

Haptic & Tangible User Interface

김래현 @

한국과학기술연구원 지능인터랙션 연구센터

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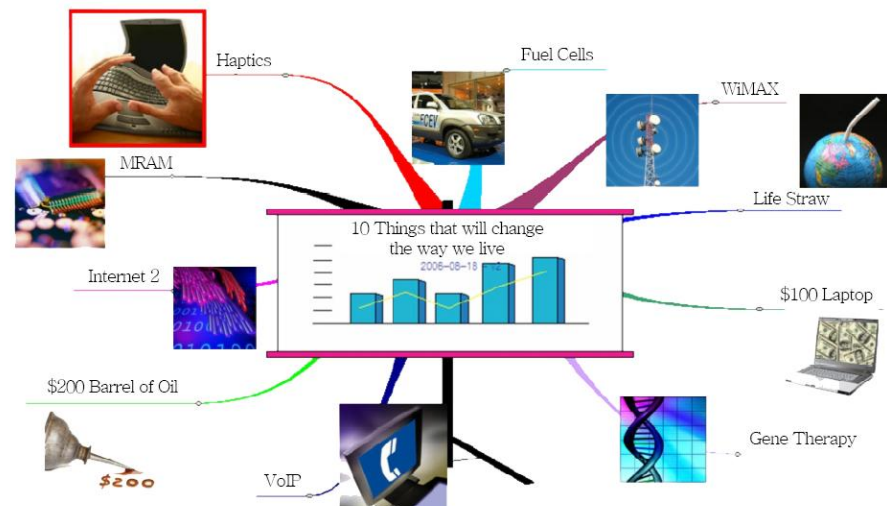
Korea Institute of Science
and Technology

한국과학기술연구원

Haptic ?

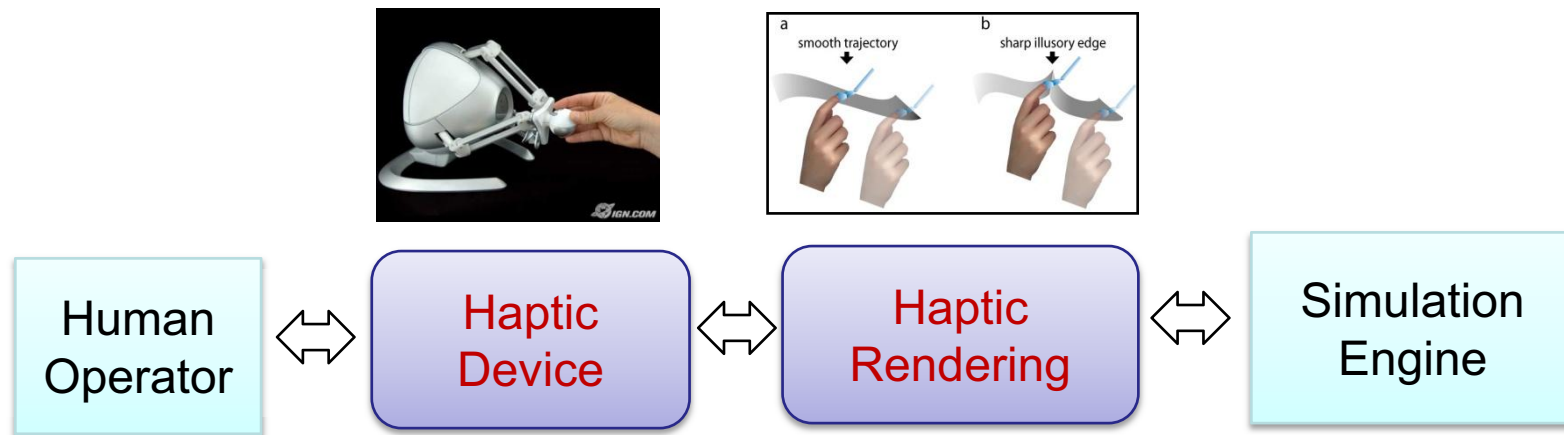


Haptic Phone (Samsung, 2008)



10 Things That Will Change The Way We Live (*Forbes*, 2006)

Haptic technology



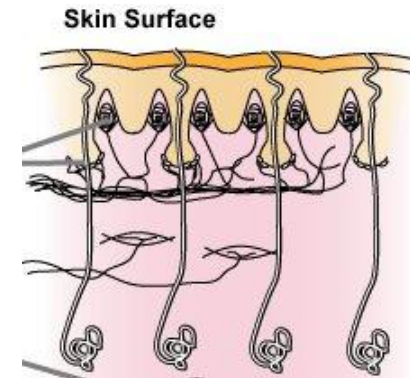
“Haptic technology works by using **mechanical actuators** to apply forces to the user. By simulating the physics of the user’s virtual world, we can **compute these forces** in real-time, and then send them to the actuators so that the user feels them”

- Minsky

Types of human haptic sensing

Tactile

- sense stimulus through the skin
- heat, pressure, vibration, pain

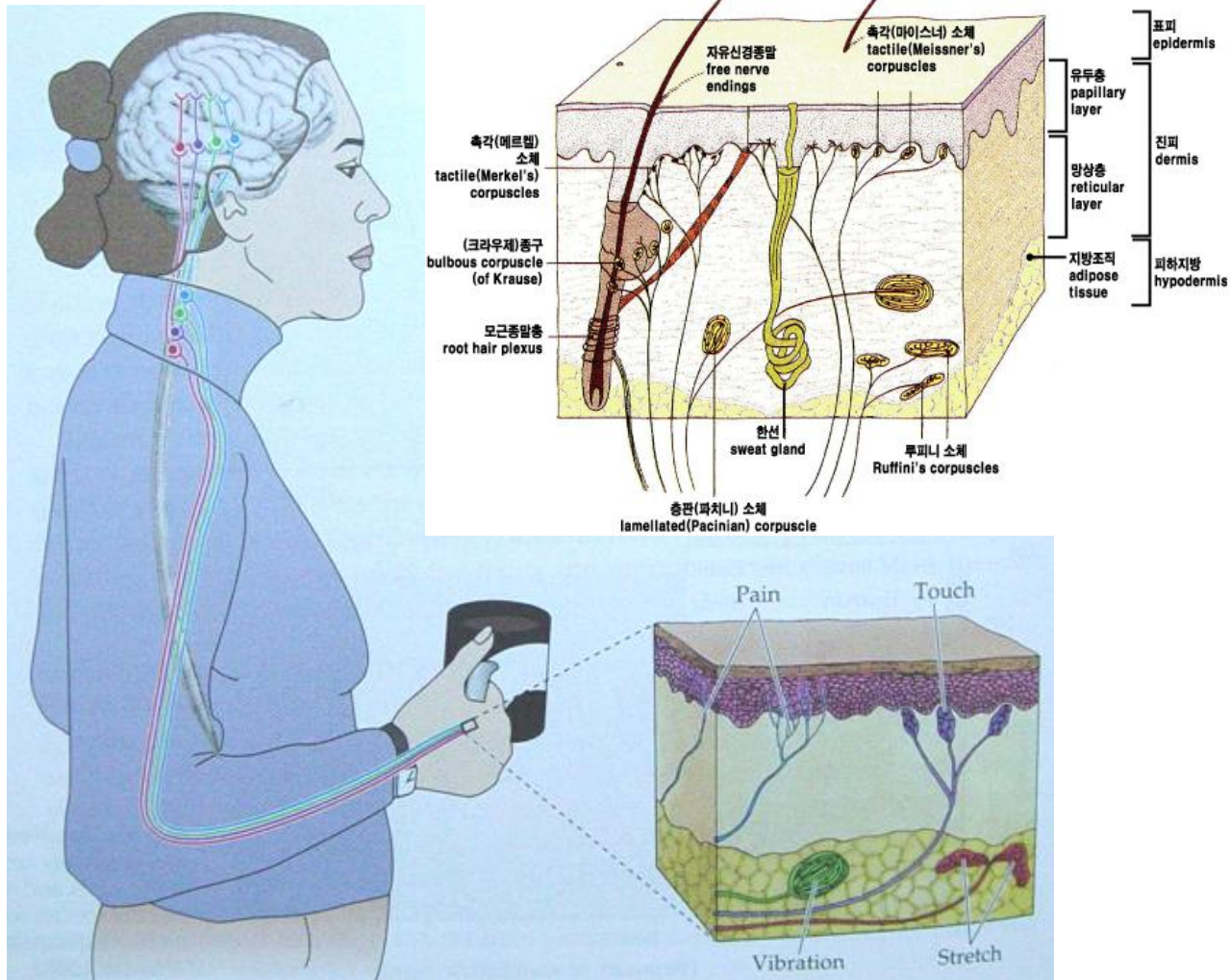


Kinesthetic

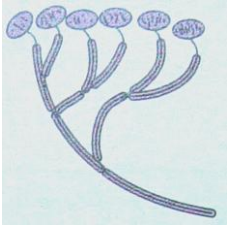
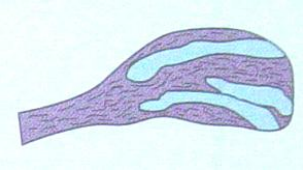
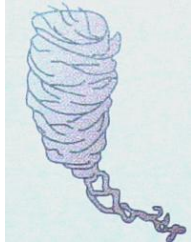
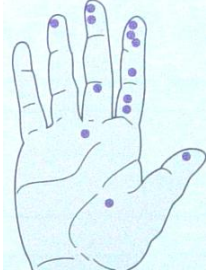
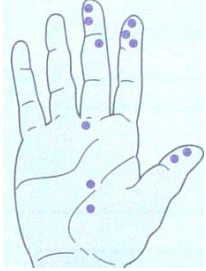
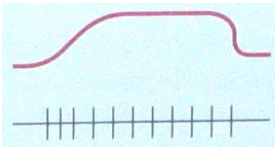
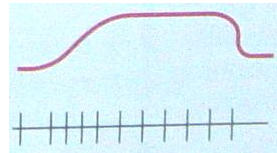
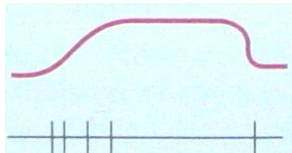
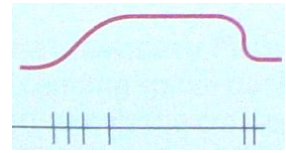
- stimulated by bodily movements
 - end organs in muscles, tendons, and joints
- force/torque feedback, motion arrest



Sensory Processing Begins in Receptor Cells



Properties of Skin Receptors

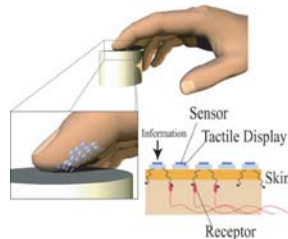
Receptors	 Merkel's Disks	 Ruffini's Ending	 Meissner's Corpuscle	 Pacinian Corpuscle
Function	Edges, Indentation	Skin stretch	Velocity, Edges	Vibration
Receptive Field	 small, sharp borders	 large, vague borders	 small, sharp borders	 large, vague borders
Stimulus Response	 Slow Adaptation I	 Slow Adaptation II	 Rapid Adaptation I	 Rapid Adaptation II

Tactile Actuators

- Linear motion type
 - » Piezoelectric actuator
 - » Linear motor
 - » Solenoid
 - » Voice Coil
 - » SMA (shape memory alloy)
 - » Electro-active polymer
- Shear type
 - » Piezoelectric bimorph
 - » Electro-active polymer
- Vibration type
 - » Linear vibrator
 - » Rotary vibrator
- Pneumatic type
 - » Piston
 - » Air pressure
 - » Suction
- Electrotactile type
 - » Electrostatic force
 - » Electrocutaneous stimulation
- Friction/Viscosity type
 - » Electro-Rheological Fluid
 - » MR Fluid
- Thermoelectric type
 - » Peltier module



Electric motor



Electrotactile



Thermoelectric module



Piezo actuator



Pneumatic tactile display (Berkeley)

Vibrotactile feedback phone

VibeTonz by Immersion

- VibeTonz Actuator
- Specification
 - » vibration effect
 - » available for the mobile implementation
 - » Alert, Caller ID, music, messaging, ringtones, and gaming
 - » Samsung, LG mobile phone



Vibrotactile feedback phone

Touch Diamond

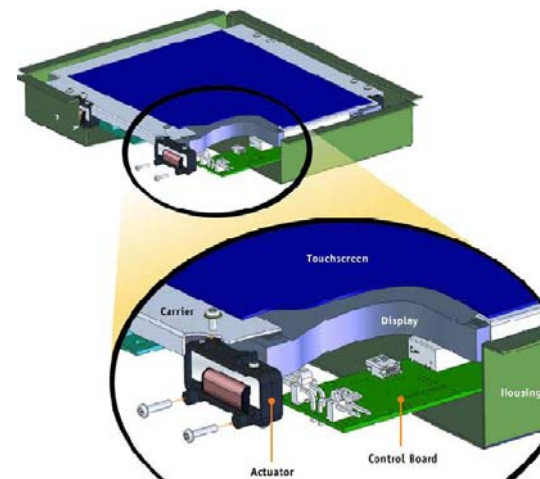
- By HTC (High Tech Computer)
- Specification
 - » Vibrant TouchFLO 3D user interface
 - » Touch-sensitive navigation control
 - » 2.8-inch touch screen
 - » Motion G sensor
 - » MS Windows mobile 6.1
 - » Integrated GPS



Touch feedback screen

TouchSense by Immersion

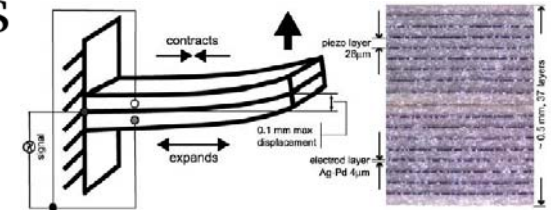
- Solenoid actuators at corners
- Specification
 - » TouchSense actuators
 - » Assembly of touch panel and display
 - » Integration KIT
 - » Button click
 - » Industrial applications



Touch feedback screen

TouchEngine by Sony

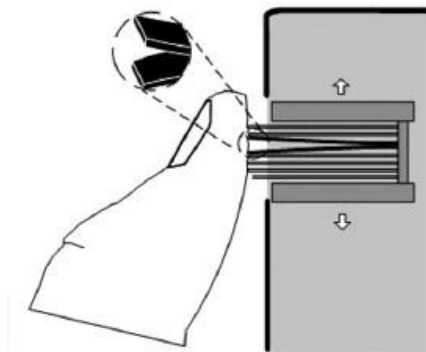
- Multi-layers of piezoelectric bimorphs
- Specification
 - » Driving voltage : $\pm 8-10V$
 - » 30x8x0.5 mm size
 - » Bandwidth > 10kHz
 - » 0.2mm displacement
 - » 5G acceleration range
 - » Impact force based on acceleration
 - » Available for only small touch screen



Laterotactile handheld device

Tactile handheld miniature bidirectional device

- Laterotactile display
- By McGill Univ.
- Specification
 - » piezoelectric actuators
 - » stimulate a user's thumb fingertip skin
 - » tactile interactions with mobile device



Tactile Display for Handheld Device

Tacton

- Tactile button
- Brown, Brewster, University of Glasgow, 2005
- Specification
 - » Form sound wave to tactile pattern
 - » Touch-screen keyboard buttons
 - » Success & error, menu control
- Key technology
 - » EIA C2 Tactor Voicecoil Vibrator



Tactile feedback pen

Ubi-Pen by ETRI

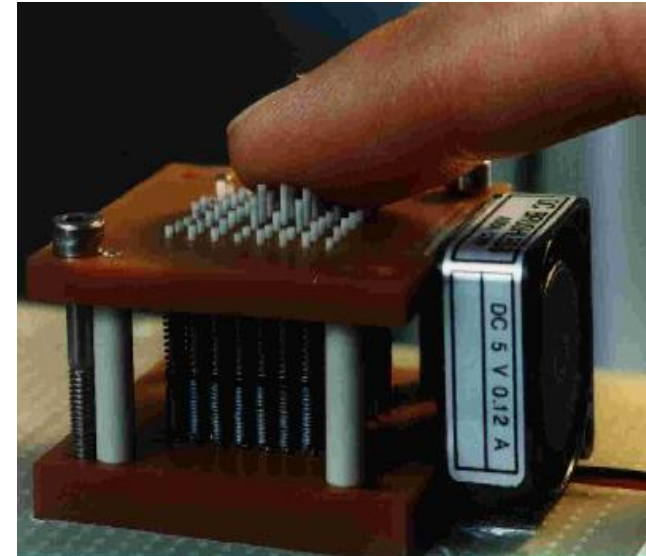
- Linear impact vibrator
 - » piezoelectric ultrasonic motor
- Tactile feedback
 - » 3x3 pin array, compact size controller
- Windows haptic user interface
 - » menu selection, dragging, popup
 - » surface tactile feedback
 - » a touch screen
 - » wireless communication
 - » sound feedback



Pin-Arrayed Tactile Display

Pin-arrayed Tactile Display

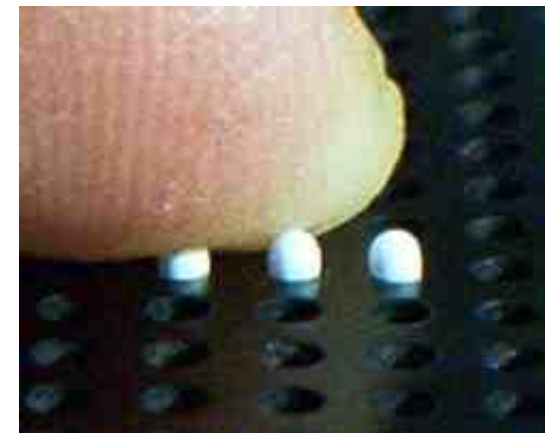
- Developer
 - » Karlsruhe, Fischer's group
- Specification
 - » Maximum operating frequency: 600Hz
- Key technology
 - » Electromagnet operating
 - » Solenoid



Tactile Display for the Blind

Video TIM

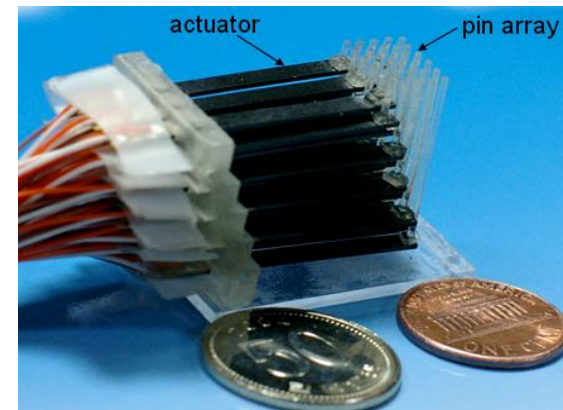
- Developer
 - » Abtim, Germany
- Specification
 - » 2.5mm dot spacing
 - » 4x4 cm size, 256 dots
 - » 24 pictures/sec
 - » Zoom in and zoom out
 - » Weight 800g
 - » 1000g including camera
- Key technology
 - » Piezoelectric actuator



Tactile Display Mouse

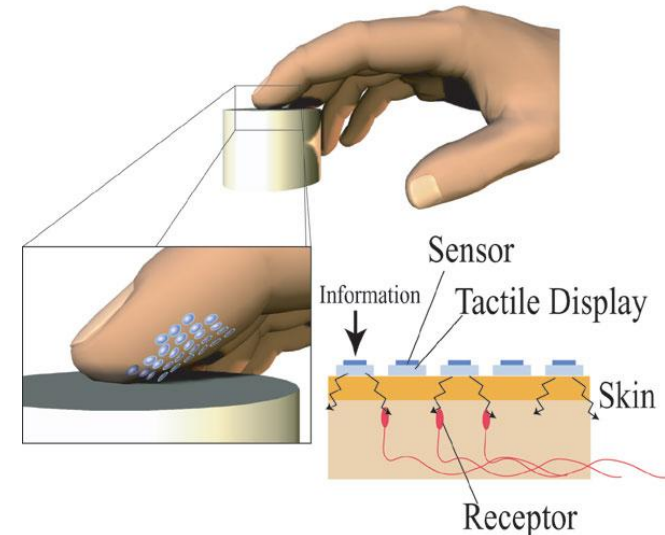
KAT(KAIST Artificial Touch)

- Developer
 - » Kyung and Kwon, KAIST, 2005
- Specification
 - » 5x6 pin array, 6g force
 - » 1.8 mm spacing
 - » 0.7mm displacement
 - » Vibration disp. > 30dBSL
 - » Bandwidth: 350Hz
 - » Tactile display mouse
- Key technology
 - » Woven arrangement
 - » Piezoelectric bimorph



SmartTouch by Univ. of Tokyo

- Use electrical stimulation through the skin
- Electric current generates an electric field inside the skin
- Vibratory and pressure sensations
- Advantages
 - » low power consumption
 - » maintains constant contact
- Disadvantage
 - » risk of user discomfort or pain

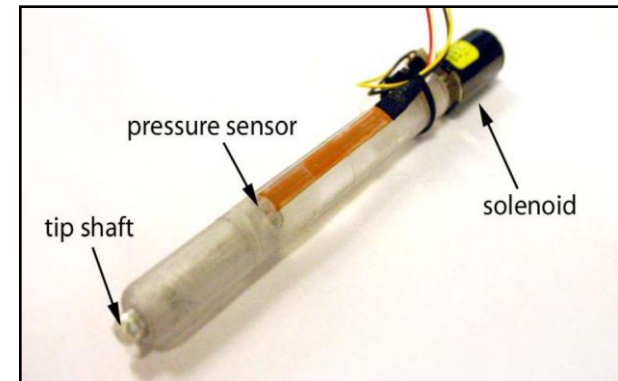


Electro-tactile stimulation

Tactile Feedback Stylus

Haptic Pen

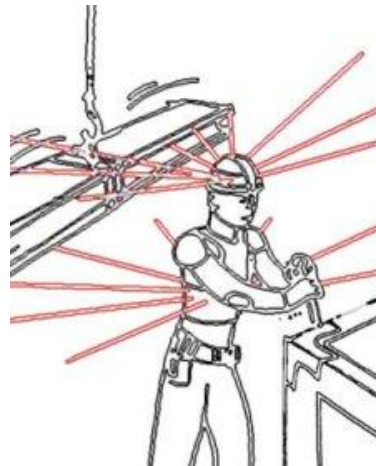
- Developer
 - » Kyung and Kwon, KAIST, 2005
- Specification
 - » 5x6 pin array, 6g force
 - » Feedback not tied to display
 - » Individualized feedback
 - » Pressure Sensitivity
 - » Non-Contact Location data
 - » Low-cost
- Key technology
 - » Pressure sensor
 - » Solenoid



Wearable haptic module

Haptic Radar

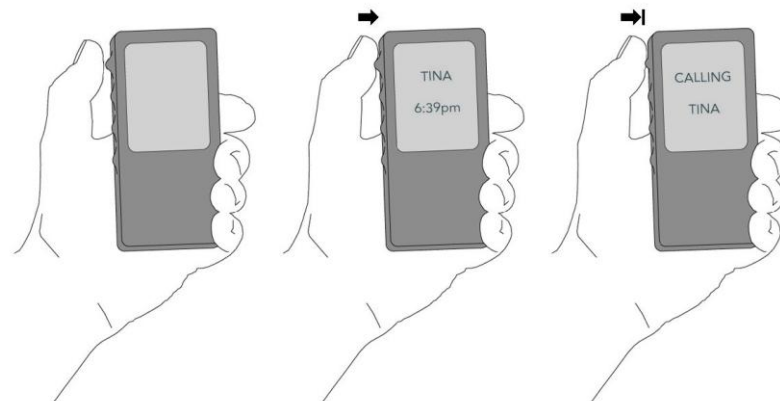
- Developer
 - » University of Tokyo' Ishikawa Komuro Laboratory
- Specification
 - » Body-mounted range sensors (Infrared)
 - » Small vibrating motors
 - » Alerts the wearer of any approaching objects



Changing phone's shape

Dynamic Knob, CHI 08

- Deutsche Telekom Laboratories, Germany
- Specification
 - » The knob alters the phone's shape according to different events and states
 - » Pushing, holding, releasing the knob
 - » servo motor to move the knob
 - » force-sensitive resistor to measure the thumb pressure



Haptic control

iDrive from BMW

- iDrive is controlled by manipulating the control knob
- Move, push, rotate the knob
- Torque feedback according to the situation
- Communication, climate, entertainment, navigation



iDrive for BMW M3, M5, & M6

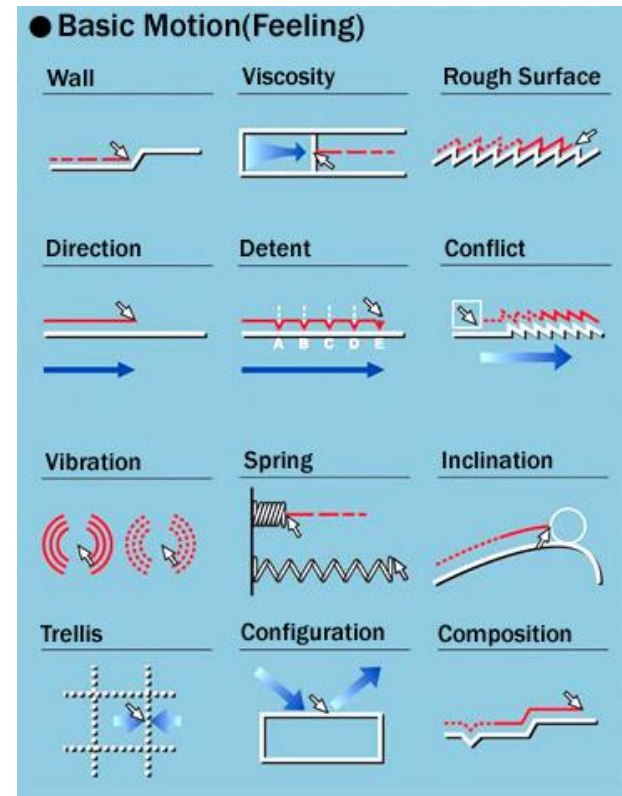
Car of future

Haptic feedback technology by Alps

- Creating a sense of touch for drivers
- a range of operating feel settings



*Haptic Steering Wheel,
Haptic Stick, Haptic Pedal*



Media control using haptic feedback



Source: Sony Corp.

Changing the shape of this video control knob changes its function
From Sony corporation



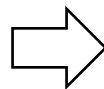
Radio control

Haptic dial by KIST

- Virtual prototyping with haptic feedback
- Hands-on experience to simulate physical reality
- Design haptic behavior in the early stage of development
- Example : dial module for a washing machine

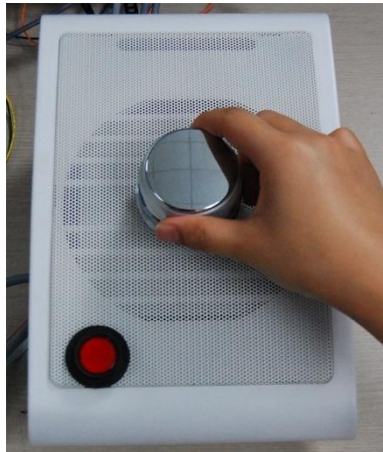


Real product



Haptic prototyping

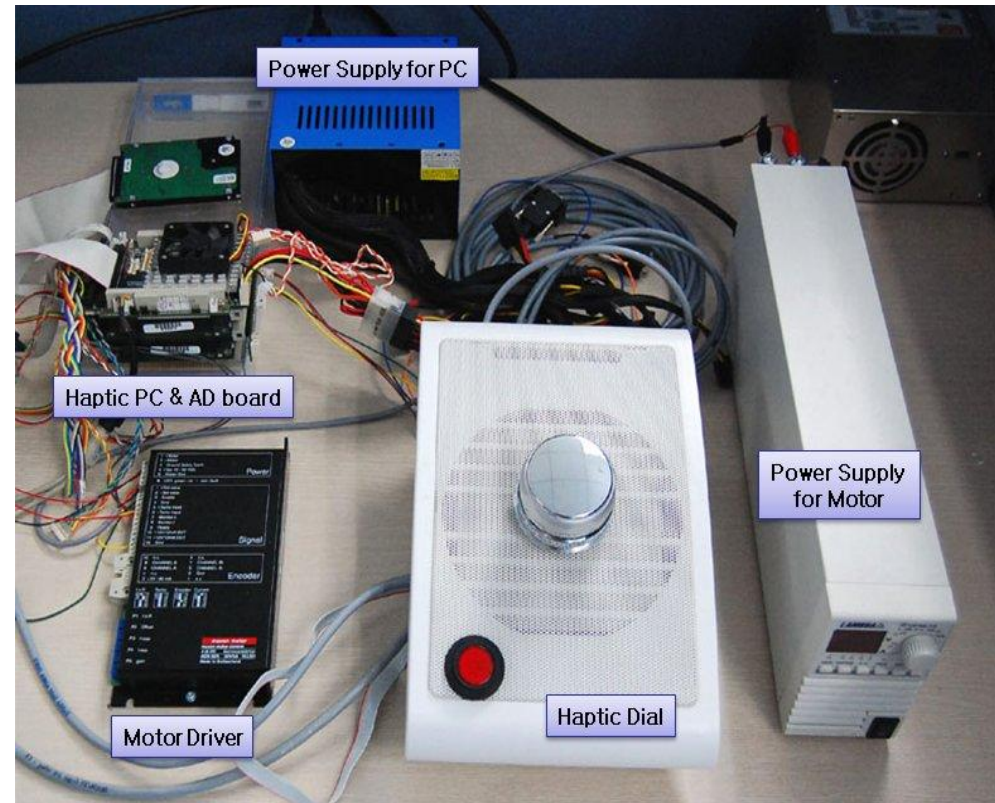
Haptic Dial System



Haptic Dial module



Physical Dial Knobs

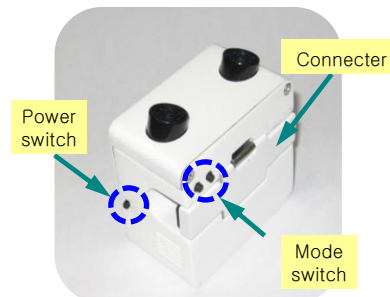
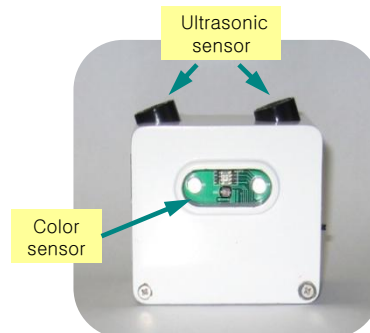
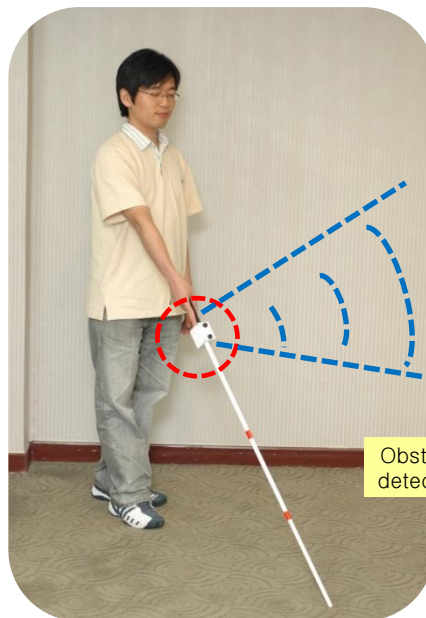


Haptic Dial System

For visually handicapped

SmartWand by KIST

- Quick and easy installation on the white cane for the visually handicapped.
- Detection of obstacles ahead, which are not covered by the white cane
- Vibration indicates whether objects are ahead or not.
- Sensing brightness around and color of objects



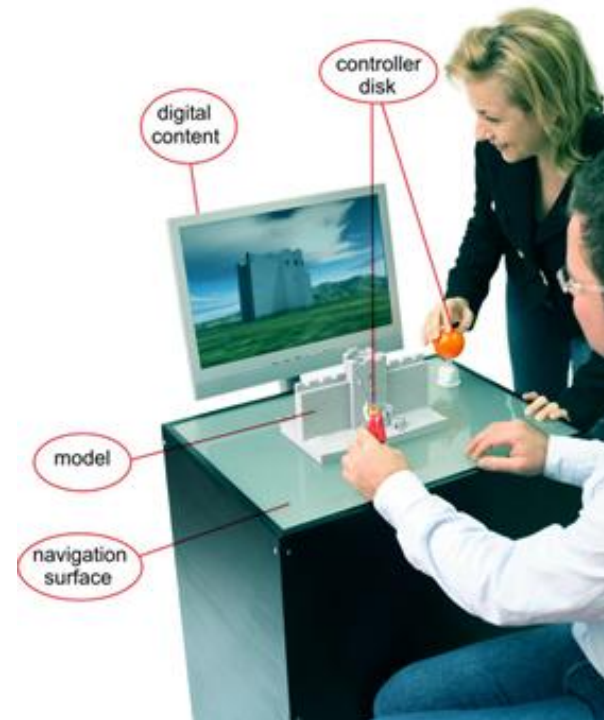
Nintendo Wii



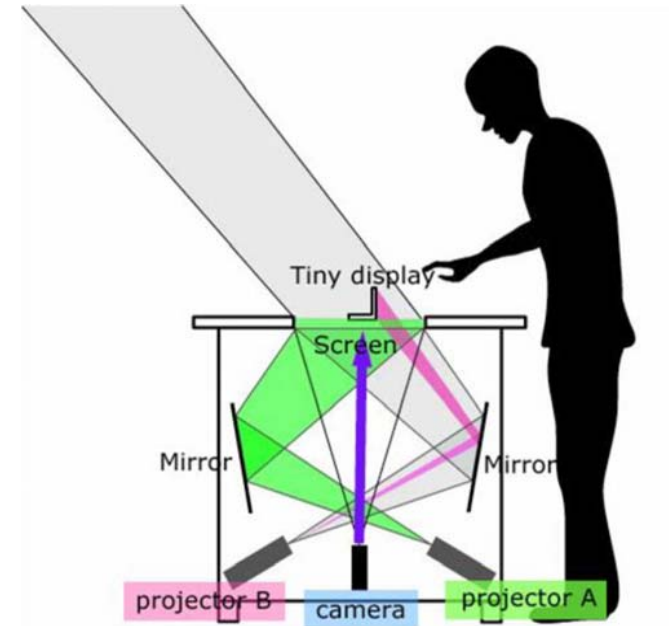
Mixed reality interface



Mixed Reality Interface (MRI) is to develop a simple-to-use human-computer interface. The system that can be used in a variety of applications - including presentations, games, architecture and landscape planning. This interface allows you to control virtual 3D models using real objects (such as toys, blocks, special characters, etc.) (SIGGRAPH 2006, Emerging technology)

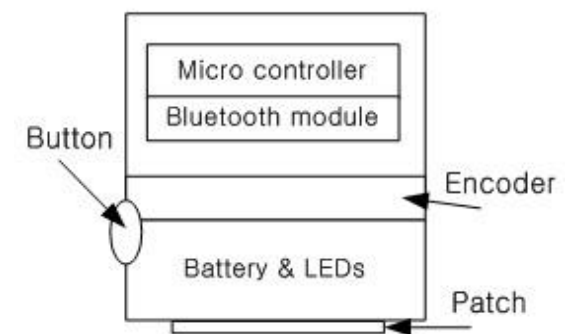
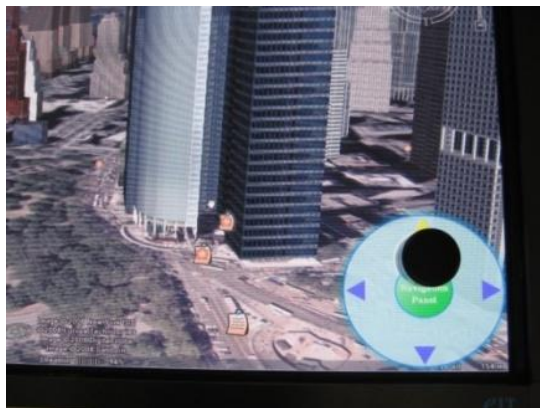
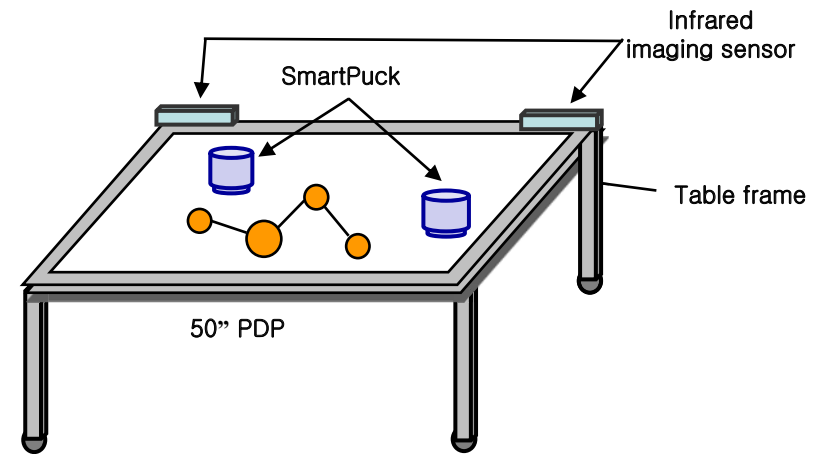


Tablescape Plus

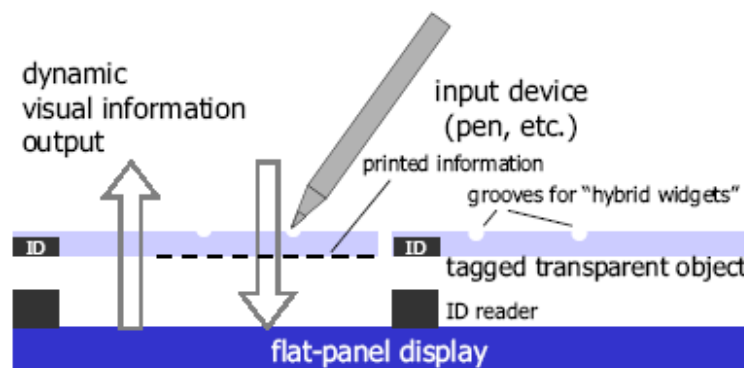
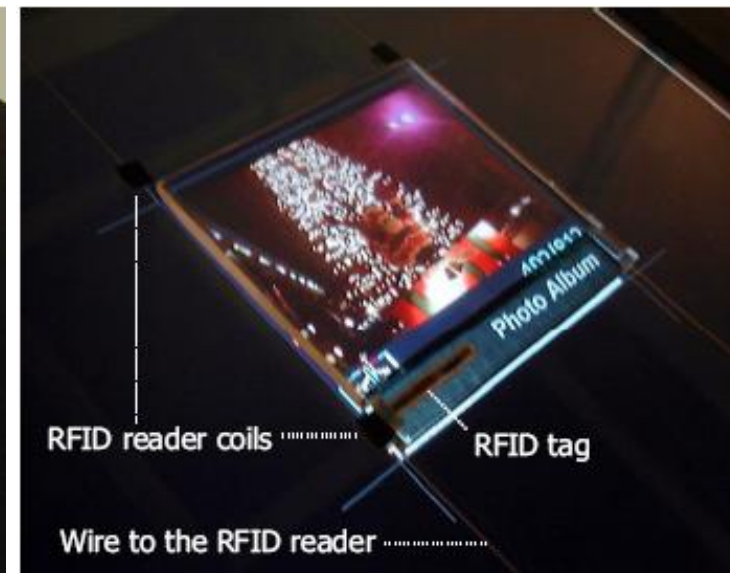


"Tablescape Plus" is an interactive tabletop video theater. Different images are projected onto the respective tiny screens placed upright on the table. As the user moves the screens, the images change. Moreover, users can develop new stories by changing the arrangement of the screens. For example, when the screens are placed side-by-side, the images on the respective screens react to one another. Users can be involved in the world of these tiny imageries, which is like a living miniature garden. (SIGGRAPH 2006, Emerging technology)

SmartPuck – KIST



DataTiles



DataTiles (Sony) : A modular platform for Mixed Physical and Graphical Interactions. Tagged transparent tiles are used as modular construction units. These tiles are augmented by dynamic graphical information when they are placed on a sensor-enhanced flat panel display. They can be used independently or can be combined into more complex configurations.

Surface computing



Microsoft Surface computing



CSI: NY, Miami

Sensitive Table/Wall/Floor



CHI 2008 : InteractiveTable



Milano design week 07:
Fiat 500 interactive screen



Sensitive Floor

고맙습니다

김래현, laehyunk@kist.re.kr

