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Smart earphones v2.0 – with enhanced detection capabilities

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Abstract

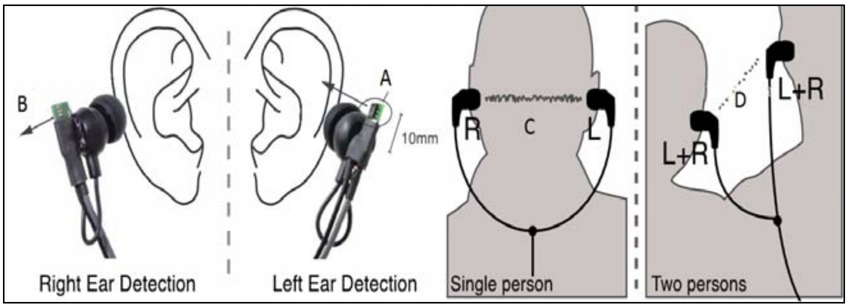
Smart earphones use both a proximity sensor and an eddy current sensor to demonstrate several implicit interaction techniques achieved by automatically detecting the intended use. The Smart earphones have three features. The first involves detecting the left and right sides of ears, which provides audio to either ear, the second involves detecting the shared use of earphones and this provides mixed stereo sound to both earphones and the third involves using the proximity sensor to detect when the earphones are withdrawn from the ear which directly triggers the pause feature. These features free users from having to check the left and right sides of earphones and they enable them to share stereo audio with other people and they do not have to worry about pausing their playback.

Keywords: Smart Earphones, Proximity sensor, Eddy current displacement sensor, Electromagnetism, Magnetic field.

1. Introduction

Even though interfaces have been widely prevalent and intuitively utilized by everyone, they are quite problematic. For instance, when we are utilizing earphones and headphones, we occasionally face problems, i.e., in placing them on the erroneous ears. This might seem a tad bit troublesome, but it demonstrates the possibility of refining conventional interfaces by making them acutely intellective. We consider that good interfaces and interactions are implicit, and users should not have to worry about them. If interfaces have perspicacity to capture the contexts of users, no matter how minute, and users are oblivious to these contexts, the interfaces and interactions will be much better than the precedent ones.

We therefore present a contrivance called smart earphones that automatically detect the left and right sides of the auditory perceivers and provide stereo audio to the most congruous side. The single greatest impediment when utilizing earphones is matching each earphone to the most opportune side of auditory perceivers as this is obligatory to relish audio experiences, particularly in professional audio engenderment and modern 3D audio environments like those for 3D games and movies. They not only free users from having to check the sides of earphones, but they withal support detection when a single set of earphones is being shared by two people. In such cases, commercially available earphones force users to divide output into two audio channels, i.e., each person is able to aurally perceive either the left or right channel. They generate stereo sound and present it to both sides of the earphones. These two features engender implicit interaction between the utilizer and the earphones, and they enable these earphones to act as a good music communication medium. However the third feature enables the user to simply remove the earphones from the auditory perceivers in order to pause their playback.



A – Proximity Sensor, B – Distance less than 30mm
C – Weak current, D – No connections.

Fig 1: Left Side detection. Right: Shared use detection

2. Auto Pause

The threshold distance has been noted down and whenever the earphones are removed from the ear, the sensors automatically measure the immediate change in distance and once it reaches the threshold limit, it automatically triggers the pause feature.

3. Side Detection

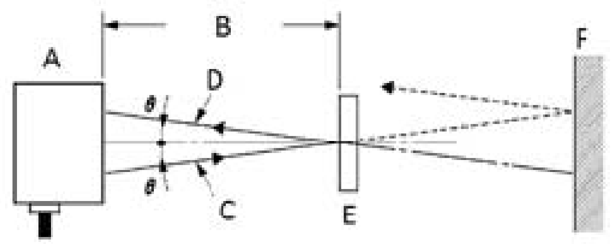
We installed a proximity sensor on each of the buds belonging to the earphones to detect the left and right sides of the ears. The distance from the canter of the earphone has been measured and whenever this distance is less than 30mm, the smart earphones activate right channel otherwise the channel is changed to the left. To enable such features, we use a proximity sensor and an analog switch IC into the earphones.

Fig 2: Left Sensor unit. Right: Photograph of headphones**.**

4. Photoelectric Sensor

This device contains the electronics, along with the optics. It requires some power source for effective operation. This sensor is capable of performing its own modulation and demodulation, amplification, and output switching. An untypical self-contained sensor provides options as built-in control timers or counters.

Remote photoelectric sensors used for remote sensing contain just the optical components of a sensor. The circuitry required for power input and amplification are positioned on a tiny control panel.



A – Emitter and receiver, B – Sensing distance, C – Emitter axis
D – Receiver axis, E – Sensing object, F – Background

Fig 3: Photoelectric sensor

A retro reflective arrangement places the transmitter and receiver at the same location and utilizes a reflector to bounce the light beam back from the transmitter to the receiver. It senses an object when the beam is interrupted and fails to reach the receiver. A proximity-sensing arrangement is one in which the transmitted radiation must reflect off the object in order to reach the receiver. Here, an object is detected when the receiver visually perceives the transmitted source rather than when it fails to visually perceive it. Diffuse sensor's emitters and receivers are located in the same location. The target behaves as the reflector, so that detection of light is reflected off the perturbance object. The emitter sends out a beam of light that diffuses in all directions, packing a detection area. The target then enters the area and deflects part of the beam back to the receiver. Detection takes place and output is toggled on or off when sufficient light falls on the receiver.

The detecting range of a photoelectric sensor is the maximum distance from which the sensor can retrieve information minus the minimum distance. A minimum detectable object is the most minuscule object the sensor can detect. More precise sensors can often have minimum detectable objects of smaller dimensions.

5. Eddy current displacement Sensor

The eddy current displacement sensor is installed into this equipment in order to further enhance the precision of the displacement between the right and left earpieces. This custom optimized displacement sensor is regarded as highly optimal in dirty environments, scenarios involving large range targets including the ones consisting of thick non-versatile materials although it works just fine with materials having counter properties to the previously mentioned. In this case, we chose to eliminate the usage of a target. Instead, we use two of these sensors on each of the earpiece to check if there is any interference in the magnetic field generated. If there is an interference pattern, then the probe will trigger a responsive action enabling the mixed audio stream. As for the environmental factors such as vacuum, this sensor works perfectly fine and coming to the other variant being temperature, -25°C to +125°C is the operating range. The maximum power consumption would be 1mW.

6. Construction of Eddy current probe

The fundamental component of the eddy current probe is the sensing coil situated at the terminal end of the device. AC is circulated into the coil thereby creating an alternating magnetic field used to determine the displacement of the target. To ensure higher focus of the magnetic field, the coil is placed in a plastic and epoxy case which is embedded into a stainless steel housing as shown in Fig.4.F

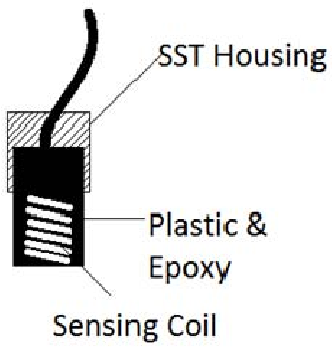


Fig 4: Construction of eddy current probe**.**

7. Range and spot size of eddy current probe

The eddy current sensors use magnetic field to fully encompass the emitting end of the probe. This generates a vast sensing field causing a larger spot size which is three times larger than the diameter of the coil. The formulated ratio would be 1:3. Special calibration will enhance the precision. Finally, the range would be 300%-500% of the coil diameter.

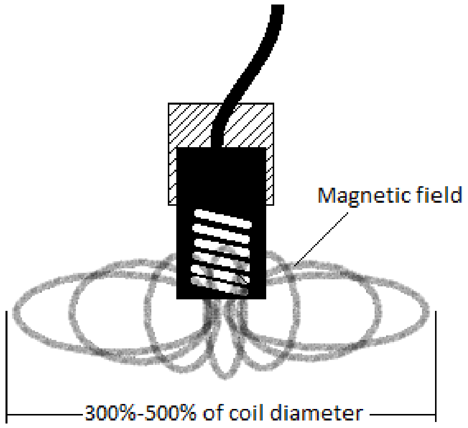


Fig 5: Range of eddy current probe

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