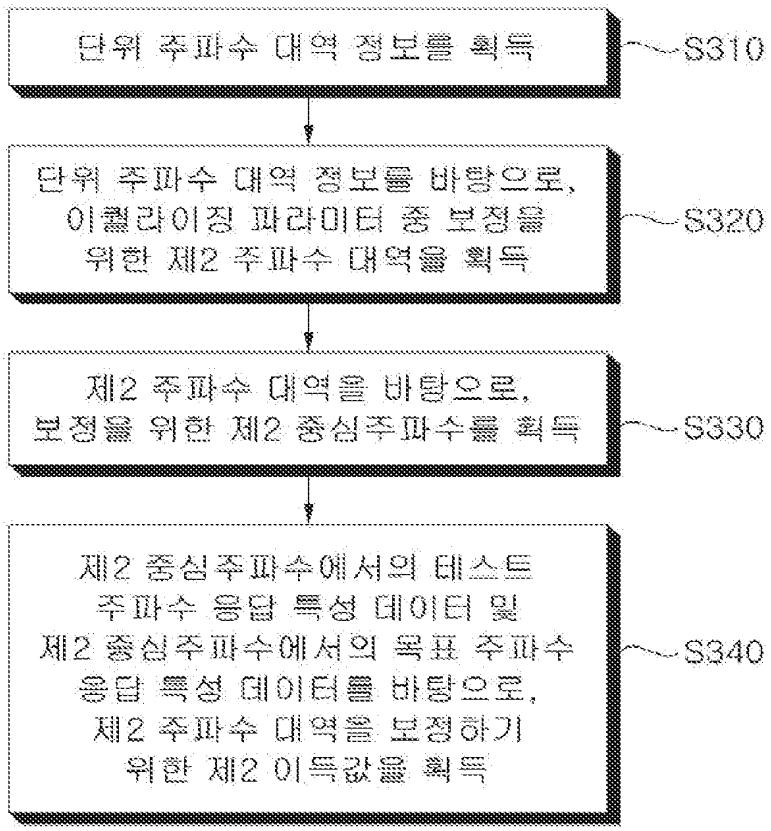
도면4a



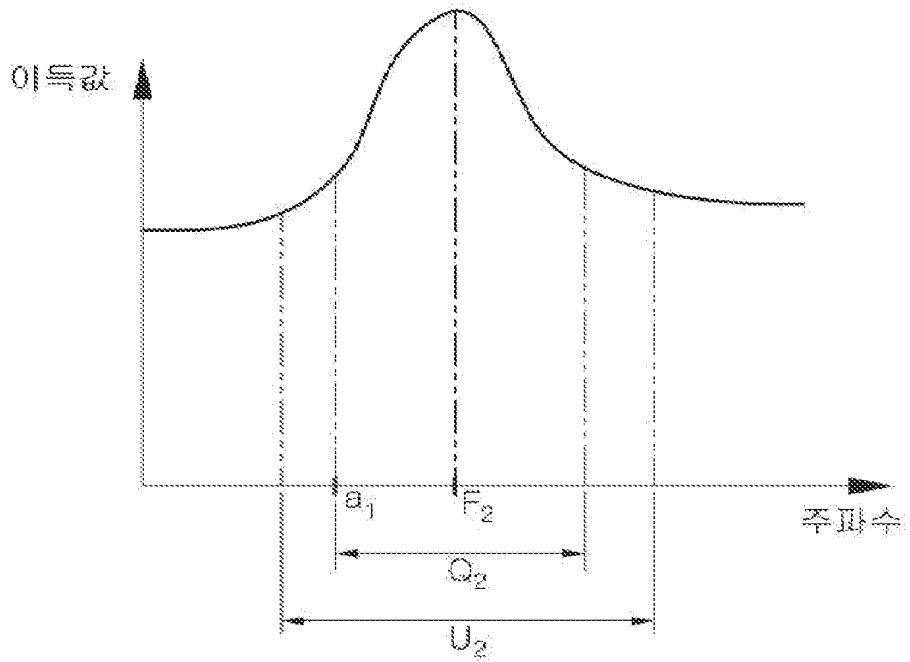
도면4b



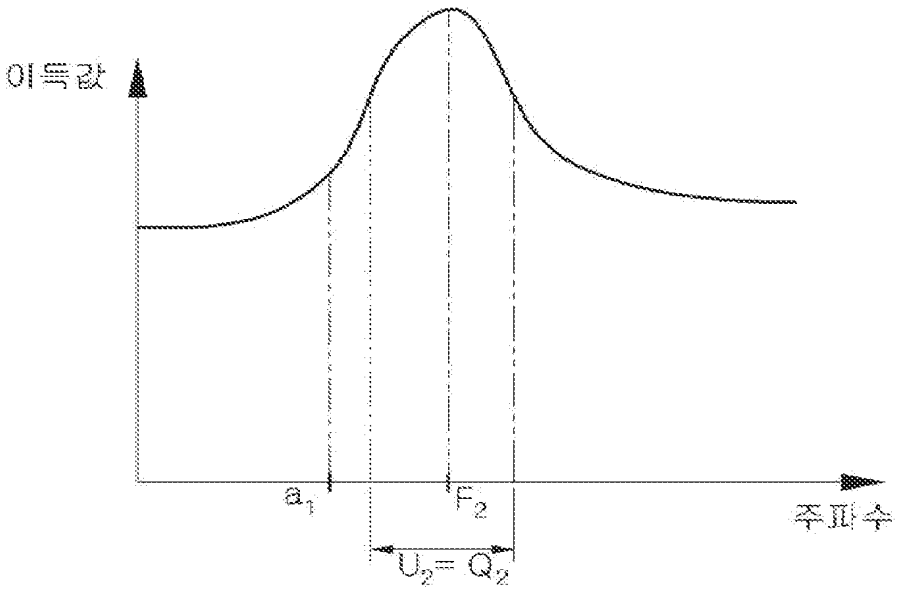
도면5


단위 주파수 대역 정보를 획득
S310
단위 주파수 대역 정보를 바탕으로, 이퀄라이징 파라미터 중 보정을 위한 제2 주파수 대역을 획득
S320
제2 주파수 대역을 바탕으로, 보정을 위한 제2 중심주파수를 획득
S330
제2 중심주파수에서의 테스트 주파수 응답 특성 데이터 및 제2 중심주파수에서의 목표 주파수 응답 특성 데이터를 바탕으로, 제2 주파수 대역을 보정하기 위한 제2 이득값을 획득
S340

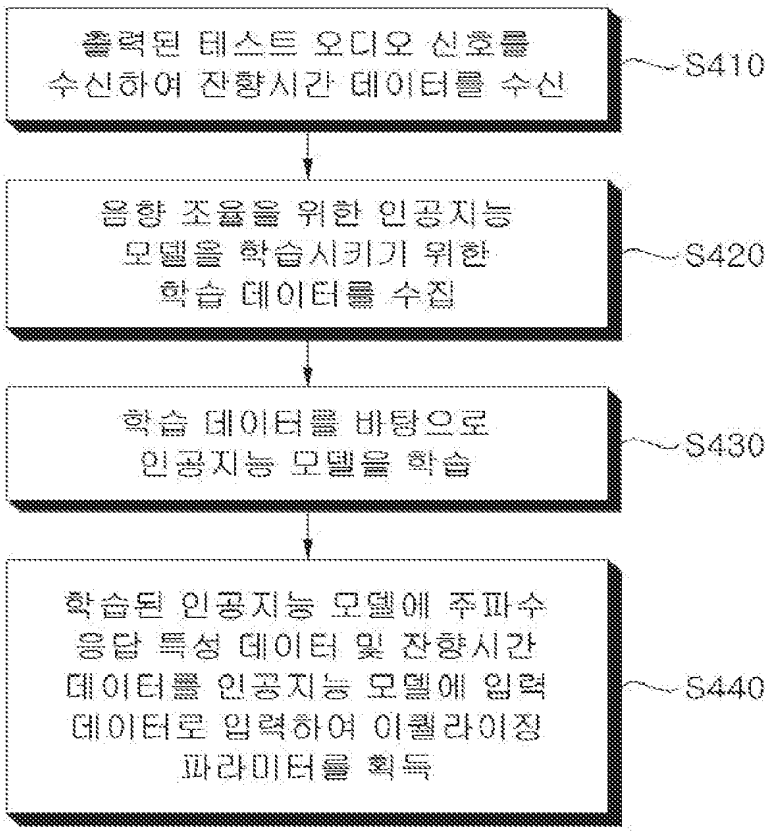
도면6a


이득값
주파수
a_1
F_2
Q_2
U_2

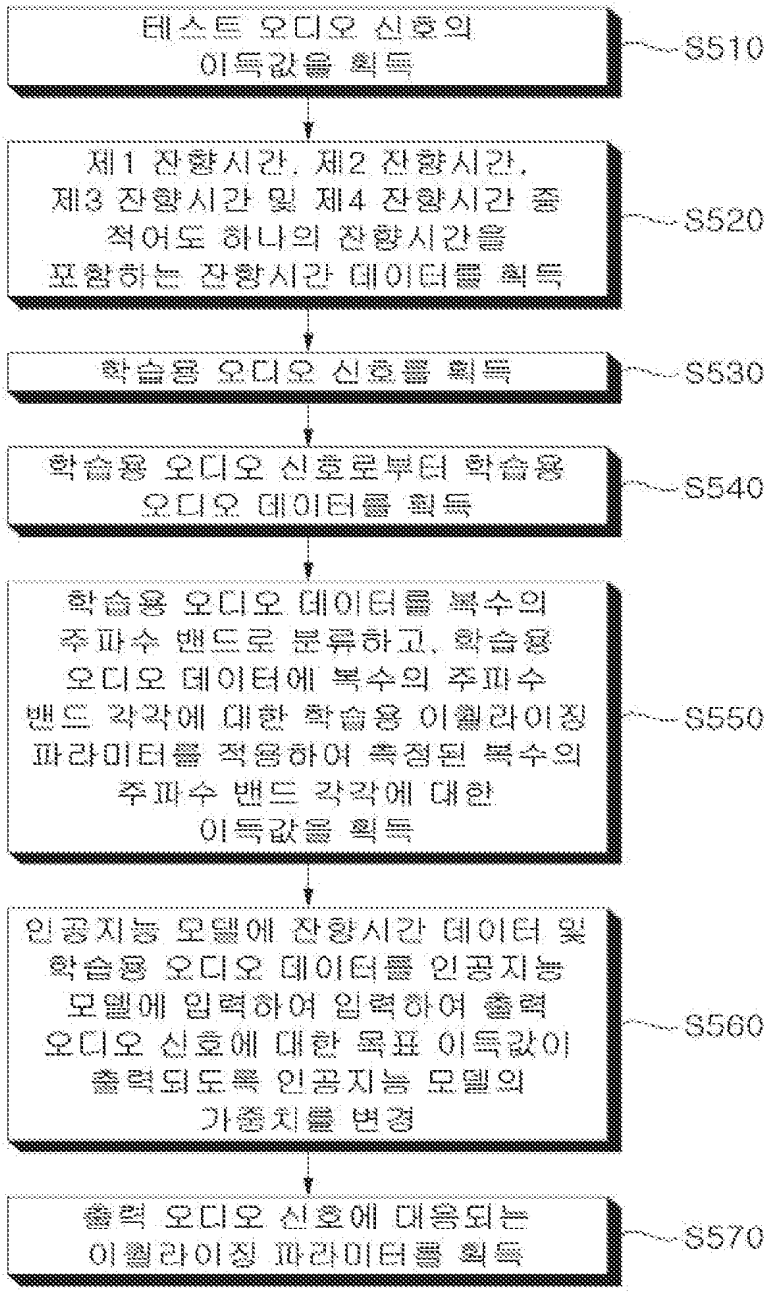
도면6


이득값
a_1
F_2
주파수
$U_2 = Q_2$

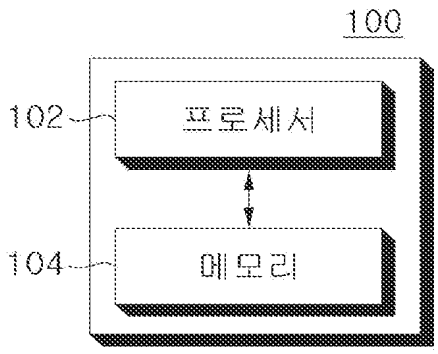
도면7


출력된 테스트 오디오 신호를 수신하여 잔향시간 데이터를 수신
S410
음향 조율을 위한 인공지능 모델을 학습시키기 위한 학습 데이터를 수집
S420
학습 데이터를 바탕으로 인공지능 모델을 학습
S430
학습된 인공지능 모델에 주파수 응답 특성 데이터 및 잔향시간 데이터를 인공지능 모델에 입력 데이터로 입력하여 이퀄라이징 파라미터를 획득
S440

도면8


테스트 오디오 신호의 이득값을 획득
S510
제1 잔향시간, 제2 잔향시간, 제3 잔향시간 및 제4 잔향시간 중 적어도 하나의 잔향시간을 포함하는 잔향시간 데이터를 획득
S520
학습용 오디오 신호를 획득
S530
학습용 오디오 신호로부터 학습용 오디오 데이터를 획득
S540
학습용 오디오 데이터를 복수의 주파수 밴드로 분류하고, 학습용 오디오 데이터에 복수의 주파수 밴드 각각에 대한 학습용 이퀄라이징 파라미터를 적용하여 측정된 복수의 주파수 밴드 각각에 대한 이득값을 획득
S550
인공지능 모델에 잔향시간 데이터 및 학습용 오디오 데이터를 인공지능 모델에 입력하여 입력하여 출력 오디오 신호에 대한 목표 이득값이 출력되도록 인공지능 모델의 가중치를 변경
S560
출력 오디오 신호에 대응되는 이퀄라이징 파라미터를 획득
S570

도면9



Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT
First Named Inventor/Applicant Name:	Abhinav GABA
Filer:	Maeng-Ho Shin/Mariam Paulos
Attorney Docket Number:	0503-0636

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1820**

Electronic Acknowledgement Receipt

EFS ID:	47235226
Application Number:	18084081
International Application Number:	
Confirmation Number:	3982
Title of Invention:	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT
First Named Inventor/Applicant Name:	Abhinav GABA
Customer Number:	68103
Filer:	Maeng-Ho Shin/Mariam Paulos
Filer Authorized By:	Maeng-Ho Shin
Attorney Docket Number:	0503-0636
Receipt Date:	19-DEC-2022
Filing Date:	
Time Stamp:	15:57:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1820
RAM confirmation Number	E2022BIF58131675
Deposit Account	504100
Authorized User	Mariam Paulos

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37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		0503-0636ApplicationAsFiled.pdf	1950206 5fad1712f7b3852b17ce41383331c0cb45346965	yes	47

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal of New Application	1	1
Specification	2	23
Claims	24	29
Abstract	30	30
Drawings-only black and white line drawings	31	41
Oath or Declaration filed	42	45
Power of Attorney	46	47

Warnings:

Information:

2	Application Data Sheet	0503-0636ApplicationDataSheetAsFiled.pdf	1256523 3eb23617c6a31c3c73d7e754c7cc09fbd2fc24e6	no	9

Warnings:

Information:

3	Information Disclosure Statement (IDS) Form (SB08)	0503-0636IDSAsFiled12-19-2022.pdf	612415 7fe042b0aeddee6f1d15c50ae3832f0e18b8d062	no	4

Warnings:

Information:

4	Foreign Reference	1_0503-0636KR10-2254522AsFiled_.pdf	1210973 af30526eafe2ccedc0cba6dadb98574f200bf9ec	no	25
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	44285 03696e213cb74a550c05976ff34e272204fdab35	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	5074402	

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/084,081	12/19/2022		1820	0503-0636	16	2

CONFIRMATION NO. 3982

FILING RECEIPT

68103
Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

Date Mailed: 01/13/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

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Akul TANEJA, Noida, INDIA;
Deepak SHARMA, Noida, INDIA;
Raja SINGHAL, Noida, INDIA;

Applicant(s)

Samsung Electronics Co., Ltd., Suwon-si, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 68103

Domestic Applications for which benefit is claimed - None.
A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
INDIA 202111061923 12/30/2021 Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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If Required, Foreign Filing License Granted: 01/10/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/084,081**

Projected Publication Date: 07/06/2023

Non-Publication Request: No

Early Publication Request: No

Title

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/084,081

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	16 minus 20 =	* 0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x =	0
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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जिस किसी से संबन्धित हो
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मैं, अधोहस्ताक्षरी जो पेटेंट अधिनियम, 1970 की धारा 73(3) के तहत महानियंत्रक एकस्व, अभिकल्प एवं व्यापार चिह्न की ओर से प्रमाणपत्र हस्ताक्षर व जारी करने के लिए प्राधिकृत अधिकारी हूँ एतदद्वारा यह प्रमाणित करता(ती) हूँ कि निम्नलिखित पेटेंट आवेदन के संबंध मे फाइल दस्तावेज़(जों) की सही प्रतिलिपि इसके साथ संलग्न है:

I, the undersigned, being an officer duly authorized to sign and issue the certificate on behalf of the Controller General of Patents, Designs and Trademarks in accordance with the provisions of Section 73(3) of the Patents Act, 1970, hereby certify that annexed hereto is a True Copy of the document(s) as filed in connection with the following Patent Application:

क) आवेदन संख्या/ a) Application Number: ***202111061923***

ख) फाइल करने की तारीख/ b) Date of Filing: ***30th December, 2021***

ग) अनुरोधित दस्तावेज़(जों) का नाम/ c) Name of the document(s) requested:

1) *Application Form-1*
2) *Complete Specification*
3) *Drawings*

filed on 30th December, 2021 (As per e-filing record)

यह प्रमाणपत्र पेटेंट अधिनियम, 1970 की धारा 147(1) के अधीन मुझमे निहित शक्तियों के तहत जारी किया गया है/This certificate is issued under the powers vested in me U/S 147(1) of The Patents Act, 1970.

दिनांक/ Dated this ***06th day of January, 2022***

G.B. Bimi

Digitally signed by G.B. Bimi
DN: c=IN, o=Personal, title=5053, pseudonym=b863d70f0d39850150ee09a2c116d2033ab8008e704b47de773aaeb6467ccda5, postalCode=110078, st=Delhi, serialNumber=b01dbff6040f24e62830efdac1dc643d51748b4138972dc9ec0922623bd90b6, cn=G.B. Bimi

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(प्राधिकृत हस्ताक्षरी/ Authorised Signatory)

FORM 1 THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 **APPLICATION FOR GRANT OF PATENT** (See section 7, 54 and 135 and sub-rule (1) of rule 20)	(FOR OFFICE USE ONLY)	
	Application No.	
	Filing Date:	
	Amount of Fee paid:	
	CBR No:	
	Signature:	
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)	**4159IN232**	

2. TYPE OF APPLICATION [Please tick (√) at the appropriate category]

Ordinary (√)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )

3A. APPLICANT

Name in Full	**Nationality**	**Country of Residence**	**Address of the Applicant**	
Samsung Electronics Co., Ltd.	KR	KR	**House No.**	416
			Street	Maetan-Dong, Yeongtong-GU
			City	Suwon-SI
			State	Gyeonggi-do
			Country	Republic of Korea
			Pin code	442-742

3B. CATEGORY OF APPLICANT [Please tick (√) at the appropriate category]

Natural Person ( )	Other than Natural Person		
	Small Entity ( )	Startup ( )	Others (√)

4. INVENTOR(S) [Please tick (√) at the appropriate category]		
Are all the inventor(s) same as the applicant(s) named above?	Yes ( )	No (√)

If "No", furnish the details of the inventor(s)

Name in Full	Nationality	Country of Residence	Address of the Inventor	
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			Street	739 Sector-12, HUDA
			City	Panipat
			State	Haryana
			Country	India
			Pin code	132103
TANEJA, Akul	Indian	India	**House No.**	
			Street	H 29 Kirti Nagar
			City	New Delhi
			State	
			Country	India
			Pin code	110015
SHARMA, Deepak	Indian	India	**House No.**	
			Street	1189, Chandaparti, Achhnera
			City	Agra
			State	
			Country	India
			Pin code	283101
SINGHAL, Raja	Indian	India	**House No.**	
			Street	Near Lovekush Apartment, Kumher Gate
			City	Bharatpur
			State	Rajasthan
			Country	India
			Pin code	321001

5. TITLE OF THE INVENTION		
A Method And System For Mitigating Unwanted Audio Noise In A Voice Assistant-Based Communication Environment		
6. AUTHORISED REGISTERED PATENT AGENT(S)	**IN/PA No.**	740
	Name	Manisha Singh
	Mobile No.	9811161518
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	**Name**	LEXORBIS
	Postal Address	709/710, Tolstoy House 15-17, Tolstoy Marg, New Delhi – 110 001
	Telephone No.	91 11 23716565
	Mobile No.	9811161518
	Fax No.	91 11 23716556
	E-mail ID	mail@lexorbis.com

8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION

Country	Application Number	Filing date	Name of the Applicant	Title of the Invention	IPC (as classified in the convention country)
Not Applicable					

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)

International application number	International filing date
Not Applicable	

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION

Original (first) application No.	Date of filing of original (first) application
-	-

11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT

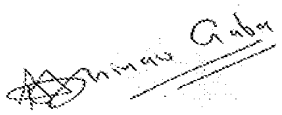
Main application/patent No.	Date of filing of main application
-	-

12. DECLARATIONS

(i) Declaration by the inventors

We, the above named inventors, are the true & first inventors for this Invention and declare that the applicant(s) herein are our assignee or legal representative.

Date : 23/12/2021



GABA, Abhinav

Date : 23/12/2021

TANEJA, Akul

Date : 23/12/2021

SHARMA, Deepak

Date: 23/12/2021

SINGHAL, Raja

(ii) Declaration by the applicant(s) in the convention country

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative. : **NA**

(iii) Declaration by the applicant

We the applicant hereby declare(s) that: -

(√) We are in possession of the above-mentioned invention.

(√) The Complete specification relating to the invention is filed with this application.

(X) The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.

(√) There is no lawful ground of objection(s) to the grant of the Patent to us.

(√) We are the assignee or legal representative of true & first inventors.

(X) The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of our invention(s).

(X) We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which We derive the title.

(X) Our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.

(X) The application is divided out of my /our application particulars of which is given in Paragraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.

(X) The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete Specification	No. of pages: 21		
No. of Claim(s)	No. of claims: 16 No. of pages: 05		
Abstract	No. of pages: 01		

No. of Drawing(s)	No. of pages: 11 No. of drawings: 11		

(b) Complete specification;

(c) Drawings;

(d) Statement and Undertaking on Form 3;

(e) Declaration of Inventorship on Form 5;

(f) Copy of duly executed Form 1;

(g) An attested copy of the General Power of Authority [Form 26] – originally filed with respect to Indian application no. **899/DEL/2014**;

(h) **Official fee of Rs. 44000 /-** [Rs. 24000/- for official filing fees + Rs. 20,000/- for Request for Examination Fees] via wire transfer dated December 30, 2021.

We hereby declare that to the best of our knowledge, information and belief the fact and matters stated herein are correct and we request that a patent may be granted to us for the said invention.

Dated this 30th day of December, 2021

Manisha Singh
Agent for the Applicant [IN/PA-740]
LEXORBIS

To,
The Controller of Patents
The Patent Office
At **New Delhi**

FORM 2
THE PATENTS ACT 1970
(39 of 1970)
&
THE PATENTS RULES, 2003
COMPLETE SPECIFICATION
(See section 10 and rule 13)

1. TITLE OF THE INVENTION

A Method And System For Mitigating Unwanted Audio Noise In A Voice Assistant-Based Communication Environment

2. APPLICANT

NAME : Samsung Electronics Co., Ltd.
NATIONALITY : KR
ADDRESS : 416 Maetan-Dong, Yeongtong-GU, Suwon-SI, Gyeonggi-do 442-742, Republic of Korea

3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification particularly describes the invention and the manner in which it is to be performed.

FIELD OF THE INVENTION

[0001] The present disclosure relates to a method and system for mitigating unwanted audio noise. In particular, the present invention relates to a method and system for mitigating unwanted audio noise in a voice assistant-based communication environment.

BACKGROUND

[0002] With the rapid growth in speech recognition and speech response-based systems, an exploration into human interaction with Artificial Intelligence (AI) based voice systems has become an integral part of livelihood and has drawn significant consideration of the user's for a better interactive experience. For example, voice assistants have become an integral part of home and office environments nowadays. There are many reasons due to which speech recognition or the speech response by the AI-based voice systems fail in the case of a noisy environment.

[0003] In an ideal scenario, in a room or hall with no activity, the voice responses from the voice assistants would be clearly audible to users. However, it is very rare to have an interaction with a voice assistant that doesn't have some form of background noise. For example, the user could be in a home with multiple noise elements present in the background, or the user could be at a quick-service restaurant with other customers' chatter, etc.. whatever the background noise is, a voice assistant needs to be able to filter through it and focus on the person asking the question and respond that accordingly. Otherwise, the voice assistant will lose its accuracy. For example, the voice assistant might provide false positives and negative responses, and might create frustration for the user. Generally, the voice assistant brings a whole new hands-free experience of asking questions, requests, or giving tasks and that is why it needs to be accurate. Therefore, the voice responses from these devices need to be loud and clear.

[0004] Elements of the noisy environment like additive noise, convolutional noise, nonlinear distortion, etc.. in the AI-based voice systems are not easy to correct and not all solutions work for each type of noise interference. For example, there is noise or some background sound in rooms and offices where different kinds of activities are ongoing. An example of such an environment is

also shown in Figure 1 of the drawings. These noises and the background sound in the room and offices make it difficult for the user of the voice assistant to be able to understand or listen to the audio response provided by the voice assistant. In general, noise is very difficult for AI-based voice systems to handle and requires various reduction methods.

[0005] Therefore, there lies a need for a method and system that can mitigate unwanted audio noise in such environments as discussed above. Accordingly, the present disclosure describes the method and the system for mitigating unwanted audio noise in a voice assistant-based communication environment to provide loud and clear voice responses to the user.

SUMMARY

[0006] This summary is provided to introduce a selection of concepts in a simplified format that are further described in the detailed description of the invention. This summary is not intended to identify key or essential inventive concepts of the invention, nor is it intended for determining the scope of the invention.

[0007] In an implementation, the present subject matter refers to a method for mitigating unwanted audio noise in the Internet of things (IoT) based communication environment. The method comprises identifying and pairing one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. The method further comprises dividing, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. Furthermore, the method comprises detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. Subsequent to the detection of the user's location, the method furthermore comprises determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location and then using a recurrent neural networks (RNN) model predicting an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data that includes information corresponding

to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices. At last, after the prediction of the optimal sound output of the voice assistance device, the method furthermore comprises correcting the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT devices of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

[0008] In another implementation, the present subject matter refers to a system for mitigating unwanted audio noise in IoT based communication environment. The system includes a pairing module, a clustering module, a prediction module, and a correction module. The paring module is configured to identify and pair one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. The clustering module is configured to divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. The clustering module is further configured to detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. Furthermore, the clustering module is configured to determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. The prediction module is configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data that includes information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise information associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.. After the prediction of the optimal sound output, the correction module is configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT devices of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

[0009] To further clarify the advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawing. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting its scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

Figures 1 illustrates an example illustration of problems indicating unwanted noise present in a voice assistance based communication environment, in accordance with a state of art;

Figure 2 illustrates a flowchart of method steps for mitigating unwanted audio noise in the IoT based communication environment, in accordance with an embodiment of the present disclosure;

Figure 3 illustrates a system architecture for mitigating unwanted audio noise in the IoT based communication environment, in accordance with an embodiment of the present disclosure;

Figure 4 illustrates an example illustration of the gaussian mixture model (GMM), in accordance with an embodiment of the present disclosure;

Figure 5 illustrates an exemplary graphical representation indicating maximum silhouette score for the selection of the number of clusters, in accordance with an embodiment of the present disclosure;

Figure 6 illustrates an example illustration of sonar technology using the ultrasonic wave and the echo signal for the detection of the user's location with respect to the voice assistant device, in accordance with an embodiment of the present disclosure;

Figure 7 illustrates a prediction method involved in the prediction of the optimal sound at the detected user's location, in accordance with an embodiment of the present disclosure;

Figure 8 illustrates a process of comparison for the selection of the target IoT node, in accordance with an embodiment of the present disclosure;

Figure 9 illustrates a phase shift network for shifting the phase of the predicted optimal sound output, in accordance with an embodiment of the present disclosure;

Figure 10 illustrates a representative architecture to provide tools and development environment described herein for a technical realization of the system 300, in accordance with an embodiment of the present disclosure; and

Figure 11 illustrates another exemplary implementation in accordance with the embodiment of the present invention, and yet another typical hardware configuration of the system 1000 in the form of a computer system 1100, in accordance with an embodiment of the present disclosure.

[0011] Further, skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and may not have necessarily been drawn to scale. For example, the flow charts illustrate the method in terms of the most prominent steps involved to help to improve understanding of aspects of the present invention. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

DETAILED DESCRIPTION

[0012] It should be understood at the outset that although illustrative implementations of the embodiments of the present disclosure are illustrated below, the present invention may be implemented using any number of techniques, whether currently known or in existence. The present disclosure should in no way be limited to the illustrative implementations, drawings, and techniques illustrated below, including the exemplary design and implementation illustrated and described herein, but may be modified within the scope of the appended claims along with their full scope of equivalents.

[0013] The term "some" as used herein is defined as "none, or one, or more than one, or all." Accordingly, the terms "none," "one," "more than one," "more than one, but not all" or "all" would all fall under the definition of "some." The term "some embodiments" may refer to no embodiments or one embodiment or several embodiments or all embodiments. Accordingly, the

term "some embodiments" is defined as meaning "no embodiment, or one embodiment, or more than one embodiment, or all embodiments."

[0014] The terminology and structure employed herein is for describing, teaching, and illuminating some embodiments and their specific features and elements and does not limit, restrict, or reduce the spirit and scope of the claims or their equivalents.

[0015] More specifically, any terms used herein such as but not limited to "includes," "comprises," "has," "consists," and grammatical variants thereof do NOT specify an exact limitation or restriction and certainly do NOT exclude the possible addition of one or more features or elements, unless otherwise stated, and must NOT be taken to exclude the possible removal of one or more of the listed features and elements, unless otherwise stated with the limiting language "MUST comprise" or "NEEDS TO include."

[0016] Whether or not a certain feature or element was limited to being used only once, either way, it may still be referred to as "one or more features" or "one or more elements" or "at least one feature" or "at least one element." Furthermore, the use of the terms "one or more" or "at least one" feature or element do NOT preclude there being none of that feature or element unless otherwise specified by limiting language such as "there NEEDS to be one or more . . . " or "one or more element is REQUIRED."

[0017] Unless otherwise defined, all terms, and especially any technical and/or scientific terms, used herein may be taken to have the same meaning as commonly understood by one having ordinary skill in the art.

[0018] Embodiments of the present invention will be described below in detail with reference to the accompanying drawings.

[0019] **Figure 2** illustrates a flowchart of method steps for mitigating unwanted audio noise in the IoT-based communication environment, in accordance with an embodiment of the present disclosure. Figure 2 depicts a method 200 that is executed by components of the system 300 of figure 3 of the drawings. **Figure 3** illustrates a system architecture for mitigating unwanted audio noise in the IoT-based communication environment, in accordance with an embodiment of the present disclosure.

[0020] The system 300 includes a paring module 302, a clustering module 304, a prediction module 306, a correction module 308, a rendering module 310, IoT devices 312 including sensor module 314, a voice assistant device 316, and a processing module 318. The aforementioned components of the system 300 are coupled with each other for transfer of information from one component to the other component in the system 300. It will be understood to a person of ordinary skill in the art that the disclosure is not limited to the architecture described above, the concept of the proposed architecture can be applied to any kind of IoT communication-based architecture supporting the voice assistance feature.

[0021] The IoT devices 312 are intended to represent devices with wired or wireless interfaces through which the IoT devices 312 can send and receive data over wired and wireless connections. Examples of IoT devices include, but ie not limited to, mobile devices, smart electronic devices, biological managers, sensory devices, functionality performing devices, and the like. The IoT devices 312 can include unique identifiers which can be used in the transmission of data through a network. Unique identifiers of the IoT devices 312 can include identifiers created in accordance with Internet Protocol version 4 (hereinafter referred to as "IPv4") or identifiers created in accordance with Internet Protocol version 6 (hereinafter referred to as "IPv6"), of which both protocol versions are hereby incorporated by reference. Depending upon implementation-specific or other considerations, the IoT devices 312 can include applicable communication interfaces for receiving and sending data according to an applicable wireless device protocol. Examples of applicable wireless device protocols include, but are not limited to, Wi-Fi, ZigBee®, Bluetooth®, and other applicable low-power communication standards.

[0022] The sensor module 314 included in the IoT devices 312 may include but is not limited to, accelerometer sensor, ultrasonic sensors, gyro sensor, proximity sensor, IR sensor humidity sensor, pressure sensor, level sensor, gas sensor, temperature sensor, motion detection sensor, and the like.

[0023] Here a detailed description of the flow of method steps of the method 200 and functionalities of the components of the system 300 will be made by referring to the voice assistant device 316. However, other smart IoT devices supporting voice assistant features and the like can also be used as reference.

[0024] The method 200 comprises (at step 202) identifying and pairing one or more IoT devices with a voice assistant device in the IoT-based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device. As an example, the pairing module 302 identifies the IoT devices 312 in the IoT-based communication environment when the voice assistant device 316 triggers an input event to the pairing module 302 as soon as the voice assistant device is ready in a wireless connection state and operation mode. After the identification of the IoT devices 312, the pairing module 302 pairs the identified IoT devices with the voice assistant device 316 based on an exchange of information between the IoT devices 312 and the voice assistant device 316.

[0025] In particular, the pairing module 302 exchanges the information between the IoT devices 312 and the voice assistant device 316 in a pairing mode based on approval of a respective connection request by the IoT devices 312 that is being transmitted by the voice assistant device 316 to the respective IoT devices 312. The exchanged information may include but is not limited to, the location information of the IoT devices 312, the information associated with environmental noise around each IoT device of the IoT devices 312, and the information associated with the perceived sound of the voice assistant device 316 at each IoT device of the IoT devices 312. The pairing module 302 may also update the exchanged information periodically based on a change in the wireless connection states of the IoT devices 312 with the voice assistant device 316. The flow of the method 200 now proceeds to (step 204).

[0026] At the step 204, subsequent to the pairing of the IoT devices 312 with the voice assistant device 316, the method 200 comprises dividing, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device. For ease of explanation, an example illustration of the gaussian mixture model is also shown in **Figure 4** of the drawings, in accordance with an embodiment of the present disclosure. As an example, the clustering module 304 divides the IoT devices 312 that are paired with the voice assistant device 316 into a plurality of clusters based on the location information of the IoT devices 312. Initially, the clustering module 304 applies the gaussian mixture model on a dataset for a different range of cluster count and then further selects a number of clusters for which silhouette score is maximum. An exemplary graphical representation indicating maximum silhouette score for the selection of the number of clusters is illustrated in **Figure 5** of the drawings, in accordance with an embodiment of the present

disclosure. Here, each cluster of the plurality of clusters includes at least one IoT device. The flow of the method 200 now proceeds to (step 206).

[0027] At the step 206, after the division of the one or more paired IoT devices into the plurality of clusters, the method 200 comprises detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. As an example, after dividing the IoT devices 312 into the plurality of clusters, the clustering module 304 further detects a location of the user with respect to a location of the voice assistant device 316 based on at least one of sensors data collected by the respective sensor modules 314 of the IoT devices 312 or the time difference between the ultrasonic wave 602 transmitted by the voice assistance device 316 and an echo signal 604 reflected from the user's body 606 in response to the transmitted ultrasonic wave 602. In particular, the clustering module 304 identifies the user's location with the help of sonar technology and classify the user as part of one of the clusters among the plurality of cluster. An example illustration of the sonar technology using the ultrasonic wave and the echo signal is shown in **Figure 6** of the drawings, in accordance with an embodiment of the present disclosure. The flow of the method 200 now proceeds to (step 208).

[0028] At the step 208, after the detection of the user's location, the method 200 comprises determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. As an example, after detecting the user's location, the clustering module 304 furthermore determines a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location. The flow of the method 200 now proceeds to (step 210).

[0029] Once the process of clustering module 304 is completed and the output generated by clustering module 304 acts as an input to the prediction module 306, and accordingly at the step 210, the method 200 comprises predicting, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data.. As an example, the prediction module 306 predicts, using the RNN model, an optimal sound output of the voice assistance device 316 that is audible at the detected user's location based on the sound information data. The sound information data includes

at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices. In particular, the sound information data includes an original sound output of the voice assistant device 316, the environmental noise information associated with the determined cluster in which the user is present, and the information related to the perceived sound of the voice assistant device 316 at each IoT device among the IoT devices 312. Further, the predicted optimal sound output of the voice assistance device 316 includes a plurality of acoustic parameters (Frequency parameters and intensity parameters). The first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level (f_{min}, f_{max}, and f_{mid}) of the predicted optimal sound output, and the second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level (I_{min}, I_{max}, and I_{mid}) of the predicted optimal sound output.

[0030] In particular, the output of the RNN is the predicted sound at the detected user's location, which can be denoted as 6 acoustic parameters such as:

Frequency parameters: f_{min}, f_{max}, f_{mid}

Intensity parameters: I_{min}, I_{max}, I_{mid}

For ease of explanation, the operations involved in the prediction of the optimal sound at the detected user's location is shown in **Figure 7** of the drawings, in accordance with an embodiment of the present disclosure. The Output Y as shown in Figure 7 denotes the predicted optimal sound at the detected user's location that can be denoted as 6 acoustic parameters as described above. The flow of the method 200 now proceeds to (step 212).

[0031] Once the process of the prediction module 306 is completed, the output generated by the prediction module 306 acts as an input to the correction module 308, and accordingly at the step 212, the method 200 comprises correcting the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value. As an example, the correction module 308 corrects the predicted optimal sound output of the voice assistance device 316. For correcting the predicted

optimal sound output of the voice assistance device 316, the correction module 308 performs a series of operations described below.

[0032] Initially, the correction module 308 calculates the sound parameter value (Δ) corresponding to each of the IoT devices of the determined cluster in which the user is present. In order to calculate the sound parameter value, the correction module 308 performs a series of sub-operations such as, combining the first set of acoustic parameters ($\Delta_f = f_{min}, f_{max}, f_{mid}$) with the second set of acoustic parameters ($\Delta_I = I_{min}, I_{max}, I_{mid}$) based on frequency bands of an audible range (for example, 20Hz – 20kHz) and then calculates the sound parameter value ($\Delta = \Delta_f + \Delta_I$) by adding or combining the parameter values of the first set of acoustic parameters with the parameter values of the second set of acoustic parameters. Here, both parameter values Δ_f and Δ_I correspond to independent variables.

[0033] Once the sound parameter value is calculated by the correction module 308 then the correction module 308 selects, as a target IoT device, an IoT device that has a minimum sound parameter value from the determined cluster in which the user is present. In particular, the correction module 308 compares the functional values (comparison function 800) of the combinations of the acoustic parameters for each neighboring IoT node with the current IoT node (I.e. the IoT node with the Ideal sound which needs to be heard in the user cluster) and selects a target IoT Node 802 on the basis of a result of the comparison indicating an IoT node with the minimum difference. Here, during the comparison, mid-range frequencies have been given a higher priority because they are most audible by humans and then the minimum range frequencies have been prioritized because they are most susceptible to loss. Accordingly, the target IoT node 802 is selected on the basis of least delta (i.e., sound parameter value Δ) from it to the determined cluster in which the user is present. An example illustration of the basis of comparison for the selection of the target IoT node is shown in **Figure 8** of the drawings, in accordance with an embodiment of the present disclosure.

[0034] Once the target IoT node (Target IoT device among the determined user cluster) is selected by the correction module 308 then the correction module 308 perform a shifting operation for shifting a phase of the predicted optimal sound output based on the sound parameter value (Δ) and the sound parameters of the selected IoT device (I.e., sound parameters of the target IoT device). As an example, the correction module 308 shifts the phase of the predicted optimal sound output

by 180° based on Δ parameters (acoustic parameters) of the selected target IoT device using a phase shift network 806 as shown in **Figure 9** of the drawings, in accordance with an embodiment of the present disclosure. The shifting in the phase of the predicted optimal sound output ensures destructive interference with noise.

[0035] Furthermore, in the final step, after shifting the phase of the predicted optimal sound output, the correction module 308 generates a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with the desired sound of the voice assistant device 316. As an example, the correction module 308 generates a corrected sound or the ideal sound to be heard at the user's location by merging the shifted phase optimal sound output with the desired sound of the voice assistant device 316.

[0036] When the new optimal sound or the corrected sound is generated by the correction module 308, then the rendering module 310 of the system 300 emits or outputs the generated new optimal sound from the selected target IoT device that can be heard clearly at the user location despite the adverse effect of the unwanted noise in the environment or surroundings around the user.

[0037] According to one embodiment of the present disclosure, the processing module 318 of the system 300 determines, based on the corrected optimal sound output of the voice assistance device 316, an optimal region in the determined cluster in which the user is present or around the determined cluster where the generated new optimal sound is hearable and accordingly updates settings of the voice assistance device 316 based on the determined optimal region in order to accurately provide loud and clear voice response to the user.

[0038] Now some specific use case examples of the present invention will be described in accordance with an embodiment of the present disclosure.

[0039] The method 200 and the system 300 of the present invention can be used in IoT-based Home Automation solutions. Many times, in an event-triggered communication between the virtual assistant device and a human, when the virtual assistant device utters some message for the user but due to the noisy environment there is no feedback if the user gets the message uttered by the virtual assistant device or not. In other words, since the user is not aware that the virtual assistant device VA is speaking information to the user, the user never gets that information. In

view of such a situation, the method 200 and the system 300 of the present invention can generate an enhanced modulated sound which if transmitted from IoT devices will reach to the user with minimized SNR. Those skilled in the art will appreciate that the aforementioned example is merely exemplary and is not intended to limit the scope of the invention.

[0040] The method 400 and the system 500 of the present invention can also be used in the case of industrial automation based IoT solutions to mitigate the unwanted noise from a noisy environment and in order to generate the enhanced modulated sound which if transmitted from IoT devices will reach to the user or other IoT devices with minimized SNR. Those skilled in the art will appreciate that the aforementioned example is merely exemplary and is not intended to limit the scope of the invention.

[0041] Referring now to Figure 10 of the Drawings, **Figure 10** illustrates a representative architecture to provide tools and development environment described herein for a technical realization of the system 300, in accordance with an embodiment of the present disclosure. Figure 10 is merely a non-limiting example, and it will be appreciated that many other architectures may be implemented to facilitate the functionality described herein. The architecture may be executing on hardware such as a computing machine 1000 of Figure 10 that includes, among other things, processors, memory, and various application-specific hardware components.

[0042] The architecture 1000 may include an operating system, libraries, frameworks, or middleware. The operating system may manage hardware resources and provide common services. The operating system may include, for example, a kernel, services, and drivers defining a hardware interface layer. The drivers may be responsible for controlling or interfacing with the underlying hardware. For instance, the drivers may include display drivers, camera drivers, Bluetooth® drivers, flash memory drivers, serial communication drivers (e.g., Universal Serial Bus (USB) drivers), Wi-Fi® drivers, audio drivers, power management drivers, and so forth depending on the hardware configuration.

[0043] A hardware interface layer includes libraries which may include system libraries such as file-system (e.g., C standard library) that may provide functions such as memory allocation functions, string manipulation functions, mathematic functions, and the like. In addition, the libraries may include API libraries such as audio-visual media libraries (e.g., multimedia data

libraries to support presentation and manipulation of various media formats such as MPEG4, H.264, MP3, AAC, AMR, JPG, PNG), database libraries (e.g., SQLite that may provide various relational database functions), web libraries (e.g. WebKit that may provide web browsing functionality), and the like.

[0044] A middleware may provide a higher-level common infrastructure such as various graphic user interface (GUI) functions, high-level resource management, high-level location services, and so forth. The middleware may provide a broad spectrum of other APIs that may be utilized by the applications or other software components/modules, some of which may be specific to a particular operating system or platform.

[0045] The term "module" or "unit" used in this disclosure may refer to a certain unit that includes one of hardware, software, and firmware or any combination thereof. The module may be interchangeably used with unit, logic, logical block, component, or circuit, for example. The module may be the minimum unit, or part thereof, which performs one or more particular functions. The module may be formed mechanically or electronically. For example, the module or the unit disclosed herein may include at least one ASIC (Application-Specific Integrated Circuit) chip, FPGAs (Field-Programmable Gate Arrays), and programmable-logic device, which have been known or are to be developed.

[0046] Further, the architecture 1000 depicts an aggregation of audio/video processing device-based mechanisms and ML/NLP-based mechanisms in accordance with an embodiment of the present subject matter. A user interface is defined as input and interaction 1001 refers to overall input. It can include one or more of the following –touch screen, microphone, camera, etc. A first hardware module 1002 depicts specialized hardware for ML/NLP based mechanisms. As an example, the first hardware module 1002 comprises one or more neural processors, FPGA, DSP, GPU, etc.

[0047] A second hardware module 1012 depicts specialized hardware for executing the data splitting and transfer. ML/NLP based frameworks and APIs 1004 correspond to the hardware interface layer for executing the ML/NLP logic 1006 based on the underlying hardware. In an example, the frameworks may be one or more or the following – Tensorflow, Café, NLTK,

GenSim, ARM Compute, etc. Simulation frameworks and APIs 1014 may include one or more of – Audio Core, Audio Kit, Unity, Unreal etc.

[0048] A database 1008 depicts a pre-trained database. The database 1008 may be remotely accessible through cloud by the ML/NLP logic 1006. In other example, the database 1008 may partly reside on cloud and partly on-device based on usage statistics.

[0049] Another database 1018 refers the memory. The database 1018 may be remotely accessible through cloud. In other example, the database 1018 may partly reside on the cloud and partly on-device based on usage statistics.

[0050] A rendering module 1005 is provided for rendering audio output and triggering further utility operations. The rendering module 1005 may be manifested as a display cum touch screen, monitor, speaker, projection screen, etc.

[0051] A general-purpose hardware and driver module 1003 corresponds to the computing device 1100 as referred in Figure 11 and instantiates drivers for the general-purpose hardware units as well as the application-specific units (1002, 1012).

[0052] In an example, the ML mechanism underlying the present architecture 1000 may be remotely accessible and cloud-based, thereby being remotely accessible through a network connection. An audio/video processing device may be configured for remotely accessing the NLP/ML modules and simulation modules may comprise skeleton elements such as a microphone, a camera a screen/monitor, a speaker, etc.

[0053] Further, at least one of the plurality of modules of the mesh network may be implemented through AI based on an ML/NLP logic 1006. A function associated with AI may be performed through the non-volatile memory, the volatile memory, and the processor constituting the first hardware module 1002 i.e. specialized hardware for ML/NLP based mechanisms. The processor may include one or a plurality of processors. At this time, one or a plurality of processors may be a general-purpose processor, such as a central processing unit (CPU), an application processor (AP), or the like, a graphics-only processing unit such as a graphics processing unit (GPU), a

visual processing unit (VPU), and/or an AI-dedicated processor such as a neural processing unit (NPU). The aforesaid processors collectively correspond to the processor 1102 of Figure 11.

[0054] One or a plurality of processors control the processing of the input data in accordance with a predefined operating rule or artificial intelligence (AI) model stored in the non-volatile memory and the volatile memory. The predefined operating rule or artificial intelligence model is provided through training or learning.

[0055] Here, being provided through learning means that, by applying a learning logic/technique to a plurality of learning data, a predefined operating rule or AI model of the desired characteristic is made. “Obtained by training" means that a predefined operation rule or artificial intelligence model configured to perform the desired feature (or purpose) is obtained by training a basic artificial intelligence model with multiple pieces of training data by a training technique. The learning may be performed in a device (i.e. the architecture 1000 or the device 1000) itself in which AI according to an embodiment is performed, and/or may be implemented through a separate server/system. "

[0056] The AI model may consist of a plurality of neural network layers. Each layer has a plurality of weight values and performs a neural network layer operation through calculation between a result of computation of a previous layer and an operation of a plurality of weights. Examples of neural networks include, but are not limited to, convolutional neural network (CNN), deep neural network (DNN), recurrent neural network (RNN), restricted Boltzmann Machine (RBM), deep belief network (DBN), bidirectional recurrent deep neural network (BRDNN), generative adversarial networks (GAN), and deep Q-networks.

[0057] The ML/NLP logic 1006 is a method for training a predetermined target device (for example, a robot) using a plurality of learning data to cause, allow, or control the target device to make a determination or prediction. Examples of learning techniques include, but are not limited to, supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning.

[0058] Referring now to Figure 11 of the Drawings, **Figure 11** illustrates another exemplary implementation in accordance with the embodiment of the present invention, and yet another

typical hardware configuration of the system 1000 in the form of a computer system 1100, in accordance with an embodiment of the present disclosure. The computer system 1100 can include a set of instructions that can be executed to cause the computer system 1100 to perform any one or more of the methods disclosed. The computer system 1100 may operate as a standalone device or may be connected, e.g., using a network, to other computer systems or peripheral devices.

[0059] In a networked deployment, the computer system 1100 may operate in the capacity of a server or as a client user computer in a server-client user network environment, or as a peer computer system in a peer-to-peer (or distributed) network environment. The computer system 1100 can also be implemented as or incorporated across various devices, such as a personal computer (PC), a tablet PC, a personal digital assistant (PDA), a mobile device, a palmtop computer, a laptop computer, a desktop computer, a communications device, a wireless telephone, a land-line telephone, a web appliance, a network router, switch or bridge, or any other machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while a single computer system 1100 is illustrated, the term "system" shall also be taken to include any collection of systems or sub-systems that individually or jointly execute a set, or multiple sets, of instructions to perform one or more computer functions.

[0060] The computer system 1100 may include a processor 1102 e.g., a central processing unit (CPU), a graphics processing unit (GPU), or both. The processor 1102 may be a component in a variety of systems. For example, the processor 1102 may be part of a standard personal computer or a workstation. The processor 1102 may be one or more general processors, digital signal processors, application-specific integrated circuits, field-programmable gate arrays, servers, networks, digital circuits, analog circuits, combinations thereof, or other now known or later developed devices for analyzing and processing data. The processor 1102 may implement a software program, such as code generated manually (i.e., programmed).

[0061] The computer system 1100 may include a memory 1104, such as a memory 1104 that can communicate via a bus 1108. The memory 1104 may include, but is not limited to computer-readable storage media such as various types of volatile and non-volatile storage media, including but not limited to random access memory, read-only memory, programmable read-only memory, electrically programmable read-only memory, electrically erasable read-only memory, flash memory, magnetic tape or disk, optical media and the like. In one example, memory 1104 includes

a cache or random access memory for the processor 1102. In alternative examples, the memory 1104 is separate from the processor 1102, such as a cache memory of a processor, the system memory, or other memory. The memory 1104 may be an external storage device or database for storing data. The memory 1104 is operable to store instructions executable by the processor 1102. The functions, acts or tasks illustrated in the figures or described may be performed by the programmed processor 1102 for executing the instructions stored in the memory 1104. The functions, acts or tasks are independent of the particular type of instructions set, storage media, processor or processing strategy and may be performed by software, hardware, integrated circuits, firmware, micro-code and the like, operating alone or in combination. Likewise, processing strategies may include multiprocessing, multitasking, parallel processing and the like.

[0062] As shown, the computer system 1100 may or may not further include a display unit 1110, such as a liquid crystal display (LCD), an organic light-emitting diode (OLED), a flat panel display, a solid-state display, a projector, a printer or other now known or later developed display device for outputting determined information. The display 1110 may act as an interface for the user to see the functioning of the processor 1102, or specifically as an interface with the software stored in the memory 1104 or the drive unit 1116.

[0063] Additionally, the computer system 1100 may include an input device 1112 configured to allow a user to interact with any of the components of system 1100. The computer system 1100 may also include a disk or optical drive unit 1116. The disk drive unit 1116 may include a computer-readable medium 1122 in which one or more sets of instructions 1124, e.g., software, can be embedded. Further, the instructions 1124 may embody one or more of the methods or logic as described. In a particular example, the instructions 1124 may reside completely, or at least partially, within the memory 1104 or within the processor 1102 during execution by the computer system 1100.

[0064] The present invention contemplates a computer-readable medium that includes instructions 1124 or receives and executes instructions 1124 responsive to a propagated signal so that a device connected to a network 1126 can communicate voice, video, audio, images, or any other data over the network 1126. Further, instructions 1124 may be transmitted or received over the network 1126 via a communication port or interface 1120 or using a bus 1108. The communication port or interface 1120 may be a part of the processor 1102 or maybe a separate

component. The communication port 1120 may be created in software or maybe a physical connection in hardware. The communication port 1120 may be configured to connect with a network 1126, external media, the display 1110, or any other components in system 1100, or combinations thereof. The connection with the network 1126 may be a physical connection, such as a wired Ethernet connection or may be established wirelessly as discussed later. Likewise, the additional connections with other components of the system 1100 may be physical or may be established wirelessly. The network 1126 may alternatively be directly connected to the bus 1108.

[0065] The network 1126 may include wired networks, wireless networks, Ethernet AVB networks, or combinations thereof. The wireless network may be a cellular telephone network, an 802.11, 802.16, 802.20, 802.1Q or WiMax network. Further, the network 1126 may be a public network, such as the Internet, a private network, such as an intranet, or combinations thereof, and may utilize a variety of networking protocols now available or later developed including, but not limited to TCP/IP based networking protocols. The system is not limited to operation with any particular standards and protocols. For example, standards for Internet and other packet-switched network transmissions (e.g., TCP/IP, UDP/IP, HTML, and HTTP) may be used.

[0066] While specific language has been used to describe the disclosure, any limitations arising on account of the same are not intended. As would be apparent to a person in the art, various working modifications may be made to the method in order to implement the inventive concept as taught herein.

[0067] The drawings and the forgoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment. For example, orders of processes described herein may be changed and are not limited to the manner described herein.

[0068] Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts necessarily need to be performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples. Numerous variations, whether explicitly given in the

specification or not, such as differences in structure, dimension, and use of material, are possible. The scope of embodiments is at least as broad as given by the following claims.

[0069] Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any component(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or component of any or all the claims.

We Claim:

1. A method for mitigating unwanted audio noise in Internet of things (IoT) based communication environment, comprising:

identifying and pairing, by a paring module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;

determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

2. The method as claimed in claim 1, wherein

the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, and

a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

3. The method as claimed in claim 2, wherein, for calculating the sound parameter value corresponding to each of the IoT device of the determined cluster, the method further comprising:

combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters.

4. The method as claimed in claim 2, wherein, for correcting the predicted optimal sound output, the method further comprising:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value;

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device;

generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device; and

outputting, by a rendering module, the generated new optimal sound from the target IoT device.

5. The method as claimed in claim 4, wherein

each cluster of the plurality of clusters includes at least one IoT device, and

the phase of the predicted optimal sound output is shifted by 180°.

6. The method as claimed in claim 4, further comprising:

determining, by a processing module based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is hearable; and

updating, by the processing module, settings of the voice assistance device based on the determined optimal region.

7. The method as claimed in claim 1, further comprising:

exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes

location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pairing, by the paring module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

8. The method as claimed in claim 1, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

9. A system for mitigating unwanted audio noise in Internet of things (IoT) based communication environment, comprising:

a paring module configured to identify and pair one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

a clustering module configured to:

divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave; and

determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

a prediction module configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

a correction module configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

10. The system as claimed in claim 9, wherein

the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, and

a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

11. The system as claimed in claim 10, wherein, for calculating the sound parameter value corresponding to each of the IoT device of the determined cluster, the correction module is further configured to:

combine the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and

calculate the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters.

12. The system as claimed in claim 10, wherein for correcting the predicted optimal sound output, the correction module is further configured to:

select, as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value;

shift a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and

generate a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device, and

wherein the system further comprises a rendering module configured to output the generated new optimal sound from the target IoT device.

13. The system as claimed in claim 12, wherein

each cluster of the plurality of clusters includes at least one IoT device, and

the phase of the predicted optimal sound output is shifted by 180°.

14. The system as claimed in claim 12, wherein the system further comprises a processing module configured to:

determine, based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is hearable; and

update settings of the voice assistance device based on the determined optimal region.

15. The system as claimed in claim 9, wherein the pairing module is further configured to:

exchange, in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pairing the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

updating the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

16. The method as claimed in claim 9, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

Dated this 30th day of December, 2021

Manisha Singh
Agent for the Applicant [IN/PA-740]
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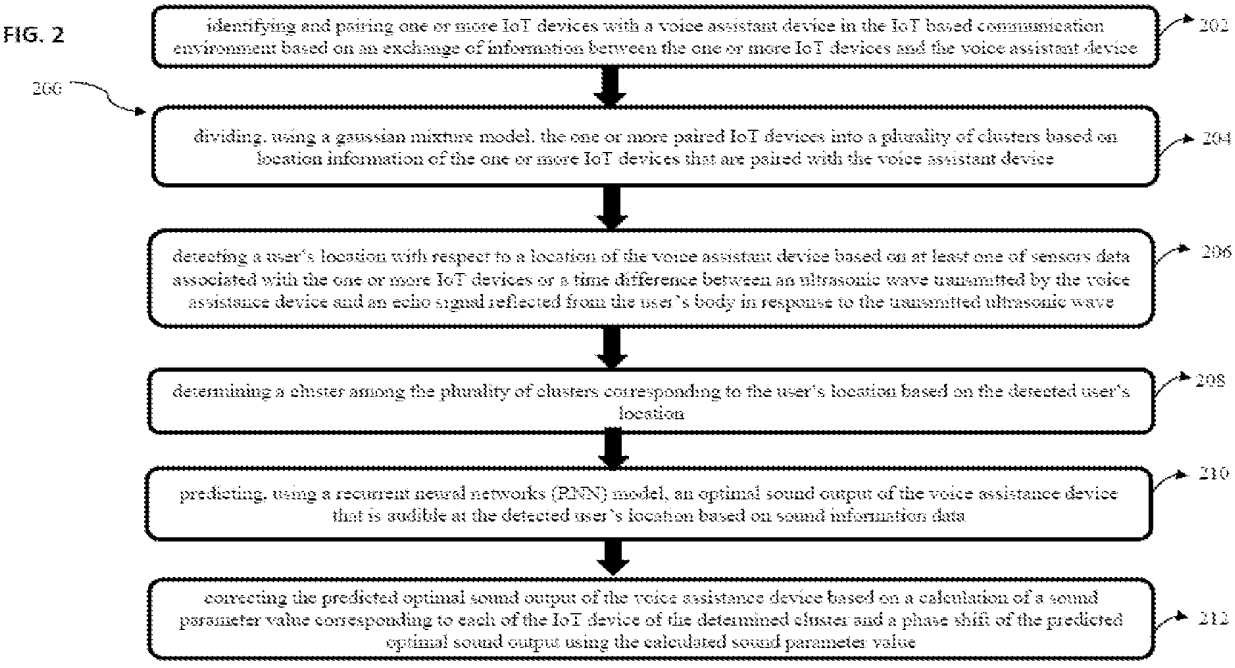
ABSTRACT OF THE INVENTION

A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Provided is a method for mitigating unwanted audio noise in IoT based communication environment that comprises identifying and pairing one or more IoT devices with a voice assistant device, and then dividing the one or more paired IoT devices into a plurality of clusters. The method further comprises detecting a user's location with respect to a location of the voice assistant device and then determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location and thereafter using a recurrent neural networks (RNN) model, predicting an optimal sound output of the voice assistance device that is audible at the detected user's location. The method furthermore comprises correcting the predicted optimal sound output of the voice assistance device using a sound parameter value associated with the determined cluster and a phase shift of the predicted optimal sound output.

FIG. 2



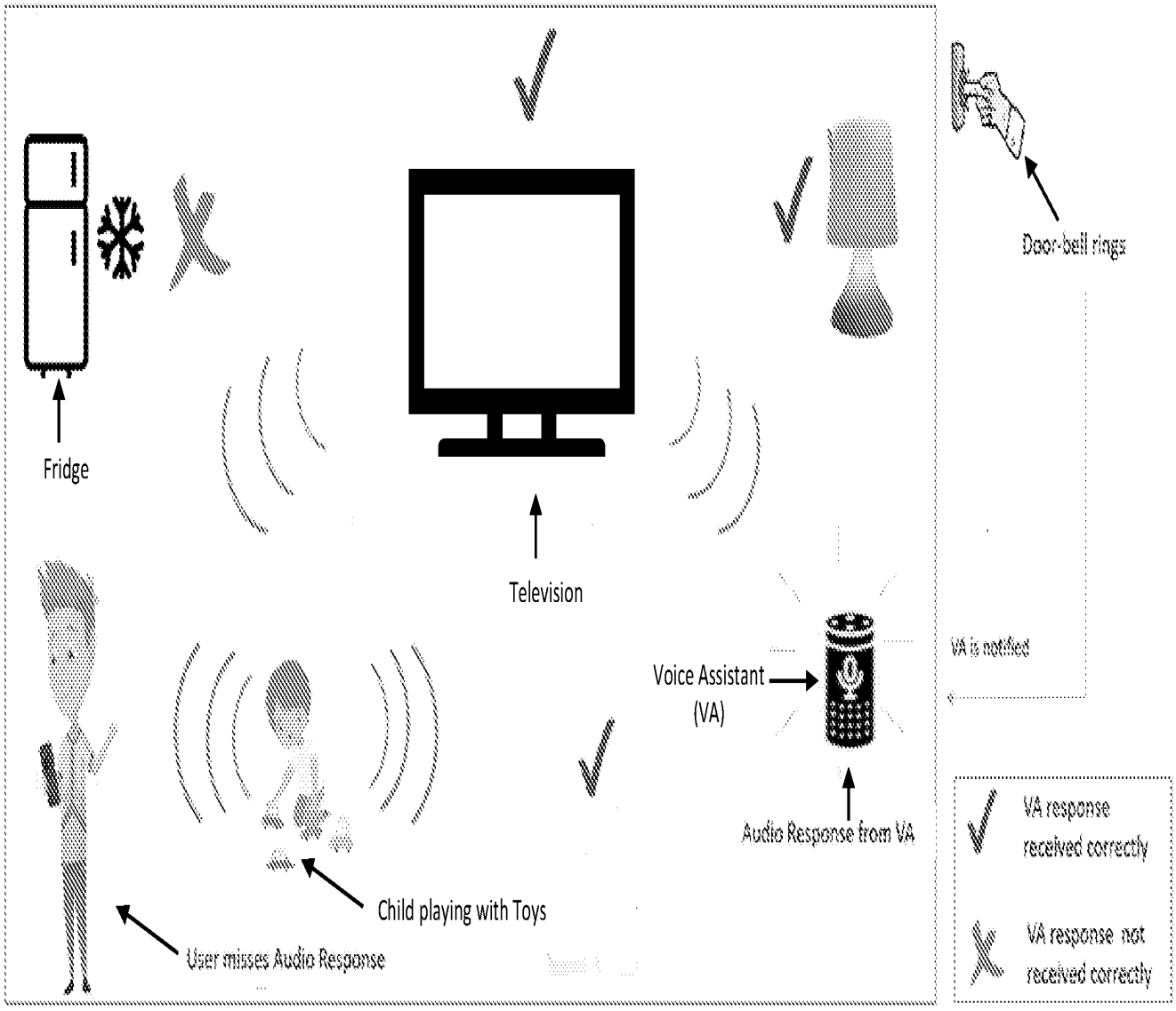


FIG. 1 (prior Art)

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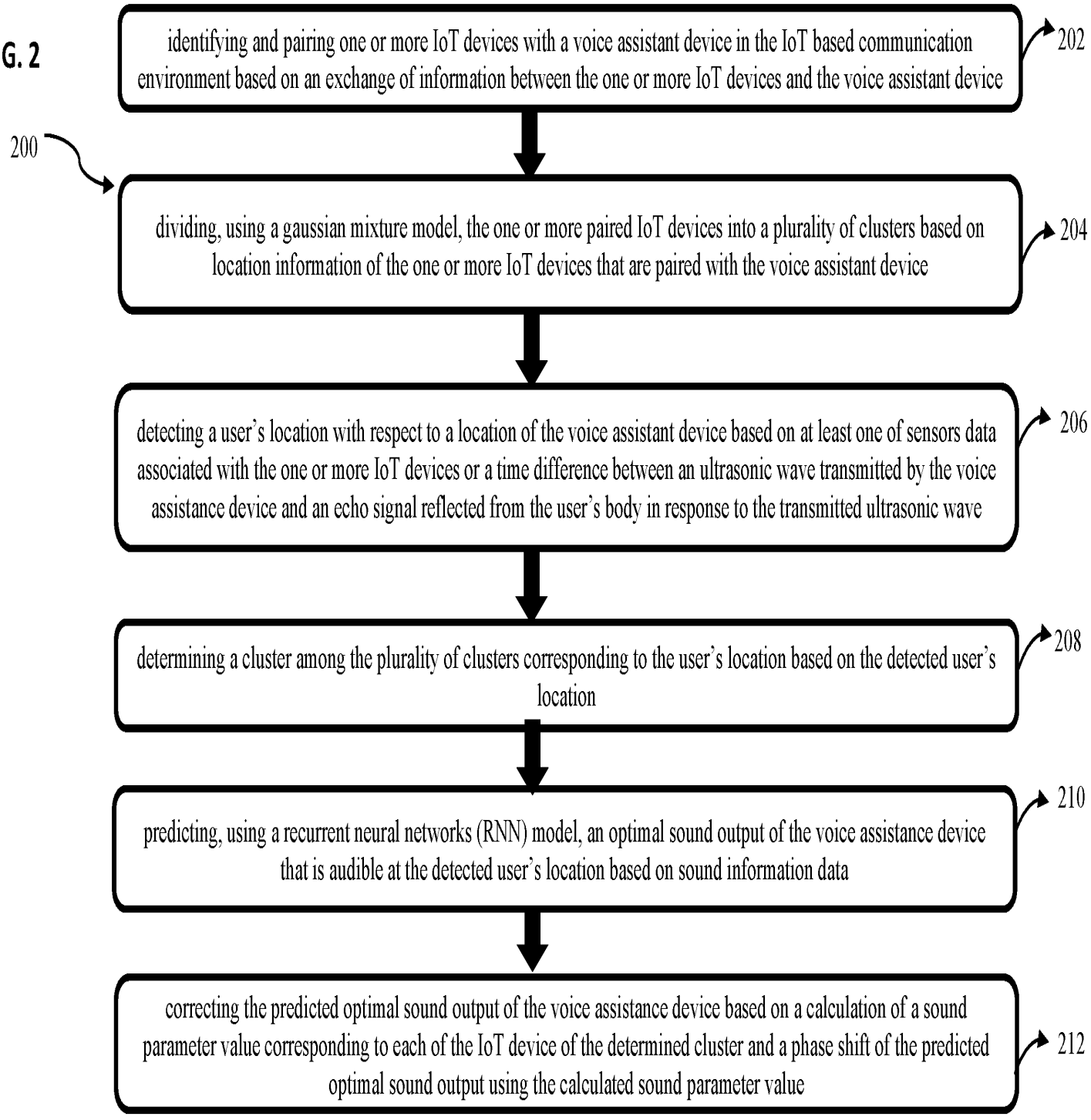
FIG. 2



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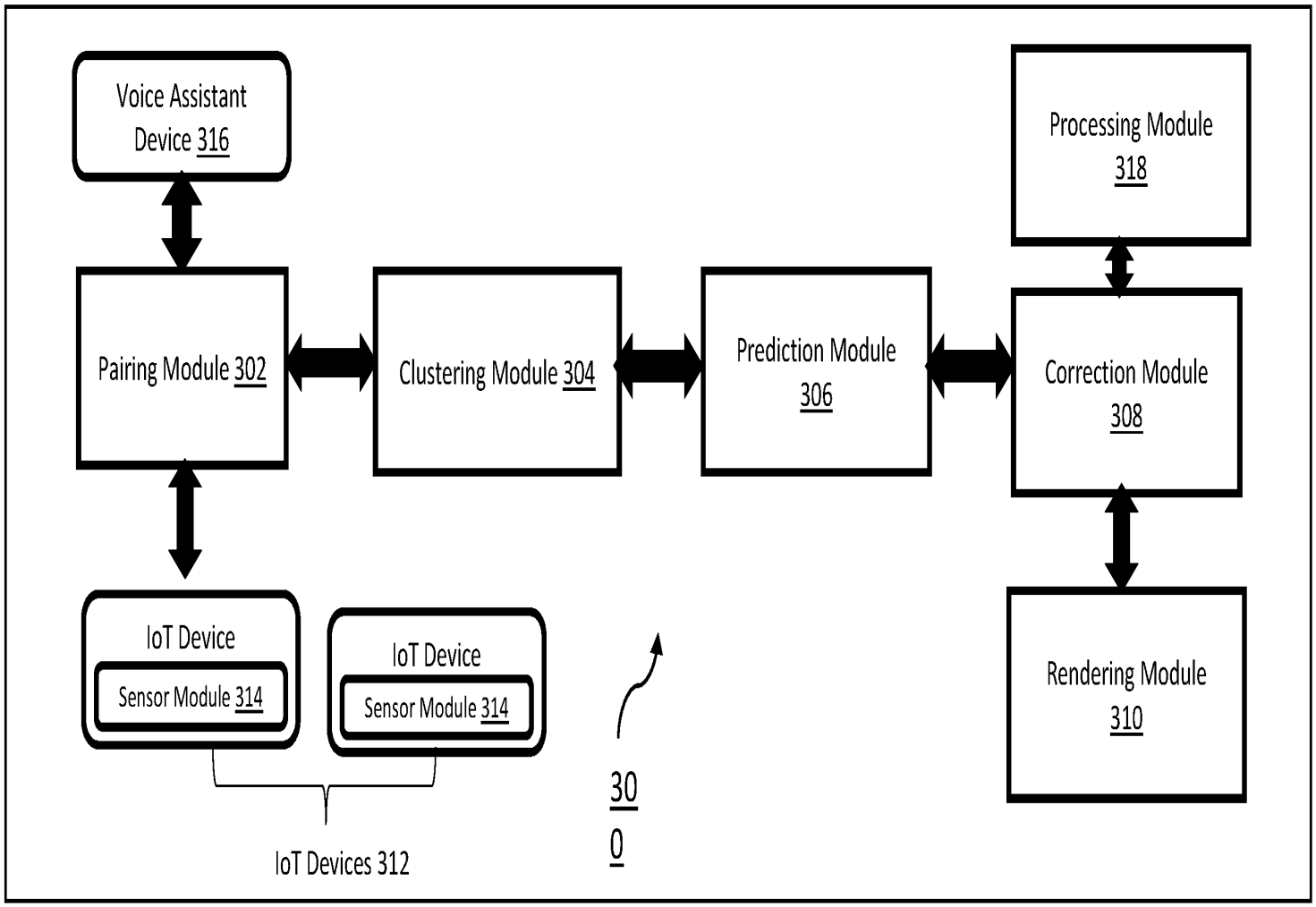
Voice Assistant Device 316
Pairing Module 302
Clustering Module 304
Prediction Module 306
Processing Module 318
Correction Module 308
Rendering Module 310
IoT Device
Sensor Module 314
IoT Device
Sensor Module 314
IoT Devices 312
300

FIG. 3

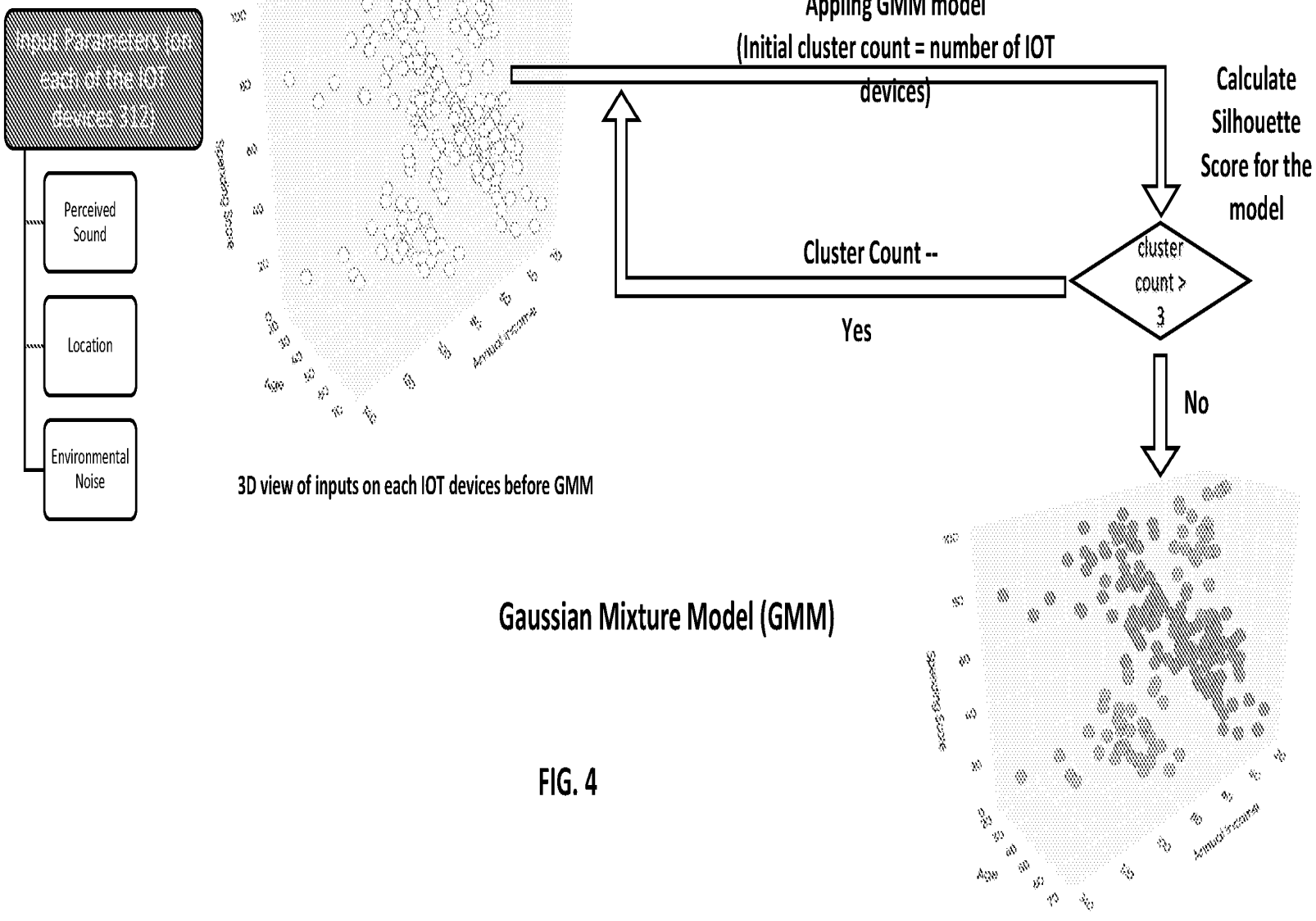

FIG. 4

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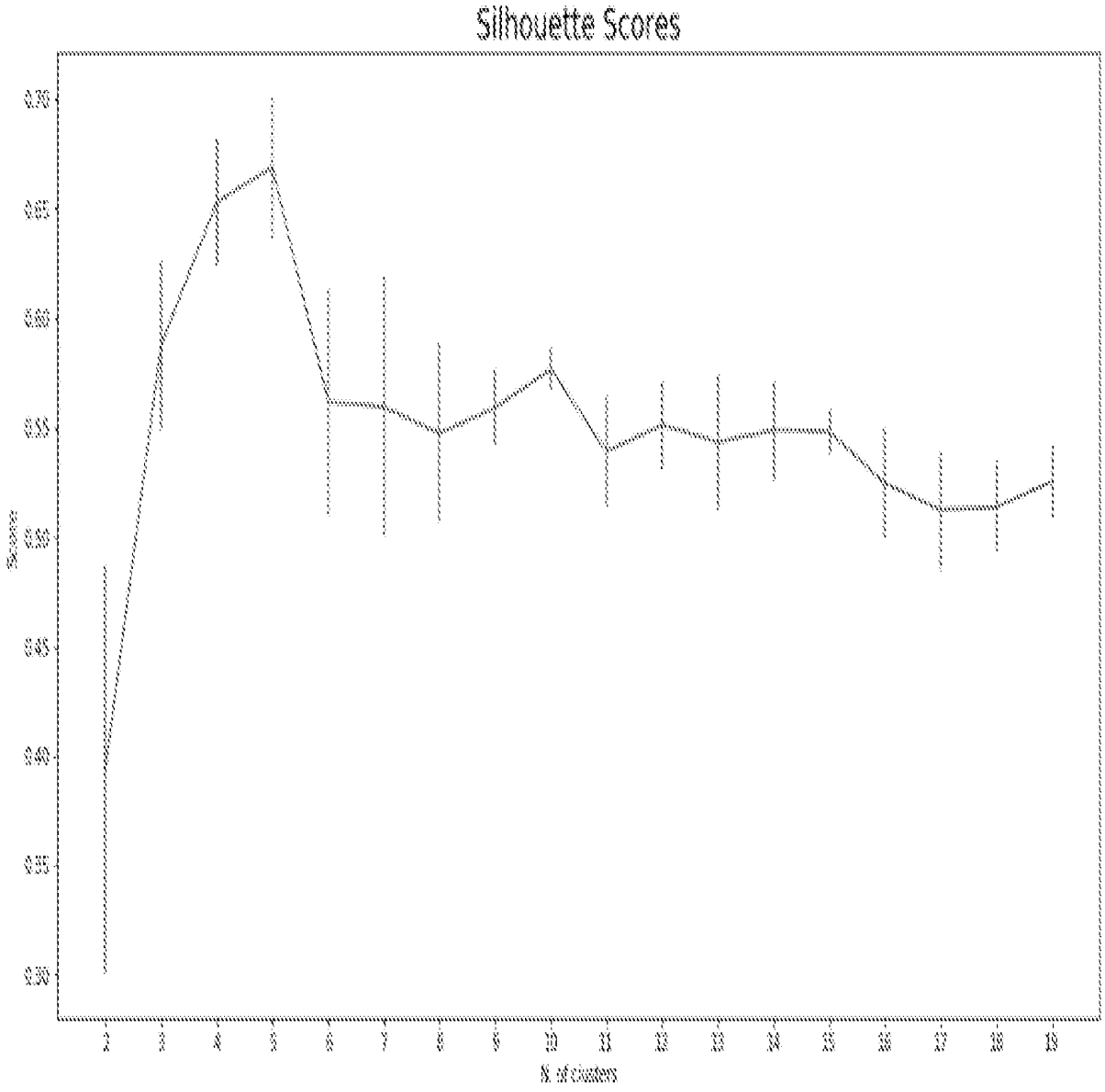
Silhouette Scores
0.700
0.695
0.690
0.685
0.680
0.675
Silhouette Score
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
N of clusters

FIG. 5

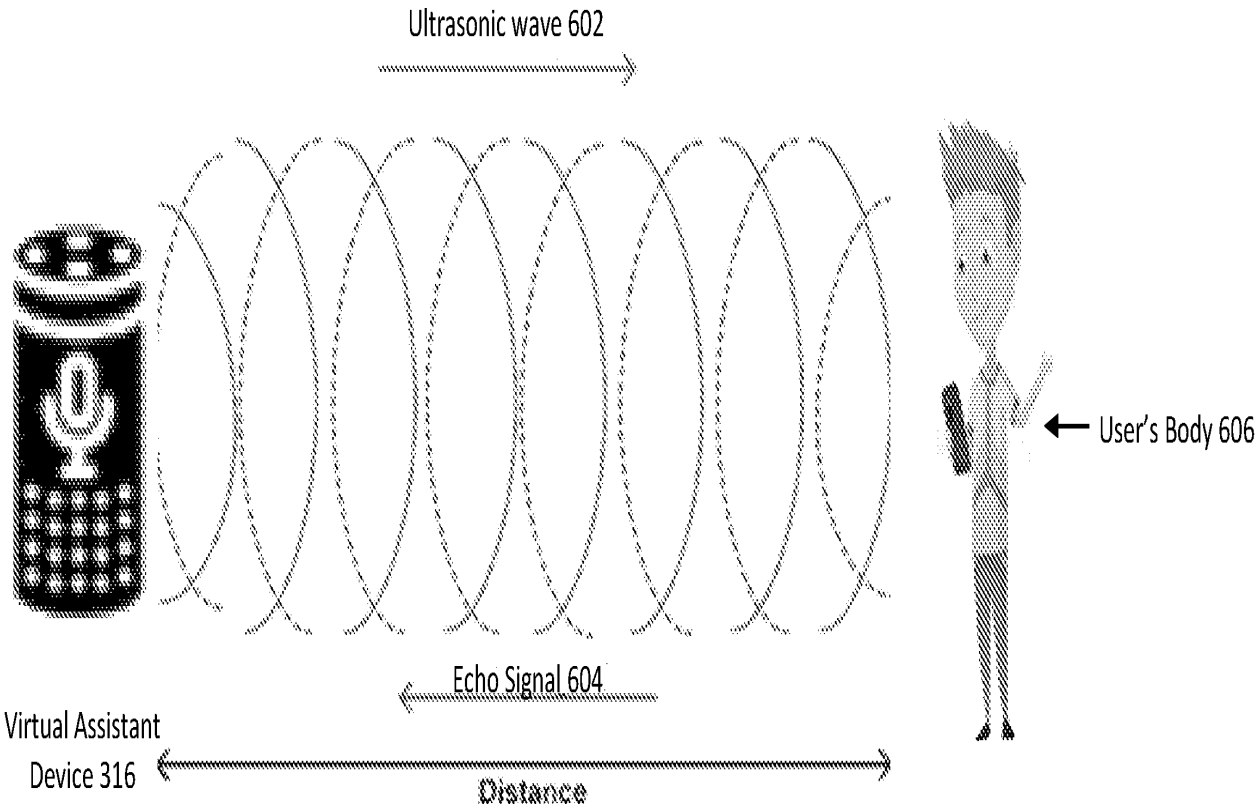
Ultrasonic wave 602
User's Body 606
Echo Signal 604
Virtual Assistant
Device 316
Distance

FIG. 6

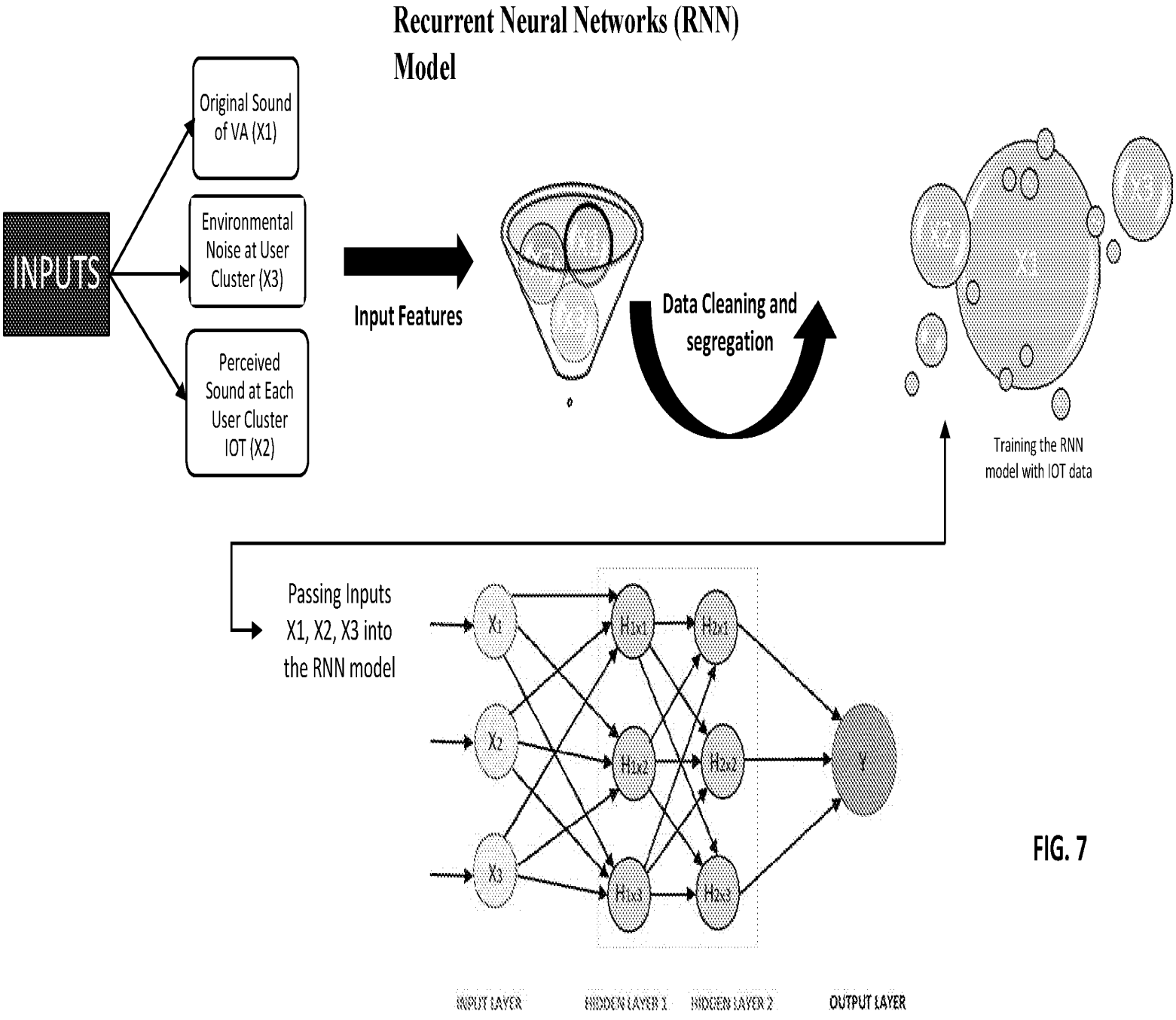

FIG. 7

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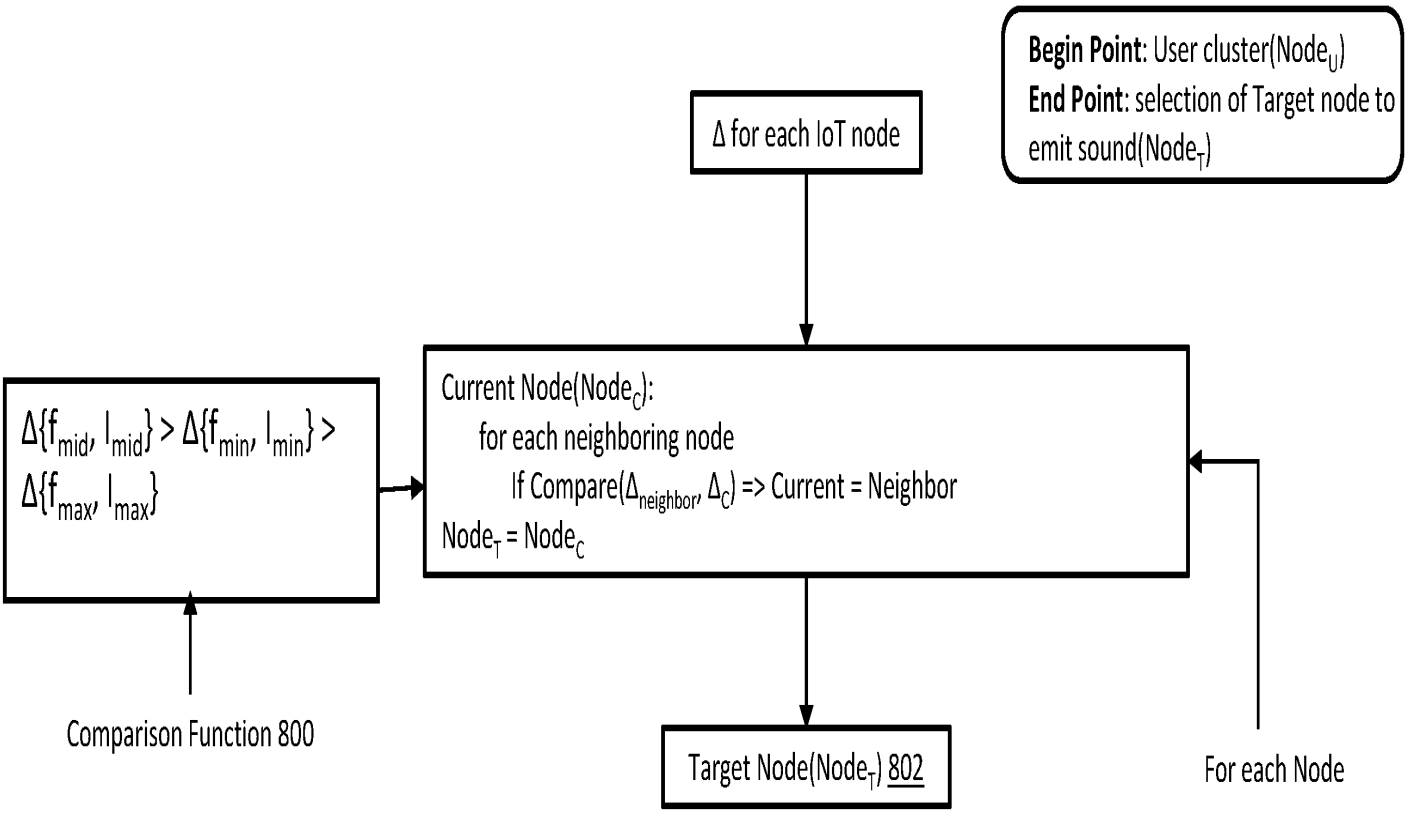
Begin Point: User cluster(Node_U)
End Point: selection of Target node to emit sound(Node_T)
Δ for each IoT node
Current Node(Node_C):
for each neighboring node
If Compare(Δ_neighbor, Δ_C) => Current = Neighbor
Node_T = Node_C
Δ{f_mid, I_mid} > Δ{f_min, I_min} > Δ{f_max, I_max}
Comparison Function 800
Target Node(Node_T) 802
For each Node

FIG. 8

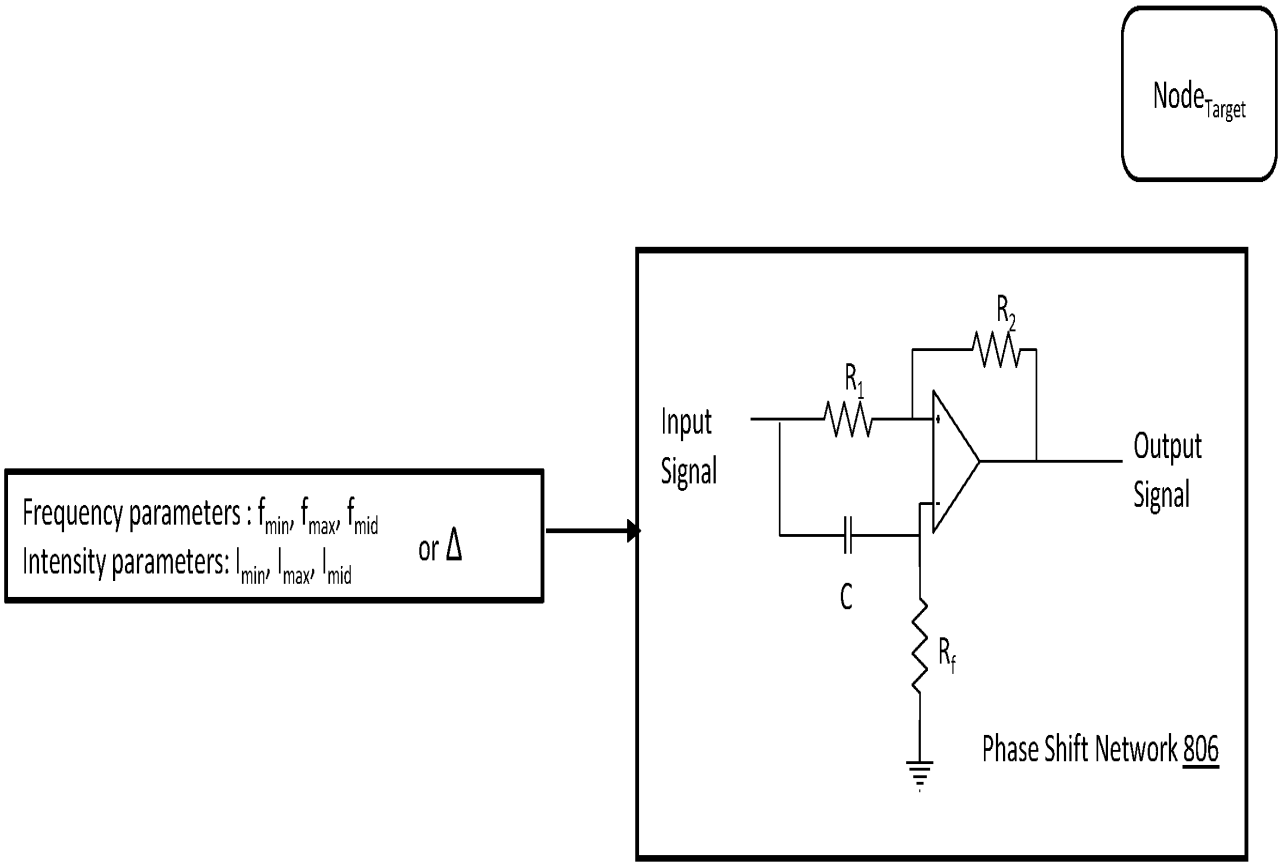
Node$_{Target}$
Frequency parameters : f_{min}, f_{max}, f_{mid}
Intensity parameters: I_{min}, I_{max}, I_{mid}
or Δ
Input Signal
R_1
R_2
C
R_f
Output Signal
Phase Shift Network 806
180° phase shift of sound parameters

FIG. 9

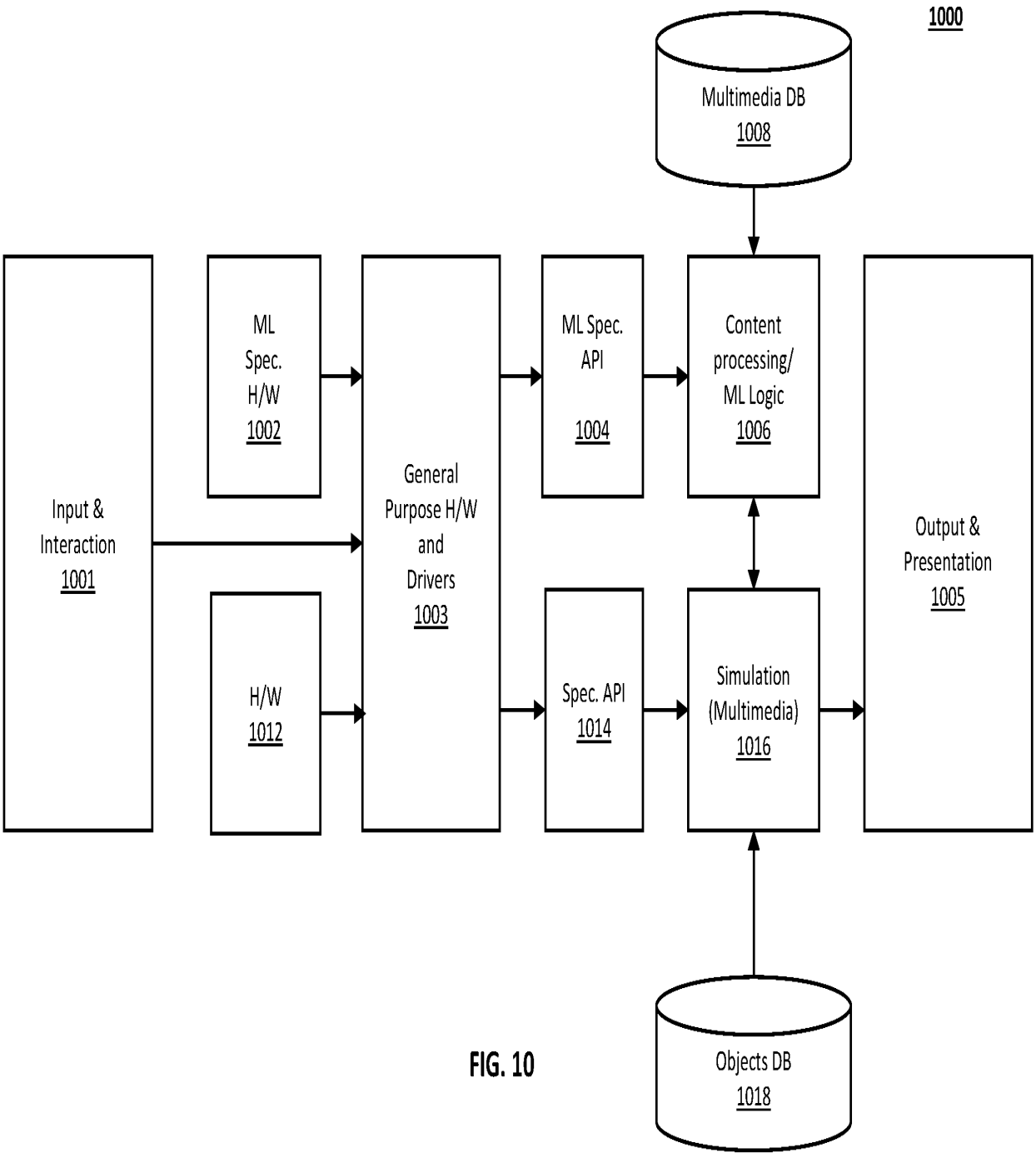

FIG. 10

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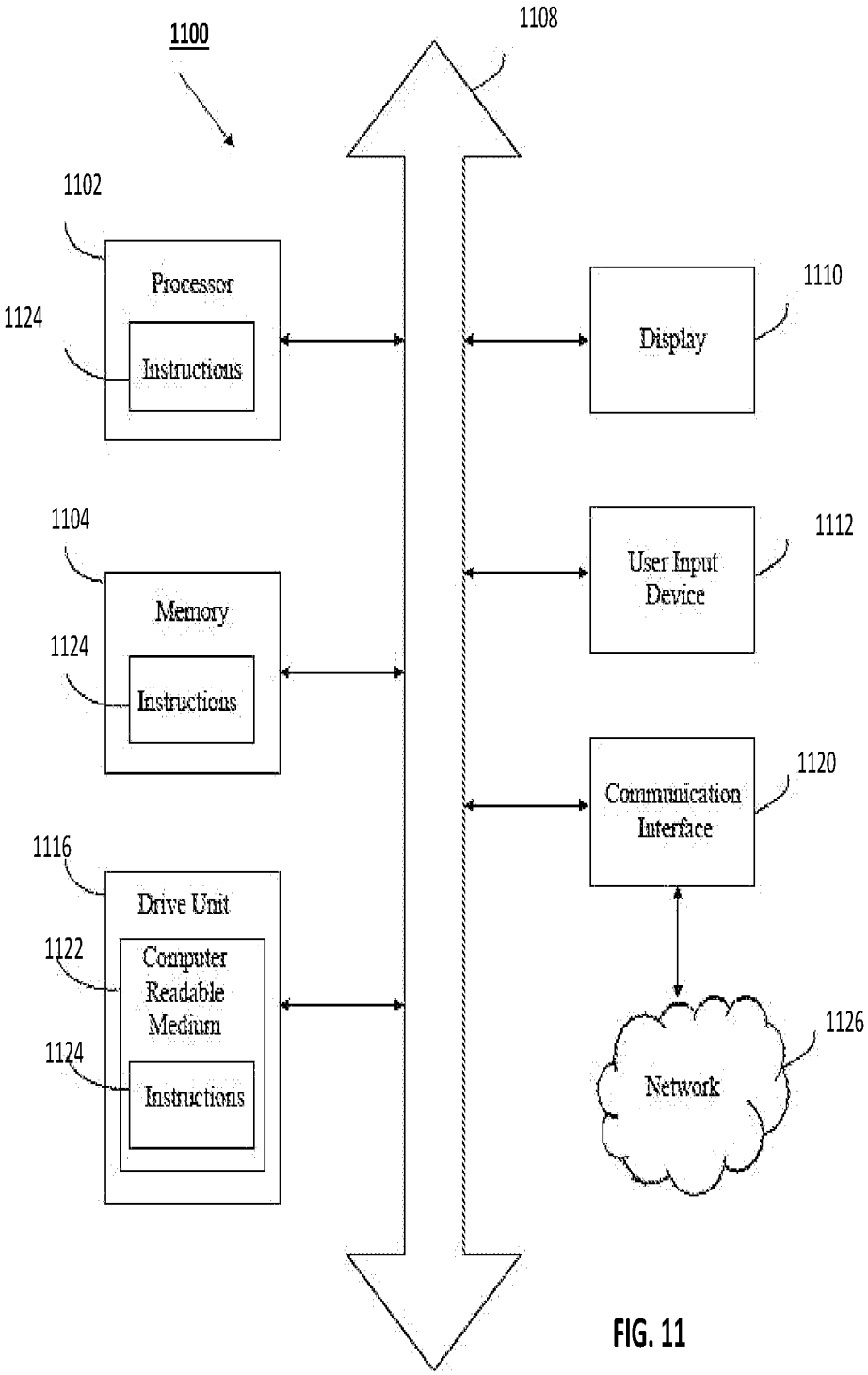

FIG. 11

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/084,081	12/19/2022	Abhinav GABA	0503-0636

CONFIRMATION NO. 3982

68103
Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

PUBLICATION NOTICE

OC000000059060961

Date Mailed: 07/06/2023

Title:METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Publication No.US-2023-0215457-A1
Publication Date:07/06/2023

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(Not for submission under 37 CFR 1.99)

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

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	2	20210327449	A1	2021-10-21	SHIN et al.	

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First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Indian Examination Report dated December 26, 2023, issued in Indian Application No. 202111061923	☐

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Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

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OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Maeng-Ho SHIN/	Date (YYYY-MM-DD)	2024-03-08
Name/Print	Maeng-Ho Shin	Registration Number	53859

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/084,081	**03/08/2024 04:30:13 PM Z ET**	**0503-0636**

Title of Invention

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3982	FILED BY	Ji-heun Suh
PATENT CENTER #	64614236	FILING DATE	12/19/2022
CUSTOMER #	68103	FIRST NAMED INVENTOR	Abhinav GABA
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Maeng-Ho SHIN

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
0503-0636IDSAsFiled03-08-2024.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	1010 KB
1_0503-0636INOAAsFiled.pdf	6	Non Patent Literature	152 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0503-0636IDSAsFiled03-08-2024.pdf	77CE3E7758C9F5E36614862E2BA4A255A0AF8F10095A80C7C059E5A358356E9132885C776E01E6E64F76D93A541819C6A0ECD935A1401622459A92FA9977D234

1_0503-0636INOAAsFiled.pdf	3E2C8484639E37405DA736A2CAD6180DD22F9C3E2BCE00DF 54B0AA1CB9E9BFC7037A4B5AD59F13B7BB8C53EE2C7606AF CAFF91D381A3351C4C85D5BA3A06F4D1

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Notice of References Cited	Application/Control No. 18/084,081	Applicant(s)/Patent Under Reexamination GABA et al.	
	Examiner NANDINI SUBRAMANI	Art Unit 2656	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-20130251079-A1	2013-09-26	Miyahara; Ryoji	G10L21/0208	375/346
*	B	US-9008329-B1	2015-04-14	Mandel; Michael	G10K15/00	704/226
*	C	US-20160364963-A1	2016-12-15	Matsuoka; Yoky	G06V10/764	1/1
*	D	US-20200072937-A1	2020-03-05	BAEK; Seungmin	H04R1/406	1/1
*	E	US-20220406326-A1	2022-12-22	PORT; Timothy Alan	H04S7/305	1/1
*	F	US-20230385017-A1	2023-11-30	Soto; Kurt Thomas	G06F3/165	1/1
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	Art Unit
	NANDINI SUBRAMANI	2656

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	11/13/2024								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	Art Unit
	NANDINI SUBRAMANI	2656

CPC - Searched*		
Symbol	Date	Examiner
G10L25/30 G10L21/0208 G10L2021/02082	11/13/2024	NS

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
G10L25/30 G10L21/0208 G10L2021/02082 with text search	11/13/2024	NS
Inventors/assignee/applicants searched with text search	11/13/2024	NS
Consulted with PE Doug Godbold	11/13/2024	NS
PE2E search, ip.com search used with search	11/13/2024	NS

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	

Content: Patent Publications (7)

US Patents | US Designs | US Applications | EPO Patents | Japan Patents | Korea Patents | WIPO Applications

1 2024-11-12 22:06 UTC | ~8,546,540 results from

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
he method comprises detecting a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave. Subsequent to the detection of the user's location, the method furthermore comprises determining a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location and then using a recurrent neural networks (RNN) model predicting an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data that includes information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, and information corresponding to the perceived sound of the voice assistant device at each IoT device of the one or more IoT devices. At last, after the prediction of the optimal sound output of the voice assistance device, the method furthermore comprises correcting the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each of the IoT devices of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.

Concept Modifiers: None

Filters: None

2 2024-11-12 22:42 UTC | ~4,905,506 results from

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the device location with respect to virtual assistant device using gaussian clustering model and accordingly determining the optimal sound output of the virtual assistant device based on the environment noise level

Concept Modifiers: None

Filters: None

3 2024-11-12 22:55 UTC | ~6,175,668 results from

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the device location with respect to virtual assistant device using gaussian clustering model and determining the noise compensation of sound output of the virtual assistant device based on the environment noise level

Concept Modifiers: None

Filters: None

Content: Non-Patent Literature (26)

IEEE Xplore Publications: IEEE Periodicals | IEEE Xplore Publications: IEEE Conferences | IEEE Xplore Publications: IEEE Standards | IEEE Xplore Publications: IEEE Early Access | IEEE Xplore Publications: SMPTE Periodicals | IEEE Xplore Publications: SMPTE Conferences | IEEE Xplore Publications: SMPTE Standards | IEEE Xplore Publications: MIT Press eBooks | IEEE Xplore Publications: Wiley-IEEE eBooks | IEEE Xplore Publications: IBM Periodicals | IEEE Xplore Publications: URSI Periodicals | IEEE Xplore Publications: VDE Conferences | IEEE Xplore Publications: Periodicals from China | IEEE Xplore Publications: Ericsson Technology Review | IEEE Xplore Publications: Manning Books | IEEE Xplore Publications: Packt Books | IP.com Prior Art Database: The IP.com Journal | IP.com Prior Art Database: Internet Society RFC | IP.com Prior Art Database: IBM TDB Archive | IP.com Prior Art Database: Legacy Journals | IP.com Prior Art Database: Software Patent Institute | OnePetro.org: Periodicals at OnePetro.org | OnePetro.org: Conferences at OnePetro.org | Other Literature: IBM Redbooks | Other Literature: PubMed Central | Other Literature: arXiv.org

4 **2024-11-12 23:30 UTC | 5,013,405 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the device location with respect to virtual assistant device using gaussian clustering model and determining the noise compensation of sound output of the virtual assistant device based on the environment noise level

Concept Modifiers: None

Filters: None

5 **2024-11-12 23:38 UTC | 3,565,342 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the noise compensation of output sound of the virtual assistant device based on the environment noise level

Concept Modifiers: None

Filters: None

Content: Patent Publications (7)

US Patents | US Designs | US Applications | EPO Patents | Japan Patents | Korea Patents | WIPO Applications

6 **2024-11-12 23:42 UTC | ~6,992,703 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the noise compensation of output sound of the virtual assistant device based on the environment noise level

Concept Modifiers: None

Filters: None

7 **2024-11-12 23:53 UTC | ~12,812,274 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the device location near the voice activated device based on ultrasonic sensor and clustering the devices near the voice activated device using gaussian mixture model

Concept Modifiers: None

Filters: None

Content: Non-Patent Literature (26)

IEEE Xplore Publications: IEEE Periodicals | IEEE Xplore Publications: IEEE Conferences | IEEE Xplore Publications: IEEE Standards | IEEE Xplore Publications: IEEE Early Access | IEEE Xplore Publications: SMPTE Periodicals | IEEE Xplore Publications: SMPTE Conferences | IEEE Xplore Publications: SMPTE Standards | IEEE Xplore Publications: MIT Press eBooks | IEEE Xplore Publications: Wiley-IEEE eBooks | IEEE Xplore Publications: IBM Periodicals | IEEE Xplore Publications: URSI Periodicals | IEEE Xplore Publications: VDE Conferences | IEEE Xplore Publications: Periodicals from China | IEEE Xplore Publications: Ericsson Technology Review | IEEE Xplore Publications: Manning Books | IEEE Xplore Publications: Packt Books | IP.com Prior Art Database: The IP.com Journal | IP.com Prior Art Database: Internet Society RFC | IP.com Prior Art Database: IBM TDB Archive | IP.com Prior Art Database: Legacy Journals | IP.com Prior Art Database: Software Patent Institute | OnePetro.org: Periodicals at OnePetro.org | OnePetro.org: Conferences at OnePetro.org | Other Literature: IBM Redbooks | Other Literature: PubMed Central | Other Literature: arXiv.org

8 **2024-11-12 23:56 UTC | 10,488,589 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determining the device location near the voice activated device based on ultrasonic sensor and clustering the devices near the voice activated device using gaussian mixture model

Concept Modifiers: None

Filters: None

9 **2024-11-13 00:00 UTC | 2,359,690 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
clustering the devices proximity locations based on ultrasonic sensor

Concept Modifiers: None

Filters: None

Content: Patent Publications (7)

US Patents | US Designs | US Applications | EPO Patents | Japan Patents | Korea Patents | WIPO Applications

10 **2024-11-13 00:02 UTC | ~1,587,217 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
clustering the devices proximity locations based on ultrasonic sensor

Concept Modifiers: None

Filters: None

11 **2024-11-13 00:03 UTC | ~13,996,587 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
clustering the devices proximity locations to voice activated devices based on ultrasonic sensor

Concept Modifiers: None

Filters: None

12 **2024-11-13 00:24 UTC | ~6,118,691 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
loudness compensation of virtual device output based on ambient noise using RNN

Concept Modifiers: None

Filters: None

13 **2024-11-13 19:48 UTC | ~7,694,062 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
Using the internet of things sensor information to automatically adjust the output sound of a voice activated system based on the location of the user

Concept Modifiers: None

Filters: None

Content: Non-Patent Literature (26)

IEEE Xplore Publications: IEEE Periodicals | IEEE Xplore Publications: IEEE Conferences | IEEE Xplore Publications: IEEE

Standards | IEEE Xplore Publications: IEEE Early Access | IEEE Xplore Publications: SMPTE Periodicals | IEEE Xplore Publications: SMPTE Conferences | IEEE Xplore Publications: SMPTE Standards | IEEE Xplore Publications: MIT Press eBooks | IEEE Xplore Publications: Wiley-IEEE eBooks | IEEE Xplore Publications: IBM Periodicals | IEEE Xplore Publications: URSI Periodicals | IEEE Xplore Publications: VDE Conferences | IEEE Xplore Publications: Periodicals from China | IEEE Xplore Publications: Ericsson Technology Review | IEEE Xplore Publications: Manning Books | IEEE Xplore Publications: Packt Books | IP.com Prior Art Database: The IP.com Journal | IP.com Prior Art Database: Internet Society RFC | IP.com Prior Art Database: IBM TDB Archive | IP.com Prior Art Database: Legacy Journals | IP.com Prior Art Database: Software Patent Institute | OnePetro.org: Periodicals at OnePetro.org | OnePetro.org: Conferences at OnePetro.org | Other Literature: IBM Redbooks | Other Literature: PubMed Central | Other Literature: arXiv.org

14 **2024-11-13 20:02 UTC | 2,234,005 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
Using the internet of things sensor information to automatically adjust the output sound of a voice activated system based on the location of the user

Concept Modifiers: None

Filters: None

15 **2024-11-14 00:56 UTC | 3,031,719 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determine the voice output voice assistant systems to overcome the surrounding noise Using sensors(ultrasound) to detect the speaker location with respect to to voice assistant systems

Concept Modifiers: None

Filters: None

Content: Patent Publications (7)

US Patents | US Designs | US Applications | EPO Patents | Japan Patents | Korea Patents | WIPO Applications

16 **2024-11-14 00:56 UTC | ~11,133,549 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determine the voice output voice assistant systems to overcome the surrounding noise Using sensors(ultrasound) to detect the speaker location with respect to to voice assistant systems

Concept Modifiers: None

Filters: None

17 **2024-11-14 17:43 UTC | ~3,412,545 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determine the volume of media playback system to overcome the surrounding noise and using sensors(ultrasound) to detect the speaker location with respect to playback system

Concept Modifiers: None

Filters: None

18 **2024-11-14 17:46 UTC | ~4,917,966 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
determine the volume of media playback system to overcome the surrounding noise and using sensors(ultrasound) to detect the user location with respect to playback system

Concept Modifiers: None

Filters: None

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	249386	((("Samsung") near3 ("Electronics") near3 ("Co") near3 ("Ltd"))).AS,AANM.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 03:41 PM
L2	317	((("GABA") near3 ("Abhinav")) OR (("TANEJA") near3 ("Akul")) OR (("SHARMA") near3 ("Deepak")) OR (("SINGHAL") near3 ("Raja"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/11/12 03:41 PM
L3	1	("20230215457").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 03:42 PM
L4	36	L1 AND L2	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 03:42 PM
L5	2	("20200072937"|"20210327449").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 04:55 PM
L6	5	("10325585"|"10878812"|"20170372725"|"20190273996"|"20210110826").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 04:55 PM
L7	1	(KR-102254522-$).DID.	(US-PGPUB; USPAT; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DK, EA, EE, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2024/11/12 04:59 PM
L8	4	("10129664" "11800318" "11164575" "11158327").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:13 PM
L9	0	WO-2019221894-$.did.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:14 PM
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			PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))				
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L15	235	("2018/0260680").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/11/12 05:16 PM
L16	0	noise near3 identif$6 AND virtual near3 assistant SAME volume near3 control	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:18 PM
L17	181	noise near3 identif$6 AND virtual near3 assistant AND volume near3 control	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:18 PM
L18	62816	(G10L25/30 or G10L21/0208 or G10L2021/02082).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DK, EA, EE, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/11/12 05:25 PM
L19	441	(G10L25/30 G10L21/0208 G10L2021/02082).cpc. AND virtual near3 assistant	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	AND	ON	ON	2024/11/12 05:25 PM
L20	37293	(G10L25/30 G10L21/0208 G10L2021/02082).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	AND	ON	ON	2024/11/12 05:28 PM
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L22	7	(G10L25/30 G10L21/0208	(US-PGPUB; USPAT)	AND	ON	ON	2024/11/12 05:33 PM

		G10L2021/02082).cpc. AND virtual near3 assistant near3 output					
L23	48	noise near3 filter$7 AND virtual near3 assistant near3 output	(US-PGPUB; USPAT)	AND	ON	ON	2024/11/12 05:35 PM
L24	48	(noise near3 filter$7) AND (virtual near3 assistant near3 output)	(US-PGPUB; USPAT)	AND	ON	ON	2024/11/12 05:35 PM
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L26	1	("20110182436").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:46 PM
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L28	5	("9008329" "11869531" "11448728" "11817114" "12117838").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 05:54 PM
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L33	1	L32 AND gauss$4	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/12 06:49 PM
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L38	4	L5 L37	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/13

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L44	15	L43 AND cluster$5	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/13 12:56 PM
L45	1	("20190139530").pn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/11/13 01:51 PM
L46	1	("20190069109").pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/11/13 02:56 PM
L47	8	("10506361" "10402151" "11867791" "20210405148" "11527249" "10499172" "20230385017" "20220239269").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/13 03:00 PM
L48	1	("20160364963").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/14 11:51 AM
L49	7	((US-20220406326-A1 OR US-20130251079-A1 OR US-20230385017-A1 OR US-20160364963-A1 OR US-20230010466-A1 OR US-20200072937-A1).did. AND PGPB.dbnm.) OR ((US-9008329-B1).did. AND USPT.dbnm.)	(US-PGPUB; USPAT)	OR	ON	ON	2024/11/14 12:09 PM

There are no Interference searches to show.

Bibliographic Data

Application No: 18/084,081

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [ ] Met After Allowance

Verified and Acknowledged: /NANDINI SUBRAMANI/ [ ]

Examiner's Signature | Initials

Title: METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/19/2022	704	2656	0503-0636
RULE			

APPLICANTS

Samsung Electronics Co., Ltd.,

INVENTORS

Abhinav GABA, Noida, INDIA

Akul TANEJA, Noida, INDIA

Deepak SHARMA, Noida, INDIA

Raja SINGHAL, Noida, INDIA

CONTINUING DATA

FOREIGN APPLICATIONS

INDIA IN202111061923 12/30/2021

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/10/2023

STATE OR COUNTRY

INDIA

ADDRESS

Jefferson IP Law, LLP

1130 Connecticut Ave., NW, Suite 420

Washington, DC 20036

UNITED STATES

FILING FEE RECEIVED

$1,820

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10325585	B2	2019-06-18	BAKER et al.	
	2	10878812	B1	2020-12-29	HELWANI et al.	

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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20210110826	A1	2021-04-15	LAMBOURNE et al.	
	2	20190273996	A1	2019-09-05	STAROBIN et al.	
	3	20170372725	A1	2017-12-28	KHOURY et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Application Number	
	Filing Date	2022-12-19
	First Named Inventor	Abhinav GABA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0503-0636

	1	10-2254522	KR	B1	2021-05-24	LEE et al.		X

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature	/NANDINI SUBRAMANI/	Date Considered	11/13/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Application Number	
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Donald A. DIPAULA/	Date (YYYY-MM-DD)	2022-12-19
Name/Print	Donald A. DiPaula	Registration Number	58115

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.S./

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20200072937	A1	2020-03-05	Baek et al.	
	2	20210327449	A1	2021-10-21	SHIN et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Indian Examination Report dated December 26, 2023, issued in Indian Application No. 202111061923	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/NANDINI SUBRAMANI/	Date Considered	11/13/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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Art Unit	
Examiner Name	
Attorney Docket Number	0503-0636

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Maeng-Ho SHIN/	Date (YYYY-MM-DD)	2024-03-08
Name/Print	Maeng-Ho Shin	Registration Number	53859

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

68103 7590 11/19/2024

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

EXAMINER	
SUBRAMANI, NANDINI	

ART UNIT	PAPER NUMBER
2656	

NOTIFICATION DATE	DELIVERY MODE
11/19/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

usdocketing@jeffersonip.com

Office Action Summary	Application No. 18/084,081	Applicant(s) GABA et al.	
	Examiner NANDINI SUBRAMANI	Art Unit 2656	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 19 December 2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-16 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-16 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 19 December 2022 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 12/19/22 03/08/24.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Introduction

1. This office action is in response to Applicant's submission filed on 12/19/2022. Claims 1-16 are pending in the application and have been examined.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

2. **Claims 1-4, 6, 8 and 9-12, 14, 16 are rejected under 35 U.S.C. 103 as being unpatentable over Baek et. al, US PgPub. 2020/0072937(*cited in IDS*) in view of Port et. al. US PgPub. 2022/0406326 further in view of Mandel et. al. US Patent 9,008,329.**

Regarding claim 1, Baek teaches **a method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising: identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant**

device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device(*see Baek, [0025-0026] describes voice command receiving devices(IoT) and a sensor network control device (IoT)*)**; dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device** (*see Baek, [0081, 0084] describes the attribute information may include relative or absolute location information of the voice command receiving devices 210 and 220, information for functions, clustering information of the devices based on the location(IoT devices paired with voice assistant device) [0091] further describes the target determining devices(gaussian model)*)**; detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave** (*see Baek, [0042, 0052] Meanwhile, a user location calculating unit 150 of the sensor network control device 100 calculates the relative location of the user 300 by using a time difference of application (arrival) (TDOA) of a voice signal applied to a sensor (microphone) within each voice command receiving device and relative location information of each voice command receiving device (step S530). Those skilled in the art may calculate the relative location of each voice command receiving device on the sensor network 400 by using visible light, infrared rays, ultraviolet rays, and the like in addition to the sound, in addition to the aforementioned method*)**; determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location**(*see Baek, Fig. 6*

and Fig. 7 describe the location of voice command receiving devices(clusters among plurality of clusters) to determine the target device (clustering module). Baek, [0076] a target device selecting unit 130 of the sensor network control device 100 derives the voice command receiving device 220 as a target of the voice command by referring to the utterance direction range 230 and the location information of the user 300 while interpreting the voice command of the user 300 (step S550) **).**

However, Baek fails to teach **predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value.**

However, Port teaches **predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data**(*see Port,[0065] the noise estimator 107 is a component that is configured to estimate the level of noise in an environment that includes the system 100. The noise estimator 107 may be configured to receive the microphone signals 106 and to calculate how much of the microphone signals 106 consist of noise and how much is due to the playback of the loudspeaker 104. [0129] According to some examples, if the classifier 602 determines that the ambient noise is engine noise, blender noise, traffic noise, street noise, etc., the signals 603 may indicate that the noise compensator 402 should implement another type of noise compensation(to predict the sound output) [0131] the*

classifier 602 may be configured to determine the type of ambient noise by implementing a neural network that has been trained according to one or more audio-based context awareness models)**; and correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value** (*see Port, [0063] In this example, the noise compensator 102 is configured to receive an audio signal 101 from a file, a streaming service, etc. The noise compensator 102 may, for example, be configured to apply a gain adjustment algorithm, such as a frequency-dependent gain adjustment algorithm or a broadband gain adjustment algorithm (phase shift)*)**.**

Baek teaches a system a location based voice recognition service system using sensors and target device selection. Port teaches methods for classifying the environment sounds to determine the noise compensation for the output a sound system (*see Port, Fig. 6*). Using the known technique of noise compensation of the sound signal based on the environment sounds as taught by Port, to determine the optimal sound output in the voice assistant devices in the reference Baek, such as enhanced sound output would have been obvious to one of ordinary skill in the art.

Baek in view of Port teach the method of claim 1, however, to further compact prosecution, Mandel further teaches **dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device** (*see Mandel, col 12 lines 48-52 teaches using a GMM to update cluster locations (which is interpreted as to determine the cluster tracker may be configured to track one or more target*

sources and one or more noise sources))**; correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value** (*see Mandel, col 10 lines 45-56 teaches using the noise estimates from the cluster tracker 410 and using the post filter 414 and NPNS 408, appropriate processing of the masked frequency bands and adding the phase shifted signals are processed by frequency synthesis module 418*)**.**

Baek in view of Port teaches a system to determine the optimal sound output of the voice assistant device. Mandel teaches methods for noise reduction using Gaussian mixture models (*see Mandel, Fig. 5*). Using the known technique of noise reduction of the sound signal based on the Gaussian mixture models as taught by Mandel, to determine the optimal sound output in the voice assistant devices in the reference Baek in view of Port, such as enhanced sound output would have been obvious to one of ordinary skill in the art.

Regarding claim 2, Baek in view of Port further in view of Mandel teaches **the method of claim 1.** Port further teaches **wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters, wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output** (*see Port, [0025] In some examples, a noise compensation method corresponding to the at least one music content type may involve a first method corresponding to a lower frequency range and a second method corresponding to an upper frequency range*)**, and wherein a second set of acoustic parameters among the**

plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output(*see Port, [0063] In this example, the noise compensator 102 is configured to receive an audio signal 101 from a file, a streaming service, etc. The noise compensator 102 may, for example, be configured to apply a gain adjustment algorithm, such as a frequency-dependent gain adjustment algorithm or a broadband gain adjustment(intensity parameters) algorithm [0138] In some examples, the hybrid noise compensation method may be an average of a first set of frequency gains that the noise estimator 407 should apply for music and a second set of frequency gains that the noise estimator 407 should apply for movie content or television content*)**.** *The same motivation to combine as claim 1 applies here.*

Regarding claim 3, Baek in view of Port further in view of Mandel teaches **the method of claim 2.** Port further teaches **combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range** (*see Port, [0127] if the classifier 602 determines that the ambient sounds correspond to speech (e.g., speech corresponding to one or more persistent conversations in the audio environment), in some implementations the signals 603 that are output by the classifier 602 may indicate that the noise compensator 402 should duck (reduce the level of) the audio 101 such that the reproduced audio remains below the level of speech.*)**, and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters**(*see Port, [0128] if the classifier 602 determines that the environmental noise is music(second set of acoustic parameters), the signals 603 may indicate that the noise compensator 402 should disable noise compensation. Disabling a noise compensation process may ensure that the noise compensation*

implemented by the system 600 and the noise compensation implemented by another system that is reproducing the music are not each attempting to increase the level of reproduced music over that reproduced by the other system).

Regarding claim 4, Baek in view of Port further in view of Mandel teaches **the method of claim 2.** Mandel further teaches **wherein correcting the predicted optimal sound output comprises: selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value**(*see Mandel, col 10 lines 3-6 multi-feature cluster tracker 410 classifies points in the energy spectrum as being speech or noise based on these local clusters and observations (minimum parameter value)*)**; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device**(*see Mandel, col 9 lines 57- col 10 line 3 discusses the multi-feature estimating the classification of the acoustic features which performs interaural phase differences and other features*)**; generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device** (*see Mandel, col 10 lines 54-62 discusses the processing of the masked frequency sub-bands and adding the phase shifted signals or multiplying with inverse frequency of the sub-band filters to determine the differences between energy estimates of sub-band framed signals*)**; and outputting, by a rendering module, the generated new optimal sound from the target IoT device** (*see Mandel, col 10 lines 60-61 Once conversion is completed, the signal is output to a user via output device 206*)**.** *The same motivation to combine as claim 1 applies here.*

Regarding claim 6, Baek in view of Port further in view of Mandel teaches **the method**

of claim 4. Port further teaches **determining, by a processing module based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible**(*see Port, Fig. 8, 802, [0146, 0148, 0149] the noise compensation is adjusted according to the ambient noise and the output is according adjusted for 104(optimal sound is audible)*)**; and updating, by the processing module, settings of the voice assistance device based on the determined optimal region** (*see Port, [0169-0170] the "background music" noise compensation(for the optimal region) is determined based on the classification of the environmental noise*)**.**

Regarding claim 8, Baek in view of Port further in view of Mandel teaches **the method of claim 1.** Port further teaches **wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices** (*see Port, [0127-0129] the classifier determines the environmental noise and accordingly signals to the noise compensator to adjust the output sound*)**.**

Regarding claim 9, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 1 and is rejected under the same grounds stated above regarding claim 1.

Regarding claim 10, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 2 and is rejected under the same grounds stated above regarding claim 2.

Regarding claim 11, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 3 and is rejected under the same grounds stated above regarding claim 3.

Regarding claim 12, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 4 and is rejected under the same grounds stated above regarding claim 4.

Regarding claim 14, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 6 and is rejected under the same grounds stated above regarding claim 6.

Regarding claim 16, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 8 and is rejected under the same grounds stated above regarding claim 8.

3. **Claims 5 and 13 are rejected under 35 U.S.C. 103 as being unpatentable over Baek et. al, US PgPub. 2020/0072937(*cited in IDS*) in view of Port et. al. US PgPub. 2022/0406326 further in view of Mandel et. al. US Patent 9,008,329 further in view of Miyahara, US PgPub. 2013/0251079**.

Regarding claim 5, Baek in view of Port further in view of Mandel teaches **the method of claim 4.** Baek teaches **each cluster of the plurality of clusters includes at least one IoT device**(*see Baek, [0083] teaches the voice command receiving IoT devices*). However, Baek in view of Port further in view of Mandel fail to teach **wherein the phase of the predicted optimal sound output is shifted by 180.**

However, Miyahara teaches **wherein the phase of the predicted optimal sound output is shifted by 180** (*see Miyahara, [0037] discusses the phase shifts of the noisy signal based on*

the rotation amount to obtain the enhanced signal (Fig. 2).[0065] describes the rotation amount generation unit (interpreted for 180). Fig. 7 and Fig. 9 show the outputs based on phase rotation).

Baek in view of Port in view of Mandel teaches a system to determine the optimal sound output of the voice assistant device. Miyahara teaches methods for noise compensation using phase shifting (*see Miyahara, Fig. 2*). Using the known technique of noise compensation of the sound signal based on the phase shifting methods as taught by Miyahara, to enhance the sound output in the voice assistant devices in the reference Baek in view of Port in view of Mandel, would have been obvious to one of ordinary skill in the art.

Regarding claim 13, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 5 and is rejected under the same grounds stated above regarding claim 5.

4. **Claims 7 and 15 are rejected under 35 U.S.C. 103 as being unpatentable over Baek et. al, US PgPub. 2020/0072937(*cited in IDS*) in view of Port et. al. US PgPub. 2022/0406326 further in view of Mandel et. al. US Patent 9,008,329 further in view of Matsuoka et. al., US PgPub. 2016/0364963**.

Regarding claim 7, Baek in view of Port further in view of Mandel teaches **the method of claim 1.** Baek teaches **exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices**(*see Baek [0033] 1) A*

*sensor location determining unit 160 of the sensor network control device 100 may calculate a signal magnitude delivered to the sensor network 400 and the relative location of each device connected to the sensor network based on a beacon signal magnitude when a beacon is installed in one or more voice command receiving devices 210 and 220 among the voice command receiving devices on the sensor network 400. Alternatively, any one of the voice command receiving devices 210 and 220 includes a device that generates a specific signal, which serves as the beacon and the sensor location determining unit 160 may calculate the relative location of each of the voice command receiving devices 210 and 220 on the radio sensor network 400 by calculating a direction in which the specific signal reaches and the relative locations with the voice command receiving devices 210 and 220 serving as the beacon based on signal magnitudes received by other voice command receiving devices(IoT devices))***;***

However, Baek in view of Port further in view of Mandel fail to teach **pairing, by the pairing module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.**

However, Matsuoka teaches **exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices**(*see Matsuoka, [0054] describes the Hub device which has information on devices coupled to the hub*)**; pairing, by the**

pairing module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information(*see Matsuoka [0055] describes the hub device creating a mesh network and connecting the different devices*)**; and updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device** (*see Matsuoka, [0058] describes the smart home network 202 where the devices in the smart home environment regularly send out messages regarding what they are sensing, and the other low-powered nodes in the smart home environment—in addition to sending out their own messages—forward the messages, thereby causing the messages to travel from node to node (i.e., device to device) throughout the smart home network 202*).

Baek in view of Port in view of Mandel teaches a system to determine the optimal sound output of the voice assistant device. Matsuoka teaches methods for managing smart devices (*see Matsuoka, Fig. 2*). Using the known technique of smart devices management using smart home network as taught by Matsuoka, to manage the voice assistant devices in the reference Baek in view of Port in view of Mandel, would have been obvious to one of ordinary skill in the art.

Regarding claim 15, is directed to system(*see Baek, Fig. 2*) claim corresponding to the method claim presented in claim 7 and is rejected under the same grounds stated above regarding claim 7.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Soto, US PgPub. 2023/0385017 teaches a adjusting the volume of a playback media system based on proximity sensors and background noises (*see Soto, Fig. 11*).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NANDINI SUBRAMANI whose telephone number is (571)272-3916. The examiner can normally be reached Monday - Friday 12:00pm - 5:00 pm EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh M Mehta can be reached on (571)272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/NANDINI SUBRAMANI/
Examiner, Art Unit 2656

/DOUGLAS GODBOLD/
Primary Examiner, Art Unit 2655

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/084,081	Filing Date 12/19/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	16 minus 20 =	* 0		x $100 =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	* 0		x $480 =	0
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	0

APPLICATION AS AMENDED - PART II

AMENDMENT	01/15/2025	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 14	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/GERALDINE L STANLEY/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	18/084,081	Confirmation No.	:	3982
First Named Inventor	:	Abhinav GABA	TC/A.U.	:	2656
Filing or 371(c) Date	:	December 19, 2022	Examiner	:	Nandini SUBRAMANI
Title	:	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	Atty. Docket No.	:	0503-0636

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Sir:

In response to the Office Action dated November 19, 2024, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 9 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions and listing of the claims in the application.

Listing of Claims:

1. (Currently amended) A method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising:

identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;

determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises:

combining, by the correction module, a first set of acoustic parameters with a second set of acoustic parameters based on frequency bands of an audible range, and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein correcting the predicted optimal sound output comprises:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.

2. (Original) The method of claim 1,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, and

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

3. (Cancelled)

4. (Currently amended) The method of claim 2, wherein correcting the predicted optimal sound output further comprises:

~~selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value;~~

~~shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device;~~

~~generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device; and~~

outputting, by a rendering module, the generated new optimal sound from the target IoT device.

5. (Original) The method of claim 4,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

6. (Original) The method of claim 4, further comprising:

determining, by a processing module based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

updating, by the processing module, settings of the voice assistance device based on the determined optimal region.

7. (Original) The method of claim 1, further comprising:

exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pairing, by the pairing module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

8. (Original) The method of claim 1, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

9. (Currently amended) A system for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the system comprising:

a pairing module configured to identify and pair one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

a clustering module configured to:

divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device,

detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave, and

determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

a prediction module configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

a correction module configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value

corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein, to calculate the sound parameter value corresponding to each IoT device of the determined cluster, the correction module is further configured to:

combine a first set of acoustic parameters with a second set of acoustic parameters based on frequency bands of an audible range; and

calculate the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein to correct the predicted optimal sound output, the correction module is further configured to:

select, as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shift a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generate a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.

10. (Original) The system of claim 9,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, and

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output.

11. (Cancelled)

12. (Currently amended) The system of claim 10,

~~wherein to correct the predicted optimal sound output, the correction module is further configured to:~~

~~select, as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,~~

~~shift a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and~~

~~generate a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device, and~~

wherein the system further comprises a rendering module configured to output the generated new optimal sound from the target IoT device.

13. (Original) The system of claim 12,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

14. (Original) The system of claim 12, further comprising a processing module configured to:

determine, based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

update settings of the voice assistance device based on the determined optimal region.

15. (Original) The system of claim 9, wherein the pairing module is further configured to:

exchange, in a pairing mode, the information between the one or more IoT devices and the voice assistant device, the exchanged information including location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information

associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pair the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

update the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

16. (Original) The system of claim 9, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

REMARKS

I. Status of Claims

After the above amendments, claims 1, 2, 4-10, and 12-16 are pending, claims 1 and 9 being independent. By this Amendment, claims 1, 4, 9, and 12 are amended and claims 3 and 11 are cancelled without prejudice or disclaimer to the subject matter therein. No new matter has been added. Applicant reserves the right to pursue the original claims and other claims in this and other applications. In view of at least the following, reconsideration and allowance are respectfully requested.

II. Rejection of Claims 1-4, 6, 8-12, 14, and 16 Under 35 U.S.C. §103

Claims 1-4, 6, 8-12, 14, and 16 have been rejected under 35 U.S.C. §103 as obvious over U.S. Patent Application Publication No. 2020/0072937 to Baek et al. (hereinafter Baek) in view of U.S. Patent Application Publication No. 2022/0406326 to Port et al. (hereinafter Port), and further in view of U.S. Patent No. 9,008,329 to Mandel et al. (hereinafter Mandel). Applicant respectfully traverses these rejections.

It is well settled that in determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. See MPEP § 2141.02. To this end, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. See MPEP § 2141.02 VI.

To establish a prima facie case of obviousness, three basic criteria must be met: (1) there must be some suggestion or motivation to modify the reference or to combine reference teachings; (2) there must be reasonable expectation of success; and (3) the prior art reference must teach or suggest all the claim limitations. See MPEP § 2142.

MPEP 2142 states that "to reach a proper determination under 35 U.S.C. 103, the Examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of all factual information, the Examiner must then make a determination whether the claimed invention "as a whole" would have been obvious at that time to that person. Knowledge of applicant's disclosure must be put aside in

reaching this determination, yet kept in mind in order to determine the differences, conduct the search and evaluate the subject matter as a whole of the invention. The tendency to resort to "hindsight" based upon Applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art."

MPEP 2143.01 states that "if proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP 2143.01 further states that "if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious."

Independent Claims 1 and 9

Independent claim 1 recites,

> *1. (Currently amended) A method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising:*
>
> *identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;*
>
> *dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;*
>
> *detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;*
>
> *determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;*
>
> *predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and*
>
> *correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound*

parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises:

combining, by the correction module, a first set of acoustic parameters with a second set of acoustic parameters based on frequency bands of an audible range, and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein correcting the predicted optimal sound output comprises:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.

Claims 9, although different in scope from claim 1, contain similar limitations.

Applicant submits that the combination of Baek, Port, and Mandel fails to disclose or render obvious the presently claimed combination of features recited in independent claim 1.

Paragraphs [0025], [0026], [0081], [0084], [0091], [0042], [0052] and [0076] of Baek are reproduced below for convenience.

> [0025] In this case, when the user utters the voice, the sensor network control device 100 may verify whether contents of utterance is the voice command or contents irrelevant to the voice command receiving devices in the sensor network.
> [0026] Here, the voice command receiving devices 210 and 220 may mean all devices including sensors capable of inputting sound through a microphone. For example, various appliances such as a lighting switch, the TV or a refrigerator, and various devices and sensors including other microphones such as a mobile phone may all correspond to the voice command receiving devices.
> [0081] For example, the attribute information may include relative or absolute location information of the voice command receiving devices 210 and 220, information for functions, clustering information, an operation sequence of the functions, and a voice command history.

> [0084] The clustering information may mean information acquired by partitioning the indoor space, for example, may be indoor space information such as a main room, a bedroom, a living room, or the like.
> [0091] The target device learning unit 135 may be learned through, for example, methods including a support vector machine, a hidden Markov model, regression analysis, a neutral network, Naïve Bayes classification, and the like.
> [0042] Meanwhile, a user location calculating unit 150 of the sensor network control device 100 calculates the relative location of the user 300 by using a time difference of application (arrival) (TDOA) of a voice signal applied to a sensor (microphone) within each voice command receiving device and relative location information of each voice command receiving device (step S530).
> [0052] Those skilled in the art may calculate the relative location of each voice command receiving device on the sensor network 400 by using visible light, infrared rays, ultraviolet rays, and the like in addition to the sound, in addition to the aforementioned method.
> [0076] Referring back to FIG. 2, a target device selecting unit 130 of the sensor network control device 100 derives the voice command receiving device 220 as a target of the voice command by referring to the utterance direction range 230 and the location information of the user 300 while interpreting the voice command of the user 300 (step S550).

As reflected above, Baek merely describes the feature of "identifying the relative positions of each device, tracking the user's position and direction through the time difference when a voice command is received, and interpreting the command based on the user's position and direction in a situation where multiple devices including microphones are connected to a sensor network."

However, Baek fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Baek fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value

and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

Paragraphs [0065], [0127], [0128], [0129], [0131] and [0063] of Port are reproduced below for convenience.

> [0065] According to this example, the noise estimator 107 is a component that is configured to estimate the level of noise in an environment that includes the system 100. The noise estimator 107 may be configured to receive the microphone signals 106 and to calculate how much of the microphone signals 106 consist of noise and how much is due to the playback of the loudspeaker 104. The noise estimator 107 may, in some examples, include an echo canceller. However, in some implementations the noise estimator 107 may simply measure the noise when a signal corresponding with silence is sent to the loudspeaker 104. In this example, the noise estimator 107 is providing a noise estimate 108 to the noise compensator 102. The noise estimate 108 may be a broadband estimate or a spectral estimate of the noise, depending on the particular implementation. In this example, the noise compensator 102 is configured to adjust the level of the output of the loudspeaker 104 based upon the noise estimate 108.
>
> [0127] For example, if the classifier 602 determines that the ambient sounds correspond to speech (e.g., speech corresponding to one or more persistent conversations in the audio environment), in some implementations the signals 603 that are output by the classifier 602 may indicate that the noise compensator 402 should duck (reduce the level of) the audio 101 such that the reproduced audio remains below the level of speech. In some such examples, determining the noise compensation method may not be based on input content type. A more detailed example is described below with reference to FIG. 11.
>
> [0128] In some examples, if the classifier 602 determines that the environmental noise is music, the signals 603 may indicate that the noise compensator 402 should disable noise compensation. Disabling a noise compensation process may ensure that the noise compensation implemented by the system 600 and the noise compensation implemented by another system that is reproducing the music are not each attempting to increase the level of reproduced music over that reproduced by the other system.
>
> [0129] According to some examples, if the classifier 602 determines that the ambient noise is engine noise, blender noise, traffic noise, street noise, etc., the signals 603 may

> indicate that the noise compensator 402 should implement another type of noise compensation. In some such examples, the signals 603 may indicate that the noise compensator 402 should operate as described above with reference to the noise compensator 402 of FIG. 4.
> [0131] According to this example, the classifier 602 is configured to receive microphone signals 106 from the microphone 105. In some implementations, the classifier 602 is configured to receive the noise estimate 408 from the noise estimator 407. Based on one or both of these inputs, in this implementation the classifier 602 is configured to determine a type of ambient noise, which may also be referred to herein as environmental noise. In some implementations, the classifier 602 may be configured to determine the type of ambient noise by implementing one or more audio-based context awareness models. Some such implementations may use Mel-frequency cepstral coefficients and their derivatives as features, and hidden Markov models (HMMs) (e.g., continuous density HMMs) as acoustic models. In some implementations, the classifier 602 may be configured to determine the type of ambient noise by implementing a neural network that has been trained according to one or more audio-based context awareness models. Alternatively, or additionally, the noise estimator 407 may be configured to determine a type of ambient noise by one or more of the foregoing processes.

As reflected above, Port merely describes the feature of "compensating for noise by using a gain adjustment algorithm such as a frequency-dependent gain adjustment algorithm or a wideband gain adjustment algorithm" and "the signals 603 that are output by the classifier 602 may indicate that the noise compensator 402 should duck (reduce the level of) the audio 101 such that the reproduced audio remains below the level of speech".

However, Port fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Port fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction

module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

Paragraphs Col.9 lines 57~col.10, lines 3-6, Col. 10, lines 54-62 of Mandel are reproduced below for convenience.

> Col.9 lines 57~col.10, lines 3-6
> Multi-feature cluster tracker 410 may receive level differences between energy estimates of sub-band framed signals from feature module 406. Multi-feature cluster tracker 410 may determine a global summary of acoustic features based, at least in part, on acoustic features derived from an acoustic signal, as well as an instantaneous global classification based on a global running estimate and the global summary of acoustic features. The global running estimates may be updated and an instantaneous local classification derived based on at least the one or more acoustic features. Spectral energy classifications may then be determined based, at least in part, on the instantaneous local classification and the one or more acoustic features.
> In some embodiments, multi-feature cluster tracker 410 classifies points in the energy spectrum as being speech or noise based on these local clusters and observations.
> Col. 10, lines 54-62
> Next, the speech estimate is converted back into time domain from the sub-band domain by frequency synthesis module 418. The conversion may comprise taking the masked frequency sub-bands and adding together phase shifted signals of the sub-bands in a frequency synthesis module 418. Alternatively, the conversion may comprise taking the masked frequency sub-bands and multiplying these with an inverse frequency of the sub-band filters in the frequency synthesis module 418. Once conversion is completed, the signal is output to a user via output device 206.

As reflected above, Mandel merely describes "the speech estimate is converted back into time domain from the sub-band domain by frequency synthesis module 418. The conversion may comprise taking the masked frequency sub-bands and adding together phase shifted signals of the sub-bands in a frequency synthesis module 418".

However, Mandel fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the

correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Mandel fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

For at least these reasons, the combination of Baek, Port, and Mandel fails to teach or suggest, *inter alia*, "wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises: combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, wherein correcting the predicted optimal sound output comprises: selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited in independent claim 1, and as similarly recited in independent claim 9.

Therefore, the applied references fail to disclose or render obvious the above-identified claim features recited in the independent claims. As such, the rejections of claims 1 and 9 under 35 U.S.C. § 103 are improper.

Accordingly, withdrawal of the rejections is respectfully requested.

Dependent Claims 2, 4, 6, 8, 10, 12, 14, and 16

Claims 2, 4, 6, 8, 10, 12, 14, and 16 variously depend from independent claims 1 and 9. Because the applied references fail to disclose or render obvious the features presently recited in independent claims 1 and 9, dependent claims 2, 4, 6, 8, 10, 12, 14, and 16 are patentable for at least the reasons that independent claims 1 and 9 are patentable, as well as for the additional features recited therein. Accordingly, withdrawal of the rejections is respectfully requested.

Dependent Claims 3 and 11

By this Amendment, claims 3 and 11 are cancelled. Thus, the rejections as to claims 3 and 11 are moot. Accordingly, withdrawal of the rejections is respectfully requested.

III. Rejection of Claims 5, 7, 13, and 15 Under 35 U.S.C. §103

Claims 5 and 13 have been rejected under 35 U.S.C. §103 as obvious over Baek in view of Port and Mandel, and further in view of U.S. Patent Application Publication No. 2013/0251079 to Miyahara (hereinafter Miyahara). Claims 7 and 15 have been rejected under 35 U.S.C. §103 as obvious over Baek in view of Port and Mandel, and further in view of U.S. Patent Application Publication No. 2016/0364963 to Matsuoka et al. (hereinafter Matsuoka). Applicant respectfully traverse theses rejections.

Applicant submits that the combination of Baek, Port, and Mandel fails to disclose or render obvious the presently claimed combination of features recited in independent claims 1 and 9, as discussed above.

Applicant submits that Miyahara and Matsuoka fail to cure the above noted deficiencies of the combination of Baek, Port, and Mandel, as applied against independent claims 1 and 9, nor does the Examiner assert as much.

Dependent Claims 5, 7, 13, and 15

Claims 5, 7, 13, and 15 variously depend from independent claims 1 and 9. Because the applied references fail to disclose or render obvious the features presently recited in independent claims 1 and 9, dependent claims 5, 7, 13, and 15 are patentable

for at least the reasons that claims 1 and 9 are patentable, as well as for the additional features recited therein.

Accordingly, withdrawal of the rejections is respectfully requested.

IV. Conclusion

In view of the foregoing, it is respectfully submitted that the present application is in condition for allowance, and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed telephone number, in order to expedite resolution of any issues and to expedite passage of the present application to issue, if any comments, questions, or suggestions arise in connection with the present application.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made.

It is believed that no additional fees are due in connection with the filing of this paper. However, please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-4100, and please credit any excess fees to the same deposit account.

Respectfully submitted,

Date: January 15, 2025

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/084,081	**01/15/2025 04:03:34 PM Z ET**	**0503-0636**

Title of Invention

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3982	FILED BY	Ji-heun Suh
PATENT CENTER #	68755913	FILING DATE	12/19/2022
CUSTOMER #	68103	FIRST NAMED INVENTOR	Abhinav GABA
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Maeng-Ho SHIN

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
0503-0636AmendmentAsFiled01-15-2025.pdf		18	-	212 KB
0503-0636AmendmentAsFiled01-15-2025-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	80 KB
0503-0636AmendmentAsFiled01-15-2025-CLM.pdf	(2-8)	7	Claims	114 KB
0503-0636AmendmentAsFiled01-15-2025-REM.pdf	(9-18)	10	Applicant Arguments/Remarks Made in an Amendment	172 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0503-0636AmendmentAsFiled01-15-2025.pdf	D40F46C2B511B6EE33D1B3411F6A78DFD178F634727C13D89D306F2BAF7511D7B95A48D54242A95C4EB21C3E30917B1054DDF05247C3E12CB6357B143415A074
0503-0636AmendmentAsFiled01-15-2025-A....pdf	BCFD181886D2B4F5EC355340D447E56153EED0ED892F9FBA01DE2DD9E93018E0D16D6C14937800D26ECFFF2912201FC020F0C0DE953A2F0069233DF2E7F23FE5
0503-0636AmendmentAsFiled01-15-2025-CLM.pdf	6334F3A96E53F235D6933FC344BF76F460F5120EDF118563158864ACBBD63EC033EE1CE326EB3C15436C2EBAEE7CAEEB1BEF85ADD5095B2C32B51C130959B76E
0503-0636AmendmentAsFiled01-15-2025-REM.pdf	22F6344218894398A312D48AD2112DBEE2487256E3C590E0AB3D6C9B66C824F22FBC3DEF8D92F4242A58D875E749C827C9808B5F357AE021FB235BCB87360677

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/084,081	Filing Date 12/19/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/03/2025	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0		x $200 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $600 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/AMANDA CHRISTINE LEMUS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/084,081	**03/03/2025 12:59:12 PM Z ET**	**0503-0636**

Title of Invention

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3982	FILED BY	Jung Park
PATENT CENTER #	69409496	FILING DATE	12/19/2022
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Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
0503-0636SupplementalAmendmentAsFiled03-03-2025.pdf		18	-	199 KB
0503-0636SupplementalAmendmentAsFiled03-03-2025-SA...pdf	(1-1)	1	Supplemental Response or Supplemental Amendment	80 KB
0503-0636SupplementalAmendmentAsFiled03-03-2025-CLM.pdf	(2-7)	6	Claims	108 KB
0503-0636SupplementalAmendm	(8-18)	11	Applicant Arguments/Remarks Made in an Amendment	165 KB

entAsFiled03-03-2025-REM.pdf

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0503-0636SupplementalAmendmentAsFiled03-03-2025.pdf	2BF1BD395B1C2778C826451CBD6A6084406281163B2976583D89C85F49DD5D4C785E0012EC13641318F89D0F852789207F9A4F6B78AAE803C04A7505496C3A80
0503-0636SupplementalAmendmentAsFiled03-03-2025-SA...pdf	F1DD94318CB337BE869E6D3E935C0B4A75FF3549011A91CF8AC512E71DBC340BA94B50AEA7D3DAAC36E2402BCE3AC637C8B9D082D1E42E7BB76CF08F20252CEB
0503-0636SupplementalAmendmentAsFiled03-03-2025-CLM.pdf	87FAFE35BB25DD7B0B646139A558D07CCCFE68C711B107650A32F2E122FF3532309222AE308D22A77949F5301DD22FD18B6C39D5E75621CB301C80A01450682F
0503-0636SupplementalAmendmentAsFiled03-03-2025-REM.pdf	73A1C9F09DFA609827DECAB09D45AFCC8D5CB7830DEA529DD0EBB7327C5F064333D293059814556377 32E24ABE9A86ED91EBD2C8CC79232498141C78B39AE3A5

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	18/084,081	Confirmation No.	:	3982
First Named Inventor	:	Abhinav GABA	TC/A.U.	:	2656
Filing or 371(c) Date	:	December 19, 2022	Examiner	:	Nandini SUBRAMANI
Title	:	A METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT	Atty. Docket No.	:	0503-0636

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL AMENDMENT

Sir:

In response to the Office Action dated November 19, 2024, and as a supplement to the Amendment dated January 15, 2025, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 8 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions and listing of the claims in the application.

Listing of Claims:

1. (Currently amended) A method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising:

identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;

determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level,

maximum frequency level, and mean frequency level of the predicted optimal sound output,

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output,

wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises:

combining, by the correction module, ~~a~~ the first set of acoustic parameters with ~~a~~ the second set of acoustic parameters based on frequency bands of an audible range, and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein correcting the predicted optimal sound output comprises:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.

2. - 3. (Cancelled)

4. (Currently amended) The method of claim ~~2~~ 1, wherein correcting the predicted optimal sound output further comprises:

outputting, by a rendering module, the generated new optimal sound from the target IoT device.

5. (Original) The method of claim 4,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

6. (Original) The method of claim 4, further comprising:

determining, by a processing module based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

updating, by the processing module, settings of the voice assistance device based on the determined optimal region.

7. (Original) The method of claim 1, further comprising:

exchanging, by the pairing module in a pairing mode, the information between the one or more IoT devices and the voice assistant device, wherein the exchanged information includes location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pairing, by the pairing module, the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

updating, by the pairing module, the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

8. (Original) The method of claim 1, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

9. (Currently amended) A system for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the system comprising:

a pairing module configured to identify and pair one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;

a clustering module configured to:

divide, using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device,

detect a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave, and

determine a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

a prediction module configured to predict, using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

a correction module configured to correct the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, and

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output,

wherein, to calculate the sound parameter value corresponding to each IoT device of the determined cluster, the correction module is further configured to:

combine ~~a~~ the first set of acoustic parameters with ~~a~~ the second set of acoustic parameters based on frequency bands of an audible range; and

calculate the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein to correct the predicted optimal sound output, the correction module is further configured to:

select, as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shift a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

generate a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.

10. - 11. (Cancelled)

12. (Currently amended) The system of claim ~~10~~ 9,

wherein the system further comprises a rendering module configured to output the generated new optimal sound from the target IoT device.

13. (Original) The system of claim 12,

wherein each cluster of the plurality of clusters includes at least one IoT device, and

wherein the phase of the predicted optimal sound output is shifted by 180°.

14. (Original) The system of claim 12, further comprising a processing module configured to:

determine, based on the corrected optimal sound output of the voice assistance device, an optimal region in the determined cluster or around the determined cluster where the generated new optimal sound is audible; and

update settings of the voice assistance device based on the determined optimal region.

15. (Original) The system of claim 9, wherein the pairing module is further configured to:

exchange, in a pairing mode, the information between the one or more IoT devices and the voice assistant device, the exchanged information including location information of the one or more IoT devices, information associated with environmental noise around each IoT device of the one or more IoT devices, and the information associated with a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices;

pair the one or more IoT devices with the voice assistant device in the IoT based communication environment based on the exchanged information; and

update the exchanged information periodically based on a change in connection states of the one or more IoT devices with the voice assistant device.

16. (Original) The system of claim 9, wherein the sound information data includes at least one of information corresponding to a current sound output of the voice assistant device, information corresponding to environmental noise associated with the determined cluster, or information corresponding to a perceived sound of the voice assistant device at each IoT device of the one or more IoT devices.

REMARKS

I. Status of Claims

The above amendments are a supplement to the Amendment dated January 15, 2025. In the Amendment dated January 15, 2025, claims 1, 4, 9, and 12 were amended. Applicant presumes the Amendment dated January 15, 2025 has been entered and hereby submits the present supplemental amendment accordingly.

After the above amendments, claims 1, 4-9, and 12-16 are pending, claims 1 and 9 being independent. Claims 3 and 11 were previously cancelled. By this amendment, claims 1, 4, 9, and 12 are amended and claims 2 and 10 are cancelled without prejudice or disclaimer to the subject matter therein. No new matter has been added. Applicant reserves the right to pursue the original claims and other claims in this and other applications. In view of at least the following, reconsideration and allowance are respectfully requested.

II. Interview Summary

Applicant appreciates the courtesies shown to Applicant's representative by Examiner Subramani in the February 27, 2025 interview. During the Interview, the subject matter of the independent claims was discussed, and the Examiner suggested various clarifying amendments to place the application in better form for further prosecution.

III. Rejection of Claims 1-4, 6, 8-12, 14, and 16 Under 35 U.S.C. §103

Claims 1-4, 6, 8-12, 14, and 16 have been rejected under 35 U.S.C. §103 as obvious over U.S. Patent Application Publication No. 2020/0072937 to Baek et al. (hereinafter Baek) in view of U.S. Patent Application Publication No. 2022/0406326 to Port et al. (hereinafter Port), and further in view of U.S. Patent No. 9,008,329 to Mandel et al. (hereinafter Mandel). Applicant respectfully traverses these rejections.

It is well settled that in determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. See MPEP § 2141.02. To this end, a prior art reference must be

considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. See MPEP § 2141.02 VI.

To establish a prima facie case of obviousness, three basic criteria must be met: (1) there must be some suggestion or motivation to modify the reference or to combine reference teachings; (2) there must be reasonable expectation of success; and (3) the prior art reference must teach or suggest all the claim limitations. See MPEP § 2142.

MPEP 2142 states that "to reach a proper determination under 35 U.S.C. 103, the Examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of all factual information, the Examiner must then make a determination whether the claimed invention "as a whole" would have been obvious at that time to that person. Knowledge of applicant's disclosure must be put aside in reaching this determination, yet kept in mind in order to determine the differences, conduct the search and evaluate the subject matter as a whole of the invention. The tendency to resort to "hindsight" based upon Applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art."

MPEP 2143.01 states that "if proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP 2143.01 further states that "if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious."

Independent Claims 1 and 9

Independent claim 1 recites,

> *1. (Currently amended) A method for mitigating unwanted audio noise in an Internet of things (IoT) based communication environment, the method comprising:*
>
> *identifying and pairing, by a pairing module, one or more IoT devices with a voice assistant device in the IoT based communication environment based on an exchange of information between the one or more IoT devices and the voice assistant device;*

dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

detecting, by the clustering module, a user's location with respect to a location of the voice assistant device based on at least one of sensors data associated with the one or more IoT devices or a time difference between an ultrasonic wave transmitted by the voice assistance device and an echo signal reflected from the user's body in response to the transmitted ultrasonic wave;

determining, by the clustering module, a cluster among the plurality of clusters corresponding to the user's location based on the detected user's location;

predicting, by a prediction module using a recurrent neural networks (RNN) model, an optimal sound output of the voice assistance device that is audible at the detected user's location based on sound information data; and

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each IoT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters,

wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output,

wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output,

wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises:

combining, by the correction module, ~~a~~ the first set of acoustic parameters with ~~a~~ the second set of acoustic parameters based on frequency bands of an audible range, and

calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein correcting the predicted optimal sound output comprises:

selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value,

shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and

> *generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device.*

Claims 9, although different in scope from claim 1, contain similar limitations.

Applicant submits that the combination of Baek, Port, and Mandel fails to disclose or render obvious the presently claimed combination of features recited in independent claim 1.

Paragraphs [0025], [0026], [0081], [0084], [0091], [0042], [0052] and [0076] of Baek are reproduced below for convenience.

> [0025] In this case, when the user utters the voice, the sensor network control device 100 may verify whether contents of utterance is the voice command or contents irrelevant to the voice command receiving devices in the sensor network.
> [0026] Here, the voice command receiving devices 210 and 220 may mean all devices including sensors capable of inputting sound through a microphone. For example, various appliances such as a lighting switch, the TV or a refrigerator, and various devices and sensors including other microphones such as a mobile phone may all correspond to the voice command receiving devices.
> [0081] For example, the attribute information may include relative or absolute location information of the voice command receiving devices 210 and 220, information for functions, clustering information, an operation sequence of the functions, and a voice command history.
> [0084] The clustering information may mean information acquired by partitioning the indoor space, for example, may be indoor space information such as a main room, a bedroom, a living room, or the like.
> [0091] The target device learning unit 135 may be learned through, for example, methods including a support vector machine, a hidden Markov model, regression analysis, a neutral network, Naïve Bayes classification, and the like.
> [0042] Meanwhile, a user location calculating unit 150 of the sensor network control device 100 calculates the relative location of the user 300 by using a time difference of application (arrival) (TDOA) of a voice signal applied to a sensor (microphone) within each voice command receiving device and relative location information of each voice command receiving device (step S530).
> [0052] Those skilled in the art may calculate the relative location of each voice command receiving device on the sensor network 400 by using visible light, infrared rays,

> ultraviolet rays, and the like in addition to the sound, in addition to the aforementioned method.
> [0076] Referring back to FIG. 2, a target device selecting unit 130 of the sensor network control device 100 derives the voice command receiving device 220 as a target of the voice command by referring to the utterance direction range 230 and the location information of the user 300 while interpreting the voice command of the user 300 (step S550).

As reflected above, Baek merely describes the feature of "identifying the relative positions of each device, tracking the user's position and direction through the time difference when a voice command is received, and interpreting the command based on the user's position and direction in a situation where multiple devices including microphones are connected to a sensor network."

However, Baek fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Baek fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

Paragraphs [0065], [0127], [0128], [0129], [0131] and [0063] of Port are reproduced below for convenience.

> [0065] According to this example, the noise estimator 107 is a component that is configured to estimate the level of noise in an environment that includes the system 100. The noise estimator 107 may be configured to receive the microphone signals 106 and to calculate how much of the microphone signals 106 consist of noise and how much is due to the playback of the loudspeaker 104. The noise estimator 107 may, in some examples, include an echo canceller. However, in some implementations the noise estimator 107 may simply

measure the noise when a signal corresponding with silence is sent to the loudspeaker 104. In this example, the noise estimator 107 is providing a noise estimate 108 to the noise compensator 102. The noise estimate 108 may be a broadband estimate or a spectral estimate of the noise, depending on the particular implementation. In this example, the noise compensator 102 is configured to adjust the level of the output of the loudspeaker 104 based upon the noise estimate 108.

[0127] For example, if the classifier 602 determines that the ambient sounds correspond to speech (e.g., speech corresponding to one or more persistent conversations in the audio environment), in some implementations the signals 603 that are output by the classifier 602 may indicate that the noise compensator 402 should duck (reduce the level of) the audio 101 such that the reproduced audio remains below the level of speech. In some such examples, determining the noise compensation method may not be based on input content type. A more detailed example is described below with reference to FIG. 11.

[0128] In some examples, if the classifier 602 determines that the environmental noise is music, the signals 603 may indicate that the noise compensator 402 should disable noise compensation. Disabling a noise compensation process may ensure that the noise compensation implemented by the system 600 and the noise compensation implemented by another system that is reproducing the music are not each attempting to increase the level of reproduced music over that reproduced by the other system.

[0129] According to some examples, if the classifier 602 determines that the ambient noise is engine noise, blender noise, traffic noise, street noise, etc., the signals 603 may indicate that the noise compensator 402 should implement another type of noise compensation. In some such examples, the signals 603 may indicate that the noise compensator 402 should operate as described above with reference to the noise compensator 402 of FIG. 4.

[0131] According to this example, the classifier 602 is configured to receive microphone signals 106 from the microphone 105. In some implementations, the classifier 602 is configured to receive the noise estimate 408 from the noise estimator 407. Based on one or both of these inputs, in this implementation the classifier 602 is configured to determine a type of ambient noise, which may also be referred to herein as environmental noise. In some implementations, the classifier 602 may be configured to determine the type of ambient noise by implementing one or more audio-based context awareness models. Some such implementations may use Mel-frequency cepstral coefficients and their derivatives as features, and hidden Markov models (HMMs) (e.g., continuous density

> HMMs) as acoustic models. In some implementations, the classifier 602 may be configured to determine the type of ambient noise by implementing a neural network that has been trained according to one or more audio-based context awareness models. Alternatively, or additionally, the noise estimator 407 may be configured to determine a type of ambient noise by one or more of the foregoing processes.

As reflected above, Port merely describes the feature of "compensating for noise by using a gain adjustment algorithm such as a frequency-dependent gain adjustment algorithm or a wideband gain adjustment algorithm" and "the signals 603 that are output by the classifier 602 may indicate that the noise compensator 402 should duck (reduce the level of) the audio 101 such that the reproduced audio remains below the level of speech".

However, Port fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Port fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

Paragraphs Col.9 lines 57~col.10, lines 3-6, Col. 10, lines 54-62 of Mandel are reproduced below for convenience.

> Col.9 lines 57~col.10, lines 3-6
> Multi-feature cluster tracker 410 may receive level differences between energy estimates of sub-band framed signals from feature module 406. Multi-feature cluster tracker 410 may determine a global summary of acoustic features based, at least in part, on acoustic features derived from an acoustic signal, as well as an instantaneous global classification based on a global running estimate and the global summary of acoustic features. The global running estimates may be updated and an instantaneous local classification derived

> based on at least the one or more acoustic features. Spectral energy classifications may then be determined based, at least in part, on the instantaneous local classification and the one or more acoustic features.
> In some embodiments, multi-feature cluster tracker 410 classifies points in the energy spectrum as being speech or noise based on these local clusters and observations.
> Col. 10, lines 54-62
> Next, the speech estimate is converted back into time domain from the sub-band domain by frequency synthesis module 418. The conversion may comprise taking the masked frequency sub-bands and adding together phase shifted signals of the sub-bands in a frequency synthesis module 418. Alternatively, the conversion may comprise taking the masked frequency sub-bands and multiplying these with an inverse frequency of the sub-band filters in the frequency synthesis module 418. Once conversion is completed, the signal is output to a user via output device 206.

As reflected above, Mandel merely describes "the speech estimate is converted back into time domain from the sub-band domain by frequency synthesis module 418. The conversion may comprise taking the masked frequency sub-bands and adding together phase shifted signals of the sub-bands in a frequency synthesis module 418".

However, Mandel fails to disclose or render obvious "combining, by the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters," as presently recited.

Additionally, Mandel fails to disclose or render obvious "selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited.

For at least these reasons, the combination of Baek, Port, and Mandel fails to teach or suggest, *inter alia*, "wherein calculating the sound parameter value corresponding to each IoT device of the determined cluster comprises: combining, by

the correction module, the first set of acoustic parameters with the second set of acoustic parameters based on frequency bands of an audible range; and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, wherein correcting the predicted optimal sound output comprises: selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value; shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device; and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device." as presently recited in independent claim 1, and as similarly recited in independent claim 9.

Therefore, the applied references fail to disclose or render obvious the above-identified claim features recited in the independent claims. As such, the rejections of claims 1 and 9 under 35 U.S.C. § 103 are improper.

Accordingly, withdrawal of the rejections is respectfully requested.

Dependent Claims 4, 6, 8, 12, 14, and 16

Claims 4, 6, 8, 12, 14, and 16 variously depend from independent claims 1 and 9. Because the applied references fail to disclose or render obvious the features presently recited in independent claims 1 and 9, dependent claims 4, 6, 8, 12, 14, and 16 are patentable for at least the reasons that independent claims 1 and 9 are patentable, as well as for the additional features recited therein. Accordingly, withdrawal of the rejections is respectfully requested.

Dependent Claims 2-3, and 10-11

By this Amendment, claims 2-3, and 10-11 are cancelled. Thus, the rejections as to claims 2-3, and 10-11 are moot. Accordingly, withdrawal of the rejections is respectfully requested.

IV. Rejection of Claims 5, 7, 13, and 15 Under 35 U.S.C. §103

Claims 5 and 13 have been rejected under 35 U.S.C. §103 as obvious over Baek in view of Port and Mandel, and further in view of U.S. Patent Application Publication No. 2013/0251079 to Miyahara (hereinafter Miyahara). Claims 7 and 15 have been rejected under 35 U.S.C. §103 as obvious over Baek in view of Port and Mandel, and further in view of U.S. Patent Application Publication No. 2016/0364963 to Matsuoka et al. (hereinafter Matsuoka). Applicant respectfully traverse theses rejections.

Applicant submits that the combination of Baek, Port, and Mandel fails to disclose or render obvious the presently claimed combination of features recited in independent claims 1 and 9, as discussed above.

Applicant submits that Miyahara and Matsuoka fail to cure the above noted deficiencies of the combination of Baek, Port, and Mandel, as applied against independent claims 1 and 9, nor does the Examiner assert as much.

Dependent Claims 5, 7, 13, and 15

Claims 5, 7, 13, and 15 variously depend from independent claims 1 and 9. Because the applied references fail to disclose or render obvious the features presently recited in independent claims 1 and 9, dependent claims 5, 7, 13, and 15 are patentable for at least the reasons that claims 1 and 9 are patentable, as well as for the additional features recited therein.

Accordingly, withdrawal of the rejections is respectfully requested.

V. Conclusion

In view of the foregoing, it is respectfully submitted that the present application is in condition for allowance, and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed telephone number, in order to expedite resolution of any issues and to expedite passage of the present application to issue, if any comments, questions, or suggestions arise in connection with the present application.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made.

It is believed that no additional fees are due in connection with the filing of this paper. However, please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-4100, and please credit any excess fees to the same deposit account.

Respectfully submitted,

Date: March 3, 2025

/James G. POHLMAN/
James G Pohlman
Reg. No. 68,921
Representative for Applicant(s)

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, D.C. 20036
Main: (202) 293-0804
Direct: (202) 293-1766

Examiner-Initiated Interview Summary	**Application No.** 18/084,081	**Applicant(s)** GABA et al.		
	Examiner NANDINI SUBRAMANI	**Art Unit** 2656	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
NANDINI SUBRAMANI	Examiner	Telephonic
Pohlman, James Reg. No.68921	Attorney of Record	

Date of Interview: 27 February 2025

Issues Discussed:

35 U.S.C. 112

Discussed the 112(b) indefinite issues due to a first set of acoustic parameters and a second set of acoustic parameters in claims 2 and 10 respectively. Discussed amendment to include claim 2 and 10 in the respective independent for further processing. No agreement was reached.

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Notice of References Cited	Application/Control No. 18/084,081	Applicant(s)/Patent Under Reexamination GABA et al.	
	Examiner NANDINI SUBRAMANI	Art Unit 2656	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-20130251079-A1	2013-09-26	Miyahara; Ryoji	G10L21/0208	375/346
*	B	US-9008329-B1	2015-04-14	Mandel; Michael	G10K15/00	704/226
*	C	US-20160364963-A1	2016-12-15	Matsuoka; Yoky	G06V10/764	1/1
*	D	US-20200072937-A1	2020-03-05	BAEK; Seungmin	H04R1/406	1/1
*	E	US-20220406326-A1	2022-12-22	PORT; Timothy Alan	H04S7/305	1/1
*	F	US-20230385017-A1	2023-11-30	Soto; Kurt Thomas	G06F3/165	1/1
*	G	US-12243548-B2	2025-03-04	Jancovich; Benjamin Alexander	G06F3/165	1/1
*	H	US-10506341-B2	2019-12-10	Bromwich; Matthew	H03G3/32	1/1
*	I	US-9706296-B2	2017-07-11	Uhle; Christian	G10K11/17837	1/1
*	J	US-9391579-B2	2016-07-12	Walsh; Martin	H03G9/005	1/1
*	K	US-8082051-B2	2011-12-20	Mihelich; Ryan J.	H04S7/307	381/303
*	L	US-11900016-B2	2024-02-13	Denton; Levaughn	H04R27/00	1/1
*	M	US-10728662-B2	2020-07-28	Davis; Ian	H04R3/04	1/1

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	**Art Unit**
	NANDINI SUBRAMANI	2656

CPC						
Symbol					**Type**	**Version**
G10L	/	25	/	30	F	2013-01-01
G10L	/	21	/	0208	I	2013-01-01
G10L	/	2021	/	02082	A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656 (Assistant Examiner)	05 March 2025 (Date)	**Total Claims Allowed:** 12	
/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656 (Primary Examiner)	05 March 2025 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2 and 7

U.S. Patent and Trademark Office — Part of Paper No.: 20250305

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	**Art Unit**
	NANDINI SUBRAMANI	2656

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G10L25/30	/	25	/	30	
G10L21/0208	/	21	/	0208	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	05 March 2025	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	12	
/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656	05 March 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2 and 7

U.S. Patent and Trademark Office — Part of Paper No.: 20250305

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	**Art Unit**
	NANDINI SUBRAMANI	2656

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10												
	2		11												
	3	8	12												
2	4	9	13												
3	5	10	14												
4	6	11	15												
5	7	12	16												
6	8														
7	9														

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656 (Assistant Examiner)	05 March 2025 (Date)	**Total Claims Allowed:** 12	
/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656 (Primary Examiner)	05 March 2025 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2 and 7

U.S. Patent and Trademark Office Part of Paper No.: 20250305

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	Art Unit
	NANDINI SUBRAMANI	2656

CPC - Searched*		
Symbol	Date	Examiner
G10L25/30 G10L21/0208 G10L2021/02082	11/13/2024	NS
G10L25/30 G10L21/0208 G10L2021/02082	03/05/2025	NS

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
G10L25/30 G10L21/0208 G10L2021/02082 with text search	11/13/2024	NS
Inventors/assignee/applicants searched with text search	11/13/2024	NS
Consulted with PE Doug Godbold	11/13/2024	NS
PE2E search, ip.com search used with search	11/13/2024	NS
G10L25/30 G10L21/0208 G10L2021/02082 with text search	03/05/2025	NS
Inventors/assignee/applicants searched with text search	03/05/2025	NS
Consulted with SPE Bhavesh Mehta	03/05/2025	NS
PE2E search, ip.com search used with search	03/05/2025	NS

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/NANDINI SUBRAMANI/ Examiner, Art Unit 2656

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/084,081	GABA et al.
	Examiner	Art Unit
	NANDINI SUBRAMANI	2656

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	In all SEARCH PE2E interference databases (U.S. Patents; U.S. PG Publications), text search for claimed subject matter. Refer to search history printout for text string.	03/05/2025	NS

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/NANDINI SUBRAMANI/ Examiner, Art Unit 2656

Bibliographic Data

Application No: 18/084,081

Foreign Priority claimed: (●) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [ ] Met After Allowance

Verified and Acknowledged: /NANDINI SUBRAMANI/ Examiner's Signature [ ] Initials

Title: METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/19/2022	704	2656	0503-0636
RULE			

APPLICANTS

Samsung Electronics Co., Ltd.,

INVENTORS

Abhinav GABA, Noida, INDIA

Akul TANEJA, Noida, INDIA

Deepak SHARMA, Noida, INDIA

Raja SINGHAL, Noida, INDIA

CONTINUING DATA

FOREIGN APPLICATIONS

INDIA IN202111061923 12/30/2021

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/10/2023

STATE OR COUNTRY

INDIA

ADDRESS

Jefferson IP Law, LLP

1130 Connecticut Ave., NW, Suite 420

Washington, DC 20036

UNITED STATES

FILING FEE RECEIVED

$1,820

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L50	4	(US-20200072937-$ | US-20220406326-$ | US-20230385017-$ | US-9008329-$).DID.	(US-PGPUB; USPAT)	OR	ON	ON	2025/02/27 11:17 AM
L51	5	("11581862" "9960743" "9980043" "9391579" "11817114").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/02/27 12:38 PM
L52	1	KR-100718423-$.did.	(US-PGPUB; USPAT; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DK, EA, EE, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2025/02/27 12:38 PM
L53	6	("9980043" "8620672" "20240221769" "9706296" "8693717" "7840012").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/02/27 01:09 PM
L54	186	audio AND (volume intensity) near3 compensa$5 AND range near2 frequenc$4 AND frequenc$4 WITH cancel$5	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:15 AM
L55	186	audio AND ((volume intensity) near3 compensa$5) AND ((range near2 frequenc$4) AND (frequenc$4 WITH cancel$5))	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:15 AM
L56	10341	L18	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:17 AM
L57	254296	L1	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:17 AM
L58	330	L2	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:17 AM
L59	265	audio AND ((volume intensity) near3 compensa$5) AND ((range near2 frequenc$4) AND (phase near3 shift$4))	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:19 AM

L60	265	(audio AND ((volume intensity) near3 compensa$5)) AND ((range near2 frequenc$4) AND (phase near3 shift$4))	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:20 AM
L61	8	("10506341" "20130148822" "7302062" "9391579" "8082051" "12243548" "11750997" "9706296").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 11:50 AM
L62	2	("10728662" "11900016").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 12:08 PM
L63	3	((US-12243548-B2 OR US-10506341-B2 OR US-8082051-B2).did. AND USPT.dbnm.)	(USPAT)	OR	ON	ON	2025/03/05 12:33 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	41	noise near3 compensation AND phase near3 shift AND G10L21/0208.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:12 AM
N2	202	noise near3 identif$6 AND virtual near3 assistant AND volume near3 control	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:12 AM
N3	50	noise near3 filter$7 AND virtual near3 assistant near3 output	(US-PGPUB; USPAT)	AND	ON	ON	2025/03/05 10:12 AM
N4	1	L32 AND gauss$4	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:13 AM
N5	186	audio AND ((volume intensity) near3 compensa$5) AND ((range near2 frequenc$4) AND (frequenc$4 WITH cancel$5))	(US-PGPUB; USPAT)	OR	ON	ON	2025/03/05 10:16 AM

Content: Patent Publications (7)

US Patents | US Designs | US Applications | EPO Patents | Japan Patents | Korea Patents | WIPO Applications

1 **2025-02-27 17:10 UTC | ~13,170,128 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
audio volume compensation based on calculating the range of frequencies of the environment devices

Concept Modifiers: None

Filters: None

2 **2025-02-27 17:50 UTC | ~13,171,409 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
audio volume compensation based on calculating the range of frequencies of the environment devices and cancellation of certain frequencies of environment devices

Concept Modifiers: None

Filters: None

3 **2025-03-05 16:16 UTC | ~9,729,201 results from**

De-Dup: Simple Family Numbers | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
audio volume compensation based on calculating the range of frequencies of the environment devices and phase shifting of certain frequencies of predicted output audio to maximize the audio volume

Concept Modifiers: None

Filters: None

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

68103 7590 03/18/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

EXAMINER
SUBRAMANI, NANDINI

ART UNIT	PAPER NUMBER
2656	

DATE MAILED: 03/18/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

TITLE OF INVENTION: METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/18/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

68103 7590 03/18/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

TITLE OF INVENTION: METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/18/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
SUBRAMANI, NANDINI	2656	704-202000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

68103 7590 03/18/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

EXAMINER	
SUBRAMANI, NANDINI	
ART UNIT	PAPER NUMBER
2656	

DATE MAILED: 03/18/2025

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/ owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

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4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
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6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
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10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/084,081	Applicant(s) GABA et al.	
	Examiner NANDINI SUBRAMANI	Art Unit 2656	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 1/15/2025 and 3/3/2025.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1,4-9 and 12-16 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656

DETAILED ACTION

Introduction

1. This office action is in response to Applicant' s submission filed on 01/05/2025 and 03/03/2035 in response to the Office Action mailed on 11/19/2024. Claims 1, 4-9 and 12-16 are pending in the application. As such, claims 1, 4-9 and 12-16 have been reconsidered and examined.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Amendment and Arguments

2. Claims 2-3 and 10-11 have been cancelled. With respect to the previous rejections of Claims 1, 4-9 and 12-16 under 35 U.S.C. § 103, the amendments to the independent claims 1 and 9 overcomes the rejections and places the claims in condition for allowance as stated in the Statement of Reasons for Allowance.

Statement Of Reasons For Allowance

3. The following is an Examiner's statement of reasons for allowance:

Claims 1 and 9 are found allowable over the prior art of record for at least the following rationale.

Regarding claims 1 and 9, Baek et. al, (US PgPub. 2020/0072937, cited in IDS) teaches determining relative location of voice activated devices connected to a user in a situation where multiple devices including microphones are connected through a sensor network (*see Baek, Fig. 1 and 3*). Port et. al. (US PgPub. 2022/0406326) teaches methods for classifying the environment sounds to determine the noise compensation for the output a sound system including frequency

based gain adjustments (*see Port, Fig. 6*). Mandel et. al. (US Patent 9,008,329) further teaches methods for noise reduction using Gaussian mixture models (*see Mandel, Fig. 5*). Jancovich et. al. (US Patent 12,243,548) further teaches a noise compensation method for the content audio data based, at least in part, on the second device ambient noise signal, to produce noise-compensated audio data(*see Jancovich, Fig. 5, 7*).

However, none of the prior art cited alone or in combination provides the motivation to teach

"dividing, by a clustering module using a gaussian mixture model, the one or more paired IoT devices into a plurality of clusters based on location information of the one or more IoT devices that are paired with the voice assistant device;

correcting, by a correction module, the predicted optimal sound output of the voice assistance device based on a calculation of a sound parameter value corresponding to each loT device of the determined cluster and a phase shift of the predicted optimal sound output using the calculated sound parameter value,

wherein the predicted optimal sound output of the voice assistance device includes a plurality of acoustic parameters, wherein a first set of acoustic parameters among the plurality of acoustic parameters corresponds to frequency parameters including minimum frequency level, maximum frequency level, and mean frequency level of the predicted optimal sound output, wherein a second set of acoustic parameters among the plurality of acoustic parameters corresponds to intensity parameters including minimum intensity level, maximum intensity level, and mean intensity level of the predicted optimal sound output,

wherein calculating the sound parameter value corresponding to each IoT device of

the determined cluster comprises: combining, by the correction module, the first set of acoustic parameters with set of acoustic parameters based on frequency bands of an audible range, and calculating, by the correction module, the sound parameter value based on the combination of the first set of acoustic parameters with the second set of acoustic parameters, and

wherein correcting the predicted optimal sound output comprises: selecting, by the correction module as a target IoT device, an IoT device from the determined cluster that has a minimum sound parameter value, shifting, by the correction module, a phase of the predicted optimal sound output based on the calculated sound parameter value and sound parameters of the selected IoT device, and generating, by the correction module, a new optimal sound corresponding to the determined cluster by merging the shifted phase optimal sound output with a desired sound of the voice assistant device" as stated in claims 1 and 9.

Similarly, dependent Claims 4-8 and 12-16 further limit allowable independent Claims 1 and 9 correspondingly, and thus said claims are also found allowable over the prior art of record by virtue of their dependency.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Soto, US PgPub. 2023/0385017 teaches a adjusting the volume of a playback media system based on proximity sensors and background noises (*see Soto, Fig. 11*).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NANDINI SUBRAMANI whose telephone number is (571)272-3916. The examiner can normally be reached Monday - Friday 12:00pm - 5:00 pm EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh M Mehta can be reached on (571)272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/NANDINI SUBRAMANI/
Examiner, Art Unit 2656

/BHAVESH M MEHTA/
Supervisory Patent Examiner, Art Unit 2656

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

68103 7590 03/27/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

EXAMINER	
SUBRAMANI, NANDINI	

ART UNIT	PAPER NUMBER
2656	

NOTIFICATION DATE	DELIVERY MODE
03/27/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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CORRECTED ***Notice of Allowability***	**Application No.** 18/084,081	**Applicant(s)** GABA et al.	
	Examiner NANDINI SUBRAMANI	**Art Unit** 2656	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

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2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

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4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

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   a) ☑ All b) ☐ Some* c) ☐ None of the:

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   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
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5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656

UNITED STATES
PATENT AND TRADEMARK OFFICE

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/084,081	**06/17/2025 03:19:47 PM Z ET**	**0503-0636**

Title of Invention

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3982	FILED BY	Soo Oh
PATENT CENTER #	70941796	FILING DATE	12/19/2022
CUSTOMER #	68103	FIRST NAMED INVENTOR	Abhinav GABA
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Maeng-Ho SHIN

Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
0503-0636IDSAsFiled06-17-2025.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1273 KB
1_0503-0636IN202041005143AsFiled.pdf	44	Foreign Reference	21506 KB
2_0503-0636INHearingNoticeAsFiled.pdf	4	Non Patent Literature	1142 KB
0503-0636IssueFeeTransmittalAsFiled.pdf	1	Issue Fee Payment (PTO-85B)	146 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0503-0636IDSAsFiled06-17-2025.pdf	334CF540574FB2DD961B7E059192CAA8034F403DFE6A42AB504E2DAAC65130F1C31FC54394DF607507EF0912F948C07AC2EFBE2EF636168EEB0B657371E47A77
1_0503-0636IN202041005143AsFiled.pdf	3AACDC4F22D78FFE1561B3FD1C06E968AE12C8A293C2A3EBB4B294AF2C44012B120CB72107B994480444DB3ECB3299E6BF3B2D320BA08A569D6CA934DB98478C
2_0503-0636INHearingNoticeAsFiled.pdf	19DD9650AAFF2CAF17D72A2DA4FCC2BC125810414A5D56E4694EA98D216CC5FB29BD1058EA507920933B33895C3E631769140F8E2563ACD4EF11D82C32C41812
0503-0636IssueFeeTransmittalAsFiled.pdf	52BBB528031EE849024B88FE72214D5E2E749F095E38D161C91C36145948F56804035B6B7435C3A429D637A4245A9758B0DCC61DE3B5889714C2219E36DB0794

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :06/02/2020

(21) Application No.202041005143 A
(43) Publication Date : 13/08/2021

(54) Title of the invention : METHOD AND DEVICE FOR COMMAND RESOLUTION BASED-ON NON-SPEECH SOUND IN IOT ENVIRONMENT

(51) International classification	:B63C0009030000, B23K0009038000, A23G0003540000, B65G0015080000, G01V0001280000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No Filing Date	:NA :NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

(71)**Name of Applicant :**
1)SAMSUNG ELECTRONICS CO., LTD.
Address of Applicant :129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-742, Republic of Korea Republic of Korea
(72)**Name of Inventor :**
1)Ravibhushan B. Tayshete
2)Sourabh Tiwari
3)Vinay Vasanth Patage

(57) Abstract :
The present disclosure provides a method and a device for command resolution based-on non-speech sound in Internet of Things (IoT) environment. The method comprises receiving a voice command from a user, wherein the voice command includes at least one IoT device control parameter, detecting at least one non-speech sound while receiving the voice command, identifying one or more IoT devices in user's surrounding based on the detected at least one non-speech sound, selecting at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter, and executing the received IoT device control parameter on the selected at least one target IoT device. Fig.1

No. of Pages : 43 No. of Claims : 32

FORM 2

THE PATENTS ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003

COMPLETE SPECIFICATION
(See section 10, rule 13)

1. Title of the Invention:

"METHOD AND DEVICE FOR COMMAND RESOLUTION BASED-ON NON-SPEECH SOUND IN IOT ENVIRONMENT"

2. APPLICANT (S) –

(a) **Name**	**: SAMSUNG ELECTRONICS CO., LTD.,**
(b) Nationality	: Republic of Korea
(c) Address	: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-742, Republic of Korea

The following specification particularly describes the invention and the manner in which it is to be performed.

TECHNICAL FIELD

[001] The present subject matter is related in general to Internet of Things (IoT) devices, more particularly, but not exclusively to a method and a device for command resolution based-on non-speech sound in IoT environment.

BACKGROUND

[002] With advancement in technology, different types of devices can be interconnected to form a system of devices called IoT. These devices can be controlled through voice or text input from users. Exiting voice assistant solutions allows users to achieve various tasks such as booking cab, playing music, creating alarm, etc. through voice or text commands. For an assigned task, voice assistant would respond to a user through a natural dialog generated via Natural Language Generator (NLG) module in an IoT system. Currently, the responses of the natural dialog and the NLG do not consider surrounding non-speech sound for an optimum resolution of voice command. Furthermore, the voice assistant does not recognize possible actions user can perform based on surrounding audio scene and/or activities. When the voice assistant cannot perform desired action for a requested query from a user, the user may feel uncomfortable. For instance, a user is in a living room and watching a television. Multiple background sounds are active from IoT devices like television, air conditioner and robot cleaner. If the user receives a phone call, the user asks the voice assistant to keep silence to receive the phone call. In this situation, the user wants the IoT devices like television, air conditioner and robot cleaner to be stopped from making sounds. However, in reality, the voice assistant without considering background non-speech sounds mutes the phone leaving all other sound making IoT devices active. Additionally, the user needs to explicitly cancel current conversation to switch to different tasks.

[003] The information disclosed in this background of the disclosure section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY

[004] In an embodiment, the present disclosure may relate to a method for command resolution in IoT environment. The method includes receiving a voice command from a user, wherein the voice command includes at least one IoT device control parameter. Further, the method includes detecting at least one non-speech sound while receiving the voice command. Furthermore, the method includes identifying one or more IoT devices in user's surrounding based on the detected at least one non-speech sound. Thereafter, the method includes selecting at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter. Finally, the method includes executing the received IoT device control parameter on the selected at least one target IoT device.

[005] In an embodiment, the present disclosure may relate to a virtual assistant device for command resolution in IoT environment. The device comprising a processor, and a memory communicatively coupled to the processor, wherein the memory stores processor-executable instructions, which on execution, cause the processor to receive a voice command from a user, wherein the voice command includes at least one IoT device control parameter. Further, the processor is configured to detect at least one non-speech sound while receiving the voice command. Furthermore, the processor is configured to identify one or more IoT devices in user's surrounding based on the detected at least one non-speech sound. Thereafter, the processor is configured to select at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter. Finally, the processor is configured to execute the received IoT device control parameter on the selected at least one target IoT device.

[006] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[007] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and together with the description, serve to explain the disclosed principles. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the figures to reference like features and components. Some embodiments of device and/or methods in accordance with embodiments of the present subject matter are now described below, by way of example only, and with reference to the accompanying figures.

[008] Fig. 1 illustrates an exemplary environment for command resolution based-on non-speech sound in IoT environment in accordance with some embodiments of the present disclosure.

[009] Fig. 2 shows a detailed block diagram of a virtual assistant device in accordance with some embodiments of the present disclosure.

[010] Fig. 3 illustrates a list comprising of target IoT devices on a user interface of an electronic device associated with a user in accordance with some embodiments of the present disclosure.

[011] Fig. 4a - Fig. 4b illustrate a flowchart showing a method for command resolution based-on non-speech sound in IoT environment in accordance with some embodiments of present disclosure.

[012] Fig. 5 illustrates flowcharts showing a method for securing a list of IoT devices with correlation to non-speech sound in accordance with some embodiments of the present disclosure.

[013] Fig. 6 illustrates a block diagram of an exemplary computer system for implementing embodiments consistent with the present disclosure.

[014] It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative systems embodying the principles of the present subject matter. Similarly, it will be appreciated that any flowcharts, flow diagrams, state transition diagrams, pseudo code, and the like represent various processes which may be

substantially represented in computer readable medium and executed by a computer or processor, whether or not such computer or processor is explicitly shown.

DETAILED DESCRIPTION

[015] In the present document, the word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment or implementation of the present subject matter described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments.

[016] While the disclosure is susceptible to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the drawings and will be described in detail below. It should be understood, however that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternatives falling within the scope of the disclosure.

[017] The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a setup, device or method that comprises a list of components or steps does not include only those components or steps but may include other components or steps not expressly listed or inherent to such setup or device or method. In other words, one or more elements in a system or apparatus proceeded by "comprises... a" does not, without more constraints, preclude the existence of other elements or additional elements in the system or method.

[018] In the following detailed description of the embodiments of the disclosure, reference is made to the accompanying drawings that form a part hereof, and in which are shown by way of illustration specific embodiments in which the disclosure may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the disclosure, and it is to be understood that other embodiments may be utilized and that changes may be made without departing from the scope of the present disclosure. The following description is, therefore, not to be taken in a limiting sense.

[019] Embodiments of the present disclosure relate to a method and a device for command resolution based-on non-speech sound in IoT environment. In today's IoT environment, IoT devices are connected such that the IoT devices communicate with each other to perform certain task. The IoT devices are controlled using voice or text command. In case of voice command, the IoT devices function well to understand the voice command and perform desired task when user voice command is clear. However, the IoT devices fail to perform or deliver output in a situation when the user voice command is not clear, or the voice command is incomplete or ambient sound is mixed with the user voice command. In order to overcome such situations, the present disclosure detects and processes voice command of a user and non-speech sound from user's surrounding in a received voice command parallelly to control operations of at least one target IoT device. The present disclosure delivers desired task expected by the user from the IoT devices by operating even when the user voice command is not clear, or the voice command is incomplete or ambient sound is mixed with the voice command.

[020] Fig. 1 illustrates an exemplary environment for command resolution based-on non-speech sound in IoT environment in accordance with some embodiments of the present disclosure.

[021] As shown in the fig. 1, the environment 100 includes an IoT device 101_1, an IoT device 101_2,... , an IoT device 101_N (collectively referred as plurality of IoT devices 101), a repository 103, a communication network 105 and a virtual assistant device 107. The plurality of IoT devices 101 may be connected through the communication network 105 to the virtual assistant device 107. In an embodiment, the plurality of IoT devices 101 may include, but are not limited to, electronic appliances, electronic devices or any objects embedded with electronics, sensors and Internet connectivity. For example, the plurality of IoT devices 101 may be a refrigerator, a chimney, a speaker, a television, an air-conditioner, a vacuum cleaner, a mobile phone, a light bulb, and the like. The plurality of IoT devices 101 may run on Universal plug and play (UPnP) protocol. A person skilled in the art would understand that, any IoT devices, not mentioned explicitly, may also be used as the IoT devices in the present disclosure. Here, any inputs from a user may be received through user interface (not shown in fig.) of one or more IoT devices or any user device. The plurality of IoT devices 101 may provide real-time output data to the virtual assistant device 107 via the communication network 105 and in turn the plurality of IoT devices 101 may receive a control signal from the virtual assistant device 107 via the

communication network 105. The real-time output data may be operating states of the plurality of IoT devices 101. The operating states may include IoT device status of the plurality of IoT devices 101. The communication network 105 may include, but is not limited to, a direct interconnection, an e-commerce network, a Peer-to-Peer (P2P) network, Local Area Network (LAN), Wide Area Network (WAN), wireless network (for example, using Wireless Application Protocol), Internet, Wi-Fi, Bluetooth and the like.

[022] In the embodiment, the virtual assistant device 107 may receive voice command from a user and control operations of at least one target IoT device based on the received voice command. The target IoT device may be the IoT device that a user intent to control through his or her voice command. The voice command may include at least one non-speech sound from user's surrounding. Here, the voice command may be referred as speech sound of the user. The virtual assistant device 107 may include an Input/Output (I/O) interface 111, a memory 113 and a processor 115. The I/O interface 111 may be configured to receive the real-time output data from the plurality of IoT devices 101. Analogously, the I/O interface 111 may be configured to transfer a control signal to the plurality of IoT devices 101. The I/O interface 111 may employ communication protocols/methods such as, without limitation, Bluetooth, cellular (e.g., Code-Division Multiple Access (CDMA), High-Speed Packet Access (HSPA+), Global System for Mobile communications (GSM), Long-Term Evolution (LTE), Worldwide interoperability for Microwave access (WiMax), or the like. The virtual assistant device 107 may be part of one or more of the plurality of IoT devices 101.

[023] The voice command from the user received by the I/O interface 111 may be stored in the memory 113. The memory 113 may be communicatively coupled to the processor 115 of the virtual assistant device 107. The memory 113 may, also, store processor instructions which may cause the processor 115 to execute the instructions for controlling operations of at least one target IoT devices. The memory 113 may include, without limitation, memory drives, removable disc drives, etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, Redundant Array of Independent Discs (RAID), solid-state memory devices, solid-state drives, and the like.

[024] The processor 115 may include at least one data processor for controlling the operations of at least one target IoT devices. The processor 115 may include specialized processing units

such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, and the like.

[025] In the embodiment, the virtual assistant device 107 may exchange data with a repository 103 directly or through the communication network 105. The repository 103 may be a database or a cloud server. The repository 103 may be initially populated or stored with data that includes at least one of sounds associated with working of the plurality of IoT devices 101, ambient sounds from user's surrounding, IoT device control parameters and association of each IoT device control parameter with one or more IoT devices during training. The data may include operating states of the plurality of IoT devices 101 that are, also, stored in the repository 103. Here, the operating states of the plurality of IoT devices 101 are maintained in real-time in the repository 103. The sounds associated with working of the plurality of IoT devices 101 may include, for example, vibration sound of a washing machine, sound emanating from chimney fan, refrigerator sound, and the like. The ambient sound from user's surrounding may include, for example, sound of water from a tap, sound of car's engine, and the like. The IoT device control parameters may include at least one of command, component type and target device. For instance, if a user gives a voice command 'reduce speed of chimney', the virtual assistant 107 identifies IoT device control parameters as command being 'reduce speed', component type being 'IoT' since chimney is an IoT device and target device as 'chimney'. The association of each IoT device control parameter with one or more IoT devices may involve, for example, associating IoT device control parameter such as speed and increase or decrease speed to the IoT devices such as chimney and/or ceiling fan, and the like. The operating states of the plurality of IoT devices 101 may include current operating states of the plurality of IoT devices 101, for example, if speaker is on and its volume is at 5, then the operating state of the speaker is 5. The repository 103 may store list of the plurality of IoT devices 101. This list includes static IoT devices that are fixed to a location (i.e. position is fixed) such as a television, a refrigerator and an air conditioner as well as dynamic IoT devices that are not fixed to any location or movable in nature (i.e. position is not fixed) such as a mobile terminal/phone and a vacuum cleaner.

[026] The repository 103 may, also, be updated by the virtual assistant device 107 or by the user at any time or both. These updates may be related to at least one of sounds associated with working of the plurality of IoT devices 101, ambient sound from user's surrounding, IoT device

control parameters, association of each IoT device control parameter with one or more IoT devices and operating states of the plurality of IoT devices 101.

[027] Fig. 2 shows a detailed block diagram of a virtual assistant device in accordance with some embodiments of the present disclosure.

[028] The virtual assistant device 107, in addition to the I/O interface 111 and processor 115 described above, may include data 200 and one or more units 211, which are described herein in detail. In the embodiment, the data 200 may be stored within the memory 113. The data 200 may include, for example, voice data 201 and other data 203.

[029] The voice data 201 may include voice command from a user. The voice command may include at least one non-speech sound from user's surrounding in the voice command. The non-speech sound from the user's surrounding may comprise at least one of sounds associated with the working of the plurality of IoT devices 101 in the user's surrounding and ambient sound from the user's surrounding other than the sounds associated with the working of the plurality of IoT devices 101. Here, the ambient sound may include sound of water falling from a tap, sound of car's while starting or driving car engine, sounds from pets, chatting of two or more individuals, etc.

[030] The other data 203 may store data, including temporary data and temporary files, generated by units 211 for performing various functions of the virtual assistant device 107.

[031] In an embodiment, the data 200 in the memory 113 are processed by the one or more units 211 present within the memory 113 of the virtual assistant device 107. In the embodiment, the one or more units 211 may be implemented as dedicated hardware units. As used herein, the term unit refers to an Application Specific Integrated Circuit (ASIC), an electronic circuit, a Field-Programmable Gate Arrays (FPGA), Programmable System-on-Chip (PSoC), a combinational logic circuit, and/or other suitable components that provide the described functionality. In some implementations, the one or more units 211 may be communicatively coupled to the processor 115 for performing one or more functions of the virtual assistant device 107. The said units 211 when configured with the functionality defined in the present disclosure will result in a novel hardware.

[032] In one implementation, the one or more units 211 may include, but are not limited to, a receiver unit 213, an automated speech recognition unit 215, a non-speech sound classifier unit 217, a control parameter identifier unit 219, an IoT query service unit 221, a correlation engine unit 223, a control unit 225, a hyper-parameter selection unit 227 and a list unit 229. The one or more units 211 may, also, include other units 231 to perform various miscellaneous functionalities of the virtual assistant device 107.

[033] The receiver unit 213 may receive voice command from a user via the I/O interface 111. The voice command may contain at least one non-speech sound from user's surrounding in the voice command. The voice command of the user may be referred as speech sound. The non-speech sound from the user's surrounding may comprise at least one of sounds associated with the working of the plurality of IoT devices 101 in the user's surrounding and ambient sound from the user's surrounding other than the sounds associated with the working of the plurality of IoT devices 101. For example, if a user says to 'reduce speed', the receiver unit 213 may receive 'reduce speed' as voice command along with ambient sound from refrigerator and chimney fan from user's surrounding.

[034] The automated speech recognition unit 215 may detect voice command of the user. The automated speech recognition unit 215 may use any speech recognition technology such as automated speech recognition (ASR) technology or speech to text (STT) technology for detecting voice command of the user. After detection, the automated speech recognition unit 215 may provide user command hypothesis by performing speech-to-text operation. The output i.e. the user command hypothesis of the automated speech recognition unit 215 is in text format. In brief, the automated speech recognition unit 215 may process the voice command for user command recognition. For example, when a user says to 'reduce speed', the receiver unit 213 may receive 'reduce speed' as voice command along with ambient sound from refrigerator and chimney fan from user's surrounding. The automated speech recognition unit 215 may detect only the voice command of the user i.e. 'reduce speed'. In the above-mentioned example of 'reduce speed', the voice command of the user is not complete speech command as the voice command does not mention at least one target IoT device.

[035] The non-speech sound classifier unit 217 is trained with non-speech data from various IoT devices and ambient sound from the user's surrounding other than the non-speech data from various IoT devices for effective IoT device type detection. The non-speech sound

classifier unit 217 may detect at least one non-speech sound from user's surrounding in the voice command. The non-speech sound classifier unit 217 may apply sound processing technique to extract Log Mel features such as Mel-Frequency Cepstral Coefficients (MFCCs) from the voice command followed by using Convolutional Neural Network (CNN) algorithm on the Log Mel features to detect the non-speech data. The above-mentioned detection method is exemplary only. Non-speech sound classification is not limited to MFCC based CNN algorithm. After detection, this unit may classify the non-speech sound to recognize one or more appropriate IoT devices. Furthermore, the non-speech sound classifier unit 217 may detect location where the voice command of the user was detected and use the detected location for recognizing one or more appropriate IoT devices. In brief, the non-speech sound classifier unit 217 may process non-speech sound to recognize relevant IoT devices. For example, when a user says to 'reduce speed', the receiver unit 213 may receive 'reduce speed' as voice command along with ambient sound from refrigerator and chimney fan from user's surrounding. The non-speech sound classifier unit 217 may detect only the ambient sound from refrigerator and chimney fan and may recognize refrigerator and chimney fan as appropriate IoT devices.

[036] The automated speech recognition unit 215 and the non-speech sound classifier unit 217 may process respective data from the received voice command in parallel. I.e. the received voice command may be fed to the automated speech recognition unit 215 and the non-speech sound classifier unit 217 at the same time for parallel processing.

[037] The control parameter identifier unit 219 may receive the user command hypothesis from the automated speech recognition unit 215 and may identify presence of one or more IoT device control parameters in the user command hypothesis. This unit is part of Natural Language Processing (NLP) system. In brief, the control parameter identifier unit 219 may process the voice command of the user using NLP technique, for example sentence segmentation, tokenisation, part of speech tagging and entity recognition to identify IoT device control parameter. For example, in the voice command of the user i.e. 'reduce speed', the control parameter identifier unit 219 may identify 'reduce' and 'speed' as control parameters.

[038] The IoT query service unit 221 may receive one or more IoT devices information recognized by the non-speech sound classifier unit 217. Based on the recognized one or more IoT devices information, the IoT query service unit 221 may obtain corresponding IoT devices

operating states. The operating states may include IoT device status. The IoT device status may refer to IoT device being ON or OFF and the IoT devices operating states may refer to mode of operation, for instance, a chimney fan may be running at speed 4 out of fan speed 1-5. The IoT query service unit 221 may obtain the operating states by querying the IoT devices directly or by querying the repository 103, which stores operation states of all available IoT devices at real-time. For example, once refrigerator and chimney fan are recognized as appropriate IoT devices by the non-speech sound classifier unit 217, the IoT query service unit 221 may obtain operating states of refrigerator as 'OFF' and chimney fan as 'ON' and '4' from the repository 103.

[039] The correlation engine unit 223 may receive the IoT device control parameters from the control parameter identifier unit 219 and the IoT devices operating states from the IoT query service unit 221. The correlation engine unit 223 may identify correlation of operating states of one or more IoT devices with the IoT device control parameter and subsequently, the correlation engine unit 223 may select at least one target IoT device from the one or more IoT devices based on the correlation. For example, on receiving operating states of refrigerator as 'OFF' and chimney fan as 'ON' and '4' from the IoT query service unit 221 and control parameters as 'reduce' and 'speed' from the control parameter identifier unit 219, the correlation engine unit 223 may identify that 'speed' correlates to chimney fan. In this case, since the refrigerator is in 'OFF' state, the correlation engine unit 223 unit won't consider it. The correlation engine unit 223 is part of NLP system.

[040] In addition to the correlation engine unit 223, the virtual assistant device 107 may include a multiple context loader unit (not shown in fig. 2) and an intent resolver and response generator unit (not shown in fig. 2).

[041] The multiple context loader unit may receive selected or short-listed at least one target IoT device from the correlation engine unit 223. The multiple context loader unit may load concurrent context stack for each of the selected IoT devices for user command matching. The multiple context loader unit may hold the current operating states of each of the selected IoT devices for accurate user command determination. It is part of NLP system. For instance, if IoT devices like a television, an air-conditioner and a vacuum cleaner are selected by the correlation engine unit 223, the multiple context loader unit may load contexts of selected IoT devices in NLP system.

[042] The intent resolver and response generator unit may resolve user command intent to one or more most appropriate IoT device. This unit may generate response for performing desired action specifying the operation(s) on IoT device(s). It is part of NLP system. For example, consider a situation where a user issues a command "Hi, please keep silence. I need to answer the phone". There could be more IoT devices like light bulbs, doorknob, etc. other than a television, an air-conditioner and a vacuum cleaner found to be active in vicinity where the user command was issued. In such situations, intent resolver and response generator unit may resolve the user command request of "keeping silence" to only to those devices that have the potential to make noisy sounds such as the television, the air-conditioner and the vacuum cleaner.

[043] The control unit 225 may perform the action of controlling operations of the selected at least one target IoT device received from the correlation engine unit 223. For instance, if user command is to 'mute devices' and the correlation engine provides at least one target IoT device such as a television, an air-conditioner and a vacuum cleaner along with their operating states 'ON', 'FAN ON' and 'ON', respectively, the control unit 225 mutes the television, turns fan off of the air-conditioner and switches off the vacuum cleaner.

[044] The hyper-parameter selection unit 227 may finalize IoT device list by determining location and/or position of the virtual assistant device 107 depending on whether the virtual assistant device 107 is fixed or movable. For instance, there are two categories of IoT devices. One category is dynamic/moving IoT devices in home such as a mobile terminal, a vacuum cleaner, etc., and other category is fixed/static IoT devices in home such a speaker, a television, refrigerator, etc. When the virtual assistant device 107 being part of an IoT device is fixed, the hyper-parameter selection unit 227 knows location of the IoT device and gets available IoT devices in that room/scene in home. When the virtual assistant device 107 being part of an IoT device is movable, the hyper-parameter selection unit 227 checks for the position of the IoT device. When the position of the IoT device is known, the hyper-parameter selection unit 227 gets available IoT devices in that room/scene in home. When the position of the IoT device is not known, the hyper-parameter selection unit 227 gets all available IoT devices in home. The IoT device list may be feed to the non-speech sound classifier 217 from the hyper-parameter selection unit 227 to generate or secure one or more appropriate IoT devices.

[045] The list unit 229 may receive output of the correlation engine unit 223 in situations when the correlation engine unit 223 selects more than one target IoT device. The list unit 229 may provide a list comprising of target IoT devices to the user for user selection via an electronic device associated with the user, as shown in fig 3.

[046] Fig. 4a - Fig. 4b illustrate a flowchart showing a method for command resolution based-on non-speech sound in IoT environment in accordance with some embodiments of present disclosure.

[047] As illustrated in fig. 4a - fig. 4b, the method 400 includes one or more blocks for command resolution based-on non-speech sound in IoT environment. The method 400 may be described in the general context of computer executable instructions. Generally, computer executable instructions can include routines, programs, objects, components, data structures, procedures, units, and functions, which perform particular functions or implement particular abstract data types.

[048] The order in which the method 400 is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the method. Additionally, individual blocks may be deleted from the methods without departing from the scope of the subject matter described herein. Furthermore, the method can be implemented in any suitable hardware, software, firmware, or combination thereof.

[049] At block 401, a voice command from a user may be received by the receiver unit 213 through the I/O interface 111. The voice command may include at least one Internet of Things (IoT) device control parameter.

[050] At block 403, the automated speech recognition unit 215 and the non-speech sound classifier unit 217 may detect voice command of the user and at least one non-speech sound from user's surrounding in the received voice command. The analysing of the at least one non-speech sound from the user's surrounding may be triggered on detection of presence of at least one IoT device control parameter in user speech command.

[051] At block 405, the automated speech recognition unit 215 may process the voice command of the user to identify IoT device control parameter. Here, each IoT device control parameter is associated with the one or more IoT devices. Furthermore, the IoT device control parameter may comprise at least one of command, component type and target IoT device.

[052] At block 407, the non-speech sound classifier unit 217 may identify one or more IoT devices in the user's surrounding based on at least one of the detected non-speech sound and location where the voice command of the user was detected. The non-speech sound from the user's surrounding may comprise at least one of sounds associated with the working of IoT devices in the user's surrounding and ambient sound from the user's surrounding other than the sounds associated with the working of IoT devices. The at least one non-speech sound is detected from the use's surrounding or from surrounding of the virtual assistant device.

[053] The operations performed in block 405 and the block 407 may be carried out in parallel i.e. processing of the voice command from the user and analysing of the at least one non-speech sound from the user's surrounding may be performed in parallel.

[054] At block 409, the correlation engine unit 223 may select at least one target IoT device from the identified one or more IoT devices based on correlation of current operating states of each of the identified one or more IoT devices with the identified IoT device control parameter. The operating states of the one or more IoT devices may be received from the IoT query service unit 221 and the IoT device control parameter may be received from the control parameter identifier unit 219.

[055] At block 411, the control unit 225 may execute the received IoT device control parameter on the selected at least one target IoT device. The control unit 225 may control operations of the selected at least one target IoT device to achieve command resolution based-on non-speech sound.

[056] The block 413 to block 417 are performed when more than one target IoT device is selected by the correlation engine unit 223.

[057] At block 413, the list unit 229 may provide a list of at least one target IoT device to the user via an electronic device associated with the user. The list may be provided when more

than one target IoT device is selected by the correlation engine unit 223 from the identified one or more IoT devices.

[058] At block 415, the receiver unit 213 may receive input from the user via the electronic device to control operations of the at least one target IoT device. The input from the user may comprise selection of the at least one target IoT device. The electronic device may include a mobile terminal, a speaker, a television, a refrigerator, a washing machine, a chimney or any other IoT enabled devices.

[059] At block 417, the control unit 225 may control operations of the at least one target IoT device based on the user input.

[060] Fig. 5 illustrates flowcharts showing a method for securing a list of IoT devices with correlation to non-speech sound in accordance with some embodiments of the present disclosure.

[061] As illustrated in fig. 5, the method 500 includes one or more blocks for securing a list of IoT devices with correlation to non-speech sound. The method 500 may be described in the general context of computer executable instructions. Generally, computer executable instructions can include routines, programs, objects, components, data structures, procedures, units, and functions, which perform particular functions or implement particular abstract data types.

[062] The order in which the method 500 is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the method. Additionally, individual blocks may be deleted from the methods without departing from the scope of the subject matter described herein. Furthermore, the method can be implemented in any suitable hardware, software, firmware, or combination thereof.

[063] At block 501, the hyper-parameter selection unit 227 may determine location from where the voice command of the user was received to identify one or more IoT devices present in vicinity of the location. The IoT devices are categorized into two sets: (i) static IoT devices that are not moving or fixed in a location such as a television, a washing machine and a

refrigerator and (ii) dynamic IoT devices that are moving or not fixed to any location such as a mobile terminal and a vacuum cleaner in a house. The location of the static IoT devices are stored in the repository 103. This step is performed when the virtual assistant device 107 is fixed i.e. non-movable. For instance, when the virtual assistant device 107 is a fixed device like a speaker, a television, a refrigerator, etc., then the virtual assistant device 107 may know location of IoT devices from the repository 103 and may get available IoT devices in that room/scene.

[064] At block 503, the hyper-parameter selection unit 227 may determine a position of the virtual assistant device 107 in an IoT environment. This step is performed when the virtual assistant device 107 is dynamic i.e. movable. For instance, when the virtual assistant device 107 is a dynamic device like a mobile terminal, a vacuum cleaner, etc., the virtual assistant device 107 may determine its position in that room/scene. The IoT query service unit 221 may assist the hyper-parameter selection unit 227 to determine the position. The position may be determined on the basis of any specific identified IoT device or a combination of IoT devices with known location or based on IoT scene. For example, during user command processing, the non-speech sound classifier unit 217 may identify a television is turned ON with the help of the IoT query service unit 221. This confirms that the virtual assistant device 107 is potentially at same location as that of the television. In another example, during user command processing, the non-speech sound classifier unit 217 may identify presence of two or more IoT devices belonging to same IoT scene with the help of the IoT query service unit 221. For instance, sounds of refrigerator and chimney are identified in same IoT scene. This potentially means that the virtual assistant device 107 is, also, in the same IoT scene. In this case, it is 'Kitchen IoT scene'.

[065] At block 505, the hyper-parameter selection unit 227 may detect one or more IoT devices present in the vicinity of the position of the virtual assistant device 107. This step is performed when the position of the virtual assistant device 107 is known. For instance, when the position of the virtual assistant device 107 is known, then the virtual assistant device 107 may get the list of available IoT devices in that room/scene. In this situation, the IoT query service unit 221 may provide a list of available IoT devices in the same position or IoT scene along with each of IoT devices status to the virtual assistant device 107. One way of achieving this is user creating IoT rooms/scenes and adding one or more non-movable IoT devices to that room/scene. When the virtual assistant device 107 is a movable device, then as soon as a nearest

sound of non-movable IoT device is detected, the room/scene of the virtual assistant device 107 is, also, identified.

[066] At block 507, the hyper-parameter selection unit 227 may determine all IoT devices connected to the virtual assistant device 107 when the position of the virtual assistant device 107 is not known. This information on all IoT devices connected to the virtual assistant device 107 may be obtained from the repository 103, which has a list of the plurality of IoT devices (static and dynamic IoT devices) stored. For instance, when the position of the virtual assistant device 107 is not known, then the virtual assistant device 107 may get all the available static and dynamic IoT devices in home.

[067] The information from block 501 to block 507 may be feed to the non-speech sound classifier 217 from the hyper-parameter selection unit 227 to generate or secure one or more appropriate IoT devices.

[068] Few examples are presented below based on figs. 4a, 4b and 5.

[069] Example 1: Consider a scenario in a kitchen where a user is listening to a recipe on an electronic device. The user is unable to listen to the recipe due to surrounding or ambient sound of a refrigerator and a chimney fan. In order to listen to the recipe clearly, the user gives a command "Hi, can't hear. Reduce speed". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the refrigerator and the chimney fan. Among the refrigerator and the chimney fan, the virtual assistant device 107 further identifies reducing speed relates to the chimney fan and not to the refrigerator and reduces the speed of the chimney fan. The user now listens to the recipe without any sound from the chimney fan. This example covers the situation where single device i.e. chimney fan is controlled from multiple unique non-speech data i.e. ambient sound of the refrigerator and the chimney fan.

[070] Example 2: Consider a scenario in a living room where a user gets a phone call on his or her mobile phone. The living room has a vacuum cleaner, a television and an air conditioner running. In order to handle the phone call without any disturbances, the user gives a command "Hi, keep silence. I want to receive the phone". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the vacuum cleaner, the television and the air conditioner. The virtual assistant device 107 further identifies keeping silence relates to all

the devices in the living room except the ringing phone itself i.e. the vacuum cleaner, the television and the air conditioner. In this situation, the virtual assistant device 107 stops the vacuum cleaner, mutes the television and turns off fan of the air conditioner. The user now picks the phone call without worrying about any sound from the devices in the living room. This example covers the situation where multiple devices such as the vacuum cleaner, the television and the air conditioner are controlled from multiple unique non-speech data i.e. ambient sound of the vacuum cleaner, the television and the air conditioner.

[071] Example 3: Consider a scenario in a kitchen where a user is washing dishes in a kitchen sink. The kitchen has lights in vicinity to a dish washing sink and a dish washer. In order to illuminate the kitchen, the user gives a command "Hi, turn on this light". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the running water and the dish washer. Based on the non-speech data, the virtual assistant device 107 identifies the location as kitchen and thereafter, identifies that devices in the kitchen being lights and the dish washer. The virtual assistant device 107 identifies that turning on this light relates to the light(s) that is (are) in vicinity to the dish washing sink in the kitchen and not to the dish washer. In this situation, the virtual assistant device 107 switches on the lights in the kitchen. This example covers the situation where one or more devices i.e. lights are controlled based on location of non-speech sound i.e. ambient sound of the running water and the dish washer.

[072] Example 4: Consider a scenario in which a user in driving a car with sunroof open. In order to make a phone call, the user gives a command "Hi, call Jacob". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of noise outside the car. Based on the non-speech data, the virtual assistant device 107 identifies that the sunroof of the car is open. The virtual assistant device 107 closes the sunroof and places the phone call to contact Jacob from the phone directory. This example covers the situation where one or more devices i.e. sunroof of the car are controlled in the middle of conversation with the virtual assistant device 107.

[073] Example 5: Consider another scenario in a kitchen where a user is listening to a recipe on an electronic device. The user is unable to listen to the recipe due to surrounding or ambient sound of a refrigerator and a chimney fan. In order to listen to the recipe clearly, the user gives a command "Hi, can't hear. Reduce speed". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the refrigerator and the chimney fan. Among

the refrigerator and the chimney fan, the virtual assistant device 107 further identifies reducing speed relates to the chimney fan and not to the refrigerator and asks the user "Do you want me to reduce chimney fan speed?". On receiving the user's voice confirmation as "Yes", the virtual assistant device 107 reduces the speed of the chimney fan. The user continues listening to the recipe without any sound from the chimney fan. This example covers the situation where single device i.e. chimney fan is controlled after confirmation from the user (without receiving confirmation via a user interface of the electronic device).

[074] Example 6: Consider a scenario in a bedroom where a user is trying to make his or her baby sleep. The bedroom has a vacuum cleaner, a television and an air conditioner running. In order to reduce the sound in the bedroom, the user gives a command "Hi, keep silence. My baby is trying to sleep". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the vacuum cleaner, the television and the air conditioner. The virtual assistant device 107 further identifies keep silence relates to all the devices in the bedroom i.e. the vacuum cleaner, the television and the air conditioner. In this situation, the virtual assistant device 107 presents a list on a user interface of a user mobile device that includes the vacuum cleaner, the television and the air conditioner along with actions to keep the devices silent i.e. mute option for the television, reducing speed for the air conditioner and stopping the vacuum cleaner (a similar example is shown in fig. 3). Since the user wants to use the air conditioner, the user gives a voice command saying, "Stop the vacuum cleaner and the television" or selects the vacuum cleaner and the television through touch command on the user interface of the user mobile device. On receiving this confirmation, the virtual assistant device 107 stops the vacuum cleaner and the television with the air conditioner still running. This example covers the situation where multiple devices i.e. vacuum cleaner and television are controlled after receiving confirmation from the user via a user interface of an electronic device or voice command.

[075] Example 7: Consider a scenario in a living room where a user wants to listen to message or messages received on his or her mobile phone. The living room has a vacuum cleaner, a television and an air conditioner running. In order to listen to the messages on the mobile phone without any disturbances, the user gives a command "Hi, keep silence. I want to hear messages". The virtual assistant device 107 of the present disclosure identifies non-speech data i.e. sound of the vacuum cleaner, the television and the air conditioner. The virtual assistant device 107 further identifies keeping silence relates to all the devices in the living room i.e. the

vacuum cleaner, the television and the air conditioner except the mobile phone as messages are to be read from the mobile phone. In this situation, the virtual assistant device 107 presents a list of devices i.e. the vacuum cleaner, the television and the air conditioner along with actions to keep the devices silent i.e. mute option for the television, reducing speed for the air conditioner and stopping the vacuum cleaner (a similar example is shown in fig. 3). Since the user wants to use the air conditioner and the vacuum cleaner, the user gives a voice command saying, "Mute the television" or selects the television through touch command on the user interface of the user mobile device. On receiving this confirmation, the virtual assistant device 107 stops the television with the air conditioner and the vacuum cleaner still running and plays the messages received on the mobile phone for the user. This example covers the situation where one or more devices i.e. air conditioner, vacuum cleaner and mobile phone are controlled by resolving user command intent conflict i.e. avoiding muting mobile phone along with television.

[076] The examples mentioned above involve voice command of a user that lacks any target IoT device or contains incomplete speech command without any mention of at least one target IoT device.

[077] Some advantages of the present disclosure are given below:

[078] An embodiment of the present disclosure provides a method that allows efficient command resolution based on non-speech sound in IoT environment in addition to voice command of a user.

[079] An embodiment of the present disclosure provides a method that can understand incomplete voice command from a user.

[080] An embodiment of the present disclosure uses IoT devices operating states of the one or more IoT device identified by the non-speech sound classifier unit making selection of the one or more IoT devices more accurate.

[081] An embodiment of the present disclosure allows users to not to remember the complete and exact commands to perform task, thus, reducing cognitive overload on the users.

[082] The proposed method will improve end-user experience and thus, increase user reliability on Artificial Intelligence (AI) assistant.

Computing System

[083] Fig. 6 illustrates a block diagram of an exemplary computer system 600 for implementing embodiments consistent with the present disclosure. In an embodiment, the computer system 600 may be used to implement the virtual assistant device 107. The computer system 600 may include a central processing unit ("CPU" or "processor") 602. The processor 602 may include at least one data processor for command resolution based-on non-speech sound in IoT environment. The processor 602 may include specialized processing units such as, integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc.

[084] The processor 602 may be disposed in communication with one or more input/output (I/O) devices (not shown) via I/O interface 601. The I/O interface 601 employ communication protocols/methods such as, without limitation, audio, analog, digital, monoaural, Radio Corporation of America (RCA) connector, stereo, IEEE-1394 high speed serial bus, serial bus, Universal Serial Bus (USB), infrared, Personal System/2 (PS/2) port, Bayonet Neill-Concelman (BNC) connector, coaxial, component, composite, Digital Visual Interface (DVI), High-Definition Multimedia Interface (HDMI), Radio Frequency (RF) antennas, S-Video, Video Graphics Array (VGA), IEEE 802.11b/g/n/x, Bluetooth, cellular (e.g., Code-Division Multiple Access (CDMA), High-Speed Packet Access (HSPA+), Global System for Mobile communications (GSM), Long-Term Evolution (LTE), Worldwide interoperability for Microwave access (WiMax), or the like, etc

[085] Using the I/O interface 601, the computer system 600 may communicate with one or more I/O devices such as input devices 612 and output devices 613. For example, the input devices 612 may be an antenna, keyboard, mouse, joystick, (infrared) remote control, camera, card reader, fax machine, dongle, biometric reader, microphone, touch screen, touchpad, trackball, stylus, scanner, storage device, transceiver, video device/source, etc. The output devices 613 may be a printer, fax machine, video display (e.g., Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), Light-Emitting Diode (LED), plasma, Plasma Display Panel (PDP), Organic Light-Emitting Diode display (OLED) or the like), audio speaker, etc.

[086] In some embodiments, the computer system 600 consists of the virtual assistant device 107. The processor 602 may be disposed in communication with the communication network 609 via a network interface 603. The network interface 603 may communicate with the communication network 609. The network interface 603 may employ connection protocols including, without limitation, direct connect, Ethernet (e.g., twisted pair 10/100/1000 Base T), Transmission Control Protocol/Internet Protocol (TCP/IP), token ring, IEEE 802.11a/b/g/n/x, etc. The communication network 609 may include, without limitation, a direct interconnection, Local Area Network (LAN), Wide Area Network (WAN), wireless network (e.g., using Wireless Application Protocol), the Internet, etc. Using the network interface 603 and the communication network 609, the computer system 600 may communicate with a repository 614. The network interface 603 may employ connection protocols include, but not limited to, direct connect, Ethernet (e.g., twisted pair 10/100/1000 Base T), Transmission Control Protocol/Internet Protocol (TCP/IP), token ring, IEEE 802.11a/b/g/n/x, etc.

[087] The communication network 609 includes, but is not limited to, a direct interconnection, an e-commerce network, a Peer to Peer (P2P) network, Local Area Network (LAN), Wide Area Network (WAN), wireless network (e.g., using Wireless Application Protocol), the Internet, Wi-Fi and such. The first network and the second network may either be a dedicated network or a shared network, which represents an association of the different types of networks that use a variety of protocols, for example, Hypertext Transfer Protocol (HTTP), Transmission Control Protocol/Internet Protocol (TCP/IP), Wireless Application Protocol (WAP), etc., to communicate with each other. Further, the first network and the second network may include a variety of network devices, including routers, bridges, servers, computing devices, storage devices, etc.

[088] In some embodiments, the processor 602 may be disposed in communication with a memory 605 (e.g., RAM, ROM, etc. not shown in fig. 6) via a storage interface 604. The storage interface 604 may connect to memory 605 including, without limitation, memory drives, removable disc drives, etc., employing connection protocols such as, Serial Advanced Technology Attachment (SATA), Integrated Drive Electronics (IDE), IEEE-1394, Universal Serial Bus (USB), fibre channel, Small Computer Systems Interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive,

Redundant Array of Independent Discs (RAID), solid-state memory devices, solid-state drives, etc.

[089] The memory 605 may store a collection of program or repository components, including, without limitation, user interface 606, an operating system 607 etc. In some embodiments, computer system 600 may store user/application data, such as, the data, variables, records, etc., as described in this disclosure. Such repositories may be implemented as fault-tolerant, relational, scalable, secure repositories such as Oracle or Sybase.

[090] The operating system 607 may facilitate resource management and operation of the computer system 600. Examples of operating systems include, without limitation, APPLE® MACINTOSH® OS X®, UNIX®, UNIX-like system distributions (E.G., BERKELEY SOFTWARE DISTRIBUTION® (BSD), FREEBSD®, NETBSD®, OPENBSD, etc.), LINUX® DISTRIBUTIONS (E.G., RED HAT®, UBUNTU®, KUBUNTU®, etc.), IBM®OS/2®, MICROSOFT® WINDOWS® (XP®, VISTA®/7/8, 10 etc.), APPLE® IOS®, GOOGLE™ ANDROID™, BLACKBERRY® OS, or the like.

[091] In some embodiments, the computer system 600 may implement web browser 608 stored program components. Web browser 608 may be a hypertext viewing application, such as MICROSOFT® INTERNET EXPLORER®, GOOGLE™ CHROME™, MOZILLA® FIREFOX®, APPLE® SAFARI®, etc. Secure web browsing may be provided using Secure Hypertext Transport Protocol (HTTPS), Secure Sockets Layer (SSL), Transport Layer Security (TLS), etc. Web browsers 608 may utilize facilities such as AJAX, DHTML, ADOBE® FLASH®, JAVASCRIPT®, JAVA®, Application Programming Interfaces (APIs), etc. Computer system 600 may implement a mail server (not shown in fig. 6) stored program component. The mail server may be an Internet mail server such as Microsoft Exchange, or the like. The mail server may utilize facilities such as ASP, ACTIVEX®, ANSI® C++/C#, MICROSOFT®, .NET, CGI SCRIPTS, JAVA®, JAVASCRIPT®, PERL®, PHP, PYTHON®, WEBOBJECTS®, etc. The mail server may utilize communication protocols such as Internet Message Access Protocol (IMAP), Messaging Application Programming Interface (MAPI), MICROSOFT® exchange, Post Office Protocol (POP), Simple Mail Transfer Protocol (SMTP), or the like. Computer system 600 may implement a mail client (not shown in fig. 6) stored program component. The mail client may be a mail viewing application, such as APPLE® MAIL, MICROSOFT® ENTOURAGE®, MICROSOFT® OUTLOOK®, MOZILLA® THUNDERBIRD®, etc.

[092] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term "computer-readable medium" should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include Random Access Memory (RAM), Read-Only Memory (ROM), volatile memory, non-volatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage media.

[093] The described operations may be implemented as a method, system or article of manufacture using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof. The described operations may be implemented as code maintained in a "non-transitory computer readable medium", where a processor may read and execute the code from the computer readable medium. The processor is at least one of a microprocessor and a processor capable of processing and executing the queries. A non-transitory computer readable medium may include media such as magnetic storage medium (e.g., hard disk drives, floppy disks, tape, etc.), optical storage (CD-ROMs, DVDs, optical disks, etc.), volatile and non-volatile memory devices (e.g., EEPROMs, ROMs, PROMs, RAMs, DRAMs, SRAMs, Flash Memory, firmware, programmable logic, etc.), etc. Further, non-transitory computer-readable media include all computer-readable media except for a transitory. The code implementing the described operations may further be implemented in hardware logic (e.g., an integrated circuit chip, Programmable Gate Array (PGA), Application Specific Integrated Circuit (ASIC), etc.).

[094] The terms "an embodiment", "embodiment", "embodiments", "the embodiment", "the embodiments", "one or more embodiments", "some embodiments", and "one embodiment" mean "one or more (but not all) embodiments of the invention(s)" unless expressly specified otherwise.

[095] The terms "including", "comprising", "having" and variations thereof mean "including but not limited to", unless expressly specified otherwise.

[096] The enumerated listing of items does not imply that any or all of the items are mutually exclusive, unless expressly specified otherwise.

[097] The terms "a", "an" and "the" mean "one or more", unless expressly specified otherwise.

[098] A description of an embodiment with several components in communication with each other does not imply that all such components are required. On the contrary, a variety of optional components are described to illustrate the wide variety of possible embodiments of the invention.

[099] When a single device or article is described herein, it will be readily apparent that more than one device/article (whether or not they cooperate) may be used in place of a single device/article. Similarly, where more than one device or article is described herein (whether or not they cooperate), it will be readily apparent that a single device/article may be used in place of the more than one device or article or a different number of devices/articles may be used instead of the shown number of devices or programs. The functionality and/or the features of a device may be alternatively embodied by one or more other devices which are not explicitly described as having such functionality/features. Thus, other embodiments of the invention need not include the device itself.

[100] The illustrated operations of figs. 4a, 4b and 5 show certain events occurring in a certain order. In alternative embodiments, certain operations may be performed in a different order, modified or removed. Moreover, steps may be added to the above described logic and still conform to the described embodiments. Further, operations described herein may occur sequentially or certain operations may be processed in parallel. Yet further, operations may be performed by a single processing unit or by distributed processing units.

[101] Finally, the language used in the specification has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the inventive subject matter. It is therefore intended that the scope of the invention be limited not by this detailed description, but rather by any claims that issue on an application based here on. Accordingly, the disclosure of the embodiments of the invention is intended to

be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

[102] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

REFERRAL NUMERALS:

Reference number	Description
100	Environment
101_1, 101_2...101_N	A plurality of IoT devices
103	Repository
105	Communication network
107	Virtual assistant device
111	I/O interface
113	Memory
115	Processor
200	Data
201	Voice data
203	Other data
211	Units
213	Receiver unit
215	Automated speech recognition unit
217	Non-speech sound classifier unit
219	Control parameter identifier unit
221	IoT query service unit
223	Correlation engine unit
225	Control unit
227	Hyper-parameter selection unit
229	List unit
231	Other units
600	Computer system
601	I/O interface
602	Processor
603	Network interface
604	Storage interface

605	Memory
606	User interface
607	Operating system
608	Web browser
609	Communication network
612	Input devices
613	Output devices
614	Repository

We claim:

1. A method for command resolution in an Internet of Things (IoT) environment, the method comprising:

receiving, by a virtual assistant device, a voice command from a user, wherein the voice command includes at least one Internet of Things (IoT) device control parameter;

detecting, by the virtual assistant device, at least one non-speech sound while receiving the voice command;

identifying, by the virtual assistant device, one or more IoT devices in user's surrounding based on the detected at least one non-speech sound;

selecting, by the virtual assistant device, at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter; and

executing, by the virtual assistant device, the received IoT device control parameter on the selected at least one target IoT device.

2. The method as claimed in claim 1, wherein processing of the voice command from the user and analysing of the at least one non-speech sound are performed in parallel.

3. The method as claimed in claim 1, wherein analysing of the at least one non-speech sound is triggered on detection of presence of at least one IoT device control parameter in user speech command.

4. The method as claimed in claim 1, wherein the non-speech sound from the user's surrounding comprises at least one of sounds associated with the working of IoT devices in the user's surrounding and ambient sound from the user's surrounding other than the sounds associated with the working of IoT devices.

5. The method as claimed in claim 4, wherein the sounds associated with the working of IoT devices and the ambient sound from the user's surrounding are stored in a repository associated with the virtual assistant device.

6. The method as claimed in claim 1, wherein each IoT device control parameter is associated with the one or more IoT devices,

wherein the association between the each IoT device control parameter and the one or more IoT devices is stored in the repository associated with the virtual assistant device.

7. The method as claimed in claim 1, further comprising:

determining, by the virtual assistant device, a location from where the voice command of the user was received to identify one or more IoT devices present in vicinity of the location, when the virtual assistant device is fixed.

8. The method as claimed in claim 1, further comprising:

, determining, by the virtual assistant device, a position of the virtual assistant device in the IoT environment, when the virtual assistant device is movable.

9. The method as claimed in claim 8, further comprising:

detecting, by the virtual assistant device, one or more IoT devices present in vicinity of the position of the virtual assistant device, when the position of the virtual assistant device is known.

10. The method as claimed in claim 1, further comprising:

determining, by the virtual assistant device, all IoT devices connected to the virtual assistant device, when position of the virtual assistant device is not known.

11. The method as claimed in claim 1, wherein the operating states of the identified one or more IoT devices are received from the repository associated with the virtual assistant device, and

wherein the operating states of the identified one or more IoT devices are maintained in real-time in the repository associated with the virtual assistant device.

12. The method as claimed in claim 1, wherein the voice command of the user comprises incomplete speech command from the user that does not mention the at least one target IoT device.

13. The method as claimed in claim 1, wherein controlling operations of the selected at least one target IoT device further comprising:

providing, by the virtual assistant device, a list of one or more target IoT devices to the user via an electronic device associated with the user, when more than one target IoT device is selected from the identified one or more IoT devices;

receiving, by the virtual assistant device, input from the user via the electronic device to control operations of the one or more target IoT devices, wherein the input from the user comprises selection of the one or more target IoT devices; and

controlling, by the virtual assistant device, operations of the one or more target IoT devices based on the user input.

14. The method as claimed in claim 1, wherein the at least one non-speech sound is detected from the use's surrounding or from surrounding of the virtual assistant device.

15. The method as claimed in claim 1, wherein executing of the identified IoT device control parameter on the selected at least one target IoT device further comprising:

controlling, by the virtual assistant device, operations of the selected at least one target IoT device to achieve command resolution based-on non-speech sound.

16. The method as claimed in claim 1, wherein the IoT device control parameter comprises at least one of command, component type and target IoT device.

17. A virtual assistant device for command resolution in an Internet of Things (IoT) environment, the system comprising:

a processor; and

a memory communicatively coupled to the processor, wherein the memory stores processor-executable instructions, which on execution, cause the processor to:

receive a voice command from a user, wherein the voice command includes at least one Internet of Things (IoT) device control parameter;

detect at least one non-speech sound while receiving the voice command;

identify one or more IoT devices in user's surrounding based on the detected at least one non-speech sound;

select at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter; and

execute the received IoT device control parameter on the selected at least one target IoT device.

18. The virtual assistant device as claimed in claim 17, wherein processing of the voice command from the user and analysing of the at least one non-speech sound are performed in parallel.

19. The virtual assistant device as claimed in claim 17, wherein analysing of the at least one non-speech sound is triggered on detection of presence of at least one IoT device control parameter in the voice command.

20. The virtual assistant device as claimed in claim 17, wherein the non-speech sound from the user's surrounding comprises at least one of sounds associated with the working of IoT devices in the user's surrounding and ambient sound from the user's surrounding other than the sounds associated with the working of IoT devices.

21. The virtual assistant device as claimed in claim 20, wherein the sounds associated with the working of IoT devices and the ambient sound from the user's surrounding are stored in a repository associated with the virtual assistant device.

22. The virtual assistant device as claimed in claim 17, wherein each IoT device control parameter is associated with the one or more IoT devices,

wherein the association between the each IoT device control parameter and the one or more IoT devices is stored in the repository associated with the virtual assistant device.

23. The virtual assistant device as claimed in claim 17, the virtual assistant device causes the processor to:

determine a location from where the voice command of the user was received to identify one or more IoT devices present in vicinity of the location, when the virtual assistant device is fixed.

24. The virtual assistant device as claimed in claim 17, the virtual assistant device causes the processor to:

determine a position of the virtual assistant device in the IoT environment, when the virtual assistant device is movable.

25. The virtual assistant device as claimed in claim 24, the virtual assistant device causes the processor to:

detect one or more IoT devices present in vicinity of the position of the virtual assistant device, when the position of the virtual assistant device is known.

26. The virtual assistant device as claimed in claim 17, the virtual assistant device causes the processor to:

determine all IoT devices connected to the virtual assistant device, when position of the virtual assistant device is not known.

27. The virtual assistant device as claimed in claim 17, wherein the operating states of the identified one or more IoT devices are received from the repository associated with the virtual assistant device, and

wherein the operating states of the identified one or more IoT devices are maintained in real-time in the repository associated with the virtual assistant device.

28. The virtual assistant device as claimed in claim 17, wherein the voice command of the user comprises incomplete speech command from the user that does not mention the at least one target IoT device.

29. The virtual assistant device as claimed in claim 17, the virtual assistant device causes the processor to:

provide a list of one or more target IoT devices to the user via an electronic device associated with the user, when more than one target IoT device is selected from the identified one or more IoT devices;

receive input from the user via the electronic device to control operations of the one or more target IoT devices, wherein the input from the user comprises selection of the one or more target IoT devices; and

control operations the one or more target IoT device based on the user input.

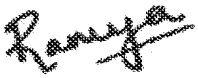
30. The virtual assistant device as claimed in claim 17, wherein the at least one non-speech sound is detected from the use's surrounding or from surrounding of the virtual assistant device.

31. The virtual assistant device as claimed in claim 17, the virtual assistant device causes the processor to:

control operations of the selected at least one target IoT device to achieve command resolution based-on non-speech sound.

32. The virtual assistant device as claimed in claim 17, wherein the IoT device control parameter comprises at least one of command, component type and target IoT device.

Dated this 06th day of February 2020



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AGENT FOR THE APPLICANT(S)

METHOD AND DEVICE FOR COMMAND RESOLUTION BASED-ON NON-SPEECH SOUND IN IOT ENVIRONMENT

ABSTRACT

The present disclosure provides a method and a device for command resolution based-on non-speech sound in Internet of Things (IoT) environment. The method comprises receiving a voice command from a user, wherein the voice command includes at least one IoT device control parameter, detecting at least one non-speech sound while receiving the voice command, identifying one or more IoT devices in user's surrounding based on the detected at least one non-speech sound, selecting at least one target IoT device from the identified one or more IoT devices, based on correlation of current operating state of each of the identified one or more IoT devices with the identified IoT device control parameter, and executing the received IoT device control parameter on the selected at least one target IoT device.

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Fig. 1

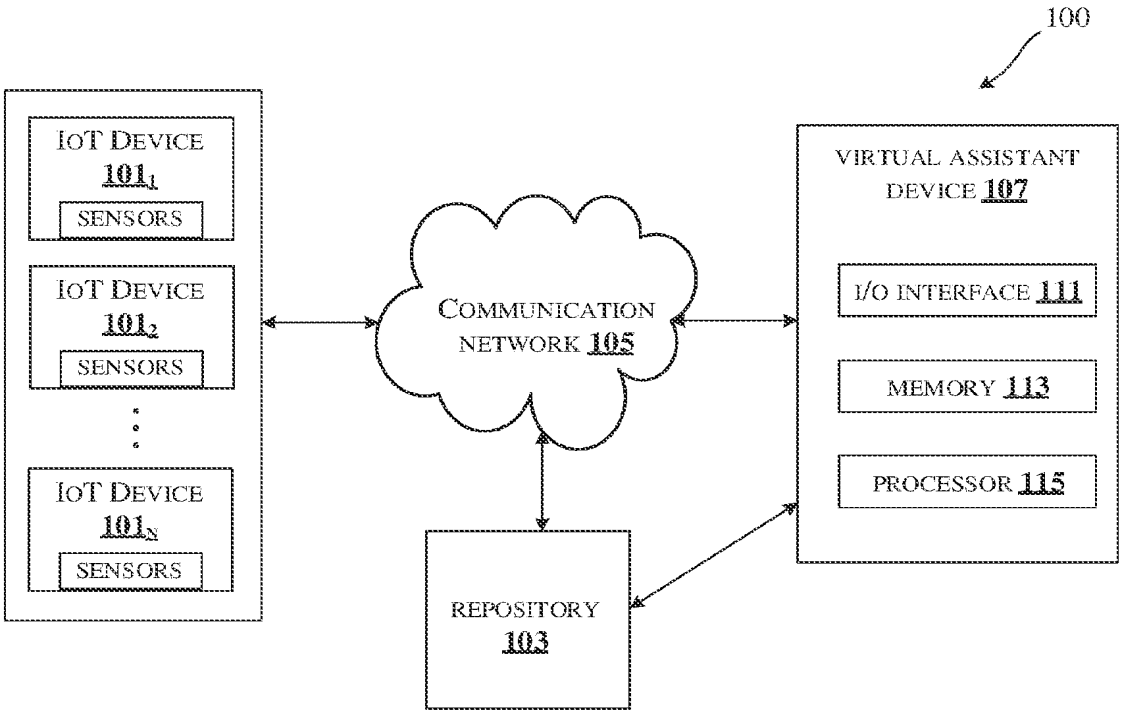

Fig. 1

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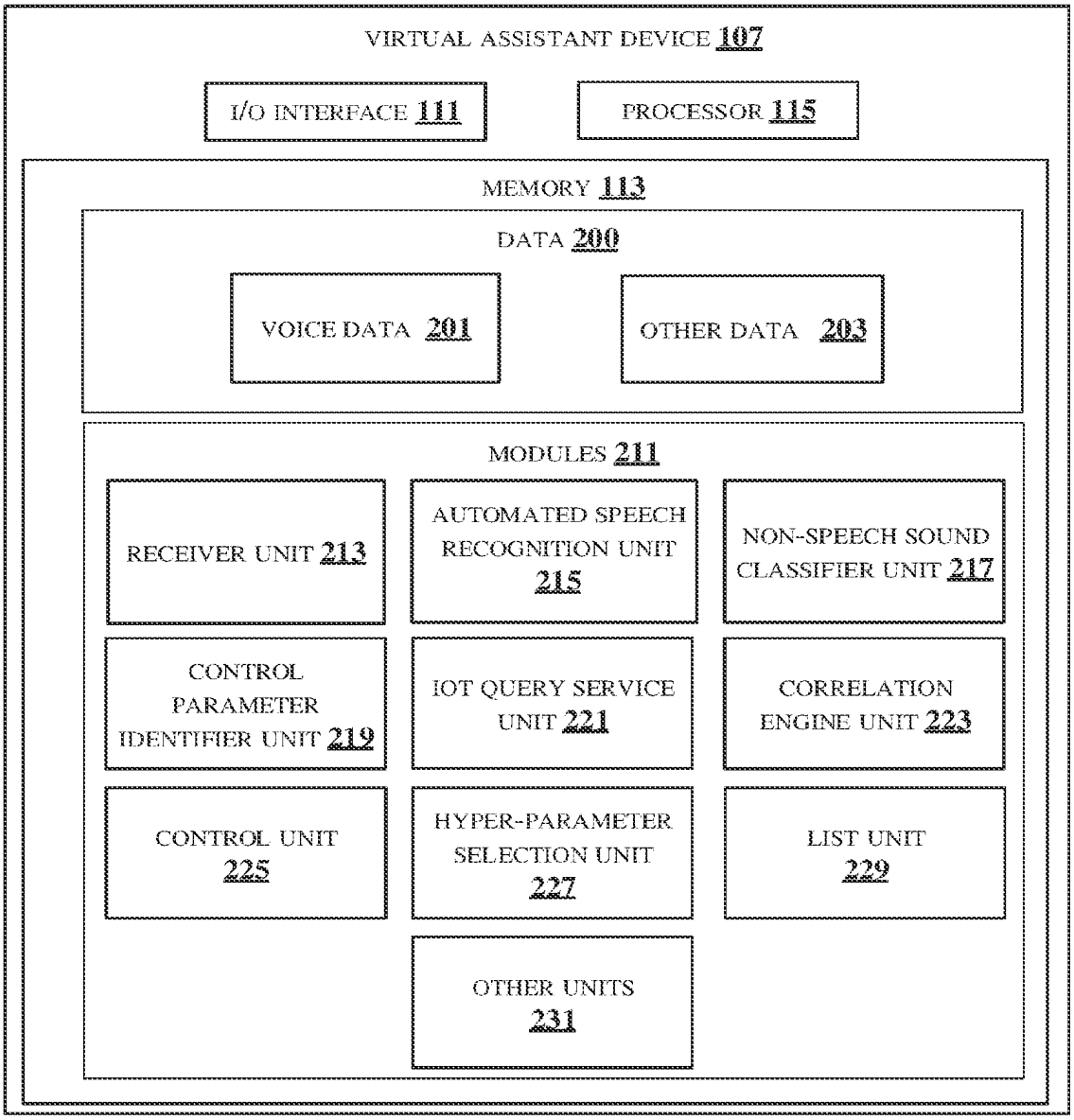

Fig. 2

R RAMYA RAO
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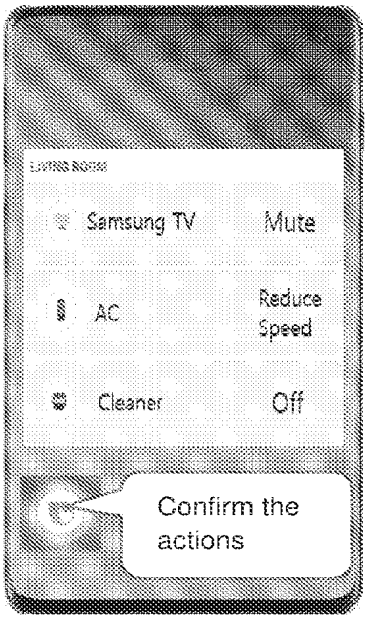

Fig. 3

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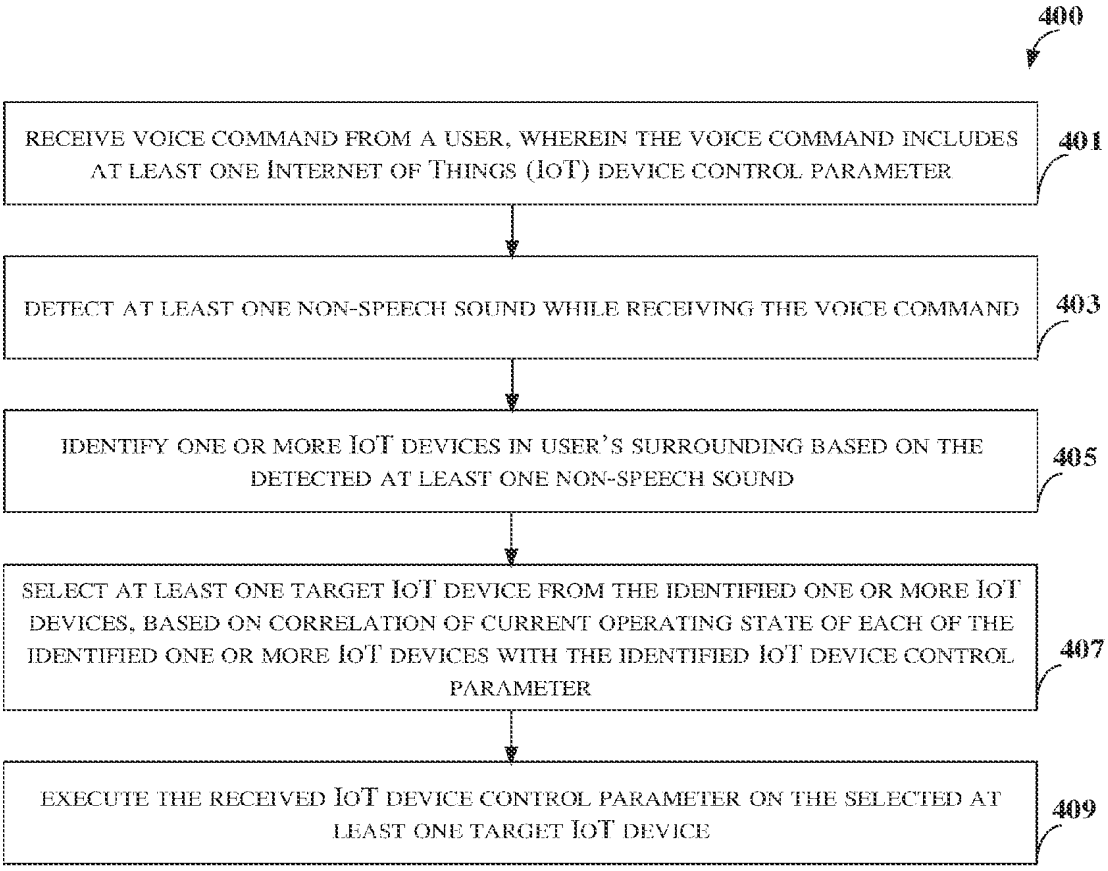

Fig. 4a

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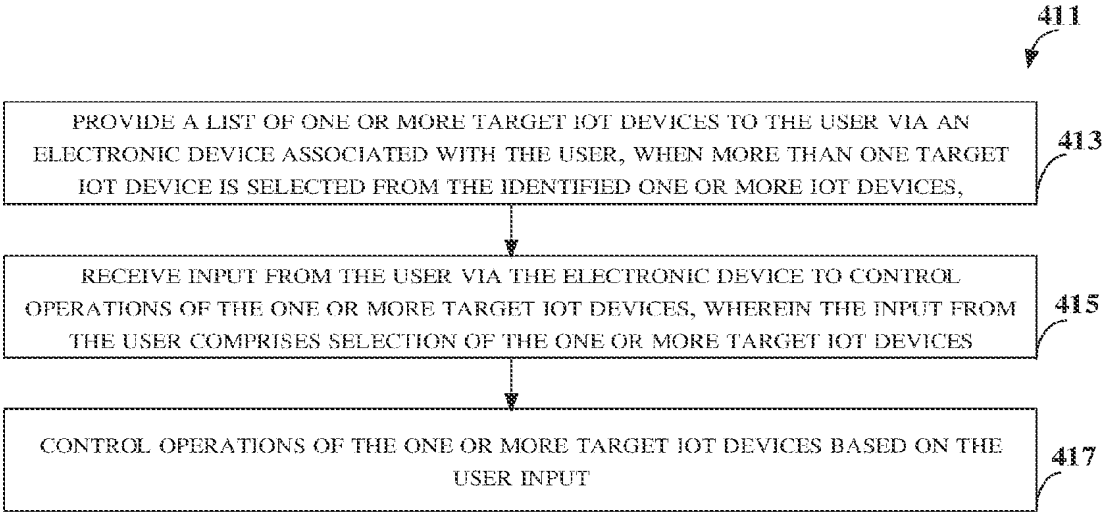

Fig. 4b

R RAMYA RAO
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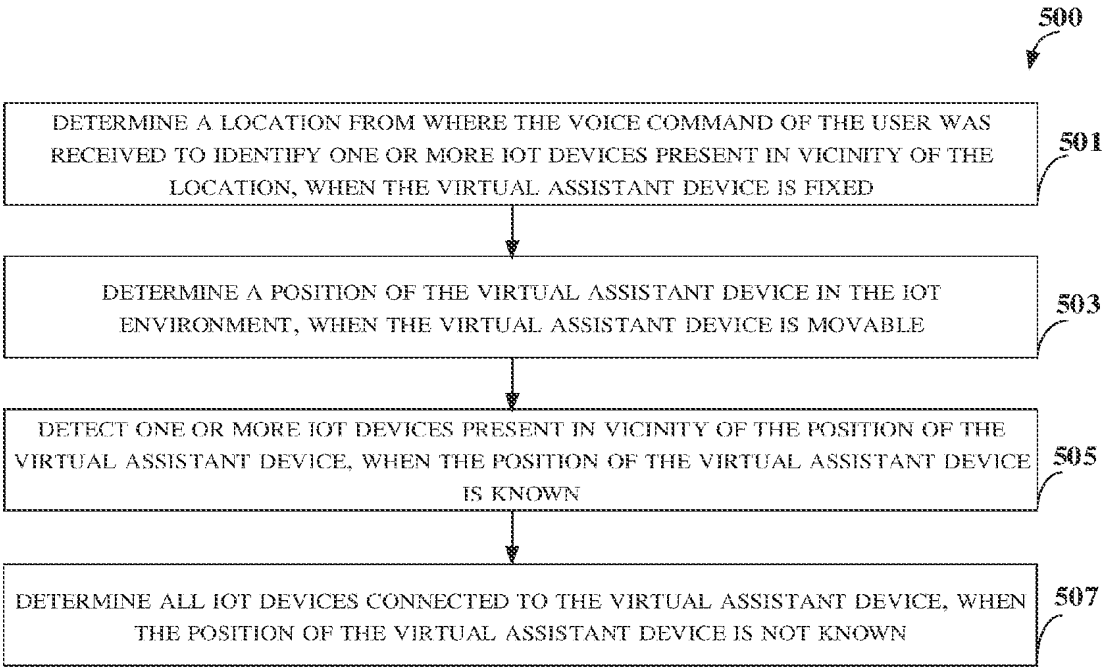

Fig. 5

R RAMYA RAO
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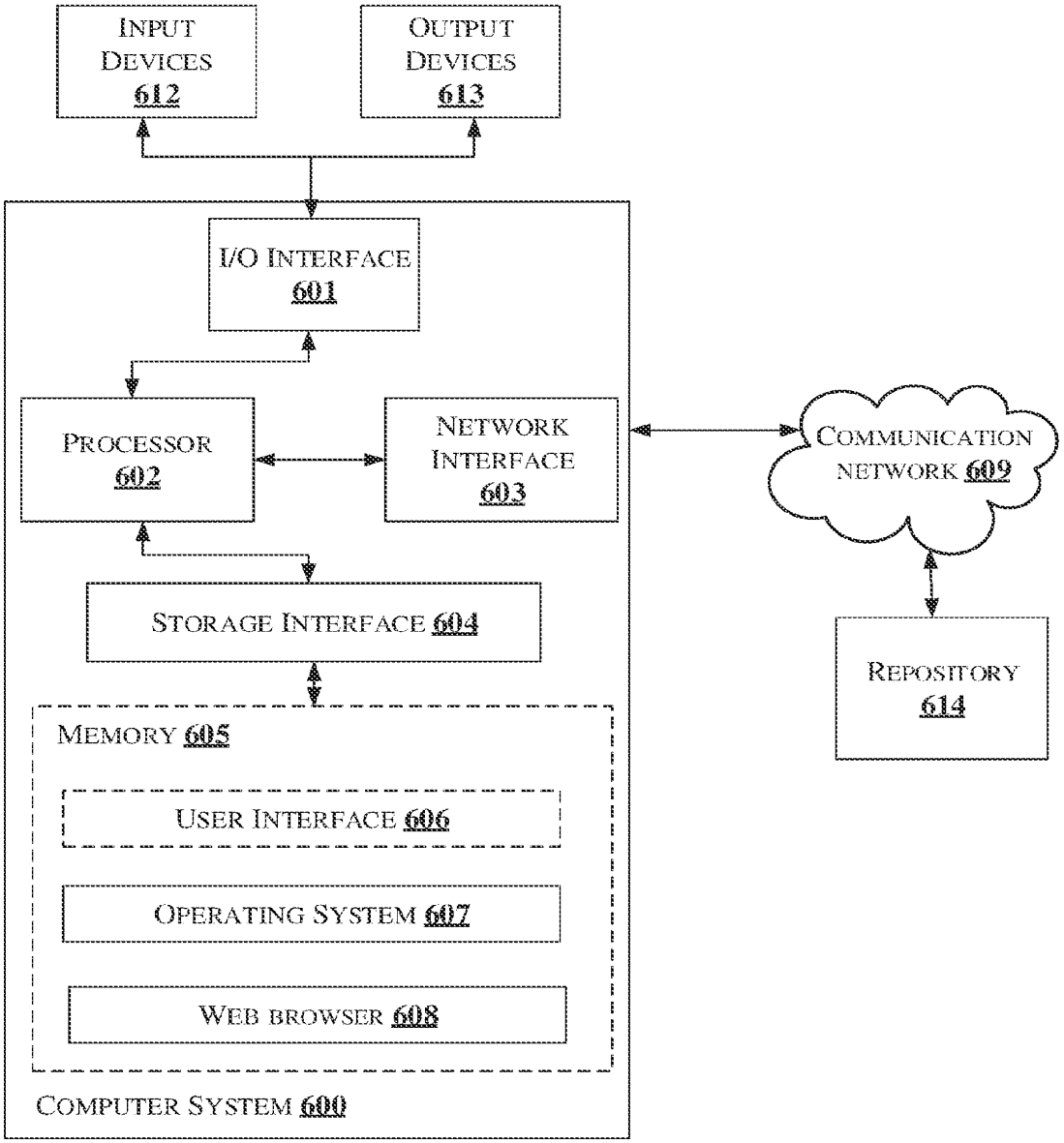

Fig. 6

R RAMYA RAO
OF K & S PARTNERS
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PTO/SB/08a (01-25)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

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If you wish to add additional U.S. Published Application citation information, please click the Add button Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	202041005143	IN	A	2021-08-13	TAYSHETE et al.		☐

If you wish to add additional Foreign Patent Document citation information, please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18084081
	Filing Date	2022-12-19
	First Named Inventor	Abhinav GABA
	Art Unit	2656
	Examiner Name	Nandini SUBRAMANI
	Attorney Docket Number	0503-0636

	1	Indian Hearing Notice dated May 14, 2025, issued in Indian Application No. 202111061923	☒

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☐ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☒ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/James G. POHLMAN/	Date (YYYY-MM-DD)	2025-06-17
Name/Print	James G. Pohlman	Registration Number	68,921

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

68103 7590 03/18/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

TITLE OF INVENTION: METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/18/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
SUBRAMANI, NANDINI	2656	704-202000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Jefferson IP Law, LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Samsung Electronics Co., Ltd.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Suwon-si, Republic of Korea

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /James G. POHLMAN/ Date June 17, 2025

Typed or printed name James G. Pohlman Registration No. 68,921

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/084,081	**06/17/2025 03:19:47 PM Z ET**	**0503-0636**

Title of Invention

METHOD AND SYSTEM FOR MITIGATING UNWANTED AUDIO NOISE IN A VOICE ASSISTANT-BASED COMMUNICATION ENVIRONMENT

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3982	FILED BY	Soo Oh
PATENT CENTER #	70941796	AUTHORIZED BY	Maeng-Ho SHIN
CUSTOMER #	68103	FILING DATE	12/19/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Abhinav GABA

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 1003	**E20256GF20588515**	**Soo Oh**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
504100	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	280.00	1	280.00
1501	UTILITY ISSUE FEE	1290.00	1	1290.00
			TOTAL AMOUNT:	**$1,570.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as

described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	12/19/2022	Abhinav GABA	0503-0636	3982

68103 7590 06/27/2025

Jefferson IP Law, LLP
1130 Connecticut Ave., NW, Suite 420
Washington, DC 20036

EXAMINER	
SUBRAMANI, NANDINI	

ART UNIT	PAPER NUMBER
2656	

NOTIFICATION DATE	DELIVERY MODE
06/27/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

usdocketing@jeffersonip.com

CORRECTED ***Notice of Allowability***	**Application No.** 18/084,081	**Applicant(s)** GABA et al.	
	Examiner NANDINI SUBRAMANI	**Art Unit** 2656	**AIA (First Inventor to File) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to IDS filed 06/17/2025.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1,4-9 and 12-16. . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 06/17/2025.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/NANDINI SUBRAMANI/ Examiner, Art Unit 2656	/BHAVESH M MEHTA/ Supervisory Patent Examiner, Art Unit 2656

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18084081
Filing Date	2022-12-19
First Named Inventor	Abhinav GABA
Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Inventor or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	202041005143	IN	A	2021-08-13	TAYSHETE et al.		☐

If you wish to add additional Foreign Patent Document citation information, please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.S./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

	1	Indian Hearing Notice dated May 14, 2025, issued in Indian Application No. 202111061923	☒

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/NANDINI SUBRAMANI/	Date Considered	06/25/2025

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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First Named Inventor	Abhinav GABA
Art Unit	2656
Examiner Name	Nandini SUBRAMANI
Attorney Docket Number	0503-0636

TIMING STATEMENT

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OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☐ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☒ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

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☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/James G. POHLMAN/	Date (YYYY-MM-DD)	2025-06-17
Name/Print	James G. Pohlman	Registration Number	68,921

PC.1.19.25

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.S./

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/084,081	07/22/2025	12367893	0503-0636	3982

68103 7590 07/09/2025

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ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 136 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

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68103 7590 07/22/2025

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EXAMINER	
SUBRAMANI, NANDINI	

ART UNIT	PAPER NUMBER
2656	

NOTIFICATION DATE	DELIVERY MODE
07/22/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

usdocketing@jeffersonip.com

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EGRANT NOTIFICATION

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The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants