# Developing User Interfaces for Next Generation Multisensory Internet


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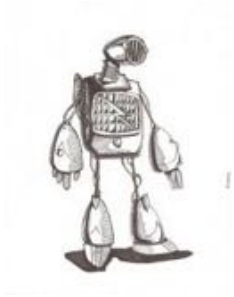
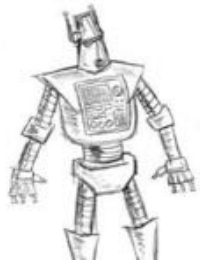
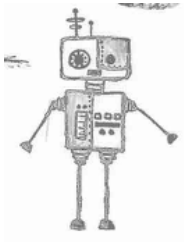
**Imagineering Institute** is the first independent **multidisciplinary** Internet and Digital Media **Research & Development** ("R&D") Institute and **Start-up Incubation space** combined. This is also the first Research Lab in Nusajaya. We focus on **inventing the future of the Internet.**

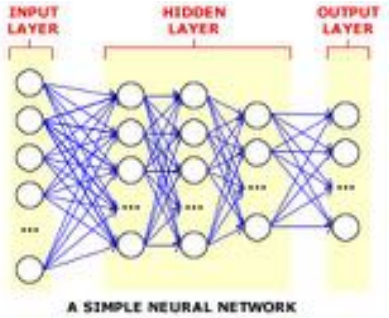





# RESEARCH THEMES

Research conducted by the Imagineering Institute falls into the following cross-cutting research areas

Digitization of Human Senses

AI & Deep Neural Networks




Robotics

Educational Technology

# Digitization of Human Senses


Future of Internet
Communication with all of our senses
From “Information Communication”
to “Experience Communication”

[Credits for the slide: Prof.Adrian David Cheok]

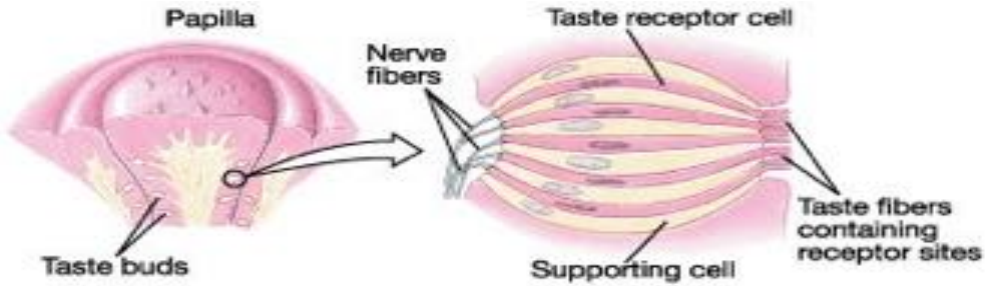
# Smell and Taste

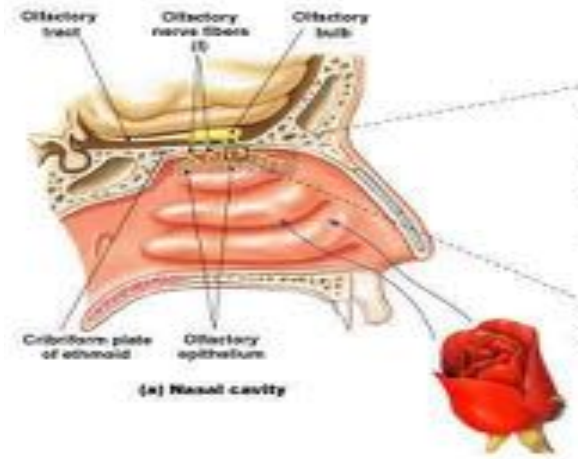
- In virtual reality (VR) applications, actuating the sense of taste and smell is currently based on chemicals, which is not an effective long-term solution, as the chemicals need to be refilled and maintained properly.
- Digital Smell and Taste research team was formed in 2009 in National University of Singapore.
- Digital taste and smell actuation technologies that do not depend on chemicals, will be a useful future step for VR. Once we reach this goal, people will be able to experience taste and smell sensations through VR and share these sensations across the internet, in the same way, as we experience audio, visual, and haptic sensations.

[Credits for the slide: Prof.Adrian David Cheok]

# Smell, Taste and Emotion

- **The olfactory bulb in the brain, which sorts sensation into perception, is part of the limbic system. This link to brain's emotional center links smell to memories, feelings, and emotions. The only two senses directly connected to limbic system**



# History

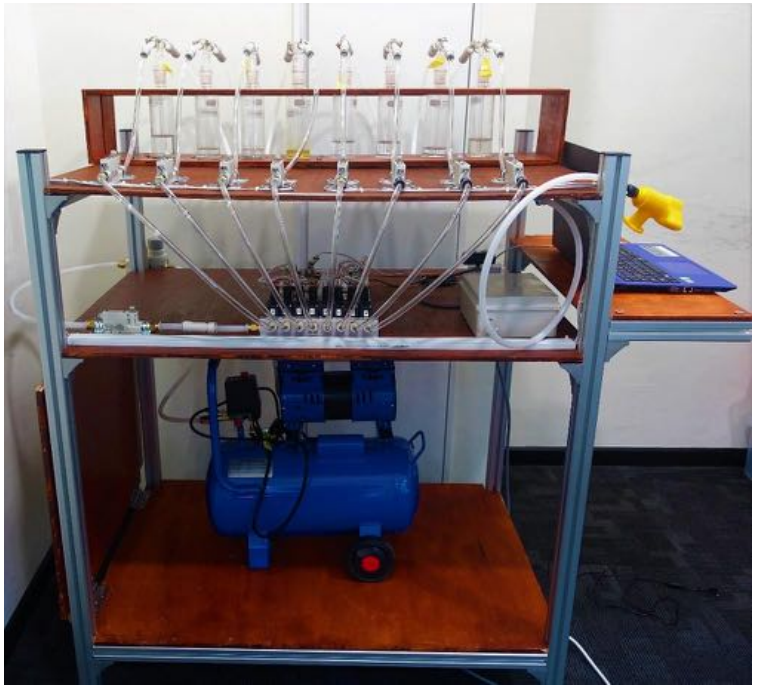
- the first Olfactometer was developed by the Dutch scientist Hendrik Zwaardemaker in 1888
- Since then much improved and sophisticated olfactometer systems were developed by both researchers, and industry.

# What is an Olfactometer?

- Olfactometers are kind of machines specially designed to deliver different odorants to the users, based on a timely protocol.
- Purchasing off the shelf systems are expensive and require additional customizations
- It is difficult to recreate these systems using literature, mainly because of the complexity and lack of implementation details

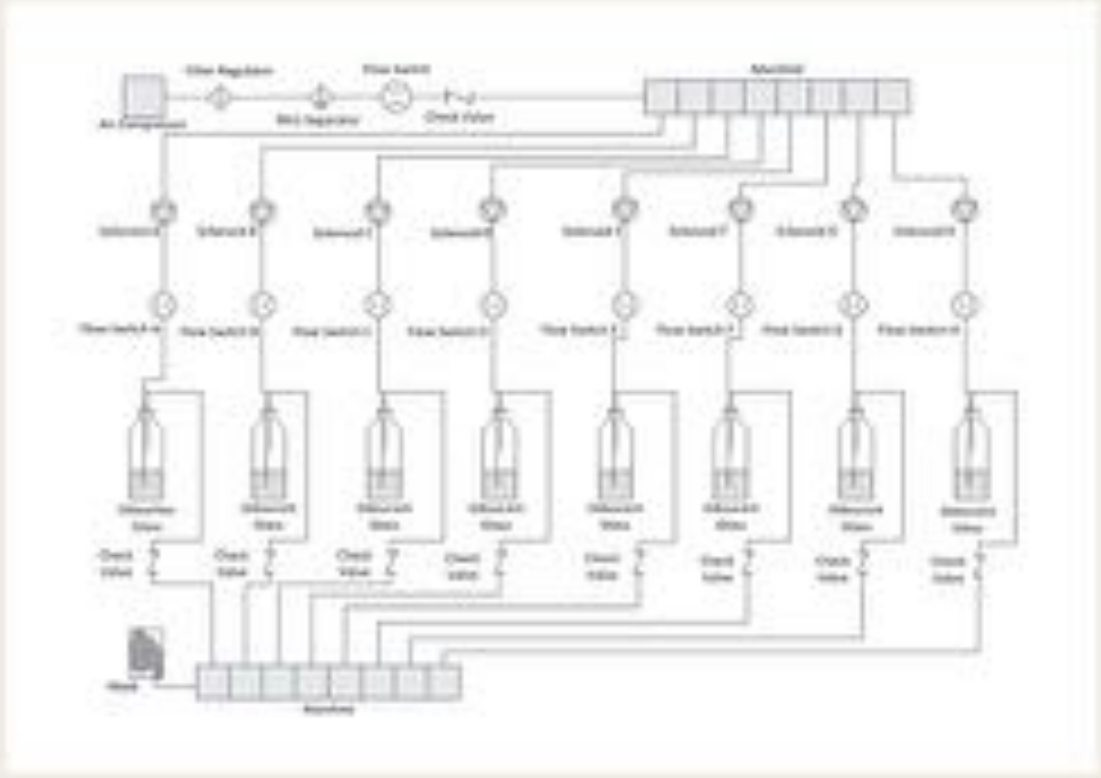
# Laboratory Olfactometer

- Olfactometer is a device used for producing smells in an accurate and controlled manner.
- The Laboratory olfactometer authors developed is a computer driven system designed to produce seven different smell channels and a continuous flow channel.




- Karunanayaka, K., Saadiah, H., Shahroom, H. and Cheok, A.D., 2017, October. Methods to develop a low cost laboratory olfactometer for multisensory, psychology, and neuroscience experiments. In *Industrial Electronics Society, IECON 2017-43rd Annual Conference of the IEEE* (pp. 2882-2887). IEEE.

# High-level Flowchart of the System



# Scentee

- Scentee, was introduced as a mobile scent actuation device which can be used with Iphone or Android devices and can be carried along.
- ‘Scentee Machina’ is a smart room diffuser.


# SCENTEE

The world's first smart phone attachment for Iphone and Android that enables the user to use their sense of smell with their Iphone or Android.

Application:

User can send scent fragrence to their friends through their smartphone.

Change the flavour of food by modifying smell.

The app and device can release an aroma at the same time as a phone clock alarm or when an individual receives a text message.

Figure 1: Scentee emit fragrance with control from smartphone

# Electric Smell Interface

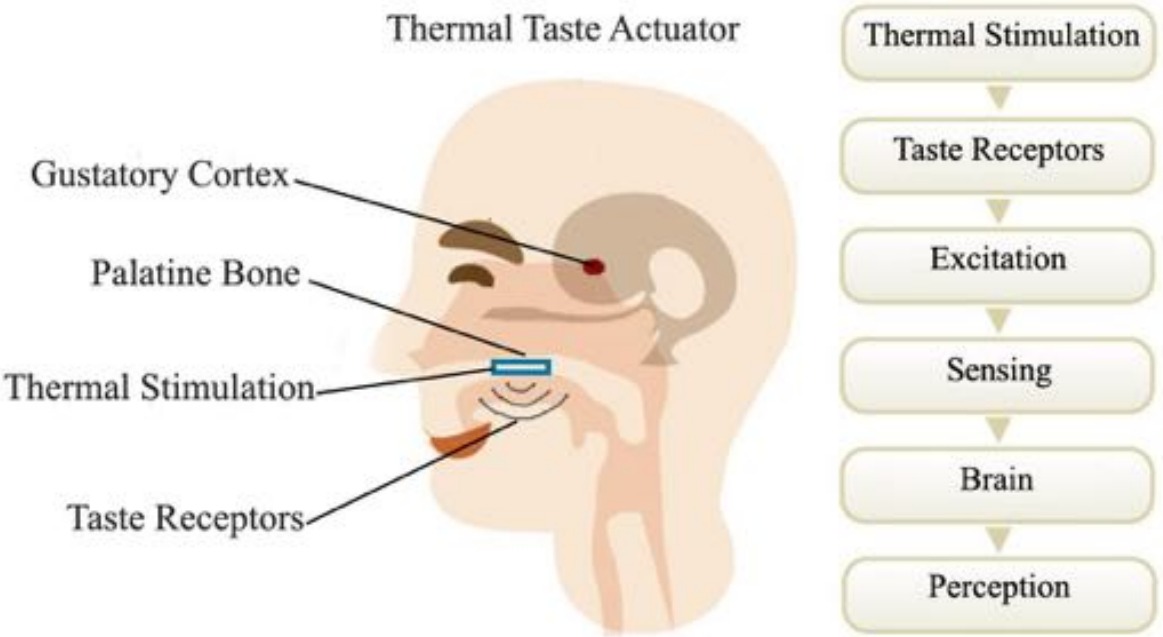
- In 2016 we proposed a new user interface that has potential to trigger smells by stimulating the olfactory receptors in the nose non-invasively with weak electrical pulses.
- Currently we are working on the user studies and improving the technology further



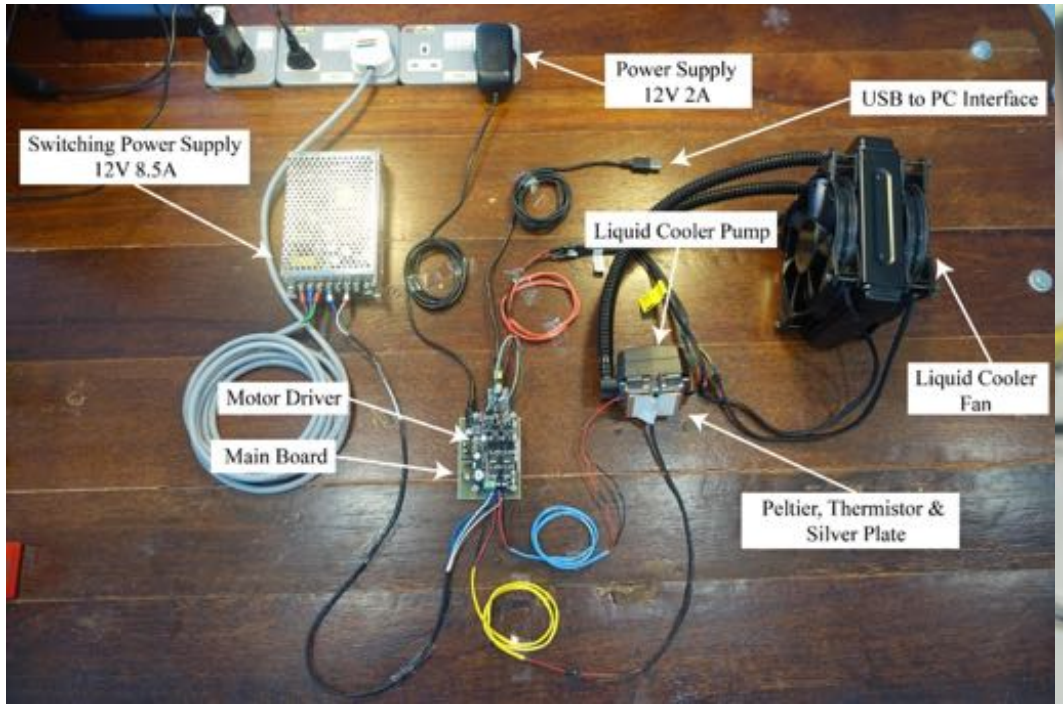
- Hariri, S., Mustafa, N.A., Karunanayaka, K. and Cheok, A.D., 2016, November. Electrical stimulation of olfactory receptors for digitizing smell. In *Proceedings of the 2016 workshop on Multimodal Virtual and Augmented Reality* (p. 4). ACM.

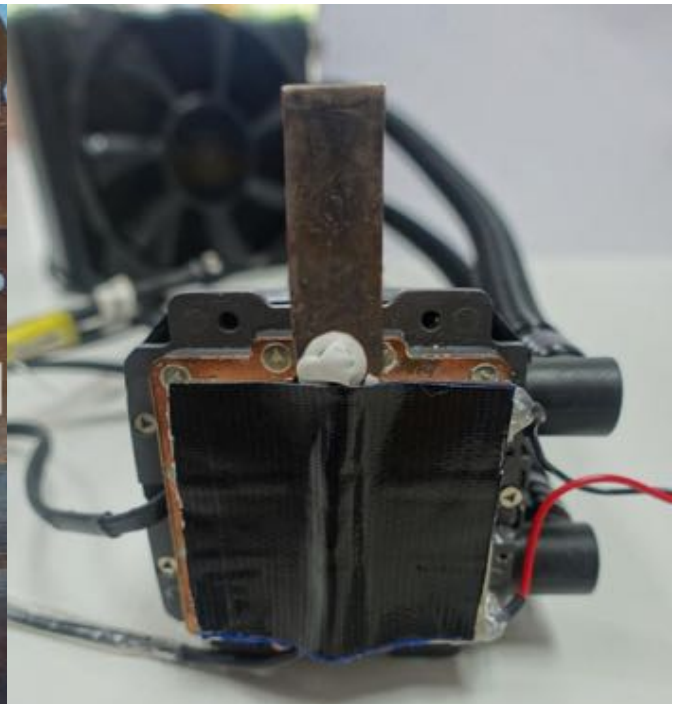
# Concept of Thermal Taste

- One way of producing taste sensations - thermal stimulation on the tongue and stimulate the TRPM5 (Transient receptor potential cation channel subfamily M member 5) taste channel. The TRPM5 stimulation with temperature can modify sweet, bitter, and umami tastes.
- Thermal tasters 25%-50% of the population (people who perceived taste sensations even without chemicals)
- Conclusion : Thermal stimulation produces taste sensations in TT and modify for non-TT
- Previously studied these effects in the Medical fieldWe developed a computer technology out of it.



# Thermal Taste Interface

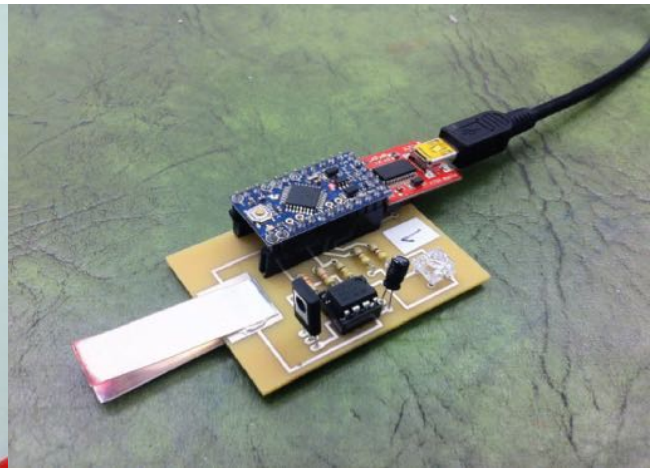


- Thermal Taste device consisted with an Arduino microcontroller, a silver plate attached to a Peltier module, a liquid cooler system, an H-bridge motor driver, a current sensor, a temperature sensor, and a USB serial interface to communicate with the PC.

# Electric Taste Interface

- In 2010, we proposed an electrical tongue stimulation device, which the user places in their mouth to produce taste sensations. This technique operates by inducing weak electric signals by changing frequency and Pulse Width Modulation (PWM) produced by the outside circuitry.




- Ranasinghe, N., Karunanayaka, K., Cheok, A.D., Fernando, O.N.N., Nii, H. and Gopalakrishnakone, P., 2011, November. Digital taste and smell communication. In *Proceedings of the 6th international conference on body area networks* (pp. 78-84). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering).

# DIGITAL SOUR TASTE

- Developed to stimulate the sour taste sensations digitally on the tongue through weak electrical stimulations.
- By varying frequencies [50Hz to 1kHz] and magnitudes of current [20 uF to 200 uF] will produce several kinds of taste sensations
- This device can give you two different sensations, sour and lemony taste.

# Practical Applications

- Smell vs Pain (How pleasant and unpleasant smells affect on pain)
- Digital Taste and Smell vs Natural Taste and smell
  → Towards artificial flavor systems
- Cross model studies (Shape, color, sound, smell, taste)

# THE FUTURE OF DIGITAL TASTE AND SMELL

Developing technologies for communication of smell and taste through the internet. We have invented electrical taste interface [electrical pulses on the tongue], thermal sweet taste interface [changing tempreture of the tongue with semiconductors rapidly to induce sweet taste] and digital smell interface (stimulating smell receptors with weak electric pulses to produce smells). Future Generations will be able to for the first time communicate and experience smell and taste over the internet digitally, impacting lifestyle, business, virtual reality, and entertainment.

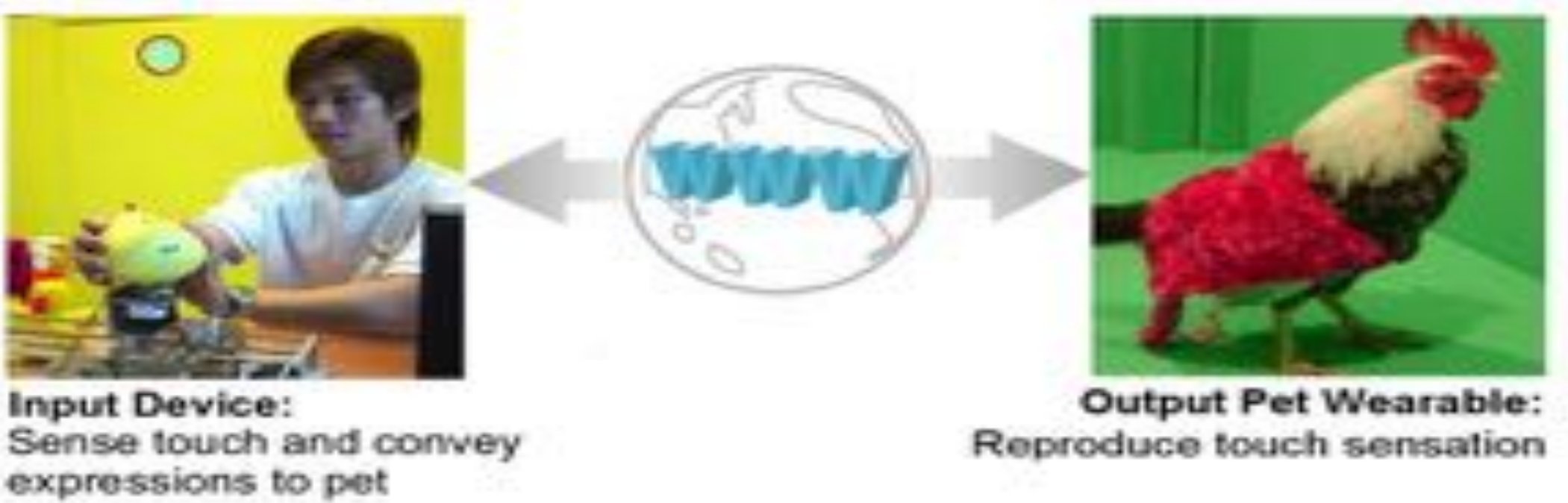
[Credits for the slide: Prof.Adrian David Cheok]

# Touch

# Poultry Internet

[Credits for the slide: Prof.Adrian David Cheok]

Remote human-pet touch communication

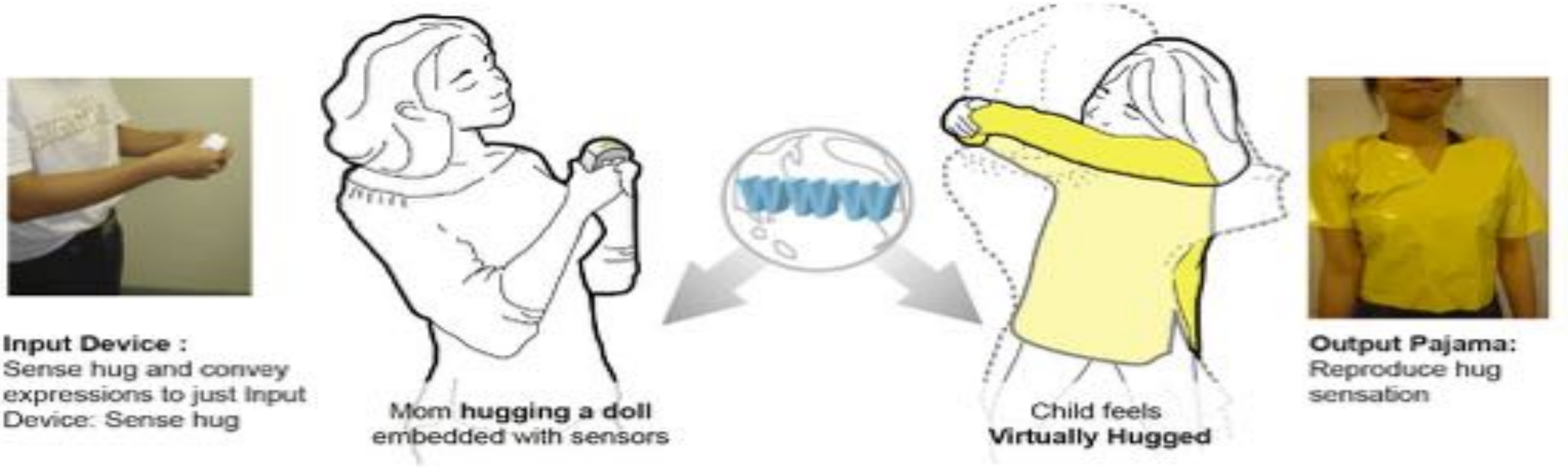



Ping Lee, Adrian David Cheok, Soon James, Lyn Debra, Wen Jie, Wang Chuang, and Farzam Farbiz. 2006. A mobile pet wearable computer and mixed reality system for human & poultry interaction through the internet. *Personal Ubiquitous Comput.* 10, 5 (July 2006), 301-317.

# Huggy Pajama

[Credits for the slide: Prof.Adrian David Cheok]

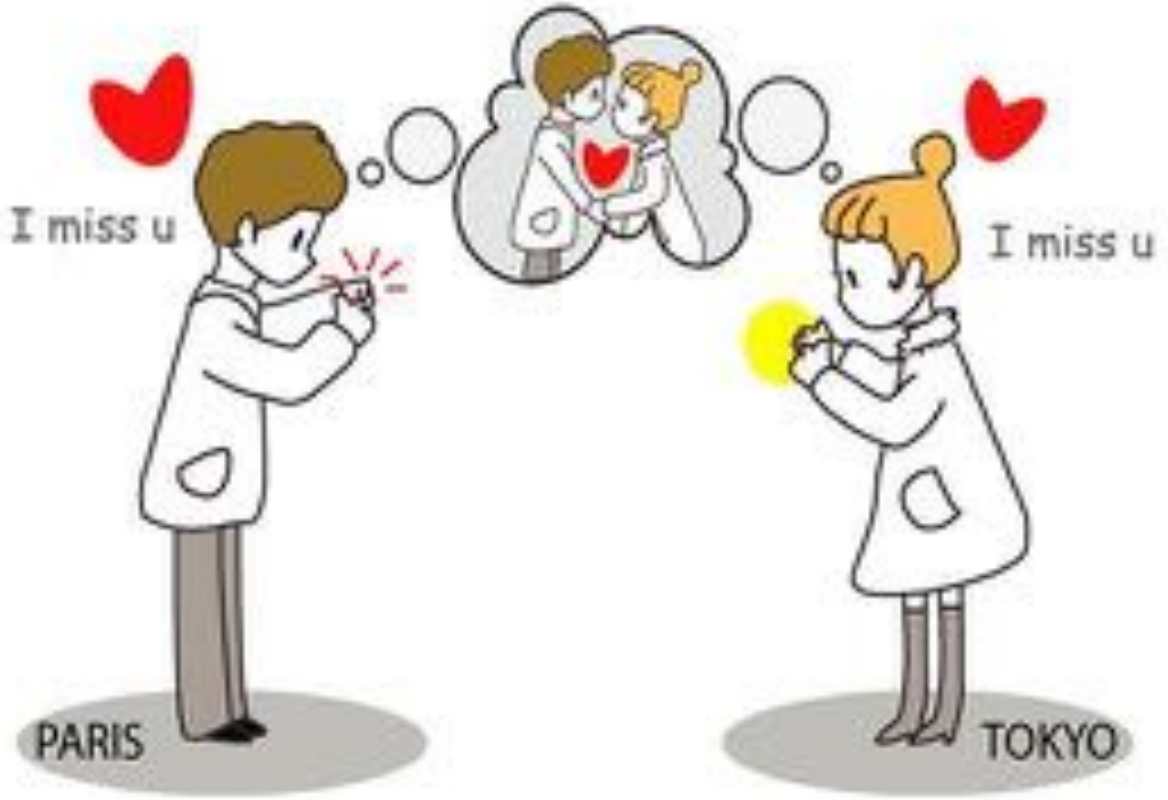
Remote bi-directional hug communication system




James Keng Soon Teh, Adrian David Cheok, Roshan L. Peiris, Yongsoon Choi, Vuong Thuong, and Sha Lai. 2008. Huggy Pajama: a mobile parent and child hugging communication system. In *Proceedings of the 7th international conference on Interaction design and children* (IDC '08). ACM, New York, NY, USA, 250-257.

# ringU Concept

[Credits for the slide: Prof.Adrian David Cheok]




*Internet based Mini-Hug Ring*

**[Credits for the slide: Prof.Adrian David Cheok]**

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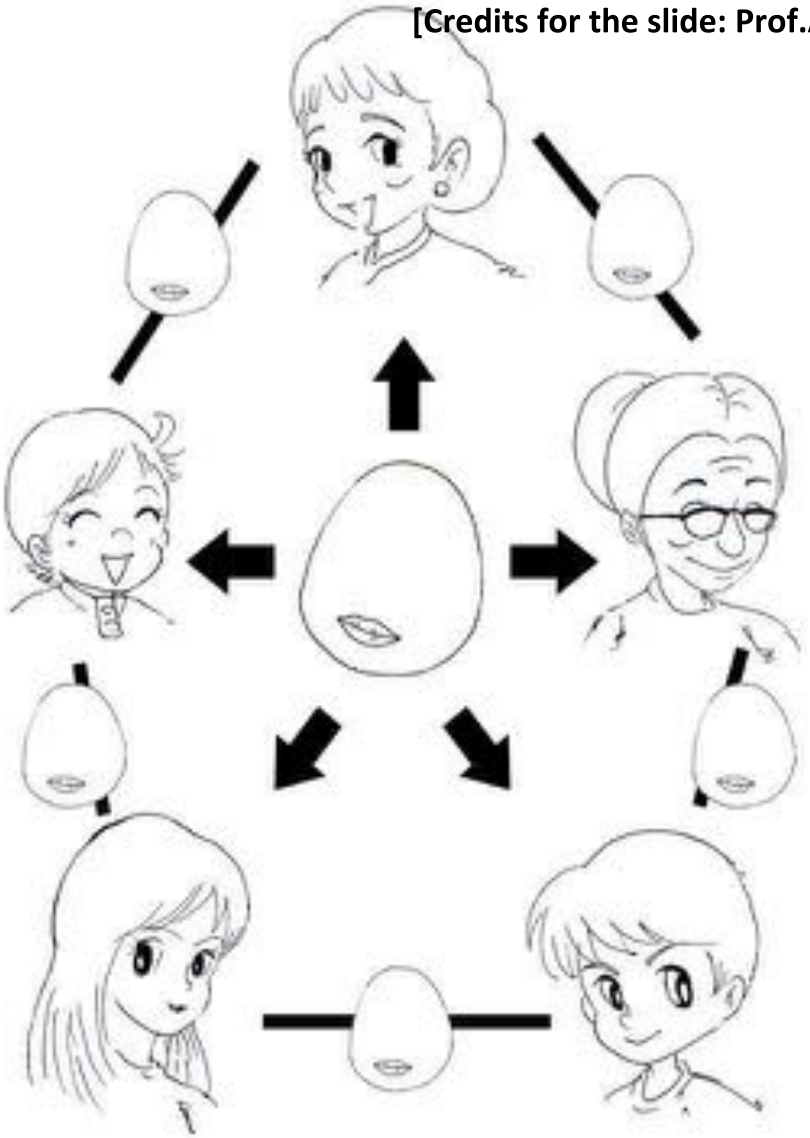
# Kissenger

[Credits for the slide: Prof.Adrian David Cheok]

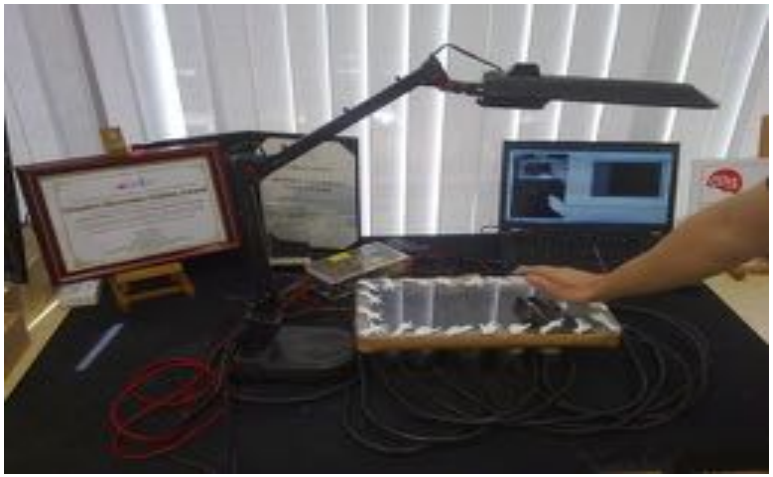
Hi-fidelity physical interface for transferring a remote and mediated kiss in real-time, facilitating intimate human telepresence in the real and virtual worlds

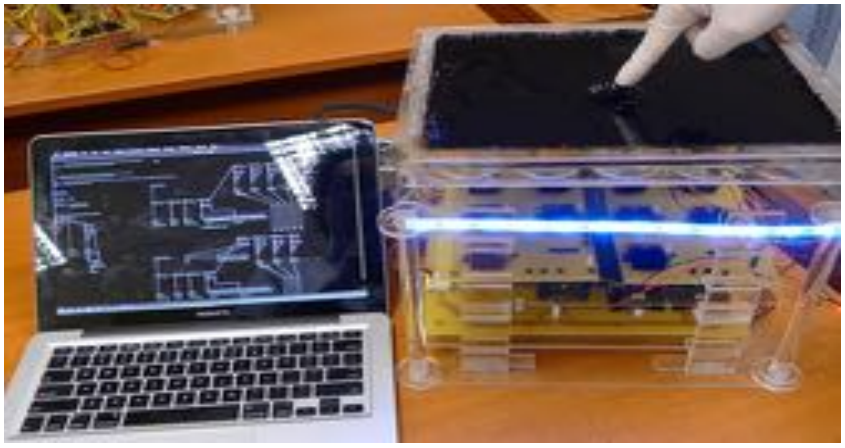



**[Credits for the slide: Prof.Adrian David Cheok]**

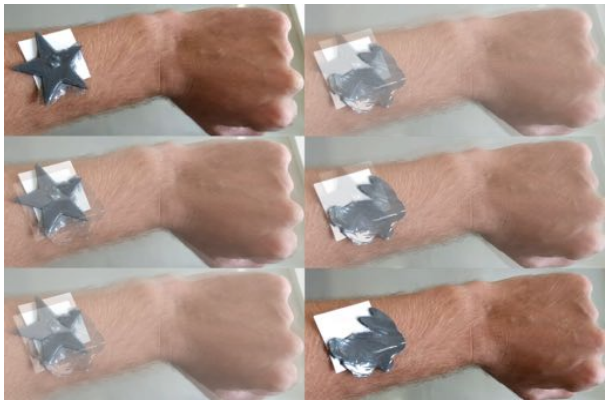
# Some Other Projects in Brief..

# Magnetic User Interfaces

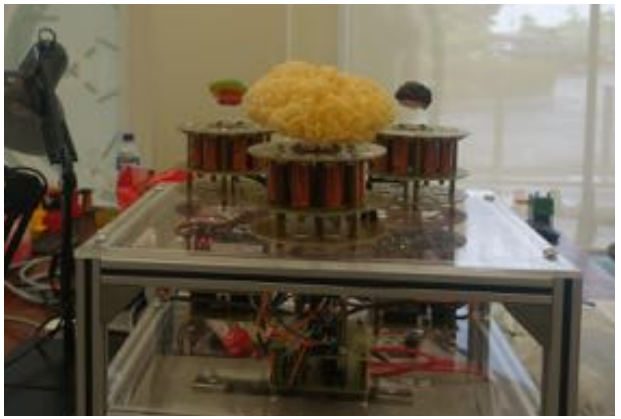




# Some Other projects

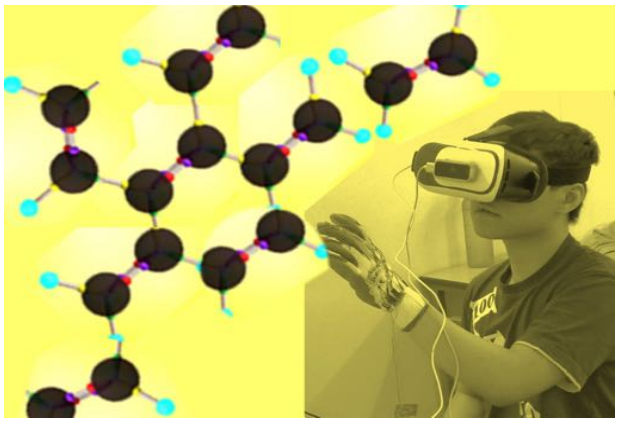


**Magnetic Temporary Tattoos**



**Magnetic Table & Magnetic Food**


**Augmented Reality for Learning**

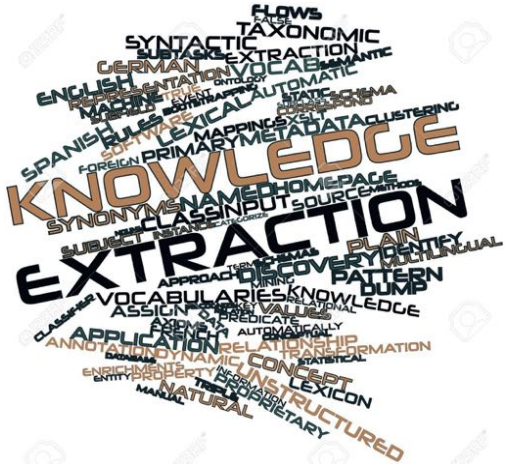


**VR Multisensory Classroom**

# Some other ongoing projects..

**Personality Chatbot**

**Ontology Driven Simulation Tool for Assessing Economic Impact**




**Knowledge Extraction and Multiplication**


**Personal E-mail Bot**

# Some other ongoing projects..

**Doctor Robot**

**Robot Teacher**


## Thank you!

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