

Haptic Feedback Alerting and Interactive Technology

Introduction

Haptic or tactile feedback allows interactive and alerting responses to provide the user with dextrous control and exploration in an intuitive way. Several types of haptic feedback exist including vibrotactile, auditory and even electro-vibration. Simple alerting schemes might produce a basic vibration or sound to alert the user of an event, but this often provides the users with no insight in how to respond. Generally, a user will know to stop or continue what they are doing with the device, but the ability to modulate and more accurately correct how they use this device is absent. For example, using a simple vibration scheme in a steering wheel to alert the user of obstacles when parking only allows them to know something is in their current path, but it does not provide them with a sense of how close it is or perhaps how to properly adjust the current trajectory [1]. However, with vibrotactile haptic feedback, pulse frequency and magnitude can be modulated depending on distances and can even shift from one side to the other to provide a greater resolution of an obstacle's location when parking [1]. The intent of this review is to examine a few of the current uses of haptic feedback and briefly discuss two cost effective schemes available for embedded systems design, and the future of haptics.

Commercial Application to Haptic Feedback Systems

REVEL

A type of haptic feedback, REVEL, provides its users with a tactile feeling of real objects by “overlying” the objects with virtually any texture desired using reverse electro-vibration [2]. Reverse electro-vibration takes a weak electric signal that is injected virtually anywhere on the user's body to create an oscillating electric field around the user's fingers. When the user slides his or her fingers on the surface of a real world object, a virtual tactile texture is felt as if the object actually had this surface. It tracks touch locations, and the tactile textures can then be modified in real time. This way, the user's hands remain free so natural interaction and augmented reality can be toggled at any time [2].

Hand Prosthesis

Robotic end effectors that manipulate objects, such as neural prosthesis, in their environment must provide tactile feedback in order for the user to sense an object much like he or she would naturally. However, current brain-machine interfaces rely heavily on visual feedback limiting the use of such devices, since vision may be not possible or difficult and perhaps not even adequate [3]. Researchers at Arizona State University developed a robotic prosthesis that uses force sensors and electromyography data from the user to control the velocity of the fingers as the user opens and closes his or her own hand. The force sensor data on the robotic prosthesis is then relayed back to the user in auditory format using multiple frequencies to correspond with forces applied. The researchers conducted a few tests using an

empty plastic coffee cup, a full soda can, and a half empty water bottle. The results were decent with several 100 percent scores meaning no deformation or slipping of each object [3].

Vehicular Navigation

An additional use for haptic feedback involved using it for the guidance of an electric or hybrid vehicle approaching a wireless charging station [4]. The haptic system is in the cushion of the seat with left and right subsystems to help guide the user into the wireless station. It provides the user with direction of appropriate alignment due to pulse frequency and magnitude increasing in the direction of accurate orientation and position. Thus, once over the wireless station correctly both subsystems vibrate continuously with maximum magnitude indicating success [4].

Haptic Feedback Device Technology

Vibrotactile Feedback

Vibration motors of various sizes and styles and haptic drivers are among the cheaper alternatives for vibrotactile feedback. Precision Microdrives provides haptic feedback evaluation kit for 125 dollars to help a designer get a sense of how they can implement haptic feedback through vibrational motors [1]. The kit uses a haptic driver DRV2605 that can be purchased alone for eight dollars at Adafruit for those who may have a microcontroller(MCU) and a project planned [5]. Of course, an MCU can be coded with an algorithm that emulates the same effect as the driver, but the vibration motors still need a motor driver that will either have to be built or purchased for approximately five dollars [6]. Typical motors that are used in embedded systems cost no more than 7 dollars per motor, and bulk options exist [1, 5].

Auditory Feedback

If a designer wanted to use an MCU and sound for haptic feedback Adafruit also sells an MP3 player for 30 dollars that can play sound files from an SD card and also has a MIDI mode like those found on keyboard controllers [5, 7]. One could play various tones or musical instruments at various frequencies to provide appropriate auditory feedback. With this approach, soothing tunes and various sounds could be used to guide a user in an environment, to help grasp an object as described above, or to properly use a tool.

Future

The advancement of haptics is opening the door for applications in medicine for those with visual disabilities and the ability to perform remote surgery [8]. Teleoperation, operating a machine at a distance, is experiencing growth and improvement with haptics [8]. Data visualization through haptic feedback provides the means for unprecedented scientific analysis [8]. Thus, the various possibilities and existing systems for haptic feedback appear to be capable of providing users with an immersive experience bridging the gap of technology to human interface in a more natural and intuitive sense.

References

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