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(54) METHOD AND SYSTEM FOR TRANSFORMING LANGUAGE INPUTS INTO HAPTIC OUTPUTS

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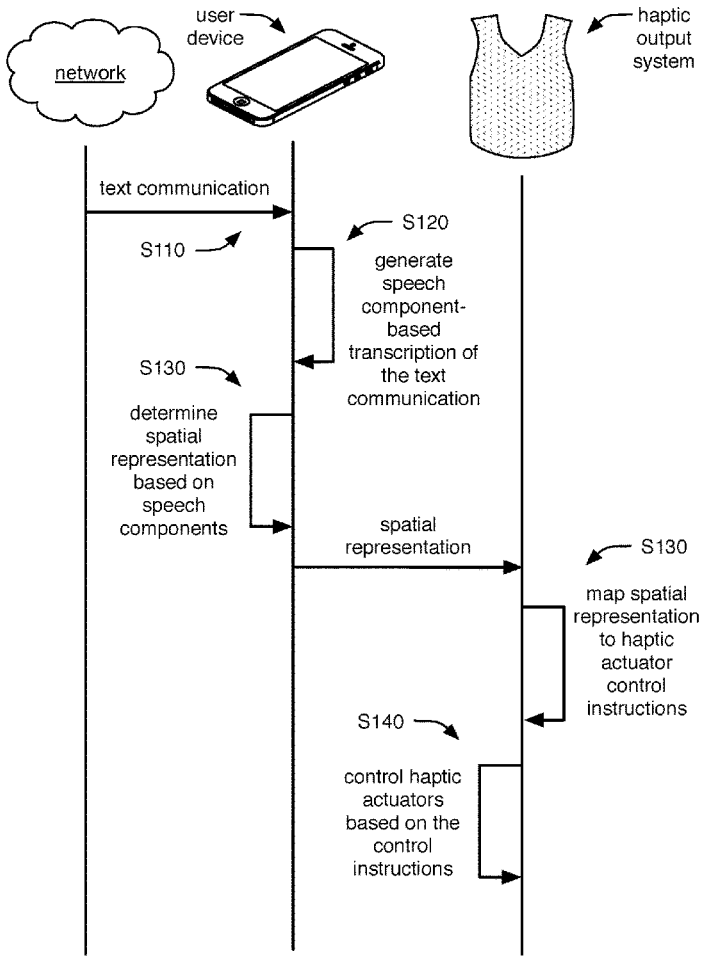
(52) **U.S. Cl.**

CPC ***G10L 21/16*** (2013.01); *G10L 13/08* (2013.01); ***G08B 6/00*** (2013.01); ***G10L 15/22*** (2013.01)

(57) **ABSTRACT**

A method for transforming input information into outputs, preferably including: receiving input information; transforming the input information into a set of intermediary components; implementing a transformation model with the set of intermediary components, the transformation model operable to encode the set of intermediary components across a set of output parameters in a device domain associated with a device; and executing control signals operable to deliver outputs, based on the set of output parameters, to a user of the device.



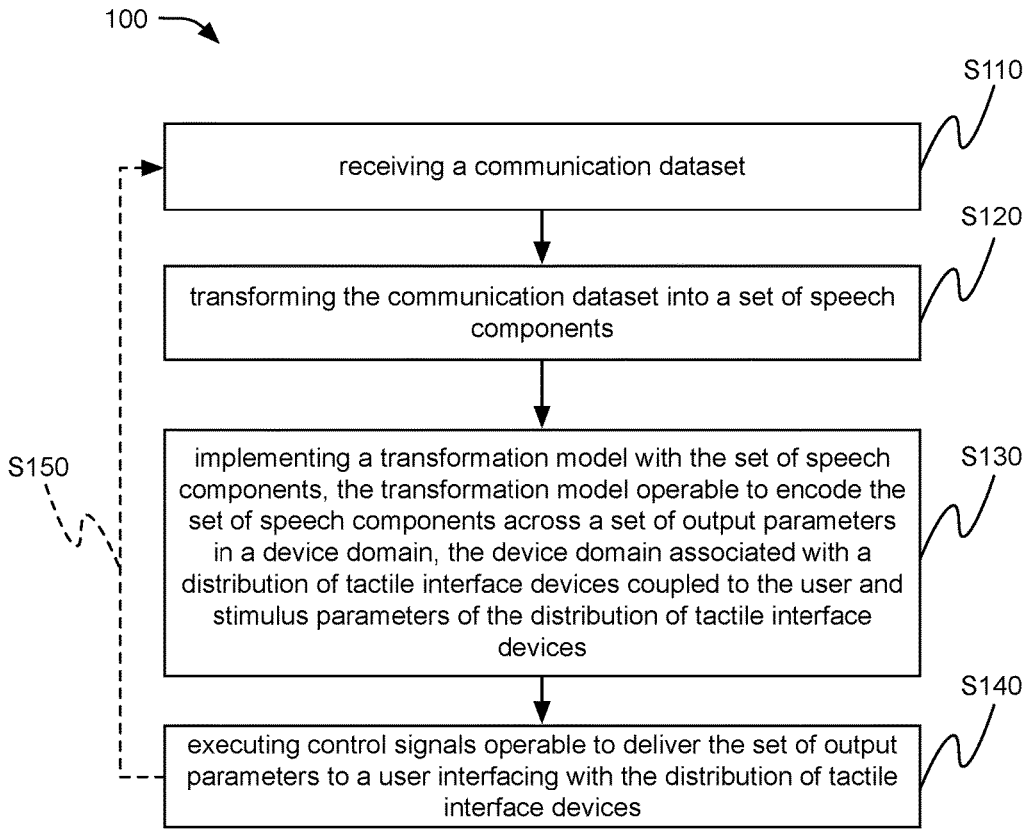


FIGURE 1A

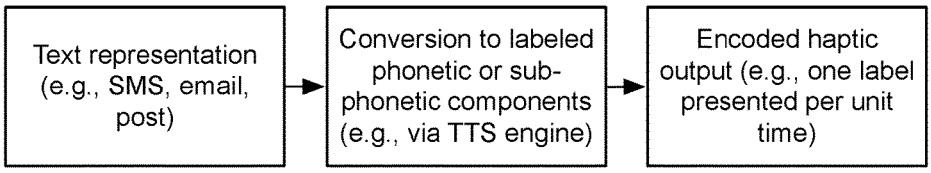


FIGURE 1B

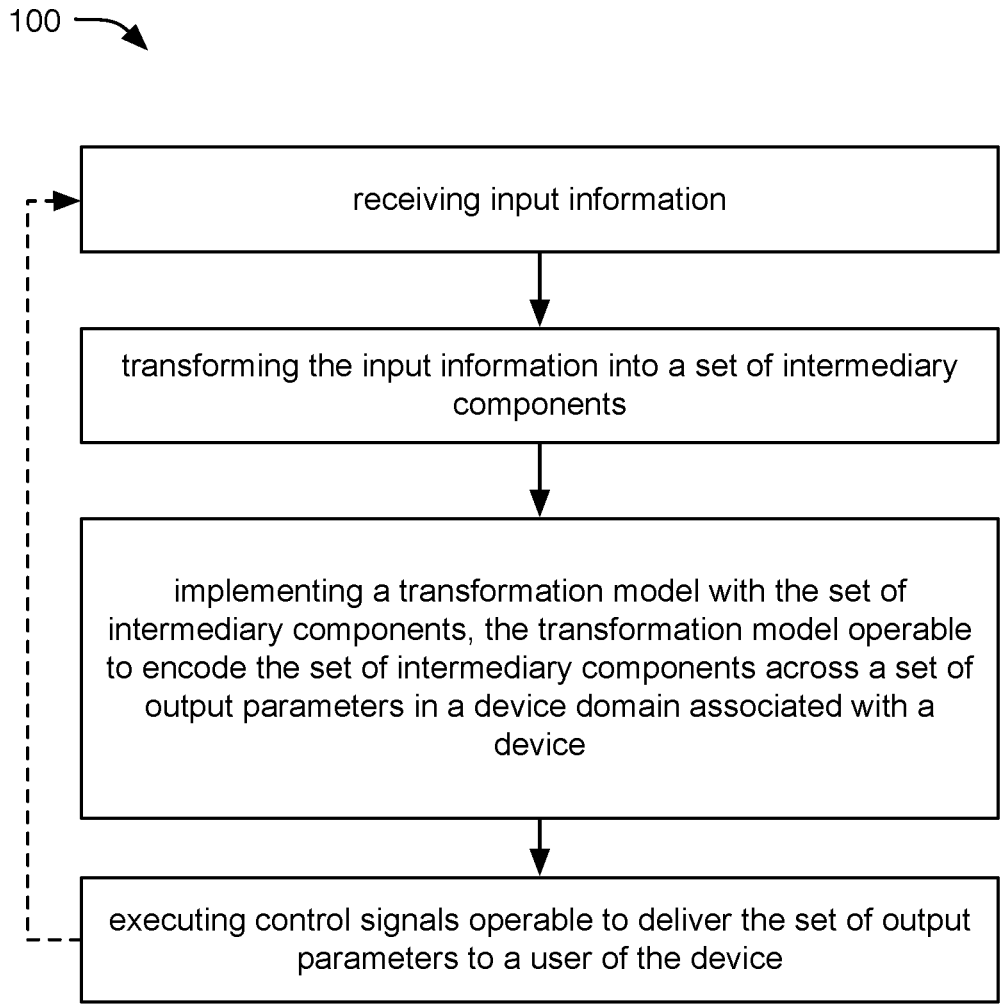

100
receiving input information
transforming the input information into a set of intermediary components
implementing a transformation model with the set of intermediary components, the transformation model operable to encode the set of intermediary components across a set of output parameters in a device domain associated with a device
executing control signals operable to deliver the set of output parameters to a user of the device

FIGURE 1C

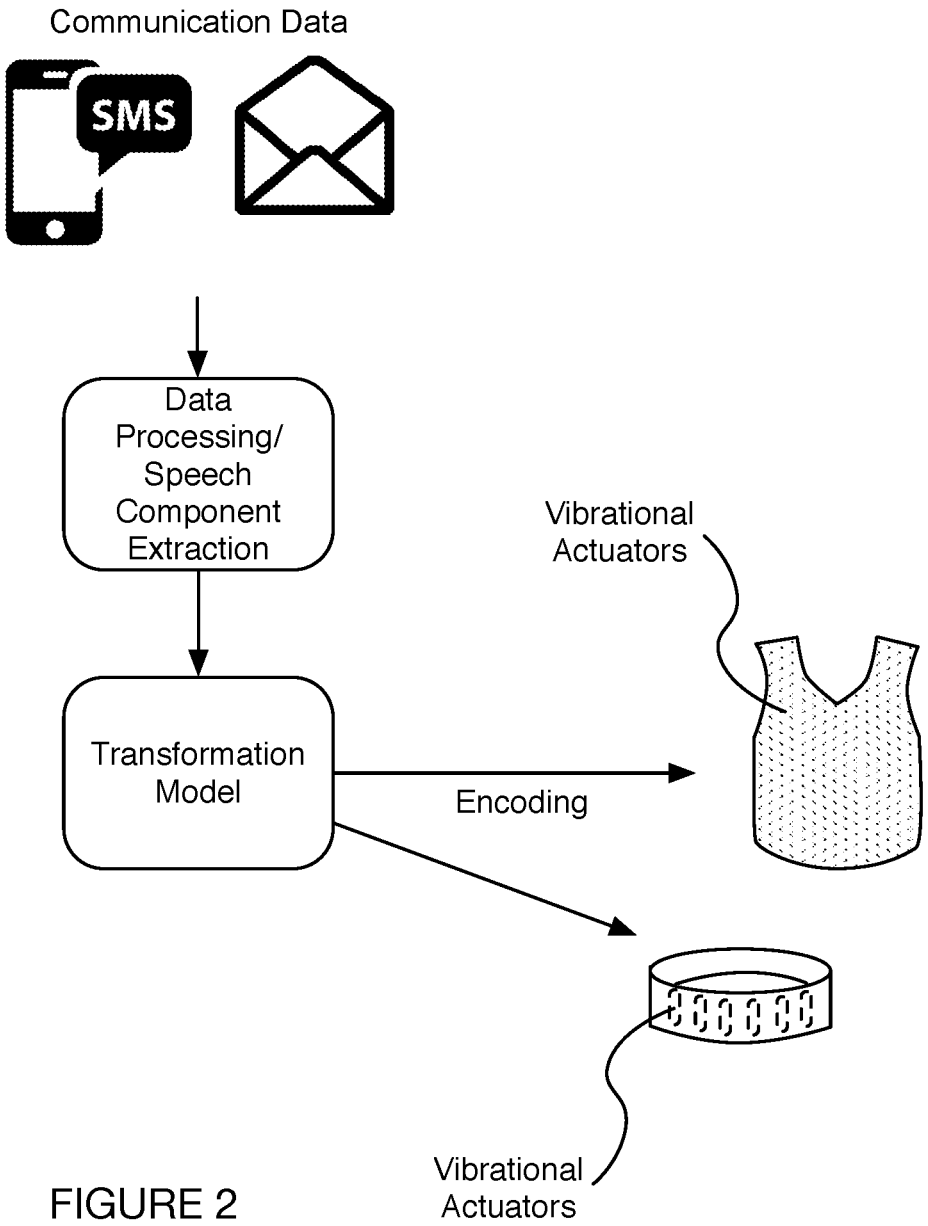

Communication Data
SMS
Data Processing/ Speech Component Extraction
Transformation Model
Encoding
Vibrational Actuators
Vibrational Actuators

FIGURE 2

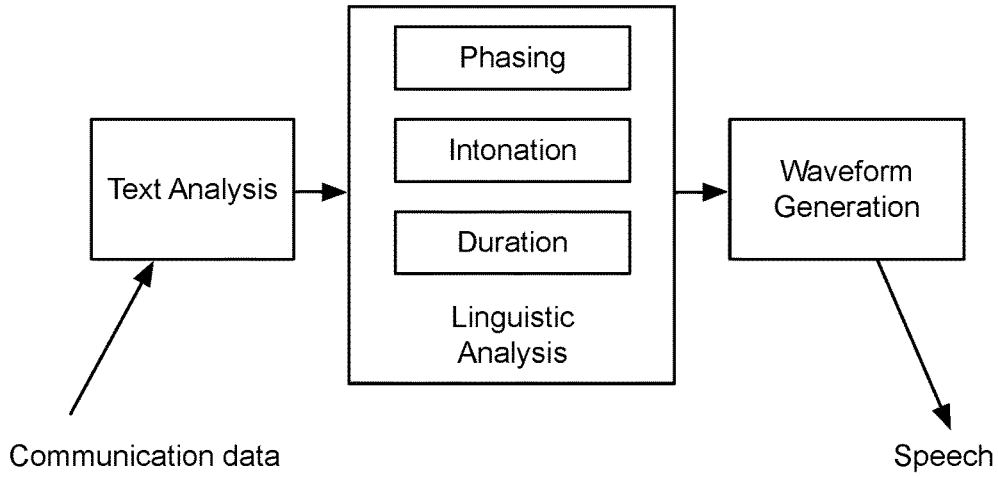

Phasing
Intonation
Duration
Linguistic Analysis
Text Analysis
Waveform Generation
Communication data
Speech

FIGURE 3

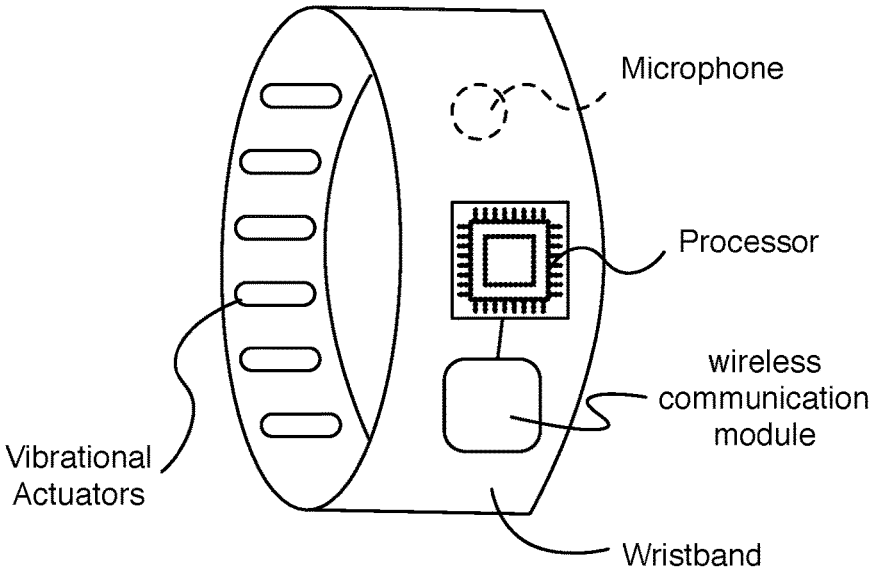


FIGURE 4A

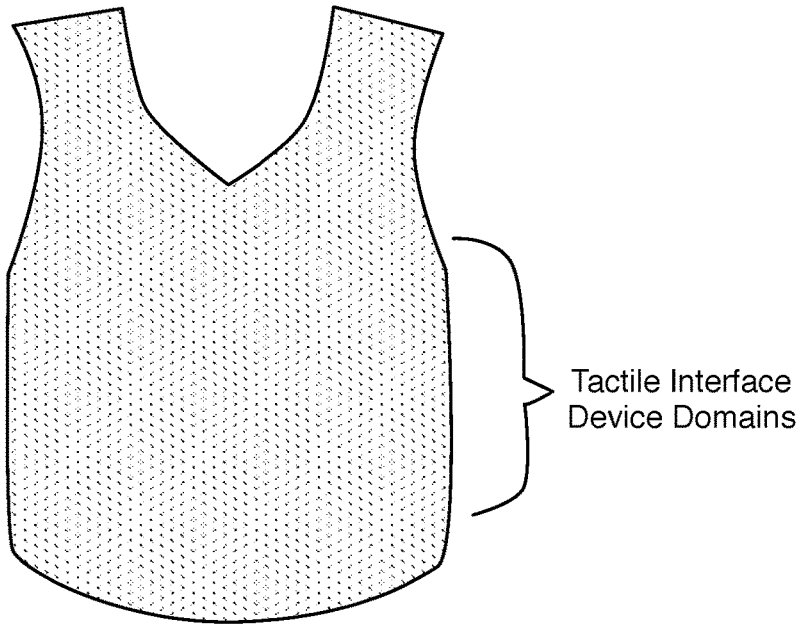


FIGURE 4B

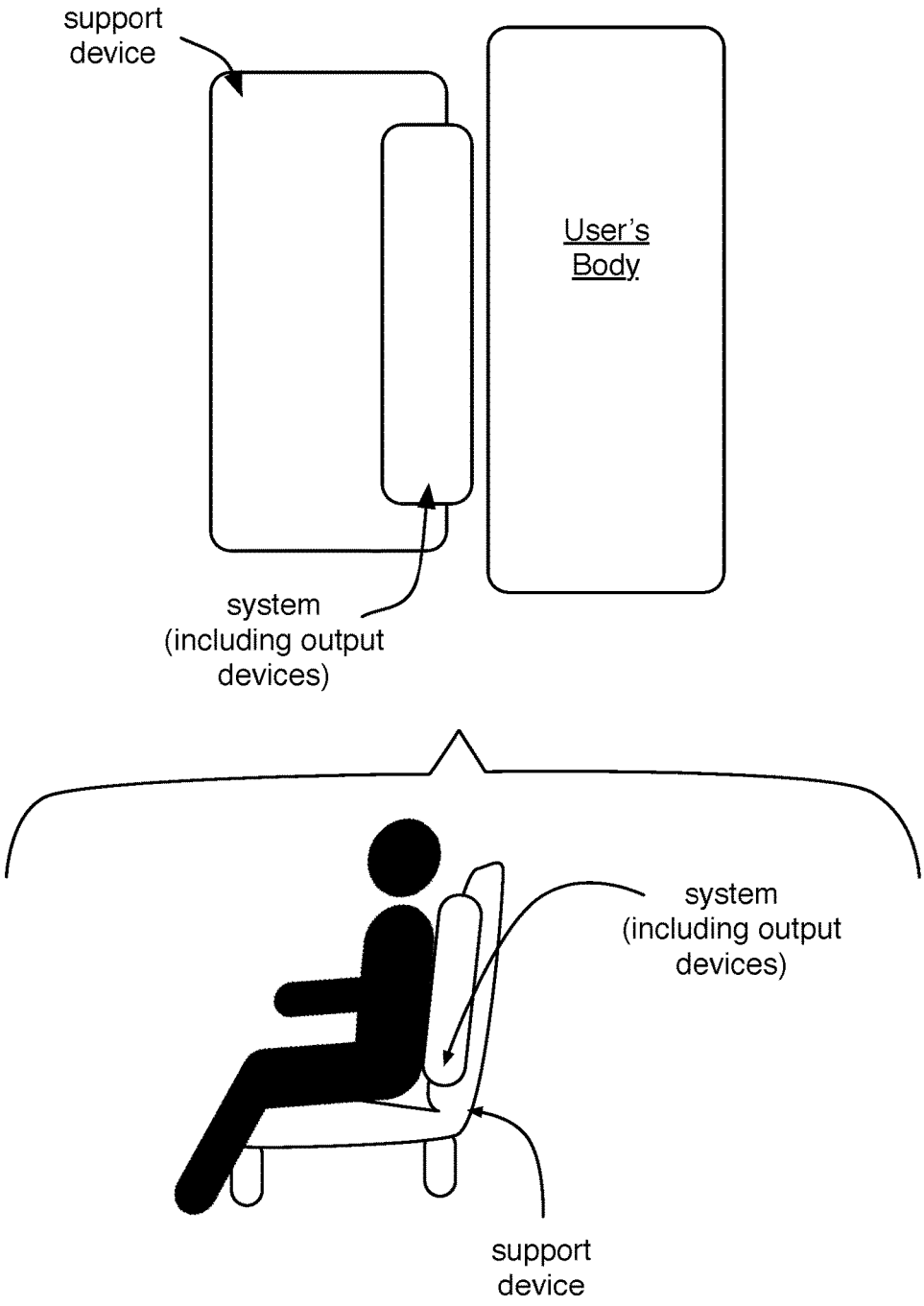

support device
User's Body
system (including output devices)
system (including output devices)
support device

FIGURE 4C

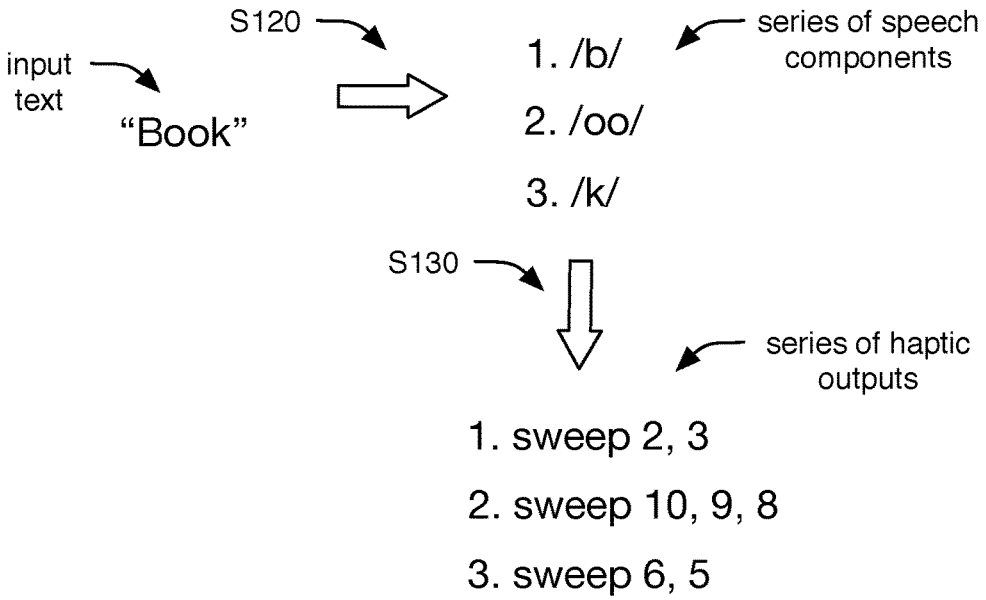


FIGURE 5A

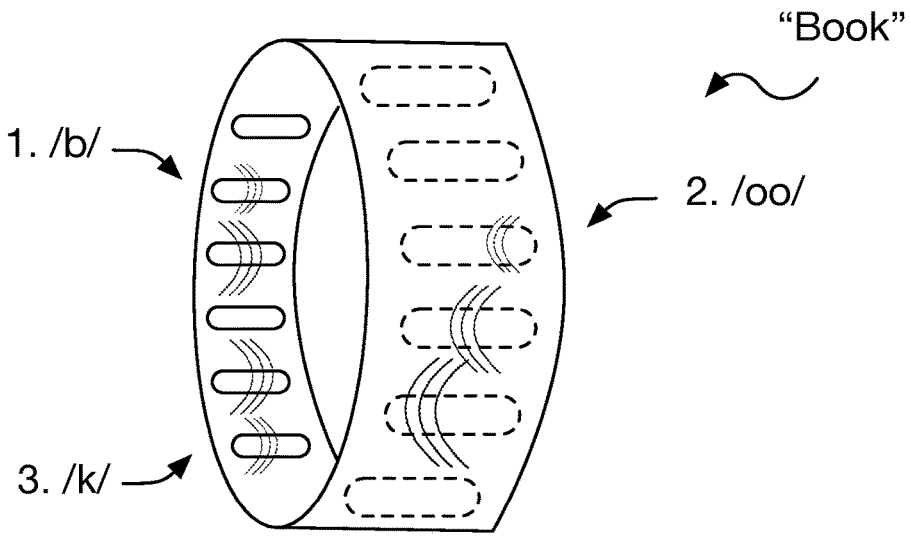


FIGURE 5B

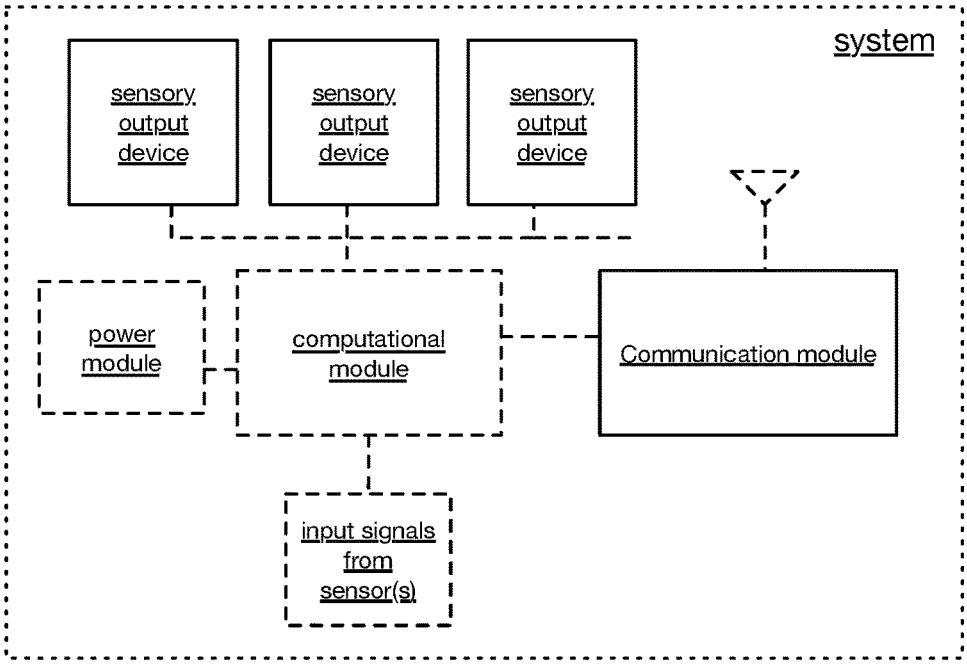


FIGURE 6A

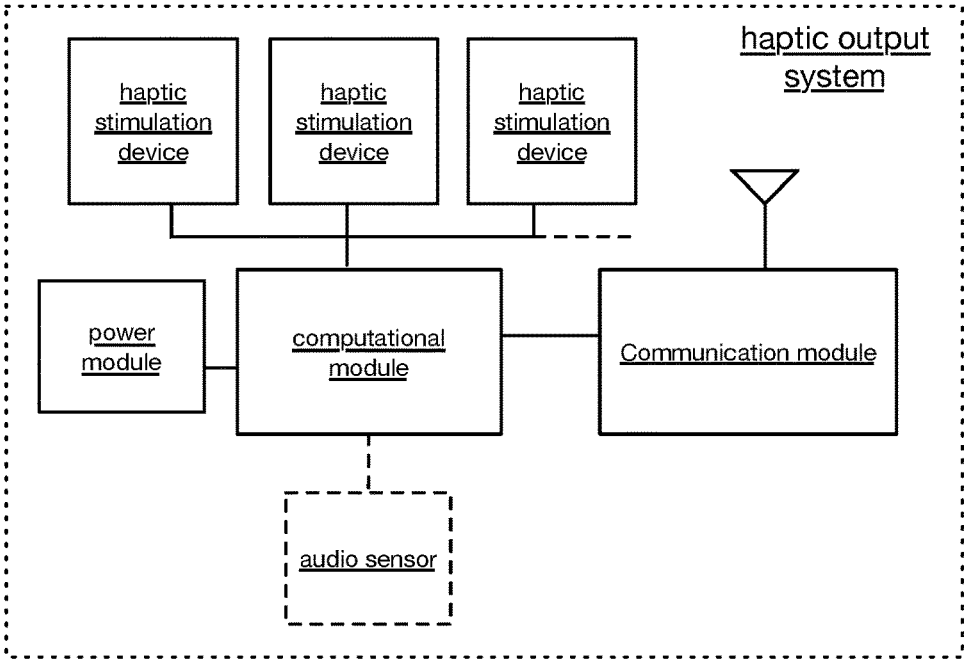


FIGURE 6B

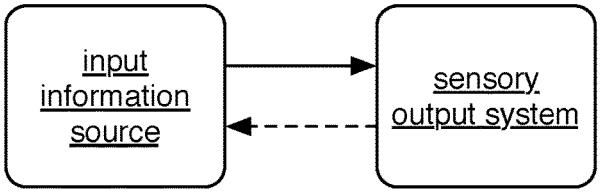


FIGURE 7A

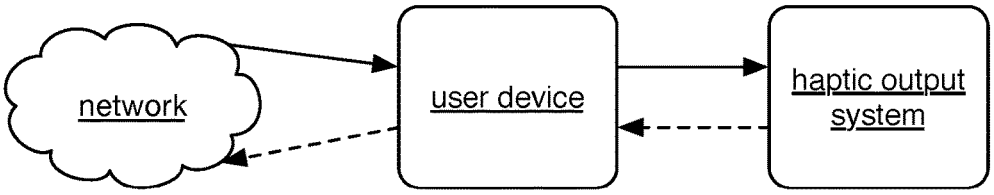


FIGURE 7B

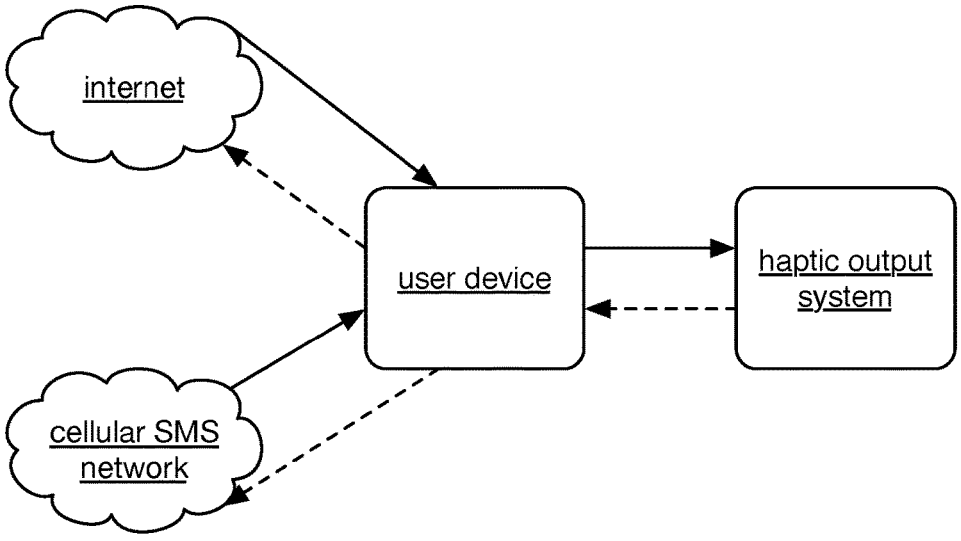


FIGURE 7C

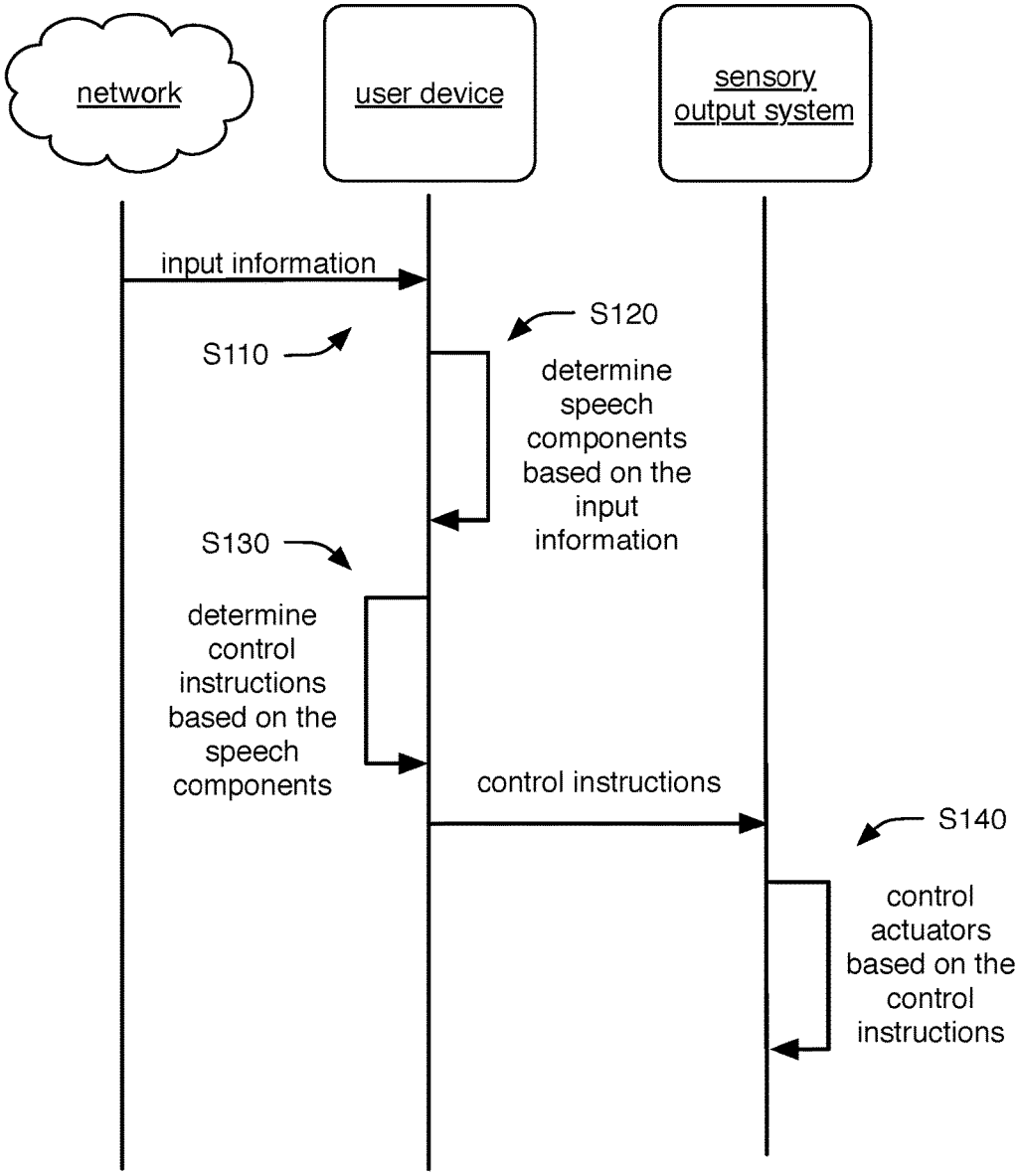

network
user device
sensory output system
input information
S110
S120
determine speech components based on the input information
S130
determine control instructions based on the speech components
control instructions
S140
control actuators based on the control instructions

FIGURE 8A

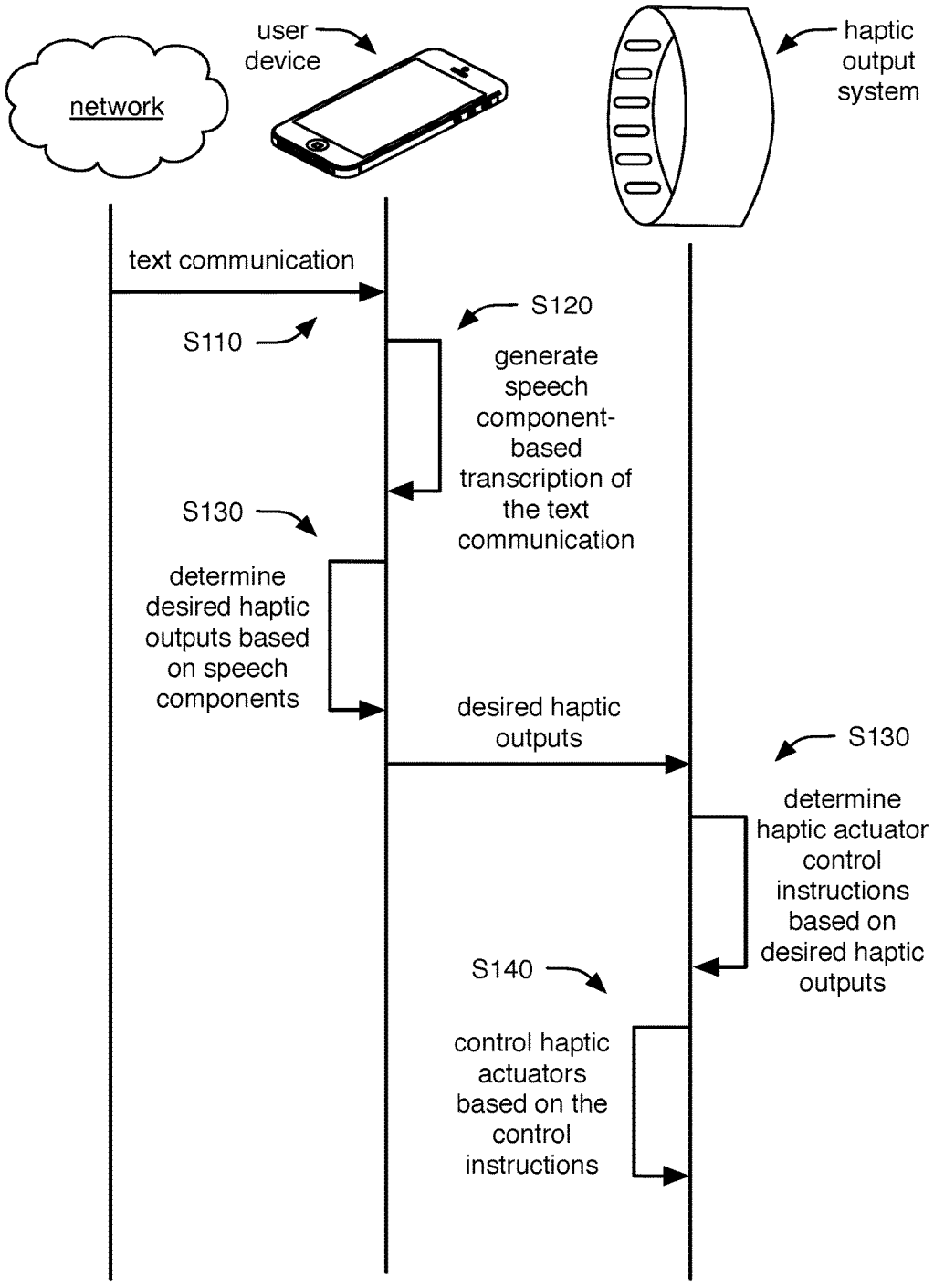

network
user device
haptic output system
text communication
S110
S120
generate speech component-based transcription of the text communication
S130
determine desired haptic outputs based on speech components
desired haptic outputs
S130
determine haptic actuator control instructions based on desired haptic outputs
S140
control haptic actuators based on the control instructions

FIGURE 8B

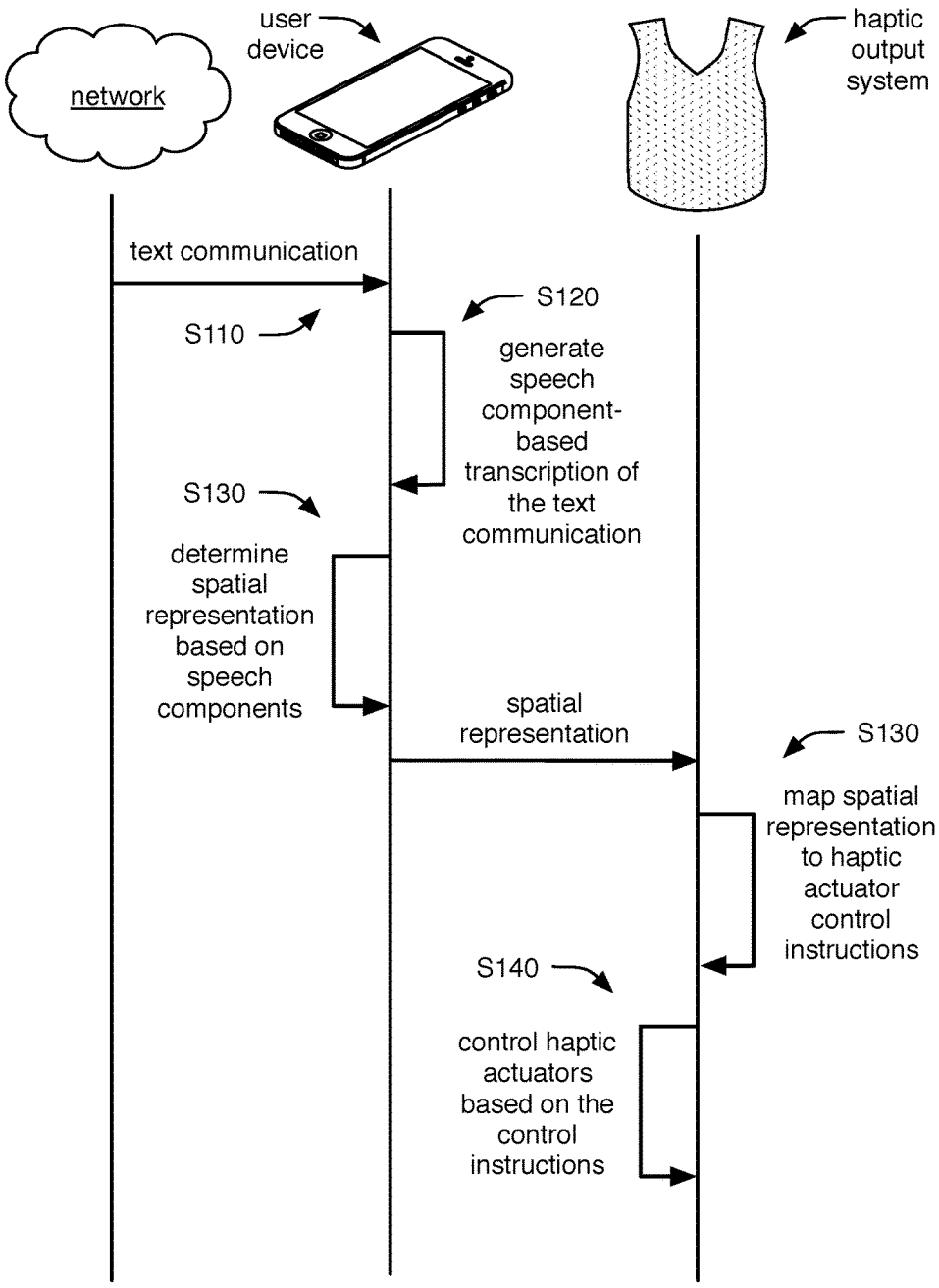

network
user device
haptic output system
text communication
S110
S120
generate speech component-based transcription of the text communication
S130
determine spatial representation based on speech components
spatial representation
S130
map spatial representation to haptic actuator control instructions
S140
control haptic actuators based on the control instructions

FIGURE 8C

METHOD AND SYSTEM FOR TRANSFORMING LANGUAGE INPUTS INTO HAPTIC OUTPUTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 15/795,054, filed 26 Oct. 2017 which claims the benefit of U.S. Provisional Application Ser. No. 62/460,028, filed on 16 Feb. 2017, and U.S. Provisional Application Ser. No. 62/486,319, filed on 17 Apr. 2017, each of which is incorporated in its entirety by this reference.

TECHNICAL FIELD

[0002] This invention relates generally to the field of information delivery, and more specifically to a new and useful methods and systems for transforming language inputs into haptic outputs.

BACKGROUND

[0003] Perception of information is an important part of an individual's ability to integrate into society, interact with objects in the environment, and perceive and respond to risks. Traditional devices for supporting individuals with sensory impairments, or other related conditions are deficient because they are highly invasive and require surgical implantation, risky (e.g., in terms of success rates, available only to certain demographics (e.g., age demographics), inconvenient to use, and/or expensive. Outside of the context of sensory impairment, it can be useful to have another modality for receiving information (e.g., derived from language inputs, derived from visual sources, derived from audio sources, etc.) when either redundancy is beneficial, or if it is inconvenient or infeasible to receive information using a more conventional modality. Available technologies are still limited in relation to how information from one sense can be encoded and processed using another sense (e.g., with respect to upsampling and downsampling issues, with respect to acuity of sensory receptors for a given sensory modality), density of information that can be processed and encoded, cost, ease of use, and adoption by users.

[0004] Thus, there is a need in the field of information delivery for a new and useful method and system for transforming language inputs into haptic outputs. This invention provides such a new and useful method and system.

BRIEF DESCRIPTION OF THE FIGURES

[0005] FIGS. **1**A and **1**B depict schematics of an embodiment of a method for transforming language inputs into haptic outputs;

[0006] FIG. **1**C depicts a schematic representation of the method;

[0007] FIG. **2** depicts a schematic of a system and method for transforming language inputs into haptic outputs;

[0008] FIG. **3** depicts a variation of a portion of a method for transforming language inputs into haptic outputs;

[0009] FIGS. **4**A-**4**C depict examples of a device used in a system and/or method for transforming language inputs into haptic outputs;

[0010] FIG. **5**A depicts a specific example of transforming input text into haptic outputs according to an embodiment of the method;

[0011] FIG. **5**B depicts a specific example of an output of an embodiment of a method for transforming language inputs into haptic outputs;

[0012] FIGS. **6**A-**6**B are schematic representations of an embodiment of elements of the system and a variation of the embodiment, respectively;

[0013] FIGS. **7**A-**7**C are schematic representations of a first, second, and third variation of the system, respectively; and

[0014] FIGS. **8**A-**8**C are schematic representations of a first, second, and third variation of the method, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] The following description of preferred embodiments of the invention is not intended to limit the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

1. Overview.

[0016] A method **100** for transforming input information into outputs (e.g., for transforming language inputs into haptic outputs) preferably includes (e.g., as shown in FIG. **1**C): receiving input information; transforming the input information into a set of intermediary components; implementing a transformation model with the set of intermediary components, the transformation model operable to encode the set of intermediary components across a set of output parameters in a device domain associated with a device; and executing control signals operable to deliver outputs, based on the set of output parameters, to a user of the device; and can optionally include repeating Blocks S**110**-S**140** (e.g., upon reception of additional input information). For example (e.g., as shown in FIGS. **1**A, **1**B, and/or **2**), an embodiment of the method **100** can include: receiving a communication dataset S**110**; transforming the communication dataset into a set of speech components (or other representative components) S**120**; implementing a transformation model with the set of speech components, the transformation model operable to encode the set of speech components across a set of output parameters in a device domain, the device domain associated with a distribution of tactile interface devices coupled to the user and stimulus parameters of the distribution of tactile interface devices S**130**; and executing control signals operable to deliver the set of output parameters to a user interfacing with the distribution of tactile interface devices S**140**; and can optionally include repeating Blocks S**110**-S**140** upon reception of additional incoming communication datasets S**150**.

[0017] The method **100** preferably functions to convert data associated with communication to another output format that is perceptible by a user through another sensory modality. In specific examples, the method can function to convert textual communication data to outputs perceptible by a user through touch sensation, in a manner that allows the user to perceive the message contained in the textual communication data through touch-based stimuli. As such, textual communication data can be continuously converted to touch-based stimuli using "speech"-style encoding, thereby providing a user with a haptic experience of textual-based communications (e.g., text messages such as messages received via SMS, emails, status updates on social media, transcribed messages, etc.). Alternatively, the method

can function to convert data associated with communication to another representation (e.g., a non-speech representation, through another encoding that map source to output in a 1:1 manner).

[0018] As such, the method **100** can be adapted to applications involving sensory substitution, whereby a user is unable to visually perceive textual communications (e.g., due to situational factors, due to visual impairments, etc.), but has a fully functioning sensation of touch. Additionally or alternatively, the method **100** can be adapted to applications involving sensory boosting for users for whom improvements in sensory functions of vision and/or touch are beneficial. Additionally or alternatively, the method **100** can be adapted to applications involving users who do not have visual or auditory sensory impairments, but who are performing activities where receiving textual communications would be distracting from the activities being performed (e.g., in relation to driving). Thus, the method **100** can allow a user to receive information that would otherwise be received through a different sensory modality. The method **100** preferably provides information to impaired users through touch sensation, However, the method **100** can additionally or alternatively implement any other suitable sensory substitution or sensory boosting regime.

[0019] As such, in specific examples, the method **100** can be used to allow a user to haptically receive communications originating in a textual format in a situation where it would not be beneficial for the user to divide his/her visual attention (e.g., in relation to operating a vehicle, in relation to being in a professional work environment, etc.).

[0020] The method **100** can be implemented using system components described in more detail below, and/or using an embodiment, variation, or example of the system described in U.S. application Ser. No. 14/750,626, titled "Providing Information to a User Through Somatosensory Feedback" and filed on 25 Jun. 2015, which is herein incorporated in its entirety by this reference. However, the method **100** can additionally or alternatively be implemented using any other suitable system or system components for providing information to users through feedback devices.

2. System.

[0021] The system preferably receives input information from one or more communication modules, and provides stimuli (e.g., through sensory output devices in proximity to the user), and can optionally include one or more sensors (e.g., configured to receive and/or generate one or more input signals), power modules, and/or computational modules (e.g., as shown in FIGS. **6**A-**6**B). The device components associated with the stimuli are preferably disposed in a single device, but can additionally or alternatively be disposed across a plurality of devices, and/or be disposed in any other suitable manner.

[0022] The stimuli can be provided by a plurality of tactile interface devices (e.g., haptic actuators, electrical stimulators, etc.) in a spatial distribution (e.g., multidimensional spatial distribution), each of which can provide a variety of available output stimuli with different stimulus parameters (e.g., as shown in FIGS. **4**A-**4**B). The device(s) can provide haptic stimuli through the tactile interface devices, and in specific examples, can include an array of tactile interface devices operable to provide configurable haptic stimuli to a user. The tactile interface devices can include vibration motors (e.g., eccentric rotating mass (ERM) devices), Linear Resonant Actuators (LRAs), piezoelectric devices, and/or any other suitable devices (and/or combinations thereof, such as hybrid devices incorporating both ERM and LRA elements).

[0023] The device(s) can additionally or alternatively be operable to provide one or more of: auditory stimuli, electrical stimuli (e.g., peripheral stimuli, etc.), olfactory stimuli, taste stimuli, and any other suitable form of stimulus.

[0024] The spatial distribution (e.g., array) of tactile interface devices can have a density from 5 devices per cm^2 to 50 devices per cm^2, or any other suitable density. Furthermore, the spatial distribution of tactile interface devices can be configured with any suitable morphological aspects. The tactile interface devices are preferably arranged in one or more arrays (e.g., high-density arrays) but additionally or alternatively arrays of any suitable density. The arrays can include multidimensional arrays (e.g., planar array, 3-dimensional volumetric array, array defined substantially along one or more device surfaces, etc.), single-dimensional arrays (e.g., linear array, curvilinear array, etc.), and/or any other suitable arrays. For example, the device can include a two-dimensional array (e.g., defined substantially on a plane, defined on a curved and/or bent surface, etc.). The arrays can be configured as one or more of: a circular array, an ellipsoidal array, a polygonal array (e.g., a triangular array, rectangular array, a pentagonal array, a hexagonal array, etc.), a circumscribing array, an amorphous array, an array substantially spanning the support structure with which the array is integrated, and any other suitable array type. Additionally or alternatively, the device can include an irregular distribution of tactile interface devices (e.g., arranged substantially on a surface and/or within a volume of the device) and/or any other suitable arrangement of tactile interface devices. Furthermore, the spatial distribution (e.g., array) can be configured across different layers of the overarching device coupled to the user.

[0025] In a first embodiment, as shown in FIG. **4**A, the array of tactile interface devices is integrated with a wrist-region wearable band device, wherein the array is distributed circumferentially about the band surface and coupled to electronics that facilitate provision of haptic stimuli. In this embodiment, the system comprises a housing operable to 1) contain electronics for powering the tactile interface devices and transitioning the tactile interface devices between different modes and 2) support the array of tactile interface devices while positioning the array of tactile interface devices in a manner such that the user can sense stimuli provided by the array. The housing can thus be coupled to or otherwise include a fastener that couples the system to a user. The fastener and housing can be of unitary construction or otherwise physically coextensive, or can be otherwise connected, coupled, or couplable. The fastener is preferably operable to be easily and/or repeatably fastened and unfastened manually by the user, and in specific examples, can include a latch, snap, buckle, clasp, hook-and-loop fastening mechanism, and/or any other suitable fastening mechanism, and/or can be operable to expand and contract (e.g., including an elastic element, such as an expansion band; including a deployment clasp, butterfly clasp, or other clasp that is physically coextensive when unclasped; etc.).

[0026] In a second embodiment, the tactile interface devices are configured to be carried with a user (e.g., worn by the user, in proximity to the user). In this embodiment, the tactile interface devices are preferably integrated into a

wearable garment, wherein the garment can comprise a top (e.g., shirt, vest, etc.), a bottom (e.g., pants, shorts, skirt, etc.), a headpiece (e.g., headband, earmuffs, hat, etc.), a backpack, an undergarment, socks, and any other suitable form of garment. Additionally or alternatively, the tactile interface devices can be configured to be mechanically coupled to the wearable garment (e.g., retained in one or more pockets of the garment, attached by fasteners such as buttons, clips, magnets, and/or hook-and-loop fasteners, attached by adhesive, etc.). Additionally or alternatively, the tactile interface devices can be configured to attach directly to a user (e.g., by suction, adhesive, etc.), preferably to one or more skin surfaces of the user. Additionally or alternatively, the tactile interface devices can be incorporated into one or more wearable devices (e.g., a head-mounted wearable device, etc.) and/or implanted devices. Additionally or alternatively, the tactile interface devices can be incorporated into prosthetic devices (e.g., lower limb prosthetics, upper limb prosthetics, facial prosthetics, etc.). In an example, such as shown in FIG. **4**B, the array of tactile interface devices can be integrated with a vest garment operable to be worn by a user as the user moves about in his/her daily life.

[0027] In a third embodiment, such as shown in FIG. **4**C, the tactile interface devices are configured to be mechanically coupled to the user by a support device that supports the user (e.g., by a support element of the support device). For example, the tactile interface devices can be integrated into the support element and/or arranged between the user and the support element (e.g., resting on top of the support element). The support devices can include seats, couches, beds, platforms (e.g., for sitting and/or standing on), walls, inclined surfaces (e.g., configured to support a leaning user), and/or any other suitable support devices, as described in U.S. application Ser. No. 15/661,934 titled "Method and System for Determining and Providing Sensory Experiences" and filed on 27 Jul. 2017, which is herein incorporated in its entirety by this reference.

[0028] Additionally or alternatively, the tactile interface devices can be disposed in a device configured to be held by the user (e.g., hand-held, held between an arm and torso of the user, held between the legs of the user, etc.). Additionally or alternatively, the tactile interface devices can be disposed in a device configured to rest on the user (e.g., retained against the user by gravity), such as a blanket. However, the tactile interface devices can additionally or alternatively be coupleable to the user (and/or otherwise configured to interact with the user) in any other suitable manner.

[0029] In some embodiments, some or all of the tactile interface devices (and/or any other suitable sensory output devices or other devices associated with the system) can be configured to be attached (e.g., permanently, removably, repeatably, etc.) to one or more attachment substrates, such as described in U.S. application Ser. No. 15/716,195 titled "System and Method for Sensory Output Device Attachment" and filed on 26 Sep. 2017, which is herein incorporated in its entirety by this reference. However, the tactile interface devices can additionally or alternatively be attached and/or otherwise coupled to the system in any other suitable manner.

[0030] Each tactile interface device (and/or other output unit) is preferably controlled by independent signals and configured to actuate independently from the other output units. Alternatively, a group of output units (e.g., a cluster or subset of the output units) can be independently controlled, such that the group of output units can operate independently from the other output units. Each controlled subset (e.g., individual output unit or cluster) can include one or more output units of the same or different types. In variations, in addition to or in alternative to controlling subsets of actuators (e.g., overlapping and/or disjoint subsets) to convey information as a function of features (e.g. in a first group for a first phoneme or other language component; in a second group, including only actuators not included in the first group, for a second phoneme or other language component; in a third group, including a subset of actuators of the first and second groups, for a third phoneme or other language component; etc.), subsets can be used to map a numerical input to a multi-actuator output. In an example, the actuators can be controlled to make the impression of upward and/or downward "sweeps" (e.g., turning actuators, such as spatially consecutive actuators, on and off in quick succession).

[0031] Each controlled subset is preferably individually identified, such that it has a locally unique identifier (e.g., index value), but can alternatively share an identifier with a second controlled subset of the device, or be otherwise identified. Each controlled subset (or the respective identifier) is preferably associated with a known, stored spatial position on the device (controlled subset position). The controlled subset position can include an arcuate position, radial position, position along an axis (e.g., lateral axis, longitudinal axis, etc.), set of coordinates, grid position, position relative to another device component (e.g., sensor, different output unit, etc.), or be any other suitable position. The controlled subset positions can be stored by the device (e.g., on volatile or non-volatile memory), can be encoded (e.g., implicitly, explicitly) via a re-indexing module (e.g., reindexing array), and/or stored (and/or otherwise made available) by any other suitable system. However, indexing and/or storing can additionally or alternatively be implemented in any other suitable manner.

[0032] Each controlled subset is preferably wired in parallel relative to other controlled subsets of the device, but can alternatively be wired in series, wired in a combination of in parallel and in series, or be wired in any other suitable manner (or not be wired). The controlled subsets of the device are preferably controlled by the processor, but can additionally or alternatively be controlled by a remote computing system (e.g., server system), external device (e.g., mobile device, appliance, etc.), and/or any other suitable computing system.

[0033] The system **100** can additionally or alternatively include one or more sensors (e.g., wherein sensors are included with the same device(s) that provide the stimuli, wherein sensors are distinct from the devices that provide the stimuli, etc.), which can optionally be configured to provide input information (e.g., supplementing and/or in place of the information received via the communication module). The sensors can include local sensors (e.g., sensing an environment of the device and/or user), remote sensors (e.g., sensing a separate environment), virtual inputs (e.g., associated with a virtual environment), and/or any other suitable sensors in any other suitable configuration.

[0034] For example, the sensors can include one or more: cameras (e.g., CCD, CMOS, multispectral, visual range, hyperspectral, stereoscopic, etc.), spatial sensors (e.g., inertial measurement sensors, accelerometer, gyroscope, altim-

eter, magnetometer, etc.), location sensors (e.g., GPS, GNSS, triangulation, trilateration, etc.), audio sensors (e.g., transducer, microphone, etc.), barometers, light sensors, temperature sensors, current sensor (e.g., Hall effect sensor), air flow meter, voltmeters, touch sensors (e.g., resistive, capacitive, etc.), proximity sensors, force sensors (e.g., strain gauge meter, load cell), vibration sensors, chemical sensors, sonar sensors, and/or any other suitable sensors. However, the system can additionally or alternatively include any other suitable sensors.

[0035] The communication modules can include wired communication modules (e.g., configured to communicate by wired data connections, such as Ethernet, USB, power line, etc.) and/or wireless communication modules (e.g., radios). The wireless communication modules preferably support (e.g., enable communication using) one or more wireless communication protocols (e.g., WiFi, Bluetooth, BLE, NFC, RF, IR, Zigbee, Z-wave, etc.). However, the system can additionally or alternatively include any other suitable communication modules.

[0036] The power module can include one or more power input elements, power storage elements, and/or any other suitable elements. The power module is preferably an electrical power module with an electrical input (e.g., electrical power connection such as a wired connector or inductive loop) and/or electrical storage element (e.g., battery, supercapacitor, etc.), but can additionally or alternatively include any other suitable power input and/or storage elements. The power module can include a battery that is preferably electrically coupled (e.g., connected by conductive wires) to the powered system components, wherein the computational module preferably controls power provision (e.g., as described below), but power provision and/or battery management can additionally or alternatively be performed by any other suitable components.

[0037] The computational module can include one or more processors (e.g., CPU or other microprocessor, control circuit, relay system, etc.), computer memory modules (e.g., RAM), computer storage modules (e.g., hard disk drive, flash memory, etc.), and/or any other suitable elements. The computational module is preferably configured to control and/or receive information from the outputs, inputs, communication modules, power modules, and/or any other suitable elements of the system. The computational module can be distributed across multiple systems (e.g., remote server, personal computing device, wearable computing device, mobile computing device, etc.) and/or in the cloud, or can alternatively be implemented in a single computing system.

[0038] The computational module is preferably configured to control the controlled subsets (e.g., output units such as tactile interface devices, groups of output units, etc.) individually. In a first example, the processor is configured to provide control signals to each controlled subset (e.g., to a control element of each controlled subset, such as an actuator control circuit). Additionally or alternatively, in a second example, the processor is configured to selectively provide power from the power module to each controlled subset (e.g., by regulating the current provided to each output unit) or to selectively command each controlled subset to enter a mode or attain a set point parameter value (e.g., by communicating a command to an integrated controller of each output unit). However, the computational module can additionally or alternatively be configured to control the controlled subsets in any other suitable manner, or can be configured to not control the controlled subsets.

[0039] As described earlier, the system can include embodiments, variations, and examples of the device(s) described in U.S. application Ser. No. 14/750,626, titled "Providing Information to a User Through Somatosensory Feedback" and filed on 25 Jun. 2015, U.S. application Ser. No. 15/661,934, titled "Method and System for Determining and Providing Sensory Experiences" and filed on 27 Jul. 2017, and/or U.S. application Ser. No. 15/696,997, titled "Method and System for Providing Adjunct Sensory Information to a User" and filed on 6 Sep. 2017; however, the system can additionally or alternatively include any other suitable devices and/or device elements.

3. Method.

3.1 Receiving a Communication Dataset.

[0040] Block **S110** recites: receiving a communication dataset, which functions to provide one or more sources of information that can be processed and delivered to the user in a new format, according to subsequent blocks of the method **100**.

[0041] In Block **S110**, the communication dataset preferably includes text representations (e.g.; files; stored data, such as data stored in memory; data streams, such as data transmitted over a network connection or data link; etc.) containing text units (e.g., letters, symbols, characters, etc.), but can alternatively include non-text representations. In variations, the text representations can include representations in ACSII format (for English language text), Unix format (e.g., POSIX format), and any other suitable format. However, the communication dataset can alternatively include character encoding, such as ISO 8859 type encoding, UTF encoding, Unicode encoding, ANSI encoding, OEM encoding, and any other suitable encoding (e.g., for accented characters, for non-ASCII characters, for European language characters, for non-Western language characters). In one example, the communication dataset includes both English characters and emojis (e.g., wherein each emoji can be translated into a text description such as a Unicode character name; wherein each emoji is directly represented in the intermediary information, such as by a supplemental 'speech component' defined in addition to the usual speech components of a language; etc.). However, the communication dataset can additionally or alternatively include non-text representations. For instance, variations of Block **S110** can include receiving image representations (e.g., memes containing text), graphics interchange format (GIF) representations, video representations, and any other suitable representations (e.g., files, stored data, data streams, etc.) from which information (e.g., text data, numerical data, semantic meaning, conceptual information, etc.), such as information of potential interest to a user, can be extracted.

[0042] The language(s) represented in the communication dataset can include any suitable language or any suitable derivative of a language (e.g., Braille, sign language, etc.), from which the communication dataset can be generated.

[0043] Block **S110** can implement one or more system components operable to collect data that is representative of communication in a textual (or other) formats. In relation to text communications, Block **S110** can thus implement systems operable to access one or more of: text messaging applications, email applications, social network applications

(e.g., Twitter, Snapchat, LinkedIn, etc.), messaging applications (e.g., WhatsApp, Viber, GroupMe, etc.), and any other suitable applications for communication.

[0044] Block S**110** can include retrieving the communication dataset with system components operable to interface with the applications described above through application programming interfaces (APIs). As such, Block S**110** can include implementing an API access process for each of a set of applications for conveying communications in textual format in order to receive the communication dataset. Additionally or alternatively, in relation to non-text formatted data, Block S**110** can include extracting text data from other data formats (e.g., image data, video data, GIF data, audio data, etc.) using character extraction algorithms (e.g., optical character recognition, natural language processing, etc.) and/or machine vision techniques for extracting and processing character data from other data formats. However, Block S**110** can additionally or alternatively include extracting other information from the received input data. In a first example, semantic meaning is extracted from text data (e.g., using natural language processing techniques), wherein the extracted semantic meaning (e.g., rather than and/or in addition to the received text data) is used as the communication dataset in other Blocks of the method **100** (e.g., the extracted semantic meaning is transformed into a set of speech components in Block S**120**). In a second example, conceptual information is extracted from non-text formatted data (e.g., using image, video, and/or audio processing and/or analysis techniques, such as image segmentation and object recognition), wherein the extracted conceptual information is used as the communication dataset in other Blocks of the method **100** (e.g., the conceptual information is transformed into a set of speech components in Block S**120**). In a first specific example, the concept of a car can be extracted from an image of a street including a car and/or from an image of an object including text associated with a car make or model. In a second specific example, the concept of a siren or emergency can be extracted from audio including a siren noise. However, Block S**110** can additionally or alternatively include extracting any other suitable information from any other suitable input information.

[0045] Block S**110** can optionally include altering the communication dataset. For example, the dataset can be filtered, abridged, condensed, transformed, and/or altered in any other suitable manner. For example, in some variations, Block S**110** can include translation of incoming communication data from one language to another language, prior to implementation of subsequent Blocks of the method **100** (with or without translation back to the original language after processing steps of the method **100** are conducted). However, translation of incoming communication data can additionally or alternatively occur at any other suitable point relative to other Blocks of the method **100**.

[0046] In an example, Block S**110** includes accessing iMessage™ data received at one or more of a user's smart device (e.g., iPhone™, iPad™, Apple Watch™), personal computer (e.g., MacBook™), and any other suitable device. In another example, Block S**110** includes accessing Twitter™ feed or messaging data associated with a messaging platform upon implementation of an authentication protocol associated with a Twitter API (or other API). In another example, Block S**110** includes receiving email data upon implementation of an authorization protocol. In another example, Block S**110** includes transforming PDF data to text data using an optical character recognition algorithm. In another example, Block S**110** includes transforming audio data into text data.

[0047] However, Block S**110** can additionally or alternatively include receiving any other suitable input information (e.g., as or in place of the communication dataset) in any suitable format. For example, the communication dataset (e.g., received as text) can include news (e.g., headlines, articles, summaries, numerical representations, such as representations of investment- and/or sports-related news, etc.; received via a news app of a user device, via radio broadcast, etc.), notifications (e.g., associated with a user device such as a smart phone), reading material such as long-form reading material (e.g., articles, books, etc.), and/or any other suitable information. In examples, the communication dataset can include (e.g., in text representation, numerical representation, and/or any other suitable representations) stock values and/or changes, sporting event scores and/or other results, and/or weather conditions and/or forecasts.

[0048] In one variant, the input information includes information related to a user's surroundings and/or the surroundings of a system component (e.g., sensor), such as information associated with nearby objects and/or people (e.g., wherein Block S**110** includes extracting information, such as text, semantic meaning, conceptual information, and/or any other suitable information, from the input information). In a first example of this variant, the system includes an image sensor (e.g., camera), and the text input includes text recognized in images captured by the image sensor (e.g., automatically detected, such as by performing image segmentation, optical character recognition, etc.), and/or other extracted information (e.g., conceptual information) includes information discerned from the images (e.g., as described above). For example, Block S**110** can include transforming an image of a sign containing a message or string of characters in the user's environment into character data, for instance, if a user is in transit and the sign contains information related to safety or travel information (e.g., in a foreign country train depot). In a second example, the system includes an audio sensor (e.g., microphone), and the text input includes text associated with sounds sampled by the audio sensor (e.g., transcriptions of speech), and/or other extracted information (e.g., conceptual information) includes information discerned from the sounds (e.g., as described above). In a third example, the method includes determining characteristics about a nearby person (e.g., identity, physical characteristics, emotional state, etc.) based on the sensor information, and the text input can include a representation of those characteristics, and/or any other suitable information determined based on those characteristics (e.g., social network connections of the person, determined based on the identity), and/or other extracted information (e.g., conceptual information) includes information discerned from the characteristics and/or information determined based on the characteristics. However, the input information can include any other suitable information.

[0049] In some embodiments, all or some of the communication dataset is generated (e.g., before being received in Block S**110**; such as generated by a human other than the user, using an electronic device remote from the sensory output system) using a text-based input technique (e.g., typing, character-wise input technique, etc.). The communication dataset can additionally or alternatively be generated based on audio inputs (e.g., speech transcription), be

automatically generated (e.g., by a computing system), and/or be generated in any other suitable manner.

[0050] The communication dataset can be received (e.g., from a remote computing system, via a network such as the internet or a cellular phone service network) using one or more communication modules (e.g., wireless communication module), can be received from storage (e.g., storage of an electronic user device), and/or received in any other suitable manner.

[0051] However, Block S**110** can additionally or alternatively be implemented in any other suitable manner.

3.2 Transforming the Communication Dataset into Speech Components.

[0052] Block S**120** recites: transforming the communication dataset into a set of speech components, which functions to convert text data from Block S**110** into a "continuous time" component representation. As such, Block S**120** includes functions to provide a step for converting text data to a speech signal or subcomponents of a speech signal, from which encodings (e.g., haptic encodings) can then be generated in Block S**130**. Block S**120** can thus transform communication data from Block S**110** into components that are more amenable to continuous and/or time-domain encodings, associated with the encoding operation performed in Block S**130**. However, variations of Block S**120** can alternatively generate components associated with non-continuous and/or non-time domain encodings.

[0053] In more detail, in relation to continuous/time-domain encodings in Blocks S**120** and S**130**, it is preferable to have entire encodings received by the brain of the user, in order for the user to be able to interpret a speech component associated with an entire encoding. Given that some language forms are fundamentally spoken and/or acoustic, it can be more efficient for a user to perceive haptic encodings transformed from speech, rather than haptic encodings derived from specific characters of written language. Alternatively Block S**120** and S**130** can include transformation of text characters directly to haptic encodings. In such an example, each letter of an English word can be encoded and presented to the user (e.g., using a motor, pattern of motors, or combination of motors for haptic stimuli), such that the user must perceive and remember each letter in order for the user to perceive the entire English word.

[0054] In one variation, Block S**120** can include implementing a text-to-speech (TTS) engine that extracts a set of acoustic components (e.g., a closed set of acoustic components) from the communication data of Block S**110**. The TTS engine can implement a synthesizer that converts language text into speech and/or renders symbolic linguistic representations (e.g., phonetic transcriptions, phonemic transcriptions, morphological transcriptions, etc.) into speech components without generating sound. The acoustic components can include phonemes (or sounds at the resolution of phonemes), or finer-time-scale acoustic components used to construct phonemes. As such, the acoustic components can be phonemes, sub-phoneme components, and/or super-phoneme assemblies, and can include aspects of tone, stress, or any other suitable phoneme feature. Block S**120** can, however, alternatively generate non-phoneme-associated components (e.g., phones, senones, subphones, diphones, triphones, quinphones, diphthongs, triphthongs, utterances, fillers, etc.) or any other suitable components.

[0055] In an example of this variation, a TIS engine implemented can include a front-end component that converts the communication data of Block S**110** with a text normalization process (e.g., a pre-processing operation, a tokenization operation), assigns a phonetic transcription to each component output from the text normalization process, and then parses the phonetic transcriptions into units (e.g., phrases, clauses, sentences). As such, the front-end component can implement a grapheme-to-phoneme conversion or any other suitable conversion, from which acoustic components of speech are extracted. In a first specific example, the grapheme-to-speech component (e.g., grapheme-to-phoneme) conversion is performed based on a predefined pronunciation dictionary (e.g., manually generated lexicon), such as a dictionary that maps text input components (e.g., graphemes, words, etc.) to speech components (e.g., phonemes, phones, syllables, etc.). A second specific example includes generating a pronunciation dictionary (e.g., as described above), then training a sequence model (e.g., weighted finite state transducer) on the pronunciation dictionary (e.g., to generate sequences of pronunciation units associated with input sequences, such as input words broken down into characters and/or other graphemes), wherein the grapheme-to-speech component conversion is performed using the resulting sequence model. A third specific example includes training a sequence-to-sequence model (e.g., neural network such as an RNN) to map from input sequences (e.g., grapheme sequences such as character strings) to sequences of speech components, wherein the grapheme-to-speech component conversion is performed using the resulting model (e.g., using the trained RNN to map the input text to a series of phonemes). The TTS engine, an example of which is shown in FIG. **3**, can further include a back-end component that converts the symbolic linguistic representation into sound, from which acoustic components (e.g., phonemes, sub-phoneme components, super-phoneme assemblies) can be classified. However, Block S**120** can omit a back-end component and never translate linguistic representations into sound. For example, a transcription (e.g., phonetic or phonemic transcription) generated from the text input can be used directly in Block S**130** to generate encoded outputs (e.g., as shown in FIG. **1**B). Furthermore, variations of Block S**120** can implement any other suitable TTS engine structure.

[0056] Upon generation of the speech/acoustic components, Block S**120** can further include classification of the components in a labeling operation, from which encoded outputs are generated in Block S**130**. In a specific example, Block S**120** can label each phoneme output with one of 47 labels corresponding to 47 phonemes (including vowel phonemes, consonant phonemes, and diphthongs) in English (e.g., as shown in FIG. **5**A). In another example, Block S**120** can label each phoneme output with one of 45 labels corresponding to 45 phonemes (including vowel phonemes, consonant phonemes, and diphthongs) in German. In another example, Block S**120** can label each phoneme output with one of 41 labels corresponding to 41 phonemes (including vowel phonemes, consonant phonemes, and diphthongs) in Mandarin, with additional sub-labels associated with tonal components of phonemes. However, labeling can be implemented in any other suitable manner depending on language specific features.

[0057] Block S**120** can additionally or alternatively include determining the speech components based on morphological aspects of the text input. For example, Block S**120** can include generating a morphophonemic transcrip-

tion of the text input, in which some elements of the text input are represented by a corresponding phoneme, whereas others are represented by a corresponding morpheme. In a first specific example, the plural morpheme |z| supplants all or some of the associated phonemes (e.g., both the /s/ of "pets" and the /z/ of "beds" are represented by |z|; the /ɪz/ of "churches" can also optionally be represented by |z|). In a second specific example, the past tense morpheme |ed| supplants all or some of the associated phonemes (e.g., terminal /d/, /t/, and/or /ɪd/phonemes). However, the speech components can additionally or alternatively have any other suitable representation.

[0058] Block S**120** can optionally include determining the language (or languages) associated with the text input, preferably determining a set of relevant speech components based on the determined language (e.g., the phonemes associated with the language), wherein the series of speech components (e.g., the phonemic transcription) can be determined based on the set (e.g., selecting only speech components included in the set). However, the set of speech components can additionally or alternatively be determined in any other suitable manner.

[0059] Furthermore, Block S**120** can additionally or alternatively be implemented in any other suitable manner. For instance, some variations of Block S**120** may additionally or alternatively implement non-phonetic techniques including one or more of: a discrete cosine transform (DCT) operation that automatically transforms acoustic components provided by a TIS engine into frequency bins associated with encoded outputs (e.g., motors, patterns of motors, combinations of motors, etc.) of Block S**130**; a fast Fourier transform (FFT) operation, an autoencoder neural network operation, and any other suitable operation applicable to windows of rendered acoustic outputs, which can be classified to a set of constituent speech components. Block S**120** can additionally or alternatively include generating the set of speech components (and/or any other suitable information) based on non-text input information. For example, in an embodiment of Block S**110** in which non-text information (e.g., conceptual information) is extracted or otherwise determined, Block S**120** can optionally include generating a set of speech components directly from the non-text information (e.g., using a data structure, such as a lookup table, that associates the non-text information with speech components). In a specific example, the concept of a nearby car can be transformed directly into the phoneme series /c/, /a/, /r/ (e.g., rather than transforming the concept into the text representation "car" and then transcribing the text representation into a phoneme series).

[0060] While conversion of text (and/or other input information) to speech components is described above, Block S**120** can additionally or alternatively include transforming the communication dataset of Block S**110** into any other suitable "continuous time" component representation. Still alternatively, Block S**120** can be omitted from implementation of some variations of the method **100**, such that the method **100** generates encoded haptic outputs either directly through communication data (and/or other data) received in Block S**110**, or through other means. In such an example, some syllabary languages (e.g., Japanese) can have direct mappings between text symbols and sound, and thus, speech components can be directly extracted from text data.

3.3 Transforming the Speech Components into Output Parameters.

[0061] Block S**130** recites: implementing a transformation model with the set of speech components, the transformation model operable to encode the set of speech components across a set of output parameters in a device domain, the device domain associated with a distribution of tactile interface devices coupled to the user and stimulus parameters of the distribution of tactile interface devices. Block S**130** functions to use speech components (e.g., phonemes, non-phonemes, etc.) extracted in Block S**120**, to generate haptic encodings associated with outputs of a device coupleable to the user. As such, Block S**130** functions to facilitate transformation of speech components into signals that can be output at a device coupled to the user.

[0062] The transformation model preferably encodes the labels of Block S**120** to haptic patterns executable using the array of tactile interface devices, wherein the haptic patterns are associated with control signals that activate devices of the array of tactile interface devices, and wherein the control signals can be executed in Block S**140** of the method **100**. The output parameters determined in Block S**130** preferably define one or more sets (e.g., lists) of output devices and associated output settings (e.g., actuation intensities). The output parameters can additionally or alternatively define a function (e.g., a function over the mathematical space defined by the spatial distribution of output devices) that maps to the output settings (e.g., wherein output settings corresponding to a particular output device can be determined based on the value of the function at the location associated with the output device). The output settings can optionally include time dependence (and/or dependence on any other suitable variables), but can additionally or alternatively be constant.

[0063] In variations of Block S**130** associated with labeled phonemes, the transformation model can encode each of the labeled outputs as one or more spatial aspects and/or device output parameters of the array of tactile interface devices. In relation to acoustic speech components described in Block S**120** above, the transformation model(s) of Block S**130** can transform, encode, or otherwise map feature sets associated with the set of objects to one or more of: subdomains (e.g., subregions, sub-clusters, sublayers, etc.) of the array of tactile interface devices; different stimulus aspects associated with the array of tactile interface devices; and any other suitable aspects of the array of tactile stimulus devices.

[0064] Speech components of Block S**120** can be mapped to domains (e.g., layers, regions, clusters, areas, etc.) of the array of tactile interface devices, examples of which are shown in FIG. **4**A. As such, different acoustic speech components, such as those generated in Block S**120** (e.g., phonemes, sub-phoneme components, super-phoneme assemblies, phones, diphones, triphones, diphthongs, triphthongs, etc.), can be mapped to different domains of the array of tactile interface devices, and/or to different stimulus parameters such as described below, which can include actuation patterns (e.g., spatial and/or temporal patterns, such as pulses, sweeps, etc.) and/or any other suitable stimulus parameters. For instance, in a device variation that has a distribution (e.g., array) of tactile stimulation devices configured about a wristband wearable: each device of the distribution of tactile stimulation devices can be associated with a corresponding phoneme, such that different devices of the distribution of tactile stimulation devices can "play" phonemes in a specific pattern that corresponds to the message of the communication data of Block S**110**, and can

be detected at a wrist region of the user. In another example, in a device variation that has a distribution (e.g., array) of tactile stimulation devices integrated with a vest worn by the user: each device of the distribution of tactile stimulation devices can be associated with a corresponding phoneme, such that different devices of the distribution of tactile stimulation devices can "play" phonemes in a specific pattern that corresponds to the message of the communication data of Block S**110**, and can be detected at the torso of the user. In a third example (e.g., employed using the wristband and/or vest described above, and/or using any other suitable system including a spatial distribution of tactile stimulation devices), stimulus parameters (e.g., sweeping actuation of neighboring and/or non-contiguous stimulation devices) can be mapped to speech component labels, such that concerted actuation of a plurality of the tactile stimulation devices (and/or of individual devices, such as described above) can "play" phonemes in a specific pattern that corresponds to the message of the communication data of Block S**110**, and can be detected by the user (e.g., at the user's wrist and/or torso). The different stimulus patterns can include patterns using the same and/or different stimulation devices from each other (e.g., a first pattern including clockwise sweeping actuation of a set of 8 devices, a second pattern including counterclockwise sweeping actuation of the 8 devices, a third pattern including pulsed actuation of 4 out of the set of 8 along with 4 other devices, etc.). Such multi-actuator mappings can potentially enable communication of a greater number of phonemes than the number of tactile stimulation devices in the system (e.g., communicating 47 unique phonemes using only 20 stimulation devices). For example, a first phoneme can be mapped to a clockwise sweep of 8 actuators, beginning at a fourth actuator of the device, and a second phoneme can be mapped to a counterclockwise sweep of 6 actuators, beginning at an eighth actuator of the device. However, variations of the example can associate devices of the array of tactile stimulation devices with speech components in any other suitable manner.

[0065] In the examples and variations described above, the domains/regions of the array of tactile stimulation devices can be fixed or dynamically modifiable. For instance, the subdomain can be dynamically modified, according to the encodings performed in Block S**130**, in order to match a character associated with a phoneme or symbol (e.g., an Emoji can be represented with a smiley-faced region of a dense array of devices).

[0066] In variations related to speech components described in Block S**120** above, the transformation model can additionally or alternatively transform, encode, or otherwise associate speech component labels with a set with stimulus parameters of the array of tactile interface devices. In variations, the transformation operation can map different speech components (e.g., speech component label, phoneme tone, phoneme emphasis, etc.) to a range of stimulus types. In variations, stimulus parameters can include one or more of: output type (e.g., intermittent, pulsed, continuous, etc.); pulse pattern; pulse waveform characteristics (e.g., sinusoidal, square wave, triangular wave, wavelength, etc.), output amplitude, output intensity; output duration; out pulse duration, etc.), device domains involved in an output (e.g., a sweeping pattern using multiple devices), and any other suitable stimulus parameter. For instance, in a device variation that has a distribution of the array of tactile stimulation devices configured about a wristband wearable: each device of the array of tactile stimulation devices can output a specific stimulus parameter corresponding to a speech component, such that the devices can relay information not only to speech component labels (e.g., phoneme labels), but also more complex language aspects (e.g., phoneme tones, phoneme emphasis, etc.) and can be detected at a wrist region of the user. In another example, in a device variation that has a distribution of the array of tactile stimulation devices integrated with a vest worn by the user: each device of the array of tactile stimulation devices can output a specific stimulus parameter corresponding to a speech component, such that the devices can relay information not only to speech component labels (e.g., phoneme labels), but also more complex language aspects (e.g., phoneme tones, phoneme emphasis, etc.) and can be detected at a torso region of the user. However, variations of the example can associate stimulus parameters of the array of tactile stimulation devices with speech components in any other suitable manner.

[0067] In variations related to speech components described in Block S**120** above, the transformation model can additionally or alternatively transform, encode, or otherwise associate speech component labels with complex or combined outputs of the array of tactile interface devices. In variations, the transformation operation can result in generation of encodings related to both subdomains and stimulus outputs available using the array of tactile stimulus devices.

[0068] In a first example, associated with the English language, the transformation model of Block S**130** can assign each of 47 phoneme labels to specific devices of the array of tactile interface devices (e.g., distributed about a wristband, distributed across a vest, etc.), such that the array of tactile interface devices can "playback" stimuli associated with different phonemes in an order corresponding to portions of the communication received in Block S**110**. As shown in FIG. **5**B, a wrist band can include an array of tactile interface devices (e.g., wherein devices and/or device actuation patterns are mapped to specific phonemes), which can be signaled to play the phoneme according to a pattern corresponding to the communication in Block S**110**. In a second example, associated with spoken Mandarin, the transformation model of Block S**130** can assign each of 41 phoneme labels to specific devices of the array of tactile interface devices and four stimulus patterns (e.g., pulse patterns) associated with four spoken tones, such that the array of tactile interface devices can "playback" stimuli associated with different phonemes and different phoneme tones in an order corresponding to portions of the communication received in Block S**110**.

[0069] In the variations and examples described above, phoneme labels generated in Block S**120** and corresponding to the communication data of Block S**110** can be played back through the array of tactile interface devices in a manner similar to the natural timing of speech; however, play back can alternatively be implemented in a manner that does not mimic natural speech timing. As such, play back can be implemented with any suitable speed, frequency, cadence, pauses (e.g., associated with grammatical components of language), gain (e.g., amplitude of stimulation corresponding to "loudness" or punctuation), pattern (e.g., spatiotem-

poral pattern played using subarrays of the array of tactile interface devices, etc.), and any other suitable output component.

[0070] Similar to transformation models described in U.S. application Ser. No. 14/750,626, titled "Providing Information to a User Through Somatosensory Feedback" and filed on 25 Jun. 2015, the transformation model implemented in Block S**130** can include one or more of the following: a linear Predictive Filtering/Coding (LPC) operation, that produces a set of filter coefficients and an energy parameter, wherein the filter coefficients can be converted to frequency-locations in a line spectral pair (LSP) representation (e.g., line spectral frequencies), and the energy parameter is mapped to a stimulus parameter (e.g., intensity, amplitude, duration, etc.); a decomposition transformation operation, where each dimension represents how much of a basis function is present; a single global axis mapping operation, wherein the possible range of frequencies may be discretized to a set of bands based on the number of tactile interface devices in the array and each element represents represent a band of frequencies; a multiple local axis mapping operation, wherein each LSP is given a different set of tactile interface devices to represent a range of frequencies; a coded local axis mapping operation, wherein each LSP is given a different set of axis representative of the frequency domain using a tree-type code (e.g., a binary code with different levels for different frequency ranges or functions); and any other suitable encoding or mapping operation.

[0071] The transformation model can be implemented using a computational module that retrieves a physical layout for the set of tactile interface devices (e.g., from storage, from inputs provided by a user or operator, etc.). Encoding and mapping can additionally or alternatively be implemented in any other suitable manner, such as described in U.S. application Ser. No. 14/750,626, titled "Providing Information to a User Through Somatosensory Feedback" and filed on 25 Jun. 2015.

3.4 Delivering the Outputs to a User.

[0072] Block S**140** recites: executing control signals operable to deliver the set of output parameters to a user interfacing with the distribution of tactile interface devices. Block S**140** functions to enable outputs to be delivered to the user through the tactile interface devices, according to the transformation and encoding algorithms of Blocks S**120**-S**130**. The control signals can be executed according to methods described in U.S. application Ser. No. 14/750,626, titled "Providing Information to a User Through Somatosensory Feedback" and/or in U.S. application Ser. No. 15/661,934, titled "Method and System for Determining and Providing Sensory Experiences" and filed on 27 Jul. 2017; however, the control signals can additionally or alternatively be executed in any other suitable manner. For instance, Block S**140** can include receiving one or more user inputs operable to adjust a gain level (or other aspect) of output stimuli, such that the user can customize the "strength" of stimuli provided through the array of tactile interface devices.

3.5 Repetition.

[0073] Block S**150** recites: repeating Blocks S**110**-S**140** upon reception of additional incoming communication datasets. Block S**150** can optionally function to provide real-time or near real-time communication updates to the user, such that the user is provided with communications through alternative sensory modes, as facilitated by the array of tactile interface devices. For example, Block S**150** can be performed in real-time or near real-time (e.g., within a time threshold, such as 100 ms, 90 ms, 75 ms, 50 ms, 110 ms, 125 ms, 150 ms, 200 ms, 300 ms, etc.), such that information provided to the user has no perceptible lag (e.g., such that the user is unable to discern a delay between receipt of the communication dataset and perception of the corresponding tactile feedback). However, Block S**150** can additionally or alternatively be performed such that information is provided to the user within a longer time period after receipt of the communication dataset (e.g., within 1 s, 2 s, 5 s, 15 s, 1 min, 10 min, etc.), and/or can be provided at any other suitable time. Block S**150** can include repeating Blocks S**110**-S**140** at a desired frequency (e.g., per unit time). Additionally or alternatively, Block S**150** can include repeating Blocks S**110**-S**140** based on any suitable trigger. For instance, Block S**150** can include repeating Blocks S**110**-S**140** with each incoming chat message, such that repetition is based on live communications from another party to the user. Additionally or alternatively, Block S**150** can be implemented in any other suitable manner.

[0074] Furthermore, the method **100** can include any other suitable Blocks operable to promote provision of communications to the user, through an array of tactile interface devices, in any other suitable manner. For instance, the method **100** can include rapidly training a user to learn to correctly identify speech components associated with haptic outputs provided through an array of tactile interface devices, by providing pre-recorded speech with time-locked haptic outputs through the array of tactile interface devices. In a specific application, such a training protocol can allow users with high-frequency hearing loss to help them discriminate between commonly confused higher frequency phonemes (e.g., /th/, /f/, /s/, /h/, /k/, /z/, /b/, /dh/, /t/, /d/, /v/, etc.). For example, the method can include providing haptic outputs (e.g., at the array of tactile interface devices) representing phoneme components related to phonemes that users with high-frequency hearing loss (e.g., presbycusis) may have difficulty perceiving. In a first specific example, the method includes providing haptic outputs representing phoneme components (e.g., high frequency phoneme components) including /f/, /z/, /b/, /th/, /dh/, /t/, /d/, /s/, and/or /v/. In a second specific example, the method includes providing haptic outputs representing phoneme components (e.g., high frequency phoneme components) including /th/, /f/, /s/, /h/, and/or /k/. However, variations of the training protocol can alternatively be implemented for users with other impairments, users with no impairments, and/or for any other suitable phonemes or speech components.

[0075] Any or all elements of the method can be performed by any elements of the system, and/or by any other suitable elements (e.g., as shown in FIGS. **7**A-**7**C and **8**A-**8**C). For example, a first portion of the method (e.g., at least Block S**110**, and possibly additional elements such as all or some of Blocks S**120** and/or S**130**) can be performed by a user device (e.g., smart phone), the results of which (e.g., text representation, series of speech components, series of haptic outputs, series of control instructions, etc.) can be transmitted (e.g., wirelessly) to a haptic output system, whereupon the haptic output system can perform a second portion of the method (e.g., the remaining elements

not performed by the user device) based on the information included in the transmission. However, the elements of the method can additionally or alternatively be distributed between devices in any other suitable manner, or can be performed by a single device.

[0076] The method **100** and/or system of the preferred embodiment and variations thereof can be embodied and/or implemented at least in part in the cloud and/or as a machine configured to receive a computer-readable medium storing computer-readable instructions. The instructions are preferably executed by computer-executable components preferably integrated with the system **200** and one or more portions of the processor and/or a controller. The computer-readable medium can be stored on any suitable computer-readable media such as RAMs, ROMs, flash memory, EEPROMs, optical devices (CD or DVD), hard drives, floppy drives, or any suitable device. The computer-executable component is preferably a general or application specific processor, but any suitable dedicated hardware or hardware/firmware combination device can alternatively or additionally execute the instructions.

[0077] The FIGURES illustrate the architecture, functionality and operation of possible implementations of systems, methods and computer program products according to preferred embodiments, example configurations, and variations thereof. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the block can occur out of the order noted in the FIGURES. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

[0078] As a person skilled in the field of biosignals will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims.

We claim:

1. A method for providing information to a user, the method comprising:

establishing a physical interface between a user and a haptic output system comprising a plurality of haptic actuators defining a spatial distribution;

receiving a text input representative of communication in a language;

generating a speech component-based transcription based on the text input, wherein the speech component-based transcription comprises a series of speech components;

determining a series of spatial representations in a device domain of the haptic output system, the series of spatial representations corresponding to the series of speech components; and

at the haptic output system, for each spatial representation of the series of spatial representations: providing a haptic output corresponding to the spatial representation, comprising, for each haptic actuator of the plurality:

mapping a respective location of the haptic actuator to a corresponding location within the spatial distribution;

based on a value of the spatial representation associated with the corresponding location, determining a respective actuation parameter; and

controlling the haptic actuator to actuate based on the respective actuation parameter.

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