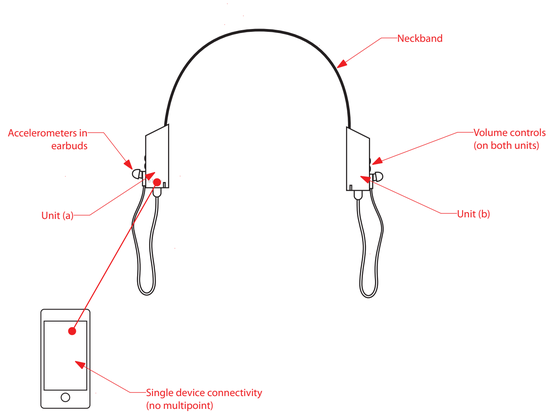
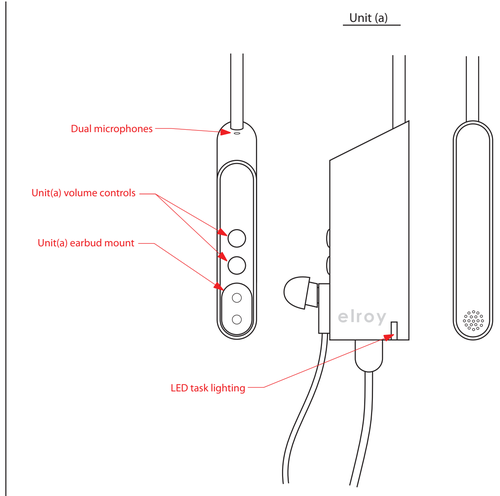
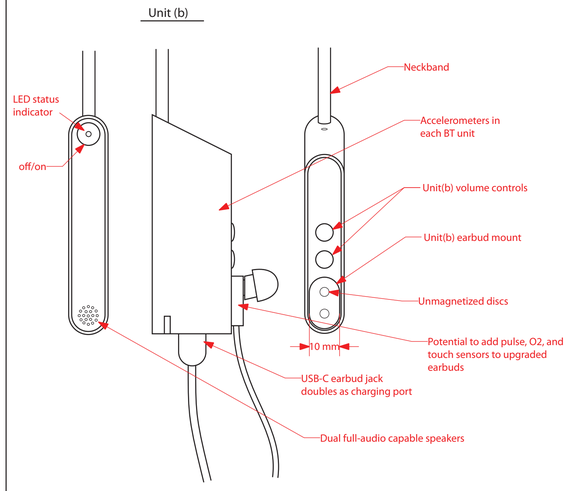
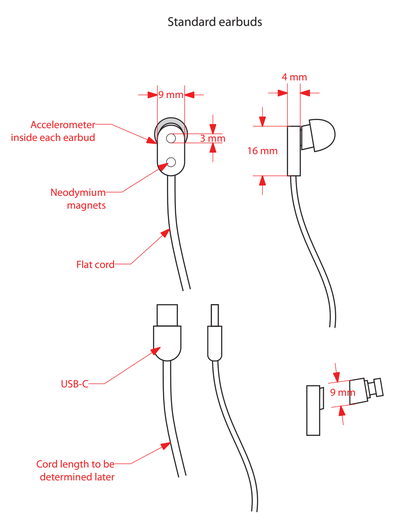






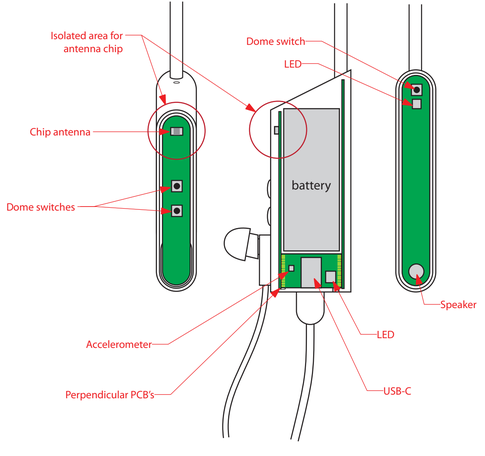


Basic features:

1) Activated magnetic earbud attachments allow you to answer/terminate calls by removing or replacing earbugs to their docking position.
2) Activated magnetic earbuds allow you to place device in do-not-disturb mode
3) Activated magnetic earbuds allow you to pause/play music based on intuitive use
4) Accelerometers inside earbuds allowing head gestures to answer calls or send incoming calls to voicemail.
5) Accelerometers in base units enable tap gestures to answer calls or send calls to voicemail.
6) Full audio capable base unit speakers allow you to talk on the phone or listen to music without earbuds.
7) Changeable earbuds, since not everyone has the same taste in earbud styles. Also to add new features, colors.
8) Red and white LED task lighting.
9) Fifteen hours battery life (at least >10 hours)

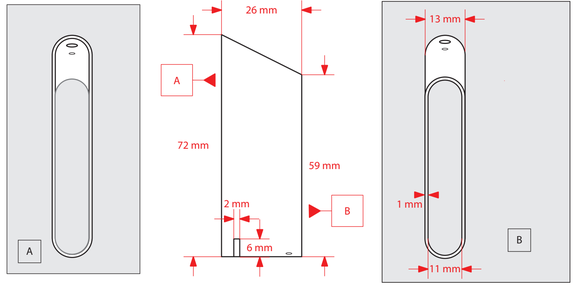
10) AR3D audio initial implementation (described on page 8)

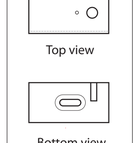
Unit (a)

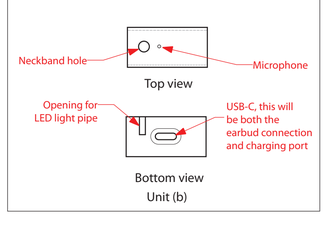


PCBA and battery arrangement

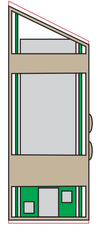
External case - Unit (b)





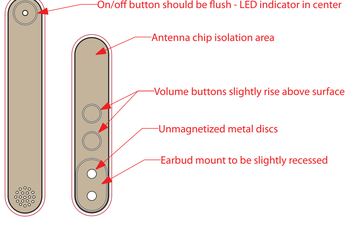


Internal chassis- Unit (b)



Design internal chassis that holds PCBA, battery, buttons, etc, which can easily slide into main external case unit. Goal is to make assembly as easy as possible. Final assembly fixed in place (not user changeable).

This method also allows potential for mass customization of colors. Color of chassis can be selected (visible at the sides of the assembled product), and external case can be a wide range of colors. Utilizes "late point differentiation" methods of production.



Working prototype functionality:

Answer call by:
- Removing one or both earbuds from docks
- Tapping the phone connected unit
- Nodding head twice

Send incoming call to voicemail by:
- Double tapping phone connected unit
- Shaking head "no" twice

Terminate call by:
- Attaching both earbuds to their docks
- Double tapping the phone connected unit

Pause music by:
- Placing both earbuds on their docks
- Attaching earbuds to each other
- Double tapping connected unit

Unpause music by:
- Removing both earbuds from their docks
- Detaching earbuds from each other
- Double tapping connected unit

Advance music track by:
- Triple tap connected unit

Go back one music track by:
- Four taps on connected unit

Place device in do-not-disturb mode:
- Connect earbuds to each other

Task light functions:
- Press both volume buttons to turn light on/off
- Light on each unit operated separately
- Volume buttons operate light for 15 secs
- Pushing volume button cycles: dim white, med white, bright white, dim red, med red, bright red
- Last color/intensity set to memory

Capable of using Apple's Siri.

Audio:
- Ability to use external speakers for calls, instead of earbuds

CPU/memory:
- Robust, *capable* of extending feature sets with users installed firmware updates
- *Capable* of updating via phone-based app
- *Capable* of storing additional, user uploaded data

Battery:
- Hopefully >10 hours battery life

Earbuds/connection:
- *Capable* of using up to 3 sensors per earbud (example: accelerometer, IR and O2 sensors)
- Attached to devices with USB-C connectors
- *Capable* to use device with one earbud only
- Ability to use device with no earbuds by routing sound through external speakers
- *Capable* to charge both devices through either USB-C connector point

Accelerometers:
- Total of 4 - One in each unit, one in each earbud

"Ability" means, implemented with working prototype phase but may not be completely debugged.
"Capable" means, not yet implemented but can later be added through firmware updates.

Important details of functional elements:

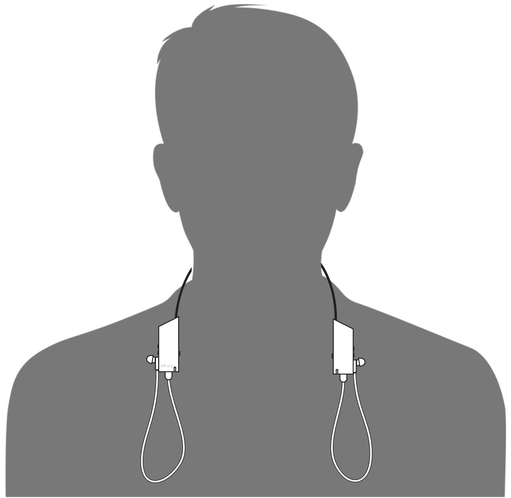
We are incorporating methods for this device to "understand" the contexts in which the earbuds are being used. We're calling this "contextual intelligence." We seek to accomplish this with accelerometers incorporated into each of the BT units and the earbuds.

The accelerometers in the BT units can sense when the earbuds click onto the units, and therefore know they are not in use. Audio then can be routed to the external speakers instead of through the earbuds. This allows the user to hear what they otherwise wouldn't.

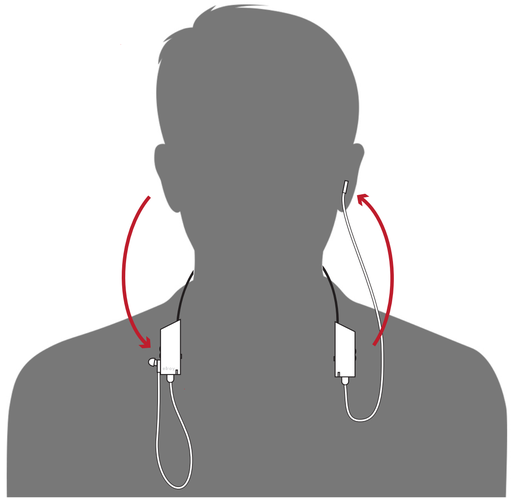
Other elements involving the accelerometers sensing unique movement signatures. Two earbuds being attached to each other via the magnets would generate such a unique signature telling the device to perform specific instructions, such as placing an active call on hold.

We believe a wide variety of functional elements can eventually be added to this device through more development of the firmware. Thus we want to make this device capable of expanded development beyond what is done with a first working prototype.

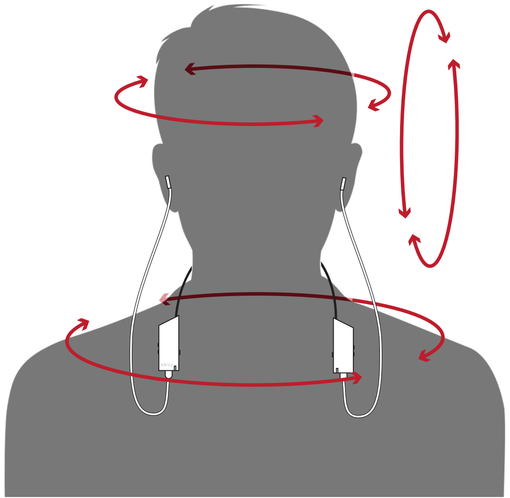
Having accelerometers in these four points also offers the capacity to use this device (in combination with others) to enhance augmented reality applications. The ability to track head movements distinct from shoulder/body position enables a unique contextual intelligence not achieved with other devices. Additionally, this adds a level of positional awareness relative to recorded or computer generated sound. Changes in head and body position can generate changes in the sound deliverd to the user giving an augmented sense of sound source or relative location.



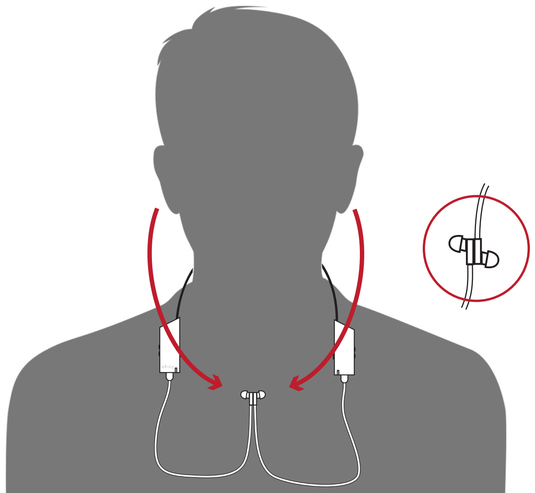
Device understands earbuds are docked when each earbud is moving in unison with the unit it's attached to. In this configuration the device understands that the earbuds are not in use and all audio feedbacks (ringer, text notification, clicks and other feedbacks heard when interacting with a phone or other device) can be routed to either the external speakers on the device or the speakers on the origin device.



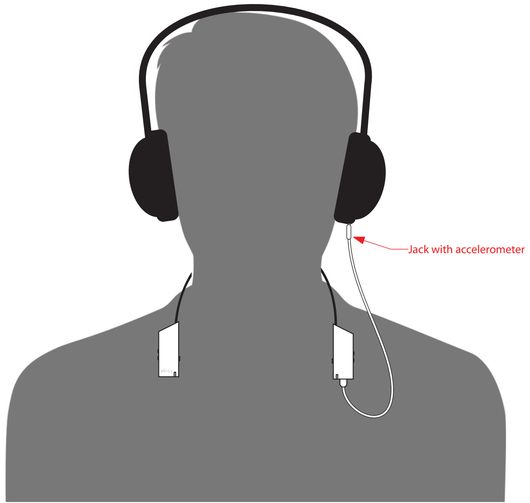
Removing an earbud from it's magnetic dock will produce a signature "click" via the accelerometers on the earbud and the base unit. This signature movement can be used to initiate the answer function for an incoming phone call or to start play of paused music. This signature movement can be enhanced by including any accompanying movements, such as the signature of the earbud moving upward toward the ears. Reverse of these actions would be used to pause music or terminate phone calls.



When earbuds are in use we have the unique capacity to isolate torso movements from head movements. Functionality can be applied in a wide range of applications, such as orienting sound in 3D space relative to the user's head and body position. This separation of movement can also be used for activating actions on a mobile device. The motion of shaking or nodding the head (relative to the body) can be used to answer a phone call or send an incoming phone call to voicemail without the use of hands.



Attaching earbuds to each other would also produce a unique signature where the "click" of the magnets meeting would be indicated simultaneously in both earbuds followed by the earbuds moving in perfect unison with each other. This can be used to place an active phone call on hold or to place the device in do-not-disturb mode. Different orientations of the earbuds should also produce a unique x/y/z axial movements when attached that could be used to produce alternate functions or modes.

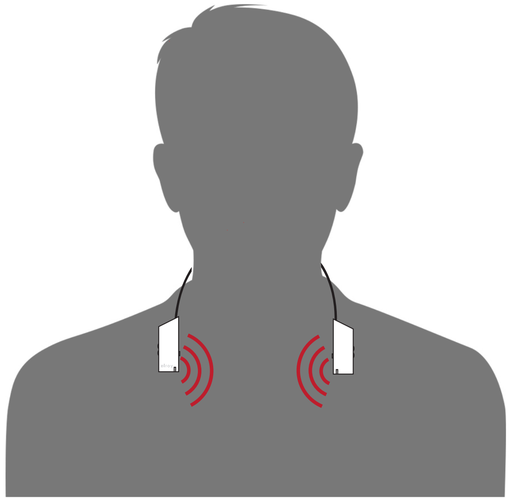


Standard corded over-the-ear headphones can also be attached and have all the functionality of the accelerometers by using an auxillary connector with a built-in accelerometer.

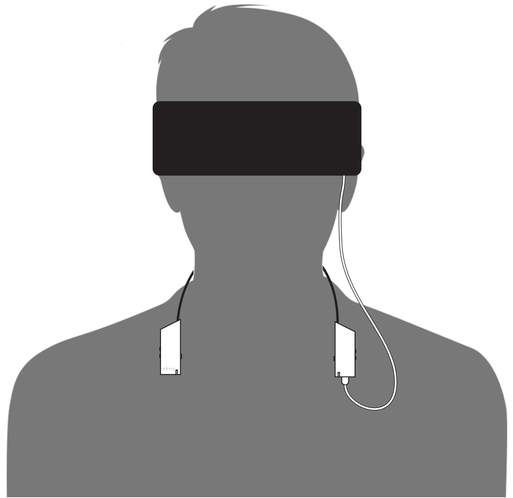
Removing one earbud from the device would retain all the same functionality as with two earbuds. Additional functionality could be build in to reference which unit the earbud is docked to. Docking earbud to unit(a) can perform different functions from docking to unit(b) in a single earbud configuration.

When earbuds are in use the accelerometers in the base units can be used to initiate functions. The unique signature of a double tap on the case can be used to answer an incoming call or advance to the next song track. If earbuds are docked to the base units a double tap would answer an incoming call, but since the earbuds are not in use, the audio of the incoming call would be routed to the external speakers on the device. Audio could then be transferred to the earbuds if they are removed from the docks and moved to the ears.

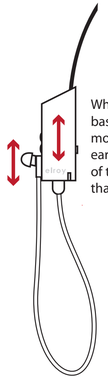
Attaching earbuds to opposing base units would also offer the possibility to expand functionality. Whereas attaching an earbud to its own base unit would produce one action, attaching to the opposite unit would produce an alternate action. Example: Attaching to its own base unit would terminate a call, attaching to the opposing base unit could activate the base unit speakers instead. Returning the earbuds to their own base units would then terminate a call.



Device can also be used without any headset or earbuds by routing audio through speakers. The device retains tap functions through the accelerometers located in each base unit as well as the capacity to track upper torso movement.



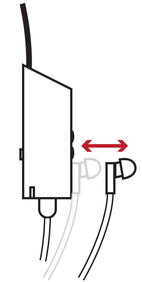
Device can add functionality to virtual reality devices, such as the Oculus Rift. Such VR devices currently can only sense head movements but with a neckband device connected there is the potential to add positional awareness for the body as well. Similarly, this can be extended to future devices intended for augmented reality.



Whenever the earbuds are connected to a base unit the two accelerometers will move synchronously. This indicates the earbuds are not in use and functionality of the device can be programmed for that conditional state.

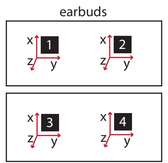
Whenever earbuds are disconnected from a base unit the two accelerometers will move asynchronously indicating that the earbuds are likely in use. This conditional state can be further confirmed by the relative movement of an opposing earbud. If the other earbud is moving in ways consistent with placement in the opposing ear the device can be assured the earbuds are, in fact, in use.

Likewise, two earbuds hanging loose would produce an asynchronous signal indicating they are not in use by the user. Audio would then be routed through the base unit instead of through the earbuds.



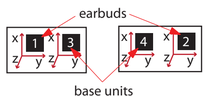
The magnetic attachments will produce a unique signature by way of the accelerometers when they "snap" together or are removed from each other. The combination of the two accelerometers producing a similar synchronous signal will indicate where the earbud(s) is (are) being connected or disconnected. With this the device "understands" the state of use or change of state. The device can be programmed to perform functions or respond to inputs in ways that are appropriate for each possible conditional state or change of state.

Accelerometer locations and configurations



An "in use" state would be identified by the accelerometers in the earbuds reporting x/y/z coordinates in a predictable and unified manner. Head turns to the right or left would generate oppositng z and -z data. A nod of the head would produce coordinated x and z data. All common head movements could be catalogued to identify "in use" conditions so that audio can be appropriately routed to the user.

In a docked configuration the earbuds and base units move in unison indicating that the earbuds are not in use, and therefore audio should be routed to another location other than the earbuds.



Conditional earbud states of use:
1) Two earbuds attached to two base units
2) One earbud attached to base unit, one earbud in user's ear
3) One earbud attached to base unit, one earbud dangling
4) Two earbuds in user's ears
5) Two earbuds dangling
6) Two earbuds attached to each other
7) Two earbuds attached to each other, reversed orientation
8) Two earbuds attached to opposing base units
9) One earbud attached to opposing base unit, one dangling
10) One earbud attached to opposing base unit, one in user's ear

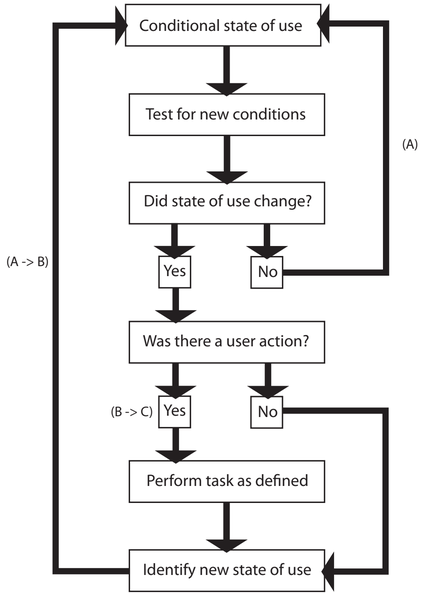
Conditional device states of use:
1) Incoming call
2) Active call
3) Music playing
4) Not in use (waiting)
5) Pairing mode

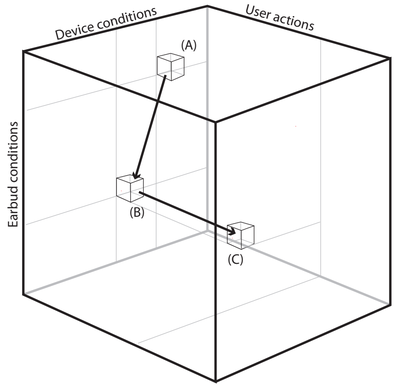
User actions through accelerometer:
1) Attach earbud to base unit
2) Remove earbud from base unit
3) Attach (remove) earbuds to (from) each other
4) Tap functions on base unit while earbuds attached
5) Tap functions on base unit while earbuds are in users ears
6) Tap functions on base unit while earbuds are dangling
7) Tap functions on base unit while earbuds are attached to each other
8) Tap functions on earbuds
9) Combinations of tap functions (left then right base unit, etc)
10) Tap functions on inactive (unpaired) base unit

User movement functions:
1) Nod head (yes)
2) Shake head (no)
3) Tilt head
4) Shoulder shrug (possible)

Earbud movement functions:
1) Move earbuds upward (toward ears)
2) Move earbuds downward (toward or below base units)
3) Move individual earbud to new position (up or down)

Device tasks:
1) Answer phone call
2) Terminate phone call
3) Place call on hold
4) Activate voice assistant (Siri)
5) Pause music
6) Unpause music
7) Advance music track
8) Go back one music track
9) Raise volume level
10) Lower volume level
11) Access other functionality
(exercise assistant or language translator)
12) Access games
(audio or movement games that don't require a visual interface; dance games, running games)





Between the state of use of the earbuds and the state of use of the device there is a 2-dimentional matrix of conditional states which the device will operate. As the user is wearing the device or changing how they are using the device this conditional state will change, and these changes can be sensed through the signal relationships of the accelerometers. A user's actions present a third dimension to the matrix.

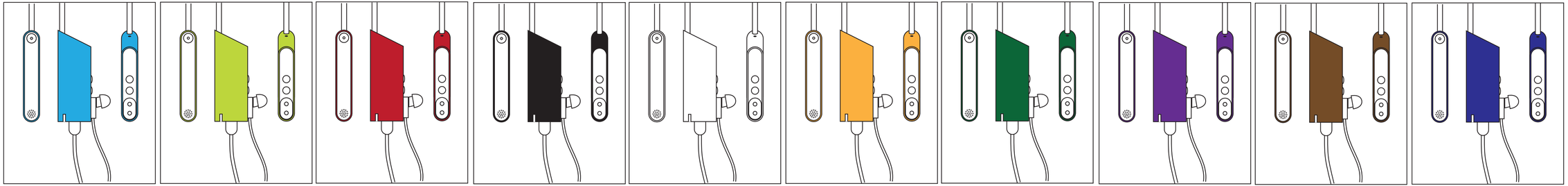
A change of conditional state from A to B would produce no specific actions for the device. When the user initiates a movement in response to this change of state, B to C, we find a set of tasks which can be performed in response to the user action.

What we're doing is adding extensive granularity to how this device understands a user's intent. By using four points of relative moment through the accelerometers we can clearly and continually track how the device is being used and with each conditional state and user action we can more accurately produce appropriate responses and actions from this device.

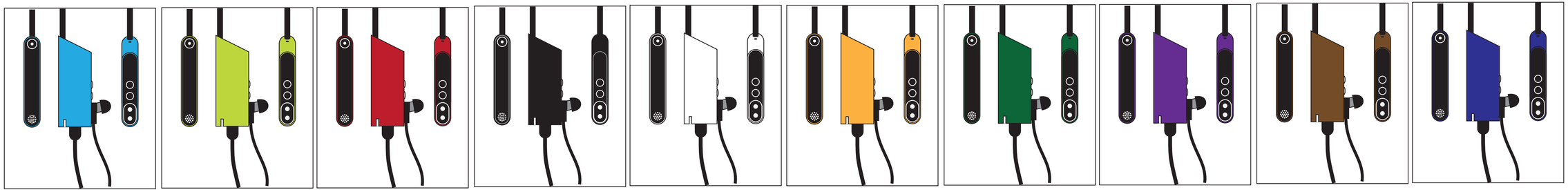
For a similar device not using these methods, tasks assigned to buttons are relatively static. In order to add functionality one must add more buttons. This severely limits what wearable bluetooth devices can do. By adding accelerometers and tracking the conditional state of use we open up an almost infinite variety of ways the device can understand the user and how the user can interface with the device.

Mass customization through late point differentiation – Product is assembled complete up until adding the external case. Simple final assembly done at shipping facility based on direct customer orders.

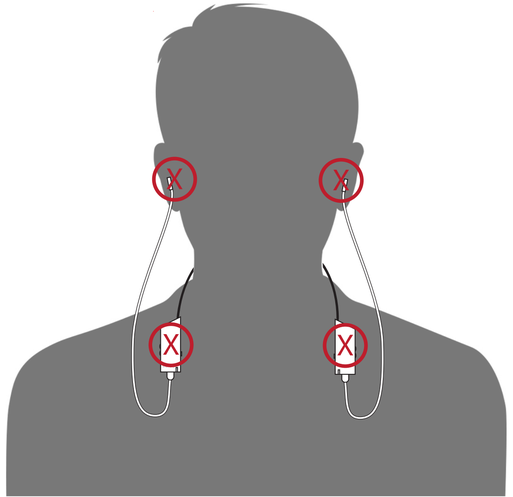
Chassis Color White



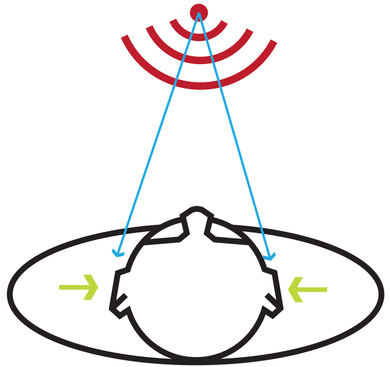
Chassis Color Black



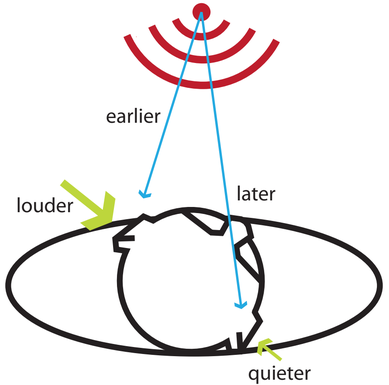
Dynamic Audio Balance (DAB) Initial Implementation



By using four accelerometers we create four separate reference points on the body. When the earbuds are in use this means the accelerometers in the earbuds give us the ability to monitor head movements relative to the shoulders and torso.



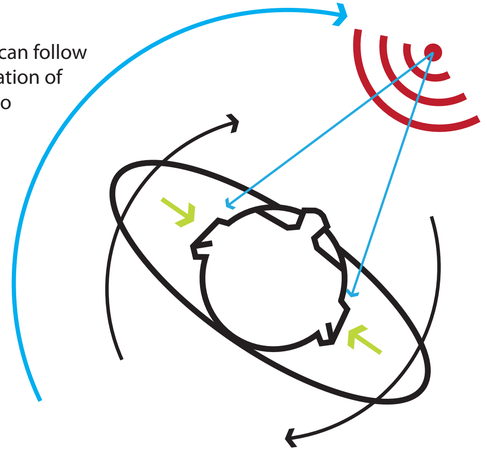
In this initial implementation we want to apply this 3D concept to phone calls only. When wearing normal earbuds audio is being delivered to both ears equally regardless of our head or body position or any change in our head or body movement. Because of this we have no sense of relative location of the person we're speaking to.



Using the accelerometers in the earbuds we want to create an effect where, when the user turns their head, the sound in the ear that moves forward is increased. Likewise, the sound in the ear that moves backward will be reduced. There is also a slight difference in the time the sound arrives at the ear which helps to identify a sound source.

This should create some increased sense that the person we're speaking to on a phone call is located in front of us.

Sound source can follow relative orientation of shoulders/torso



But, this presents a problem if we only track head movement with the earbuds. The accelerometers in the earbuds cannot know if it is our head turning or our body turning.

For this problem we use the accelerometers on the base units to keep the sound source oriented in front of us. If both the earbuds and base units accelerometers, together, indication a change in direction, the balance between the left and right audio channels would remain unchanged. This will keep the sense that the person we are speaking to is in front of us.