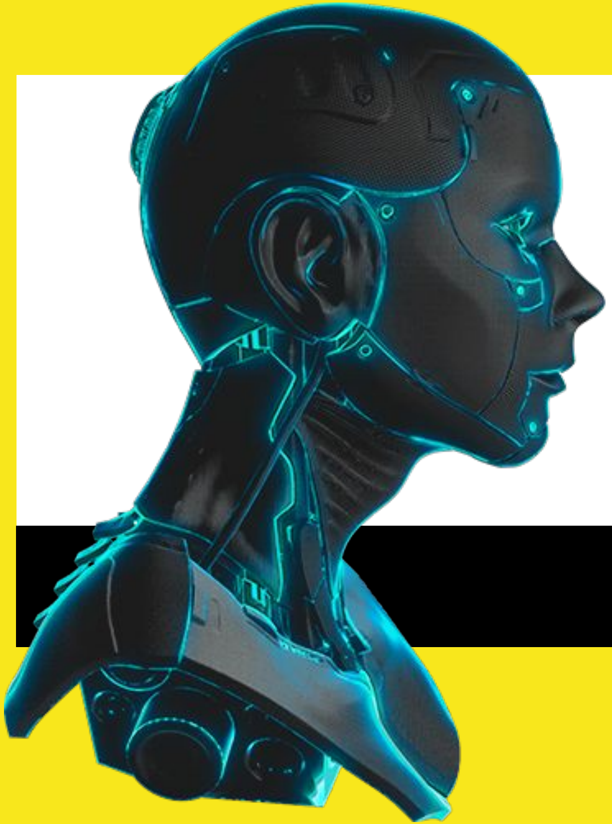
SIGGRAPH 2021
VIRTUAL 9-13 AUGUST



Siggraph 2021
Emerging Technologies

111003853 跨院博 劉士達

How to Submit Program

- 大會形式採全部虛擬方式
- two-page abstract -> four-page paper
- Virtual-only event
- Each look at the five criteria (concept; novelty; interest; quality, craft and completeness) 概念性、新奇性、吸引性、品質、工藝性、完整性
- Jurors陪審團機制
- 2019年主題 Thrive Together (共同成長)
- 2020年主題 Think Beyond (超越思考)
- 2021年主題 Virtual (虛擬世界)
- 2022年主題 似乎沒有

- Concept
  - ideas, problems. solutions, aesthetics
- novelty
  - How new and fresh in this work?
- interest
  - Will conference participants wants to see it? Will it inspire them?
- quality, craft and completeness
  - The materials must convince the jury that your solution works.
  - Some aree rejected because the jury is left guessing when the submission includes unanswered questions, gaps in research, insufficient explanations.

Program Content - Taking Flight 飛行或空拍機

Presentations:

Augmented Reality Representation of Virtual User Avatars Moving in a Virtual Representation of the Real World at Their Respective Real World Locations
Contributors: Christoph Leuze, Matthias Leuze

用模擬飛行軟體+手機APP定位+Holo lens的AR頭盔進行跨界模擬飛行，運用GPS定位、手機APP、伺服器

SwarmPlay: A Swarm of Nano-quadcopters Playing Tic-tac-toe Board Game Against a Human
Contributors: Ekaterina Karmanova, Valerii Serpiva, Stepan Perminov, Roman Ibrahimov, Aleksey Fedoseev, Dzmitry Tsetserukou

運用四台微型飛行器在室內群體飛行，加入了增強式學習(RL)的AI與另一個人玩起圈圈叉叉遊戲

DronePaint: Swarm Light Painting With DNN-based Gesture Recognition
Contributors: Valerii Serpiva, Ekaterina Karmanova, Aleksey Fedoseev, Stepan Perminov, Dzmitry Tsetserukou

用運用微型飛行器在室內用手勢方式進行控制，並用DNN深度神經網路的方式

Program Content - Haptics 觸覺相關

Presentations:

Demonstrating Touch&Fold: A Foldable Haptic Actuator for Rendering Touch in Mixed Reality

Contributors: Shan-Yuan Teng, Pengyu Li, Romain Nith, Joshua Fonseca, Pedro Lopes

結合物聯網與MR技術，能在虛擬擴增3D物件中透過觸覺震動裝置，讓使用者感受到觸控(碰)到虛擬物件，並且能計算一些動作姿態反應。

Demonstrating MagnetIO: Passive Yet Interactive Soft Haptic Patches Anywhere

Contributors: Alex Mazursky, Shan-Yuan Teng, Romain Nith, Pedro Lopes

結合物聯網與磁感應技術，將磁鐵整合在一個軟性的貼片上面，透過不同貼片的位置與ID編碼，能透過磁感應晶片辨識觸動的反應進行互動。

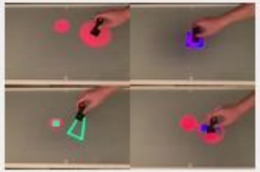
Balanced Glass Design: A Flavor Perception Changing System by Controlling the Center of Gravity

Contributors: Masaharu Hirose, Masahiko Inami

結合線性馬達控制人喝水的方式，進行重力的改變後，使虛擬喝水的感覺比較不一樣，不同的容量跟改變馬達推動的距離會自動改變。

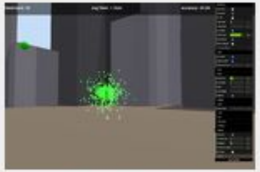
Program Content - Speed and Precision 速度與精準度

Presentations:



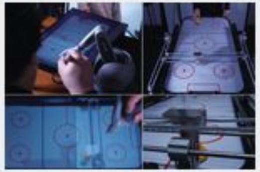
MetamorHockey: A Projection-based Virtual Air Hockey Platform Featuring Transformable Mallet Shapes
Contributors: Shun Ueda, Shingo Kagami, Koichi Hashimoto

虛擬的冰上曲棍球遊戲，運用投影技術與高速攝影機進行影像辨識，可達420FPS的穩定速度進行。



Gaming at Warp Speed: Improving Aiming With Late Warp
Contributors: Ben Boudaoud, Pyarelal Knowles, Joohwan Kim, Josef Spjut

相關的FPS遊戲常因為延遲導致遊戲的結果不同，因此這篇DEMO運用VR技術(Late Warp)來避免延遲問題。



Behind the Game: Implicit Spatio-temporal Intervention in Inter-personal Remote Physical Interactions on Playing Air Hockey
Contributors: Azumi Maekawa, Hiroto Saito, Narin Okazaki, Shunichi Kasahara, Masahiko Inami

結合機器手臂控制冰上曲棍球遊戲，可遠端方式與另位一玩家進行對打，精準度跟速度都可縮小到25ms~100ms。

Program Content - COVID Inspried Innovations 疫情相關

Presentations:

Health Greeter Kiosk: Tech-enabled Signage to Encourage Face Mask Use and Social Distancing
Contributors: Max Hudnell, Steven King

結合Kiosk與深度影像偵測，結合AI技術偵測是否有帶好口罩，不使用GPU運算減少成本。

Experiment Assisting System With Local Augmented Body (EASY-LAB) for Subject Experiments Under the COVID-19 Pandemic
Contributors: Yukiko Iwasaki, Joi Oh, Takumi Handa, Ahmed A. Sereidi, Vitvasin Vimolmongkolporn, Fumihiro Kato, Hiroyasu Iwata

結合VR頭盔進行體驗輔助系統，把虛擬世界的體驗動作傳動到另外一個機器手臂或輔助機器人系統進行同步運作。

Sustainable Society With a Touchless Solution Using UbiMouse Under the Pandemic of COVID-19
Contributors: Daisuke Akagawa, Junichi Takatsu, Ryoji Otsu, Seiichi Hayashi, Benjamin Vallet

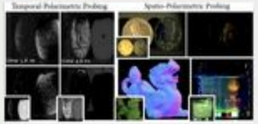
結合深度攝影機與AI演算法的線性迴歸模型，讓手當作滑鼠一般進行點擊、位移、等動作精準度更高，免除接觸實體滑鼠的染疫風險。(某某大觀園好像以前就做過)

Program Content - Display and Imaging 視覺與影像

Presentations:

Reverse Pass-through VR
Contributors: Nathan Matsuda, Brian Wheelwright, Joel Hegland, Douglas Lanman

FB實驗室結合紅外線攝影機、光場顯示器、眼動偵測技術，讓帶VR頭盔不再是觀落陰，眼球的觀看位置可以顯示在頭盔前面。



Polarimetric Spatio-Temporal Light Transport Probing
Contributors: Seung-Hwan Baek, Felix Heide

此篇論文被收錄到ACM Trans Graph, SCI Journal期刊內，IF=5.414

MagnetIO

Passive yet Interactive Soft Haptic Patches Anywhere

文章來源

：https://dl.acm.org/doi/10.1145/3411764.3445543

MagnetIO:Passive yet Interactive Soft Haptic Pathes Anywhere

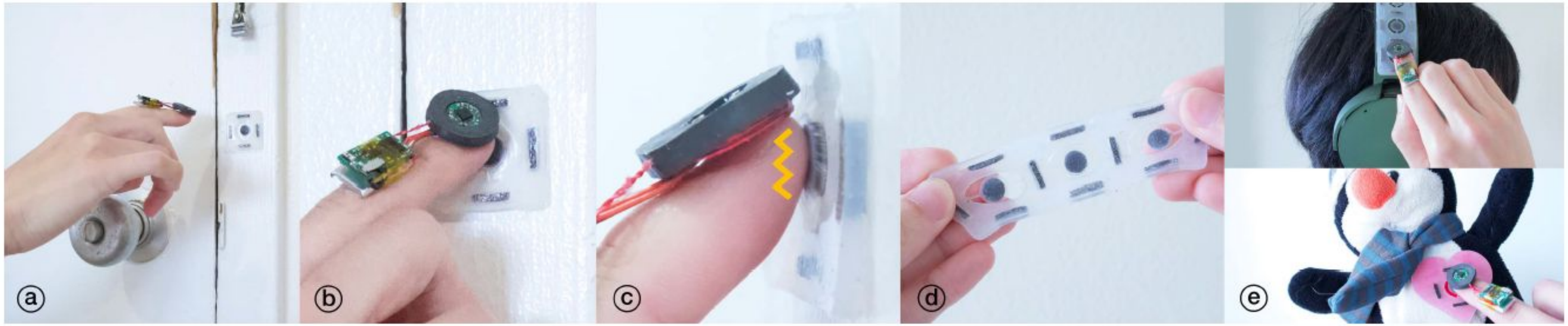
作者 :Alex Mazursky, Shan-Yuan Teng(鄧善元), Romain Nith, Pedro Lopes (HCI Lab)

Keywords: soft magnets, ubiquitous haptics, fabrication / 出處 :ACM Siggraph 2021 Emerging Technologies

ABSTRACT

MagnetIO 為一個磁性震動感應模組, 透過電磁場感應方式, 經由 Voice-coil (音圈)(喇叭原理相似)以及電池來驅動, 並能 夠穿戴在使用者手指上, 可再任何軟性表面上進行附著, 並且可以透過電磁場方式進行連結感應 (像是RFID), 並且透過音圈中間的音場共鳴 產生回饋感受。這個感測裝置利用 neodymium powder(釹粉)與silicone(矽膠)翻模方式自行製作感應貼片。此外音圈所互動過程可 產生0~500Hz的音頻, 經由這個音頻進行 resonate(諧振/共振)(電台收音機), 使感應貼片的四個方向 產生Linear Resonant Actuator(LRA)線性諧振致動器 (顫動效果), 如此一來就能讓感應貼片能以被動方式被驅動。

實體樣貌



Introduction

研究目的:

To enable sensing these interactions,researchers engineered conformable/stretchable sensing devices so that these can comfortably fit around non-planar surfaces, which is the case for everyday objects or the human body.

Researchers are still looking for techniques that allow deploying large numbers of actuators without the constraints of power delivery to every single individual actuator, wireless communication across all actuators, microcontrollers, etc.

A new type of haptic actuator, which we call MagnetIO,that is comprised of two parts: one battery-powered voice-coil worn on the user’s fingernail and any number of interactivesoft patches that can be attached onto any surface (everyday objects, user’s body, appliances, etc.).

設計目標:

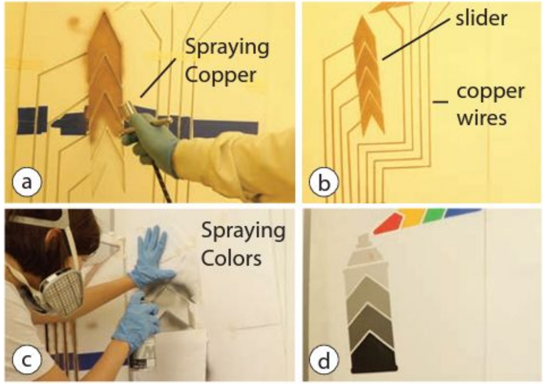
a. 可服貼性/可延展拉伸的方式進行感測
b. 軟性磁性感應ID貼片可貼在任何地方，日常生活的物件或人體身上
c. 要能大量佈署，並且不依靠電力方式 產生致動、無線傳輸、甚至是微處理器
d. 按下當下會有震動回饋
e. 可穿戴性
f. 相關應用，可黏貼在耳機上、玩偶身上、生活用品上 ...等
g. 基於上述的目標，作者提出了 MagnetIO，一個利用Voice-coil音圈的方式將致動器與磁力圈分離，並可以進行在任何表面上進行感測互動

Related Works

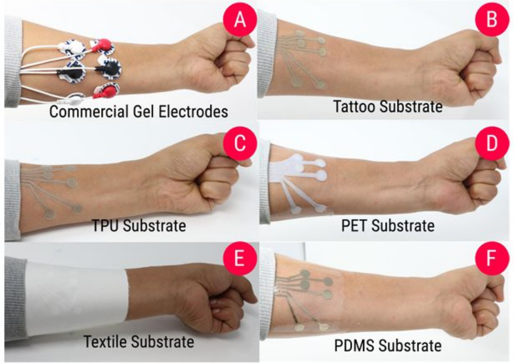
文章中提到的RelatedWorks

1. Michael Wessely et al. “Sprayable User Interfaces: Prototyping Large-Scale Interactive Surfaces with Sensors and Displays.” CHI 2020. (MIT CSAIL)

2. Aditya Shekhar Nittala et al. “PhysioSkin: Rapid Fabrication of Skin-Conformal Physiological Interfaces.” CHI 2020.



此篇論文運用噴漆的方式，結合電路走線作為外框造型，可在不同的表面進行互動甚至顯示出畫面。



此篇論文運用數位自造方式，調製特殊的導電油墨以及運用一般噴墨印表機進進行轉印到手臂上面進行感測點設置。

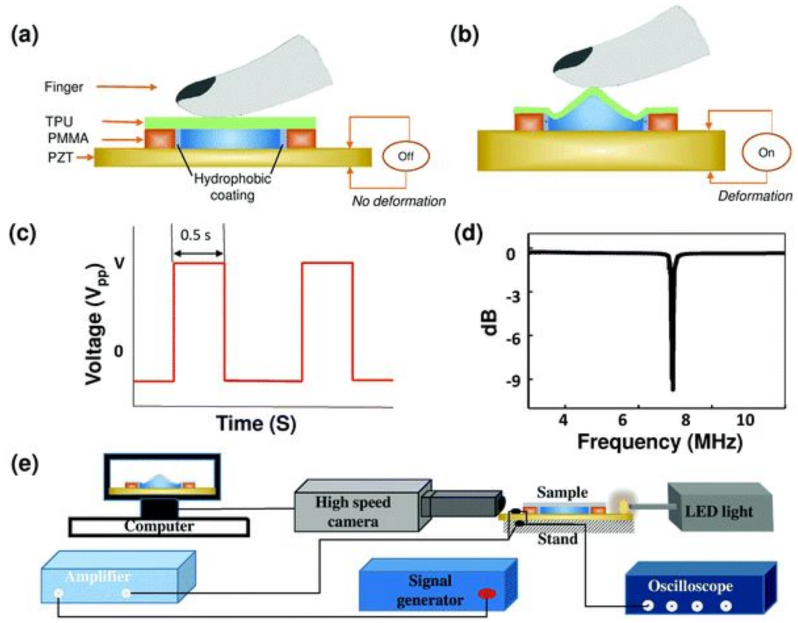
Soft Inkjet Printing					
Substrate	**Conductor**	**Insulation**	**Skin-Contact**	**Thickness**	**Time**
Tattoo Paper	Silver + PEDOT:PSS	PVP	Tattoo Adhesive	~1 μm	[10-15] mins
TPU	Silver + PEDOT:PSS	PVP	SSA	[50-300] μm	[10-15] mins
PDMS	Silver + PEDOT:PSS	PVP	SSA	Custom Thickness [50-300] μm	[10-15] mins
Textile Transfer Film	Silver	PVP	Form-Fitting Garment	[1-3] μm	[25-35] mins
Instant Inkjet Printing					
Substrate	**Conductor**	**Insulation**	**Skin-Contact**	**Thickness**	**Time**
PET	Silver Nanoparticle	Transparent Scotch Tape	SSA	[250-300] μm	[5-10] mins

同樣在這一篇論文中發現，可以看出不同軟性噴墨印表機去做噴製貼片的差異，像是TPU的效果就比較差，而本論文提出的Tatto Paper導電性好，且薄。

Related Works

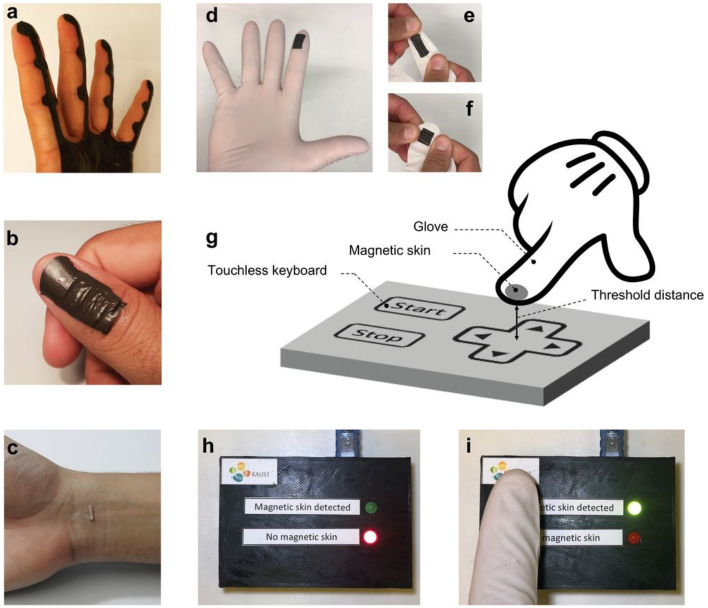
額外找的RelatedWorks

1. Asma Akther et al. “Miniaturised acoustofluidic tactile haptic actuator” Journal of Soft Matter. 2019.



此篇論文探討軟性觸碰的擷取方式,TPU+PMMA作為支撐，結合訊號擷取方式得到電壓訊號。

2. Abdullah S. Almansouri et al. “An Imperceptible Magnetic Skin” Advanced Materials Technologices. 2019.



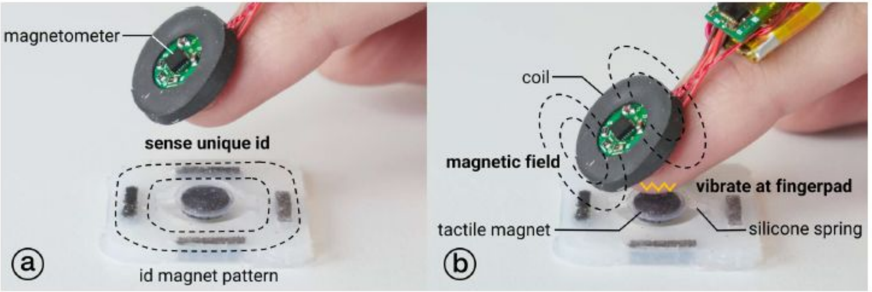
此篇論文探討導電油墨的繪製與感測方式，可以經由不同的繪製位置以及互動方式來進行。

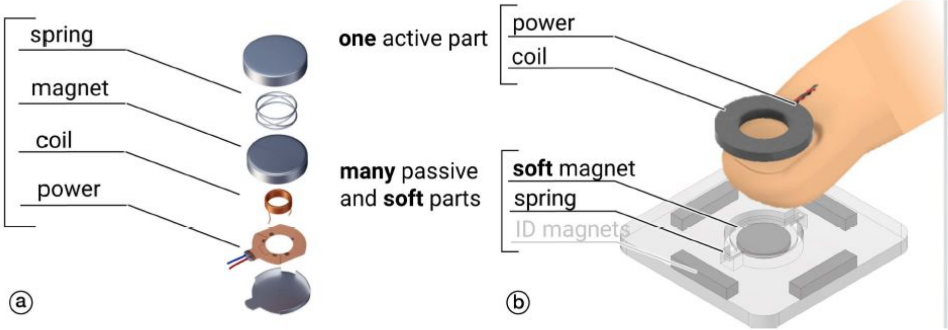
MagnetIO設計方式

關鍵的設計方式:

1. Our approach, which we call MagnetIO, introduces a new type of haptic actuator that is passive (i.e., requires no electronics, no battery, etc.) until the user's finger, which is instrumented with a wearable voice-coil, touches it, causing it to vibrate.

2.MagnetIO is composed of many passive interactive patches and one nail-worn device, which features a miniaturized and customengineered voice-coil, inertial measurement unit (IMU), battery, microcontroller and wireless. MagnetIO's complete voice-coil and circuitry fits entirely on the user's fingernail.





關鍵的辨識方式:

(a) When the user's finger approaches an interactive patch, its magnetometer reads and recognizes its unique 3D magnetic ID.

(b) activates the wearable-coil, generating a magnetic field that vibrates the patch under the fingerpad.

MagnetIO互動回饋與物聯網控制

互動回饋方式:

(a) Our user at home, wearing our coil, surrounded by surfaces with interactive patches.

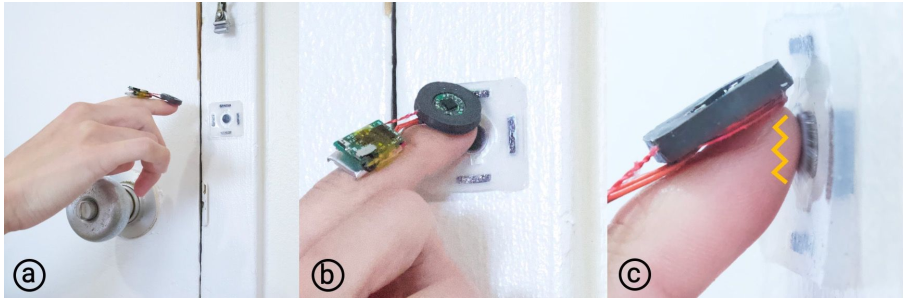
當使用者回到家之後穿戴感測指環，並靠近門鈴的位置。

(b) They tap their wall, which has a passive patch that controls their home alarm.

按下門鈴並進行控制。

(c) The user feels the patch vibrate to indicate that their alarm is now disabled.

使用者按下後感受到震動並關閉響鈴。

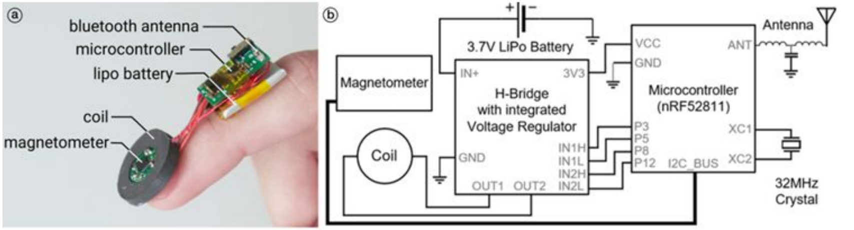


物聯網的應用方式:

1. 感測貼片可連續串接數個ID作為不同的位置辨識，例如貼於手錶上增加3~4個感應點，或是服貼於茶壺表面。

2.主控制板採用藍芽控制晶片nRF52811，具備超低功耗與IMU的特色，可用3.7V鋰電池進行供電與產生磁場進行感應震動。

3.透過藍芽傳輸方式，可實現Ad-Hoc的互動觸覺貼片回饋



Applications(Conclusion)

互動的應用設計:

a. 按壓兒童故事書中的某一個圖片或圖像讀取RFID之後呼叫出聲音或效果
b. 桌遊的格子內當按下之後從VR或AR眼鏡內擴增出畫面
c. 彈奏吉他時候可任意貼在適合的地方利用觸覺按下方式觸發RFID的Tag
d. 加裝在一些遊戲把手或是原有的控制器上面增加RFID的Tag進行觸發
e. 黏貼在玩偶上面產生觸發動作, 而不需要用額外電池

Technical Evaluations(Connection)

在本篇完整的paper於 CHI'21發表，裡面第七章提到：

1. Impact of particle size on elasticity

2. Measuring & optimizing the vibration response of our soft patches

3. Measuring & optimizing the magnetic feld of our coil

4.Comparing MagnetIO's vibration to a Linear Resonant Actuator

5.Identifying patches by means of magnetic signatures

如何評估感測器的可用性?

1. 尺寸大小與電磁感應的範圍，矽膠的混和最小顆粒需小於200µm

2.量測震動與最佳化軟性貼片的過程，大約7.5mm是最好的厚度，但不能小於5mm

3.量測磁場感測範圍，將震動的產生都發生在貼片上面，比使用線圈震動強度高達16倍

4.採用LRA(線性諧振致動器)的方式，用4V的電壓進行驅動，可達到更寬的頻率寬度

5.作者除了自製感測貼片也進行ID測試感應，最終最多可以同時識別8個貼片，並且準確率高達99.06%

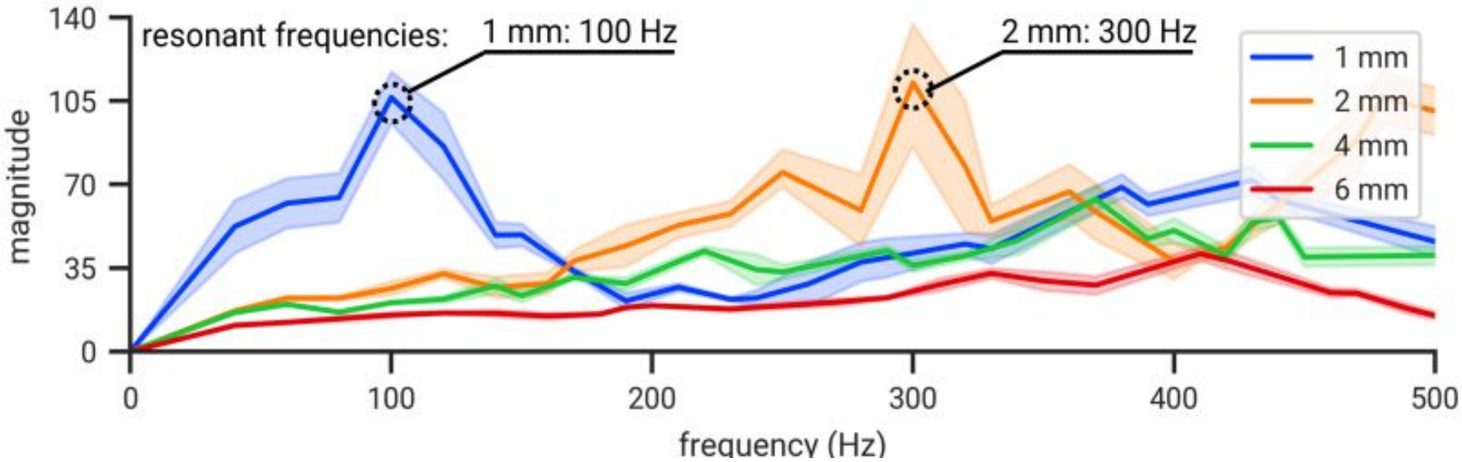
Technical Evaluations(Connection)

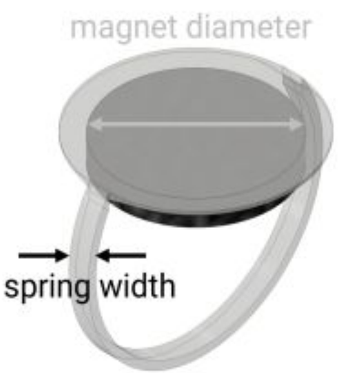
磁力與震動相互關係

1. 指環大小的寬度與電磁感應的範圍會有影響, 震動相互關係取決於互動體驗

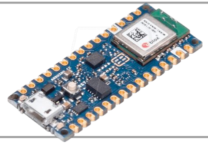
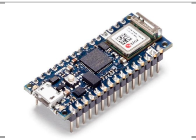
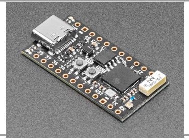
2 經過實驗與測試, 100Hz的時候1 mm所能感測的磁場可達105mm ... 直徑範圍左右(低頻)

300Hz的時候 2mm所能感測的磁場可達104mm ...直徑範圍左右(高頻)





最近的一些穿戴式開發套件(Connection)

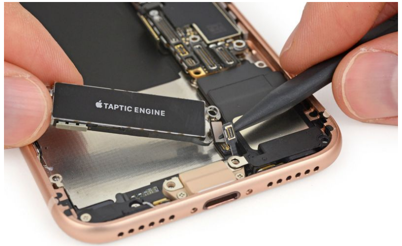
						
型號	Arduino Nano 33 BLE	Arduino Nano 33 IoT	SeeedStudio XIAO ESP32S3	TinyS3 ESP32S3	Raspberry Pi Pico W	RTL8720DN
晶片	nRF52840	SAMD21	Xtensa 32-bit LX7 雙核心處理器	32bit Dual Core 雙核心處理器	RP2040 雙核心處理器	Realtek RTL8720DN
無線傳輸方式	藍芽5.2	WiFi	藍芽5.0 + WiFi	藍芽5.0 + WiFi	WiFi	WiFi 2.4G/5G/藍芽5.0三合一
Flash / SRAM	1MB / 256K	256K / 32KB	8MB / 8MB	8MB / 8MB	2MB / 264K	未知
感測器	9軸IMU	6軸IMU	無	無	無	無
IO數量	14個	14個	11個	17個	26個	12個
價格	USD $26.30	USD $24.00	USD $7.49	USD $20.00	USD $4	USD $10

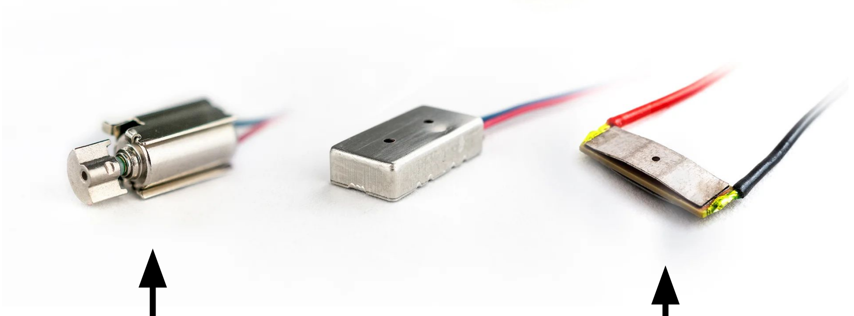
心得(Comments)

- 作者運用LRA, Linear Resonant Actuator線性諧振致動器取代傳統的震動馬達，又因為LRA的特色就是透過Voice-coil 的特色，經過磁圈的震動頻率與馬達震動的兩個特色融合非常巧妙。

- 作者除了磁性感測，還融入了RFID的概念，讓每一片感測點具備物件識別功能，並且還運用了數位自造的方式，可自行翻模出感測節點，未來也許還可以搭配動作姿態感測(IMU)，可達到連續觸發的互動。

- 對於穿戴式開發的相關模組，前面整理了一些近期比較主流的開發套件，原本以前需要自行整合IC、WiFi模組、甚至感測器，現在幾乎都內建在一個晶片裡面，並且還同時支援好幾種無線傳輸技術，價格也比過去更便宜尺寸更小，更容易做到穿戴科技的一些應用。





ERM, Eccectric Rotation Mass
偏軸轉動貫量
簡稱:震動馬達
自1960年代使用至今

LRA, Linear Resonant Actuator
線性諧振致動器
簡稱:Taptic Engine (iPhone手機內常用) 自2015使用至今

Reference

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- LRA https://www.boreas.ca/blogs/piezo-haptics/mechanical-fundamentals-of-piezo-haptic-actuators?logged_in_customer_id=&lang=tw
- Voice-coil https://www.machinedesign.com/mechanical-motion-systems/article/21836669/what-is-a-voice-coil-actuator