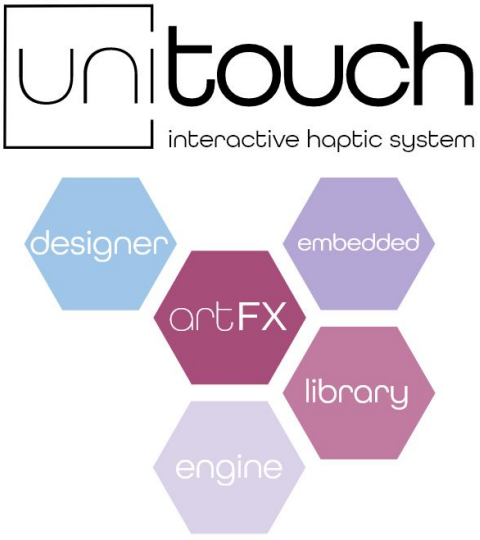
Unitouch™ - Interactive Haptic System

Product Description

v1.0

Unitouch™
Interactive Haptic System

Unitouch™ is an interactive haptic software *ecosystem* tailored to seamlessly integrate interactive haptics into next-generation hardware and software products.



Core

At the heart of **Unitouch™** is **artFX**, a digital signal processing engine engineered to support the *procedural synthesis* of haptic signals. The core function of **artFX** is to dynamically modulate haptic signals and assign them to one or several outputs.

artFX utilizes *data-flow processing technology* to provide precise control over the haptic sensations experienced by users. This technology is far more powerful than previous waveform-based techniques because **artFX** operates in real-time to render sensations *on-the-fly*. This technology overtakes the competition's waveform-based techniques because it enables designers to design and create immersive interactions rapidly and effortlessly.

Along with **artFX,** Actronika created the **Unitouch™ Library**. This library comprises a collection of ready-made haptic signal synthesizers based on the procedural methods of **artFX**. The library facilitates the creation and the integration of haptic feedback into products. The content of the **Unitouch™ Library** is categorized into: (1) haptic experiences, (2) touch interactions, and (3) application contexts. The content of the **Unitouch™ Library** is fully editable. It can be loaded onto many computational platforms to synthesize haptic signals on the fly.

Integrated Haptic Processing Units

Great haptic feedback crucially depends on end-to-end low-latency processing to meet the needs imposed by the fundamental tactile perceptual thresholds and by the requirement of the robust elicitation of haptic illusions. What is more, Actronika focused on the integration of haptic interactions in embedded systems by addressing the constraints of the limited computational resources available in embedded systems.

The need for a system that opens up the possibility to integrate haptics in various products is trending rapidly. Actronika anticipated this trend and developed the **Unitouch™** ecosystem while focusing on highly realistic haptic rendering. **Unitouch™** can remarkably enhance existing user interactions. It also unleashes the creation of completely new ones without having to worry about hardware limitations and having to rely on extensive knowhow.

Actronika provides two types of integrated systems that support the **Unitouch™** ecosystem:

Unitouch™ Embedded supports the realisation of "Haptic Processing Units". The low-level integration of haptics into your product is achieved by coupling **artFX** to the **Unitouch™ Library**. A Haptic Processing Unit then runs haptic algorithms on top of a Real-Time Operating System embedded systems equipped with an ARM Cortex-M processor. Designed to directly drive an amplification stage for voice-coil actuators, **Unitouch™ Embedded** ensures that optimal performance is obtained from Actronika's **HapCoil™** lineup of actuators. One Haptic Processing Unit can manage up to twenty channels depending on the targeted architecture. An API and helpers are available in C/C++, C#, Python and Java for major OS (Windows, Ubuntu, macOS, Android) and bare-metal.

Unitouch™ Engine is the embodiment of the Unitouch™ ecosystem as a *plugin* for other applications. It is designed to tightly control haptic feedback within an application context. **Unitouch™ Engine** communicates with compatible devices to output synthesized haptic signals on-the-fly**. Unitouch™ Engine** is available for **Unreal Engine 4** and **Unity3D** game engines as a plugin, or in C++, C#, Python and Java for major OS (Windows, Ubuntu, macOS, Android) as a dynamic link library.

Actronika provides a set of tools, described next, to ease the design of integrated haptic applications.

Development Tools

Tools are available in **Unitouch™ Designer**, a node-based editor that makes it possible to interactively design **procedural haptic pipelines,** based on the working principles instantiated in **artFX. Unitouch™ Designer** allows one to:

- Explore and edit the **Unitouch™ Library**.
- Create a new design from scratch.
- Live preview on any compatible hardware.
- Share your design between collaborators.

Unitouch™ Designer is available for major OS (Windows, Ubuntu and macOS).

What is coherent haptics ?

Human perception is a complex process where our brains process diverse sensory inputs to elicit coherent and stable conscious sensations.

Conscious experience is the result of the integration of multiple sensory streams produced by all sensory modalities (vision, audition, touch, smell, taste, proprioception, thermoception, vestibular, also including the many interoceptive modalities) which are correlated with our prior experience. The brain's objective is to maintain coherency despite the many perturbations arising from behaviour, the autonomic system, and/or external causes. It follows that severe incoherences between these streams (e.g. time lags, lack of congruency, and so on) lead to incorrect experiences, uneasiness, and even physical discomfort when the disparities are too great. Human performance also suffers.

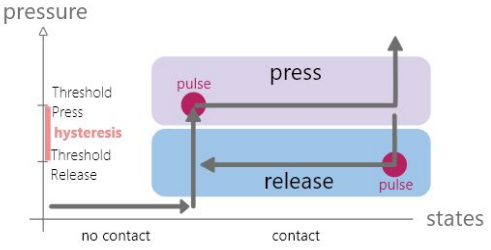
All perceptual modalities are subserved by populations of biological sensory units. Quite often these units subserve several modalities. Such is the case for example of audition and touch or proprioception and touch. The opposite is also true, that is, equivalent sensations can be elicited by different populations of sensory units because brains are highly integrated perceptual machines.

In haptics, information arising from vibrotaction (elicited by the rapid fluctuations of mechanical inputs), have been repeatedly shown to play a major role in the sensory stream we experience during our daily lives, hence, vibrotaction also plays a major role in maintaining coherence.

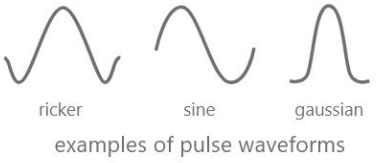
With **Unitouch™**, Actronika provided its clients with the means to integrate finely controlled haptic stimuli that drive realistic and coherent sensations.

Example: Virtual Switches

We all use mechanical interfaces in our daily lives to activate functions. Switches are an example of this kind of interface. Physical objects correspond to a collection of perceptual attributes, many vibrotactile, but also auditory and visual attributes. The perceptual attributes of switches can be rendered with appropriate transducers. Scott MacKenzie and Aleks Oniszczak, in 1997, described the synthesis of the behavior of a virtual button (a pressure switch) integrated in a touchpad. To reduce inadvertent switches, they programmed the interaction such that the pressure applied by a user on a surface was compared to different thresholds for trigger and for release. See Figure below.



The change of state in the interaction was notified with a salient mechanical event that can be modeled by impulsive signals. Such signals are exemplified below, among many other options.



examples of pulse waveforms

With **Unitouch™ Designer,** having gained the ability to specify precisely controlled vibrotactile inputs**,** designers can create interactions that are phenomenologically coherent and congruent with many existing and novel digital interactions. Sometimes, however, designers may desire to create non congruent, yet coherent, haptic signals. Magical effects, for instance, can be created this way especially when they are associated with an element of surprise.

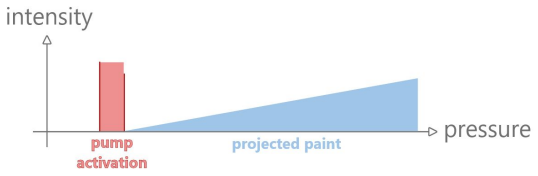
Certain physical interactions, such as buttons, can also be recreated by correctly orchestrating real-world signal samples. Complex interactions require the dynamic generation of the haptic signals to create realism through the elicitation of haptic illusions. Our brains have learned to identify *patterns*, such as specific temporal sequences. The quality of interactions then rest on the deterministic synthesis of these sequences as a function of external events. Other interactions rely crucially on the stochastic properties of haptic signals that are associated with external events. **Unitouch™ Designer** enables interaction designers to expertly and creatively combine these different methods of haptic signal generation.

Example: Virtual Paint Gun

Actronika designed the emulation of paint guns for professional training in Virtual Reality settings. The setup comprised a HTC Vive controller mounted onto an actual paint gun. The trigger of the paint gun acted on a force sensor that was used to drive the digital interaction. Two haptic synthesisers were implemented to realize it.

1. Activation and deactivation of the pump from real-world samples.
2. Throttle-controlled projection of the paint.

Paint projection was emulated with a haptic signal having stochastic properties similar to that of real paint projection. As in real life, the virtual flow was modulated by the pressure applied to the trigger.



The haptic virtual paint gun hardware and software, integrated in a graphic virtual work visible through a VR headset, provided the trainees with an uncanny sensation of realism.

Example: Surfaces

Exploring surfaces is something we do hundreds of times a day. New devices and appliances, however, tend to eliminate mechanical interactions and replace those by sensorially dull touch-sensing technologies. The result is an overload of the other sensing modalities, especially vision, in order to ensure a degree of interface usability. The **Unitouch™** ecosystem helps to reinstate the lost coherence between perceptual modalities in advanced user interfaces through the tight control of the oscillations of surfaces. What is more, recent technical advances carried out at Actronika now makes it possible to localize these oscillations to specific areas of a surface*, unleashing whole new types of interactions.

** Patent pending.*

Example: Handheld and Wearable devices

Together with the miniaturisation the devices come smarter and more powerful computing chips, sensors, and actuators. From devices we hold in our hands, such as portable phones or game controllers, to devices we wear, haptic technology empowers these devices to convey information in a unique and unobtrusive manner. The **Unitouch™** ecosystem facilitates the development of efficient and pleasant interactions that boosts user experience.

Example: Seats

Our sedentary lifestyle causes us to spend a lot of time sitting at the office, in transportation, or at home. The industry focuses on the comfort and ergonomy of seats. At the same time, there is huge interest in the integration of technology in seats to augment their values by adding innovative features. **Unitouch™** enables the integration of haptic feedback in seats to transmit information, such as alerts or notifications, or enhance the immersion in entertainment media.

These examples illustrate how Actronika's **Unitouch™** ecosystem provides its customers with an end-to-end solution to the integration of haptic in many products, from design to deployment.

Applications

The applications and the sectors of application of the **Unitouch™** ecosystem are numerous. Here is a sampling:

Touch Screens	**Automotive**
Dashboards	**Mobile**
Trackpads	**Computer peripherals**
Appliances	**Domotics**
Gamepads	**Entertainment**
Smartphones	**Wellness**
Remote controllers	**Biomedical**
Wearables	**Smartwatches**
Suits	**Seats**

Actronika also provides services to help you integrate our ecosystem into your product. Please contact us at contact@actronika.com if you would like to know more.