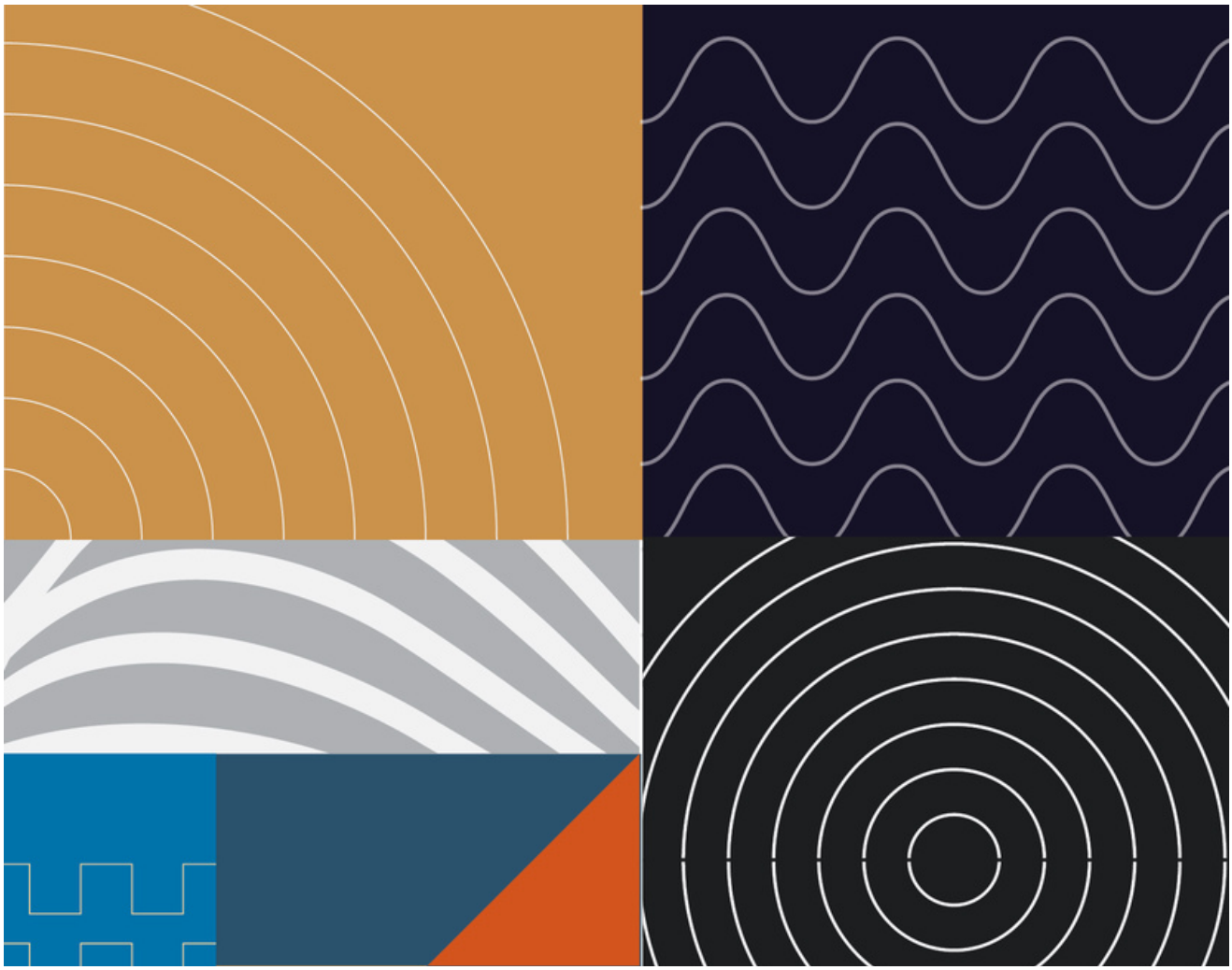
WHITEPAPERS

Haptics



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WHAT ARE HAPTICS?

If you've owned a smartphone or played video games in the last 10 years, chances are you've encountered haptic technology in your digital devices. Haptic feedback refers to any type of technology used to deliver a tactile response while interfacing with a device, machine, or computer. That is, haptics delivers physical sensations typically by producing vibrations that allow an end user to literally feel feedback from their devices – typically in response to a deliberate touch or integrated into a notification.

Haptic technology typically falls into one of three categories: graspable, wearable, and touchable. As mobile device consumers, most of us quickly recognize the touchable (i.e., smartphone screens) and wearable (i.e., smartwatches or fitness trackers) types. For gamers, their hand-held controllers and rumble packs good reference points.

On devices with touchscreens, haptic feedback simulates the feeling of pushing physical buttons. Haptics also enable vibration-based alerts on your smart devices, such as for calls and texts on your smartphone or a reminder from your smartwatch to meet your fitness goals. These haptic "bumps" are usually coordinated with on-screen notifications that are part of an integrated user experience, prompting the user to view the screen for more information or take the next step within an interface.

Haptics are also commonly used in combination with audible sounds to create a richer sensory experience within a digital interface. For example, in modern video games, haptic feedback in controllers often orchestrates seamlessly with in-game sound effects to simulate the sensations of key actions. By helping the player to feel the ground shake in an explosion or experience the turbulence of a car crash, video games deliver a much more immersive and realistic user experience.

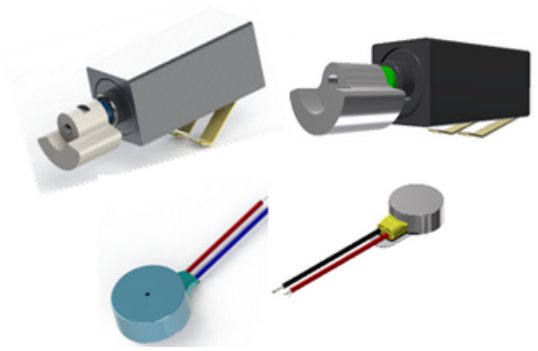
ENHANCING PERCEPTION AND INTERFACE EFFECTIVENESS

Computer scientists have shown that by combining haptics with sound and visual effects, touchable device interfaces can create sensations – or sensory illusions – that improve the effectiveness of the intended user experience. For example, playing the sound of a button clicking while the end-user pushes an image of a button makes them feel as if they have completed that step of the process. Similarly, making the screen appear to depress under the pressure of a finger creates the illusion of the screen feeling softer.

Haptics help to enhance an end user's perception and cognition by improving the tactile experience and better integrating it with all senses that are engaged by a digital interface – such as sight and sound (and potentially even smell and taste).

As haptic technologies continue to evolve, new markets are exploring the potential for other practical uses of haptics well beyond today's emphasis on commercial applications. And although haptics have been used primarily to make human-machine interactions more perceptible – via phone vibrations or the rumble of a game controller – haptic technology is directing its focus on making digital interfaces seem even more natural by mimicking the feel of natural interactions with materials or environments.

Eccentric Rotating Motor



Linear Resonant Actuators

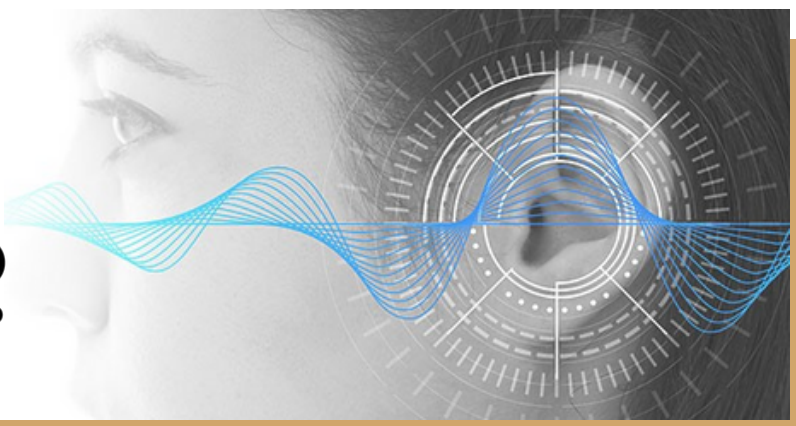
Expanding Into Industrial Markets

Consumer-based use cases for haptics are seemingly endless and increasing every day.

Combined with the advent of virtual reality (VR), augmented reality (AR), and the Internet of Things (IOT) technologies – which have implications for both entertainment and real-world utility – the stage is set for even wider adoption of haptics in commercial and industrial segments.

Today, many device manufacturers are making the business case for leveraging this potentially transformative technology to assist humans as they perform essential – even lifesaving – functions. Most notably in recent years, automotive driver-assist features have integrated haptics into steering wheels to send feedback to drivers when they're drifting out of lanes, following too close, or not gripping the wheel properly. This is just one of many examples in a rapidly expanding and emerging landscape.

Designers and manufacturers of medical devices, industrial human-machine (HMI), and security platforms are integrating haptic feedback to improve the user experience and functionality in mission-critical applications. Let's look at the growing potential for haptic technologies in these industries.



Medical Applications

In addition to improving the HMIs (digital interfaces) in a wide range of medical apparatus and instruments, haptics are emerging rapidly in remote, minimally invasive surgeries, VR-enabled training simulators, and patient rehabilitation.

Examples Include:

- Integrating haptics into commonly used medical devices and surgical tools
- Providing haptic feedback during robot-assisted surgery
- Simulating real-world and/or VR-based surgical procedures to build medical skills
- Supporting the use of VR in medical procedures
- Enabling haptic feedback in rehabilitation therapy

Industrial Applications

The industrial sector is taking cues from the proliferation of haptics in commercial applications to develop more intuitive HMI's with tablet-style, touch screen control panels. In these environments, haptics-enabled interfaces can support improved machine control while the increased use of touch screens reduces the amount of failure points inherent to traditional industrial HMI panels with moving parts (E.g. buttons and switches).

Among the industrial applications that have started to use more haptic-enabled touch interfaces include:

- Industrial/manufacturing machinery
- HMI control panels
- Point-of-sale devices
- Data terminals, ATMs
- Building automation systems

In the home security and home automation sectors, haptics are also being integrating into a variety of touchscreen displays.

Industry 4.0

With the emergence of the fourth industrial revolution (or Industry 4.0), VR, AR and IOT technologies are enabling real-time communication and interaction among digital systems and human operators. Like the commercial sector, the potential applications for these technologies in industrial settings are limitless. Already, they are being used to remotely assist technicians during repairs and are increasingly integrated into training programs.

Various types of haptic technologies offer communication enhancements to these interfaces via gloves, clothes and touchscreen tablets that deliver feedback and share information with the end user. In these busy and potentially dangerous environments, haptics can also enable more precise, remote control over machinery.

Whats Creating the buzz

The evolution of next-generation electronic components is driving haptic advancements and delivering tactile enhancements across a wide range of HMIs. As a leading expert and innovator in the audio electronics component space, PUI Audio is partnering with offering haptic devices manufacturers in the medical, industrial, and security market sectors.

The most common method of making devices vibrate is a small, direct current (DC) motor (aka vibe motor). A flywheel is mounted on a rotating shaft that passes directly through its center during normal operation, producing smooth rotation and no vibration. To create a vibration, an eccentric rotating mass (ERM) counterweight is added to the shaft to create an artificial imbalance.

More advanced components are based on linear resonant actuator (LRA) technology, which are typically the size of a small coin. Instead of rotating an LRA vibrates in a single plane up and down to create carrying degrees of haptic response. LRAs are composed of a wire raid (aka voice coil), a small circular magnet, and a spring that is connected to the device enclosure. As the AC current passes through the coil, a magnetic field exerts varying degrees of force causing he magnet to move up and down. In turn, this mechanical movement exerts a force on the spring, creating a sense of vibration at a pre-set frequency.

Partner With A Haptic Expert

The business case for adopting haptics within industrial applications and HMIs is growing every day. As the market becomes more familiar with the many advantages of haptics, many device manufacturers are integrating more advanced capabilities to achieve competitive differentiation in their devices.

To ensure that you're specifying the best-fit components for your next haptic device design cycle, be sure to partner with a full-service electronics expert. PUI Audio has the electronic components, deep engineering expertise, and haptic design and testing labs to help make your next haptic product launch a resonating success. If you're ready to explore the potential of haptics in your next product design, then please visit puiaudio.com to connect to our engineering team or email us at info@puiaudio.com.

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