Practical Human Computer Interaction Design for Mobile Audio Interface

Dr. Simon LUI

- Director, Tencent Music
- Adjunct Professor, Singapore University of Technology and Design

Part I.

Who am I

Who am I

Simon Lui

- Director, Tencent Music
- Adjunct Professor, SUTD Singapore

Formerly,

- Visiting Assistant Professor, MIT
- Marie Curie Fellow, EU

CAREER GUIDANCE

Making the Jump Into Games

Three members share advice for entering a fast-growing industry

BY ANIA MONACO

Top: App developer Simon Lui. Bottom: Screen shot from A Knights Dawn, *a mobile game developed by Nicholas Peterson's studio.*

WHILE SOME industries are cutting jobs during these difficult economic times, others are growing so fast they can't find enough workers. One such field is the video-game industry. Despite occasional slumps, video- and computer-game sales have been climbing for several years, and that trend is likely to continue, according to many analysts. Game-related spending by consumers is expected to reach US $112 billion by 2015, up from $67 billion last year, according to a study in July by Gartner, a technology research company.

Recent sales successes have been unprecedented. Activision's *Call of Duty: Black Ops*, a first-person shooter game, this year set a record when it brought in more than $650 million during its first five days on the market. Also this year, Microsoft's Kinect—a real-time motion-capture add-on to the Xbox 360—established a record in the first 60 days of its launch, becoming the *Guinness Book of World Records*' "Fastest-Selling Consumer Electronics Device" of all time.

Fueling the industry's growth is the popularity of smartphones, tablet computers, and other portable devices that run game apps. Mobile game sales are expected to jump from 15 percent of all games in 2010 to 20 percent in 2015, according to the Gartner report.

So, how can you get involved in this booming industry? Three IEEE members who are also game developers shared their advice with *The Institute*. IEEE Member Nicholas Peterson is founder of and senior developer at VisionaryX, a game development studio in Schönaich, Germany. Member David Callele, a consultant on product requirements, is founder of Experience First Design, a studio in Saskatoon, Sask., Canada. Member Simon Lui founded EC2 Hong Kong, an iPhone/iPad app developer.

COMPUTER SCIENCE

Education is important for aspiring game developers, but few universities offer a major in the field. Rather, if you want to work in the game industry, "you should have a degree in any computer science or sound- or light-engineering-related field," Peterson says. "But people with backgrounds in sociology, physics, art, design, and business are also needed." He earned a bachelor's degree in computer science and then spent 20 years in the IT industry working on software development and consulting before starting his company. "Systems engineering, programming, and project management courses also helped me," he adds.

Computer science is also the path Callele took. He received bachelor's degrees in electronics and computer science and then earned a master's and a doctorate in computer science, specializing in requirements for video-game design. "A solid academic base coupled with practical experience in high-reliability software design and implementation gave me the tools I needed to enter the industry," he says. "I started out by debugging new products for middleware developers and doing technical writing—like for documenting software-development kits—which demonstrated that I was not just technically competent but also an effective communicator."

Lui earned a Ph.D. in computer science but learned app development mostly on his own. "When I started working as an app developer in 2008, it was not such a popular area, so there were no tutorials available," he says. "I learned from the materials and application programming interface provided by Apple. Developing apps is mostly a self-taught process." But nowadays students have many more resources, he points out. Stanford University, for example, offers a free iPhone Apps development course, available through iTunes U.

Would-be game developers might want to consider an alternative to a typical four-year university, Peterson suggests. "One of the key weaknesses of our traditional education system is the difficulty of keeping up with the top-of-the-line technologies used in a growing, fast-paced industry like gaming," he says.

Private technical schools and game development academies could be another way to go. "The advantage of these schools—which usually offer one-, two-, or three-year programs highly focused on a particular area—is that students finish with a certificate or perhaps even a bachelor's degree that is specifically in game development and have usually been taught by people from industry using the most current tools," Peterson says. For example, students at the Games Academy in Berlin use the complex CryEngine, a game-development tool. The engine was created by Crytek, a video-game company that used it to develop its first-person shooter *Crysis*, hailed by gamers for its realistic graphic design.

A common drawback of such alternative schools, Peterson notes, is that they lack in-depth teaching of the more general topics also needed in the game industry, such as project management, higher mathematics, and process engineering. "And since there is no R&D tied to these schools, their knowledge base doesn't grow each year," he adds.

MATH AND MORE

What are game- and app-development companies looking for in job candidates? The short answer is a variety of technical skills, plus creativity.

TOP: MATTHIEU PUIGT. BOTTOM: VISIONARYX

My business story

- US$40000 for 1 app, under part-time mode (2010)

My business story

a Hong Kong magazine

- S$7000/month, part-time mode (2011)

兩年賺30萬 雷兆恒

唔使𢥧做老闆

智能手機平台有很多，Windows Phone、Symbian、Bada、Android 等，但 Simon 笑言：「雖然手機的功能可能相若，但下載平台依然係 App Store 勝一籌。例如 Android 的收費模式和設定 [illegible]，另外 Microsoft [illegible] Protection 方面問題，[illegible] 其他平台上出 Apps。」

假如 80 後的你，人工低想[illegible]，其實只要學懂學習 Objective C、C++ 或 Java 等程式語言，就可成為 Apps Developer [illegible]。「[illegible] 全球每個人只需付 99 美元註冊費，成為正式的軟件開發者便可，[illegible] Program 上架的過程 [illegible] 出 App 時，沒有太多前人經驗參考 [illegible]，[illegible] iTunes U 上 [illegible] 免費 Video Course [illegible] 了。」

集體回憶 搞天下太平

眼看有不少成功例子，會否吸引更多人走去做軟件開發者，市場會飽和嗎？不會，只要你搵 App 吸引，大把人 Download [illegible]。例如 Simon 製作的《Tinha War 天下太平》遊戲 [illegible]，[illegible] 香港人集體回憶，售 US$1.99（約 HK$15.6）[illegible] OK。

他說：「這 App 的創作靈感來自與女友的對話，[illegible] iPad 像一張白紙，[illegible] 天下太平。之後我便著手去設計出來上 [illegible]，首月便賣出約 4,000 個，4 個月共有 8,000 個左右，之後每月仍 [illegible] 收入。」

另外，Simon [illegible] 不斷更新 App，他的第一個 App《e MTR》共更新了 17 次，而《天下太平》[illegible] 更新了 7 次，[illegible] Wi-Fi 對戰等的新功能。

因應喜好去寫 App

Simon 再只推出的 App 是按自己喜好去製作，他 [illegible] App [illegible]，如《SoundMitate》、《e Violin》等等。Simon 補充一句：「計劃做 Target 老人家或小朋友的 App，[illegible] Apple 產品的使用 [illegible]，例如 [illegible] iPhone，[illegible] iPad [illegible]，所以 [illegible] 不同類型的 App。」

雷兆恒（Simon）

[illegible]

Tinha War 天下太平
itunes.apple.com/hk/app/id385558940?mt=8

本地製作 App 推介

《TrackRider》 Free

《iMKG》 US$2.99

itunes.apple.com/hk/app/id384721460?mt=8

itunes.apple.com/us/app/imkg/id308100687mt=8

自作掘金apps

假如你在大學修讀電腦科學系，又或者識C、Java、Objective C等電腦程式語言，再學懂點寫蘋果apps，就可以自己設計一個app，放上app store賣到全球蘋果iPhone/iPad用戶。我們訪問了兩個比較成功的app開發者，希望大家可以闖出條血路。

1 天下太平app賺9萬 Simon Lui

要數本地獨立人士自製app的成功例子，一定要提Simon Lui。兩年前他得到一部iPod Touch，想到假如有份地鐵資訊app的話，出街時便會方便，於是自己寫一個並放上app store，兩年來下載次數達2萬，成績不俗。Simon現於理工大學修讀電腦科學博士，主力研究利用人工智能分析聲效。他自己又熱愛玩古典音樂，小提琴、鋼琴都懂，於是地鐵app之後便設計一些小提琴app作消閒之用。

接着便是近幾個月來本地大熱app「天下太平」，推出4個月以來錄得9,000次下載次數，每個售價1.99美元，扣除償除10次（app收益由開發者與蘋果七三分賬），至今收入約9萬港元，算是自家製的暢銷app。「有一次我女友同我講，個一個iPad app好簡單，只要當它是一張白紙，在上面畫嘢、塗鴉等，於是我再諗到細個鍾意玩天下太平遊戲，就着手設計。」天下太平是上一代流行的紙上戰略遊戲，Simon改良它成為iPhone/iPad遊戲，可以二人對戰，還有不同難關讓用戶挑戰，最特別是可以自己生產和自畫士兵公仔，難怪大受「集體回憶」的年長用戶歡迎。

成功app秘訣：「從自己需要、喜好出發。」

Simon Lui同時還設計了一個日本三味線app，一種並不普及的樂器，用戶下載後可彈出三味線樂音；還有一個叫SoundMitate，它播放一段音樂後，你要跟着唱出來，然後app會按你的準確度評分，這個也是他將研究電腦與聲音意义的實踐。提到製作成功app的要素，他說創作一個面向全球的app會比較難掌握方向，所以最好先做一些本地化的app，然後主打功能性和搞笑式兩類，再按自己的需要和喜好設計app，推出後在網上社交網絡宣傳，還要按用戶評價進行修改。不過，Simon認為事前花多點時間在程式、數據和介面的設計，成功的機會相對較大。

Simon Lui設計app貼士：

1. 對C、Java、Objective C電腦語言有認識/修讀電腦科學系學士。
2. 由iTunes U下載免費教學課程，學習寫app的方法。
3. 策劃程式、數據、用戶介面。
4. 到蘋果網站登記成為合資格上載app會員，收費$800。
5. 上載app後，等待蘋果審批，一切收益由開發者與蘋果七三分賬。
6. 於facebook、forum等網上社交網絡宣傳app，並收集用戶意見。

THE C PROGRAMMING LANGUAGE

Stanford on iTunes U

本地製土炮apps推介

《iHKG》 USD$0.99
[illegible]

《按揭通》 Free
[illegible]

《不失禮遊日對話書》 USD$3.99
[illegible]

《深宵交通》 Free
[illegible]

《拍拍曬》 Free
[illegible]


我們八十後有「天下太平」


人在過程中會追求新事物


人們大概都肯花少許錢買這兩類軟件

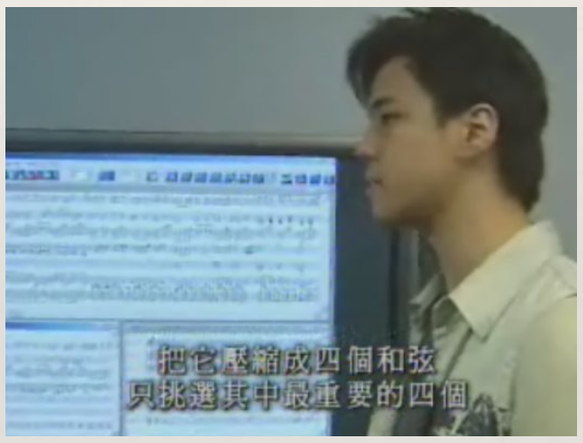

城記
您是什么时候开始
城记》开心网互动平台，网址：www.kaix


appledaily.com.hk
可否在上面試試將舊元素

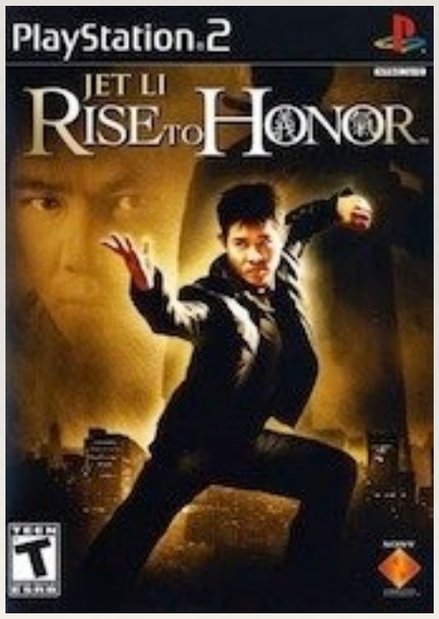

MOBILE GAMES TRENDS

My music

- Pop music arranger
- Concert master and Principle Erhu of various orchestra, Champion in classical guitar competition.
- On stage with: 陈奕迅(Eason Chan), 刘德华(Andy Lau), 郑秀文(Sammi Cheng), 古巨基(Leo Ku)…
- CD production for: 方皓玟, 傅珮嘉, 王浩信, 关楚耀, 刘浩龙…



Some of my previous works



… ok let’s go back to the main topic

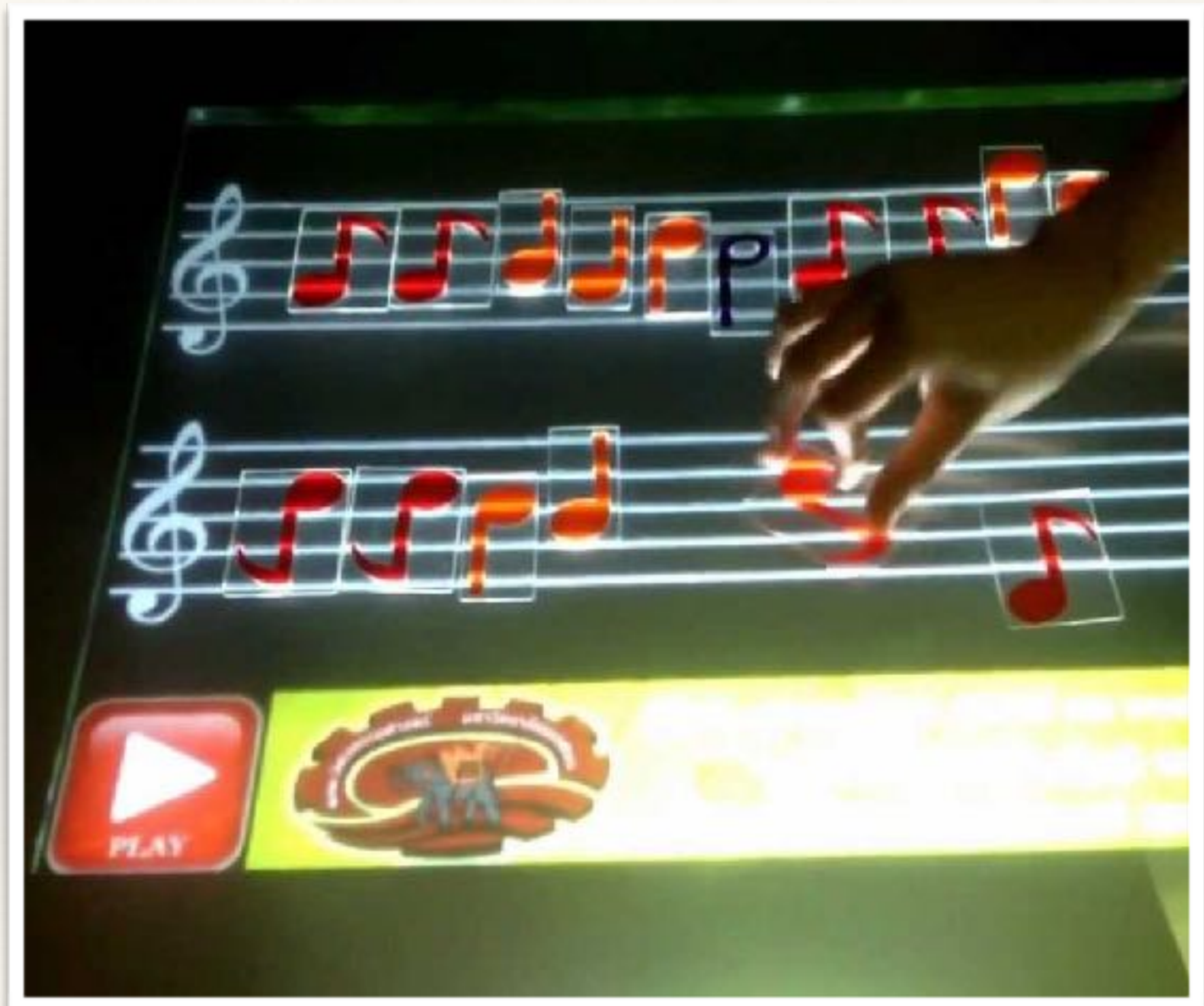
Part II.

Mobile Audio Interface

Audio Interface

Audio Interface allows users to interact with music system

- The system responses to user action
- User responses to system trigger



Mobile Audio Interface

- Mobile devices are usually small and smart devices
  - smartphone
  - smart watch
  - smart band
- Interactive, allows communication, with various sensors

Design an Mobile Audio Interface

Here are the major steps :

1. Control space design
2. Sound space design
3. Mapping
4. User experience design, revise it until perfect

1. Control Space Design

- Let's use smartphone as an example (iPhone / Android)
  - gyroscope
  - accelerometer
  - microphone
  - touch screen

1. Control Space Design

- Smartphone (iPhone / Android)
  - gyroscope
  - accelerometer
  - microphone
  - touch screen

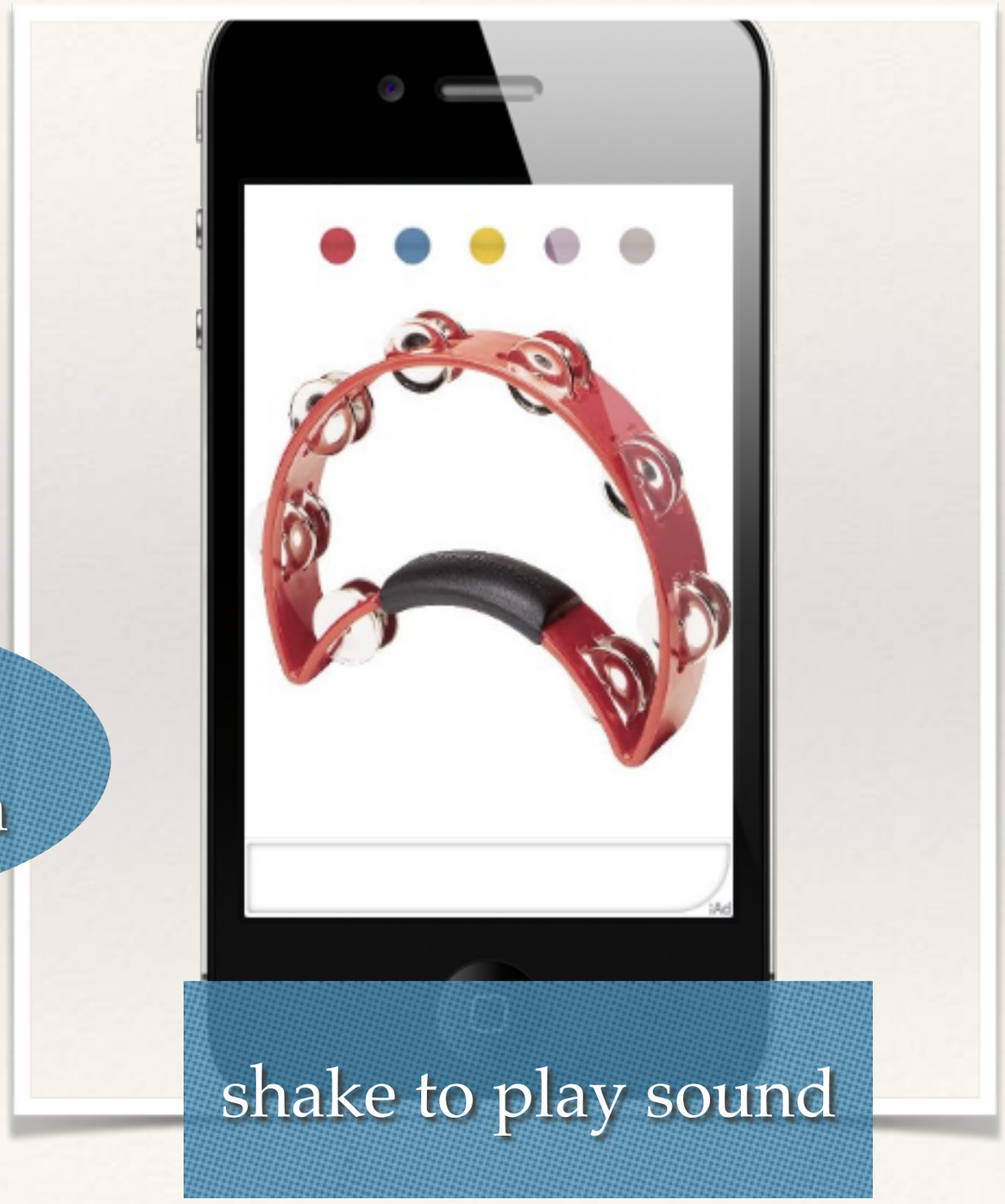
orientation

tilt to change sound

1. Control Space Design

- Smartphone (iPhone / Android)
  - gyroscope
  - accelerometer
  - microphone
  - touch screen

xyz acceleration

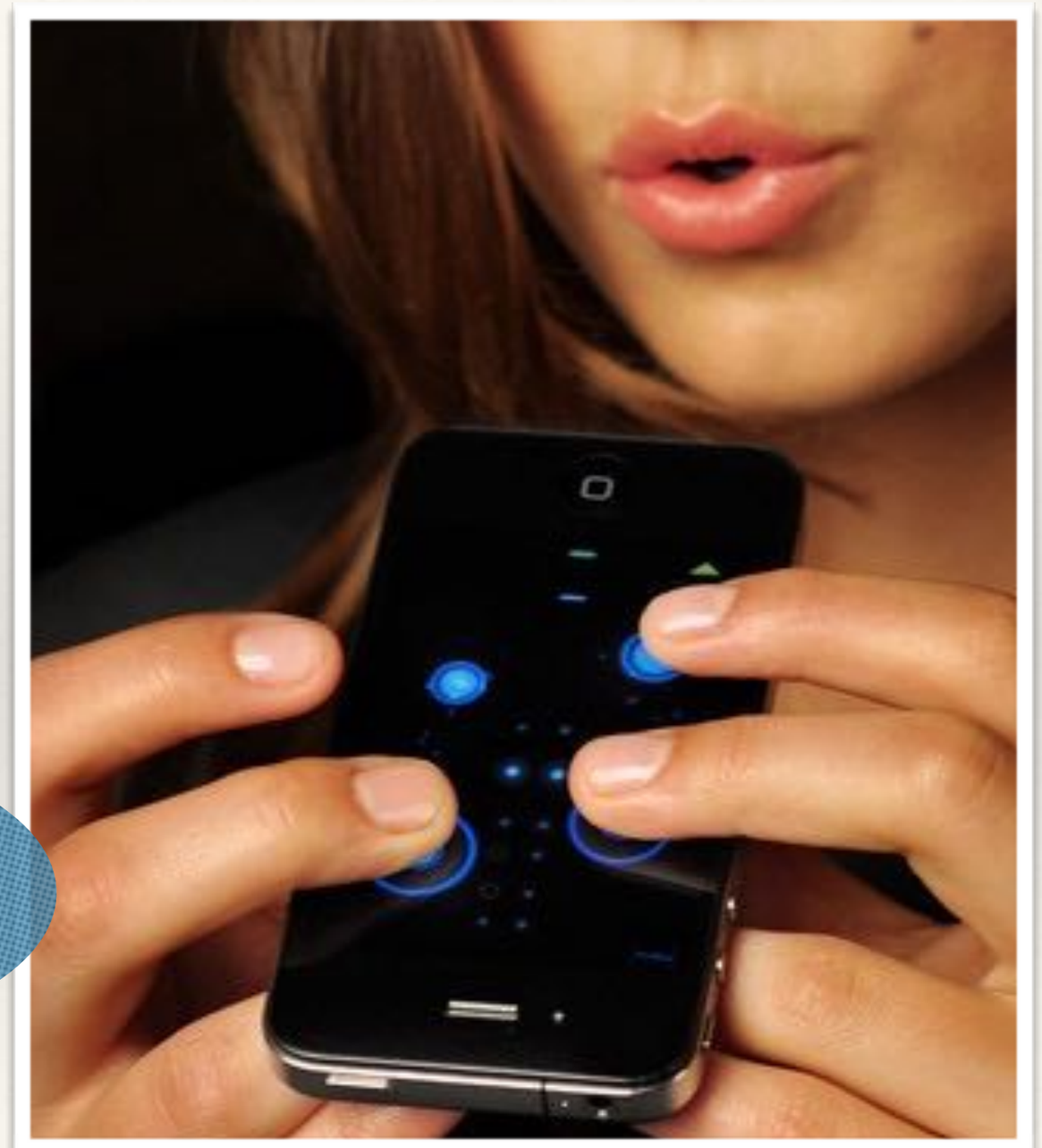


shake to play sound

1. Control Space Design

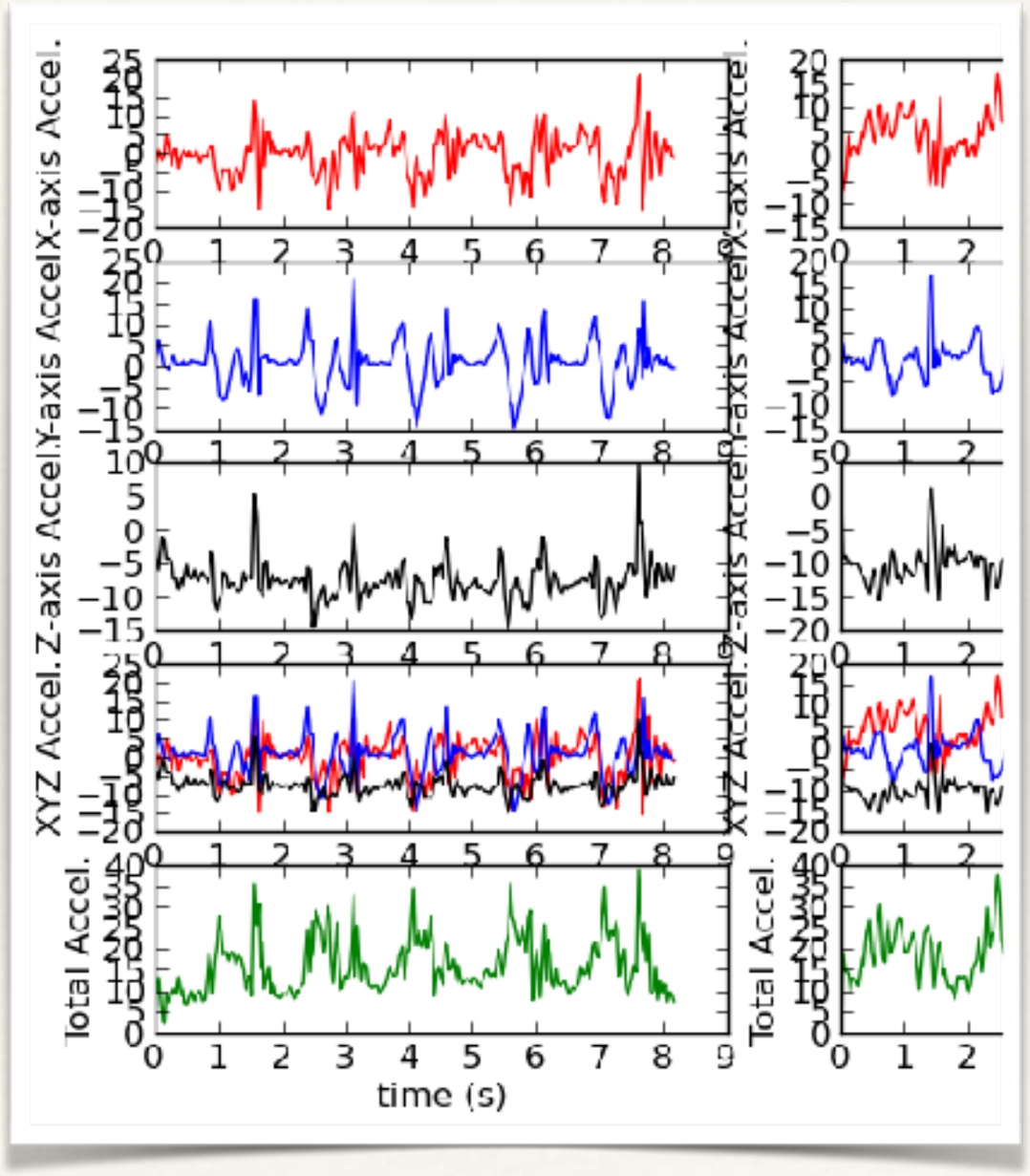
- Smartphone (iPhone / Android)
  - gyroscope
  - accelerometer
  - microphone
  - touch screen

dynamic



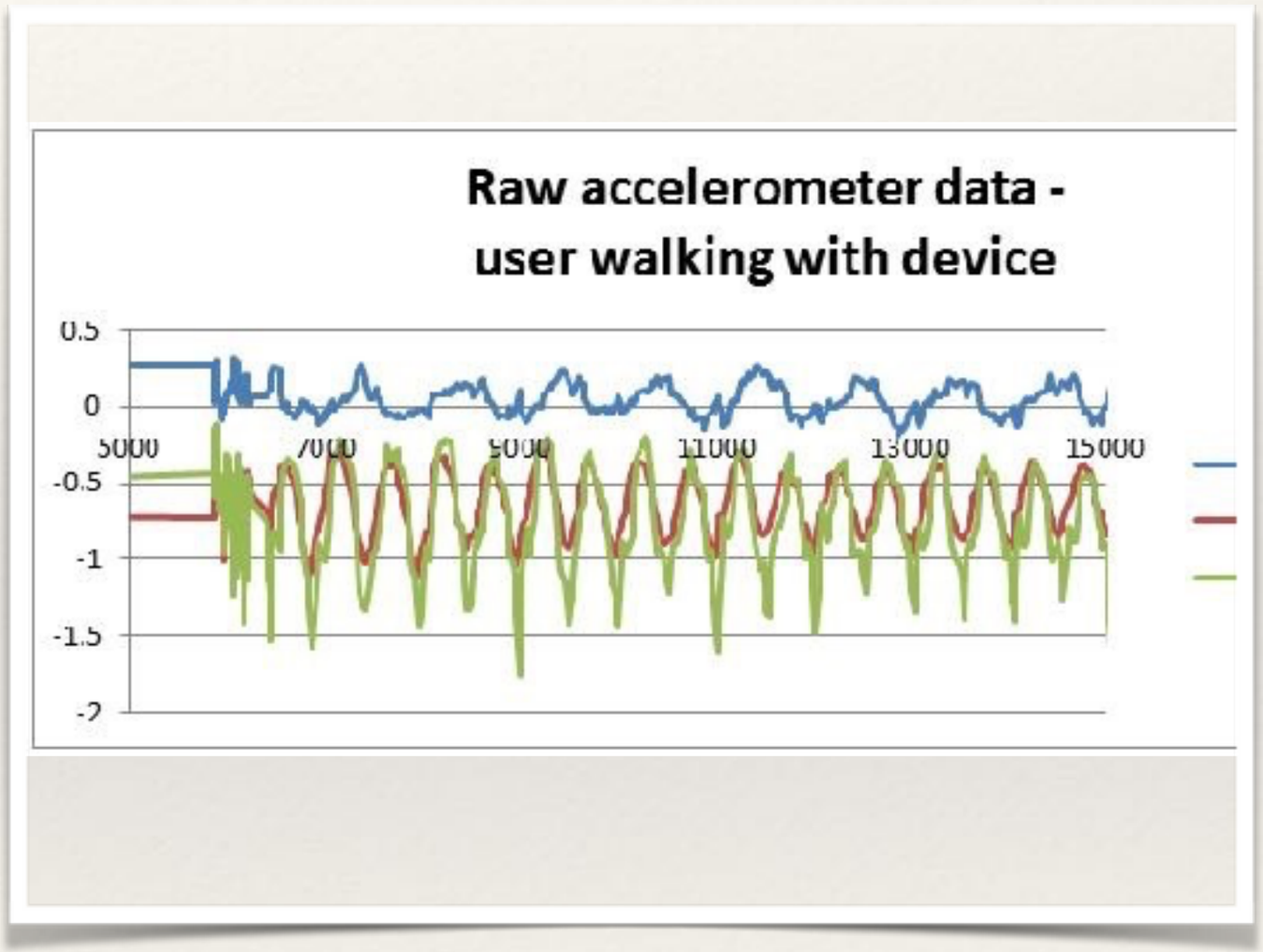
1. Control Space Design

- One major challenge: the captured data usually contain noise
- Do we need to consider the noise? Can we just remove the noise?
- It depends.



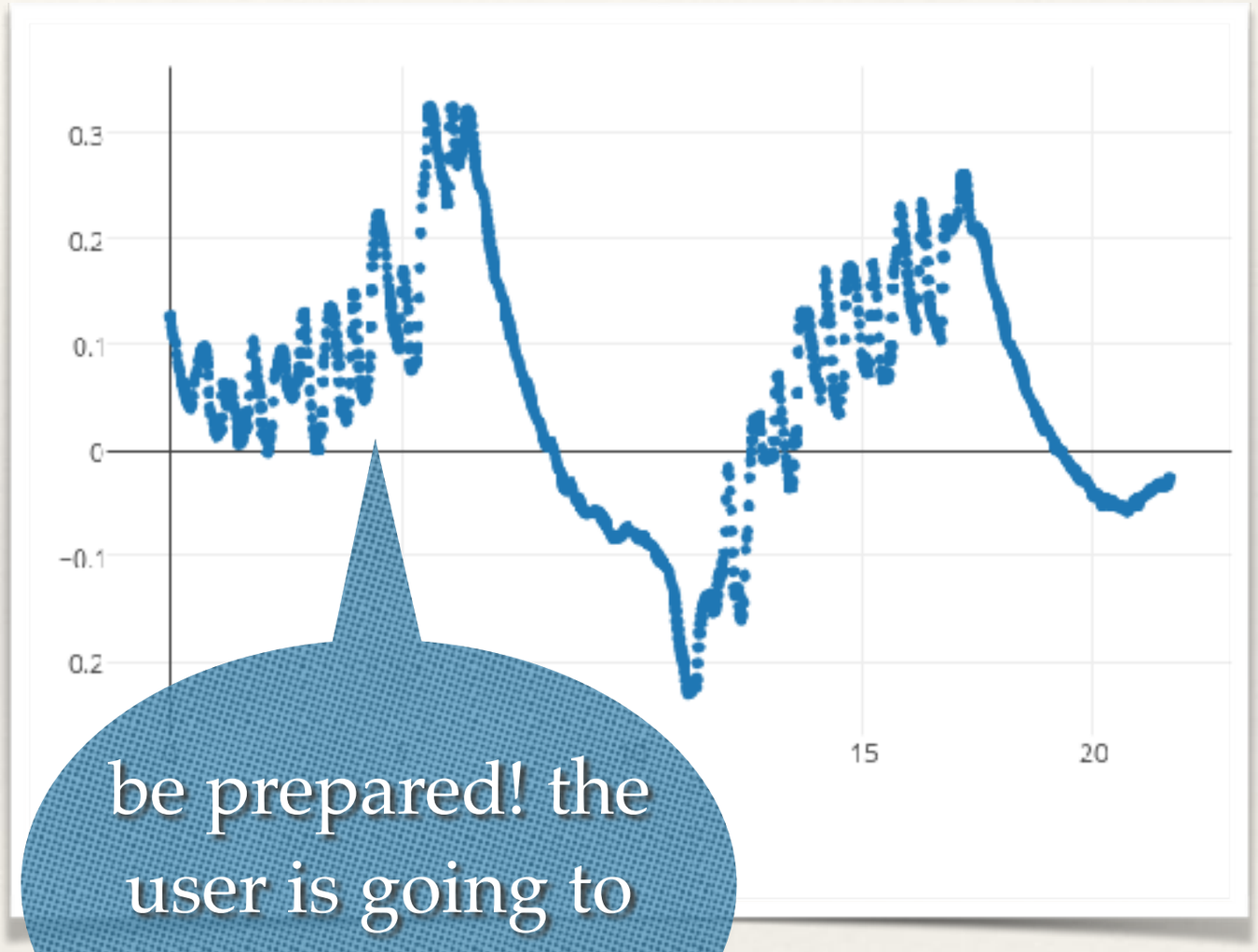
1. Control Space Design

- Example 1: gross body movement (walking)
- low pass filter, delete the noise



1. Control Space Design

- Example 2: fine movement (shaking hand)
- you might want to keep the noise
- noise tell you to preload
- pre-loading vs lazy loading



1. Control Space Design

OK, we have two contradicting concepts here:

- pre-loading: load everything into memory before use
- lazy loading: load the information at the very last moment

- TRADEOFF: mobile phone has very limited resources (e.g. MEMORY)

1. Control Space Design

- Other popular smart device sensors:
  - motion (position, rotation, velocity, acceleration, pressure)
  - electrical (voltage, resistance, impedance)
  - optical (colour, intensity)
  - magnetic (induced current, field direction)
  - neurophysiological (heart rate, skin conductance, brain wave, muscle activities)
- Some examples in next few pages.

Leap Motion

sensor: fine hand movement (by IR and camera)

Kinect

sensor: gross body movement (by IR - body temperature)

MYO

sensor: fine hand movement (by muscle spark)

EEG - Emotiv

sensor: 18 EEG sensors

EEG - MUSE

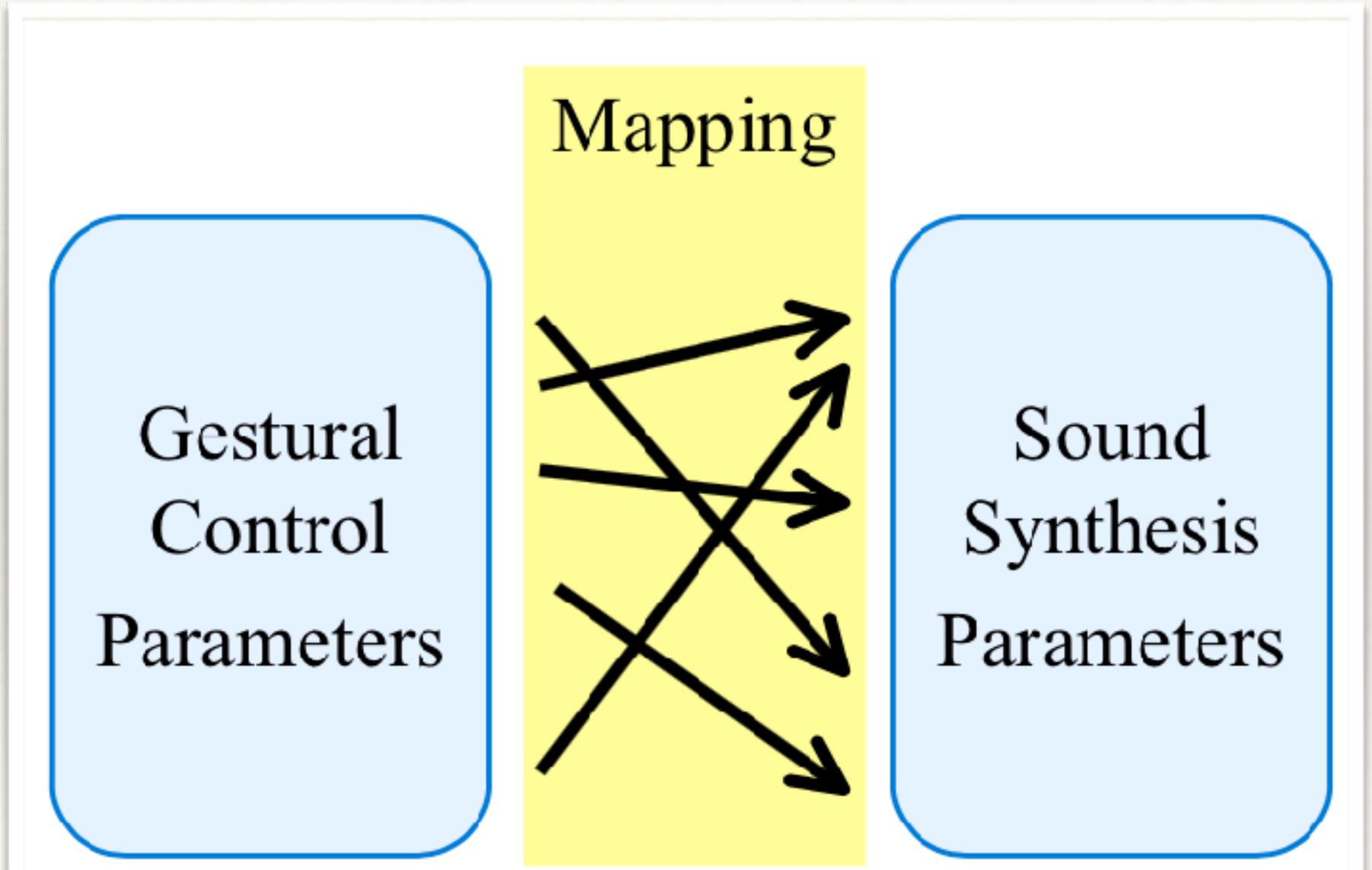
sensor: 7 EEG sensors

2. Sound Space Design

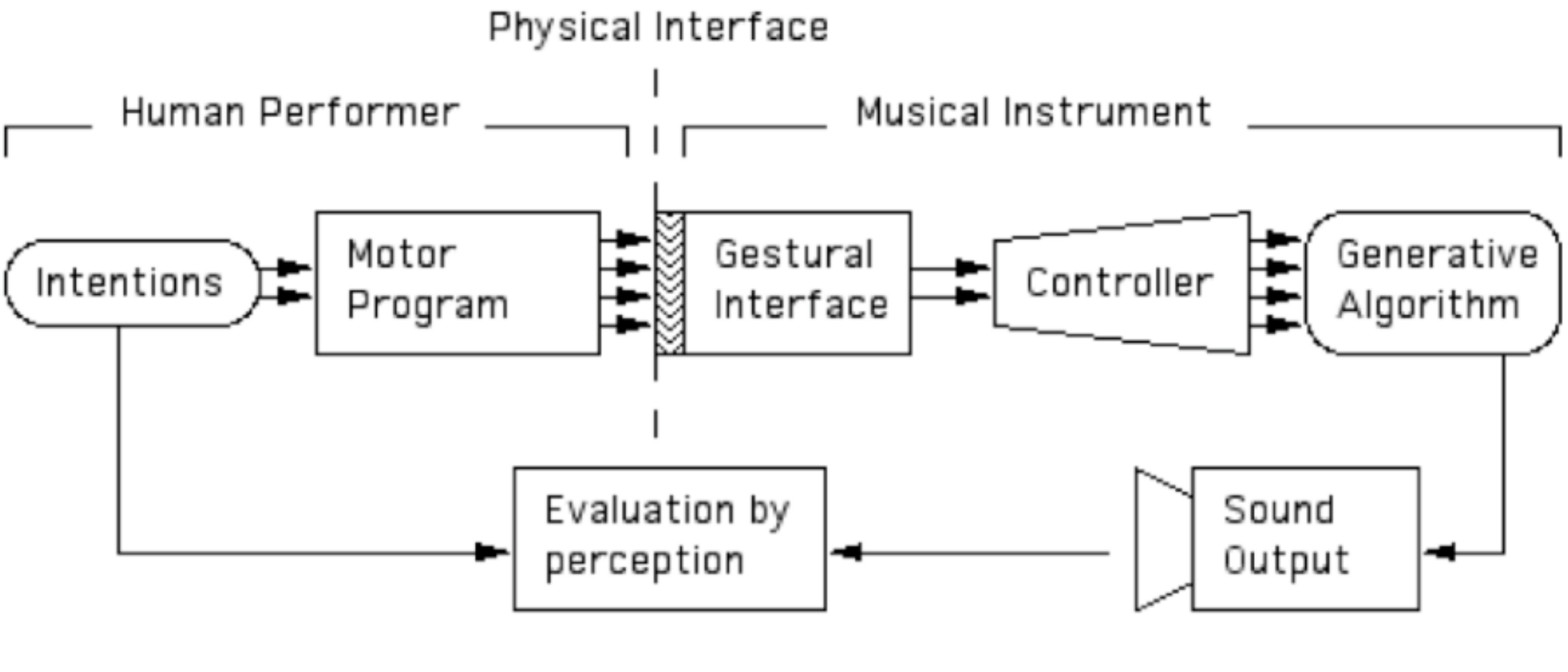
- It is about producing sound, for example:
  - Sampled sound (e.g. recorded each music note in a studio, with real instrument)
  - Synthesized sound (e.g. FM, additive, wavetable)
- This is too much into the audio research field, hence I will to skip it today.

3. Mapping

- Problem: How to design the input gesture to output sound mapping?



3. Mapping


Physical Interface
Human Performer
Musical Instrument
Intentions
Motor Program
Gestural Interface
Controller
Generative Algorithm
Evaluation by perception
Sound Output

3. Mapping

Traditional musical instrument vs New audio interface

- Features of Traditional Musical Instrument (e.g. violin, guitar…)
  - High controllability
  - Cost: Difficult to learn
  - Virtuosity: require 10000+ hours of practice

3. Mapping

Traditional musical instrument vs New audio interface

- Features of New audio interfaces

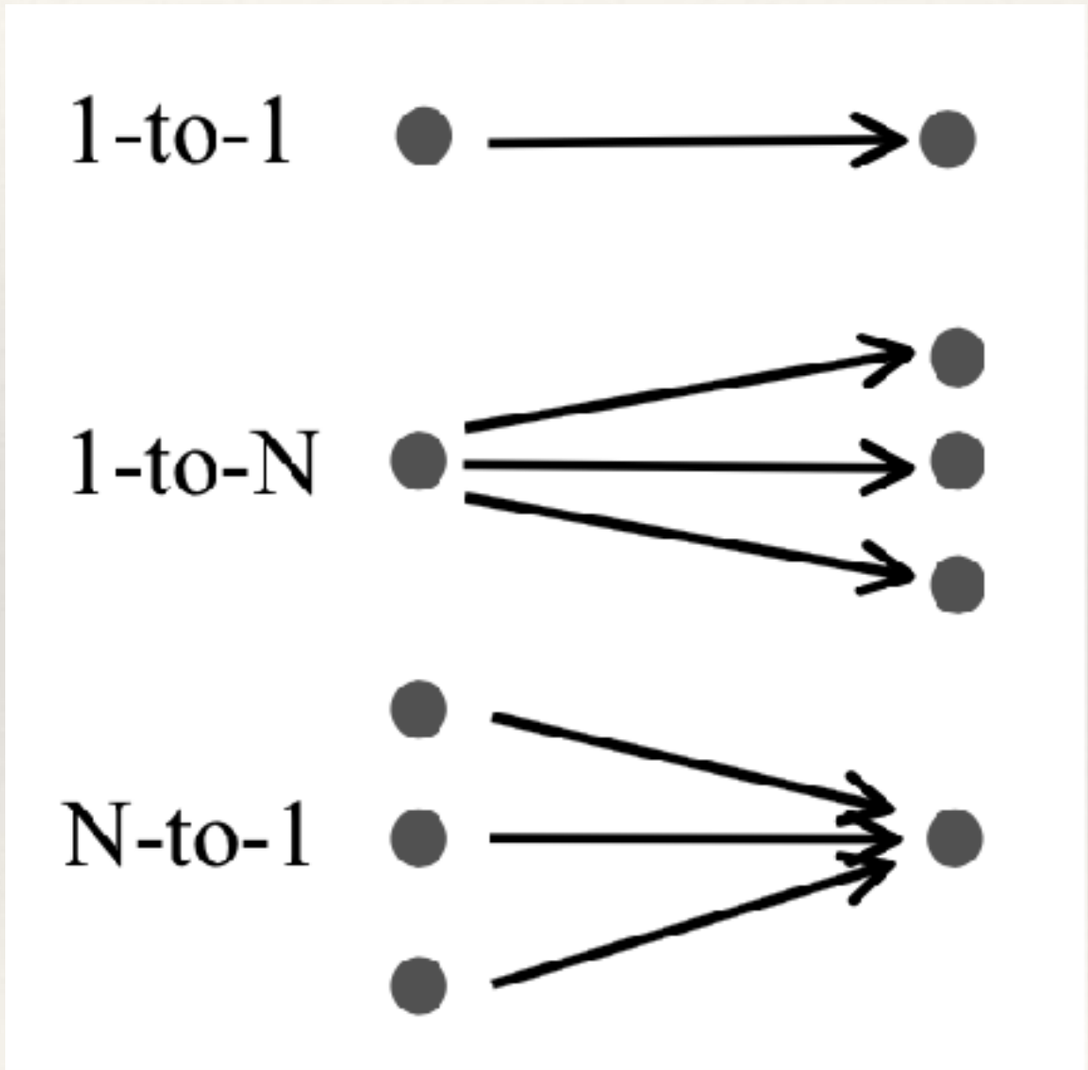
1. Provide special way of contact (e.g. touch, shake, rotate)
2. Develop novel sound pattern (not just a single note/chord)
3. Can enhance improvisation
4. The performance can be effortlessness, can perform traditional components in a easy way (e.g. difficult chord progression, scale, arpeggio)

3. Mapping - design consideration

- 1. latency between gesture and sound (e.g. Android API, user response, way of control, synthesis method)

3. Mapping - design consideration

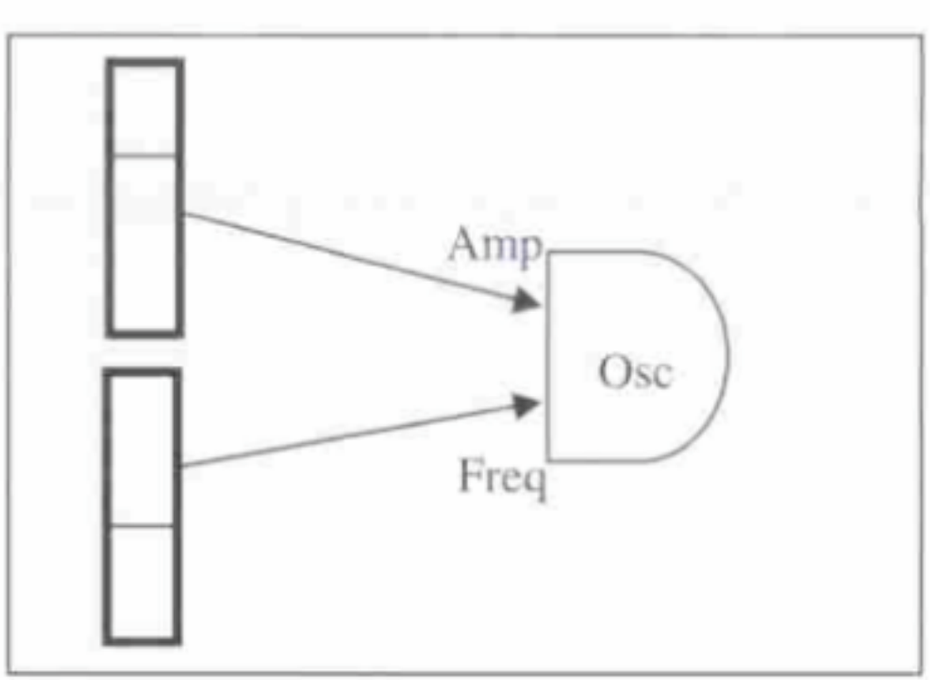
- 2. dimension (e.g. N to 1, 1 to N, 1 to 1 fix, 1 to 1, random)



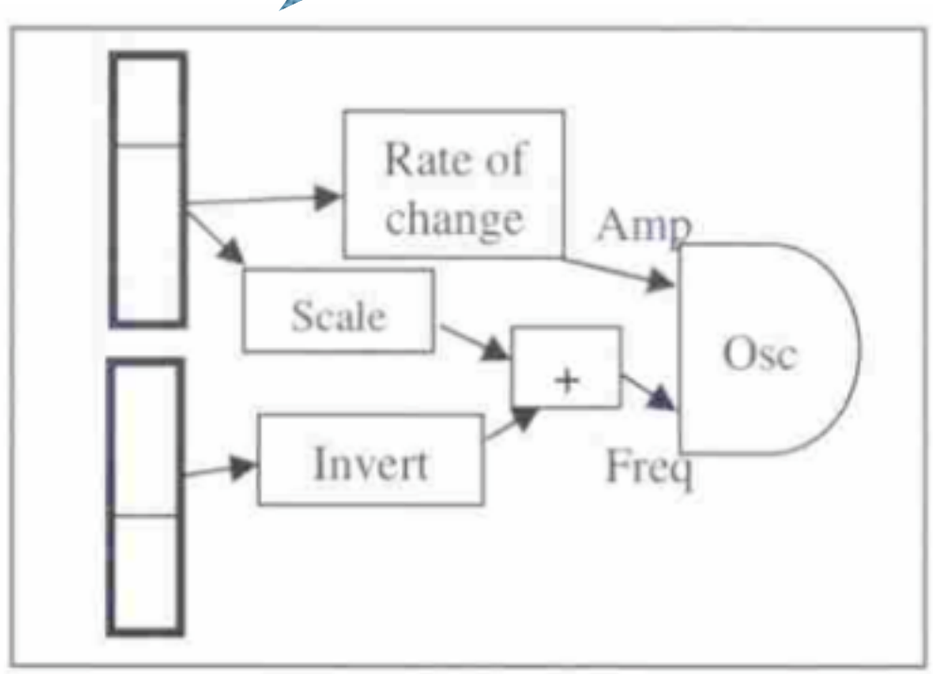
3. Mapping - design consideration

- 3. complexity

affect scalability, efficiency



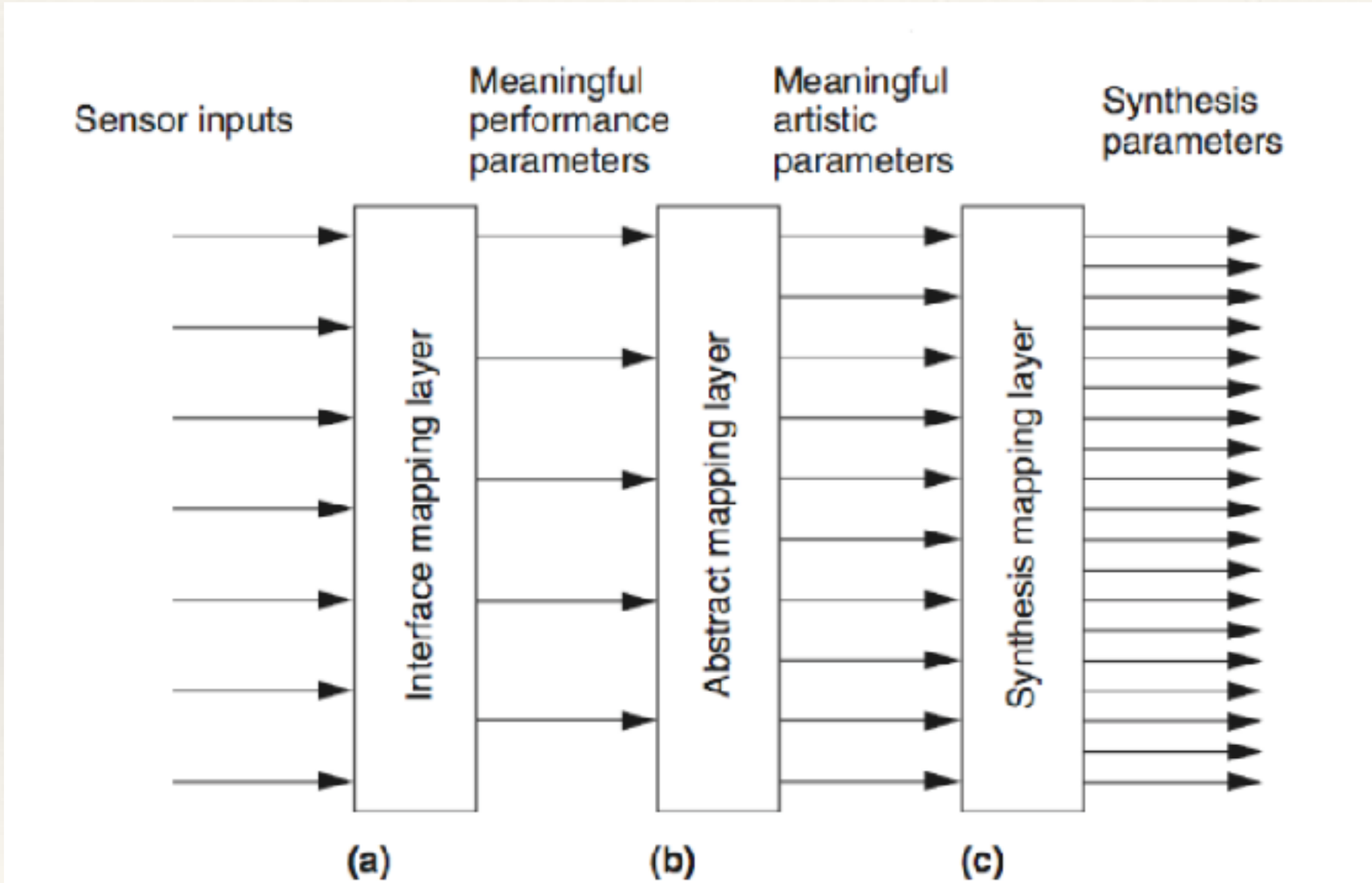
Simple



Complex

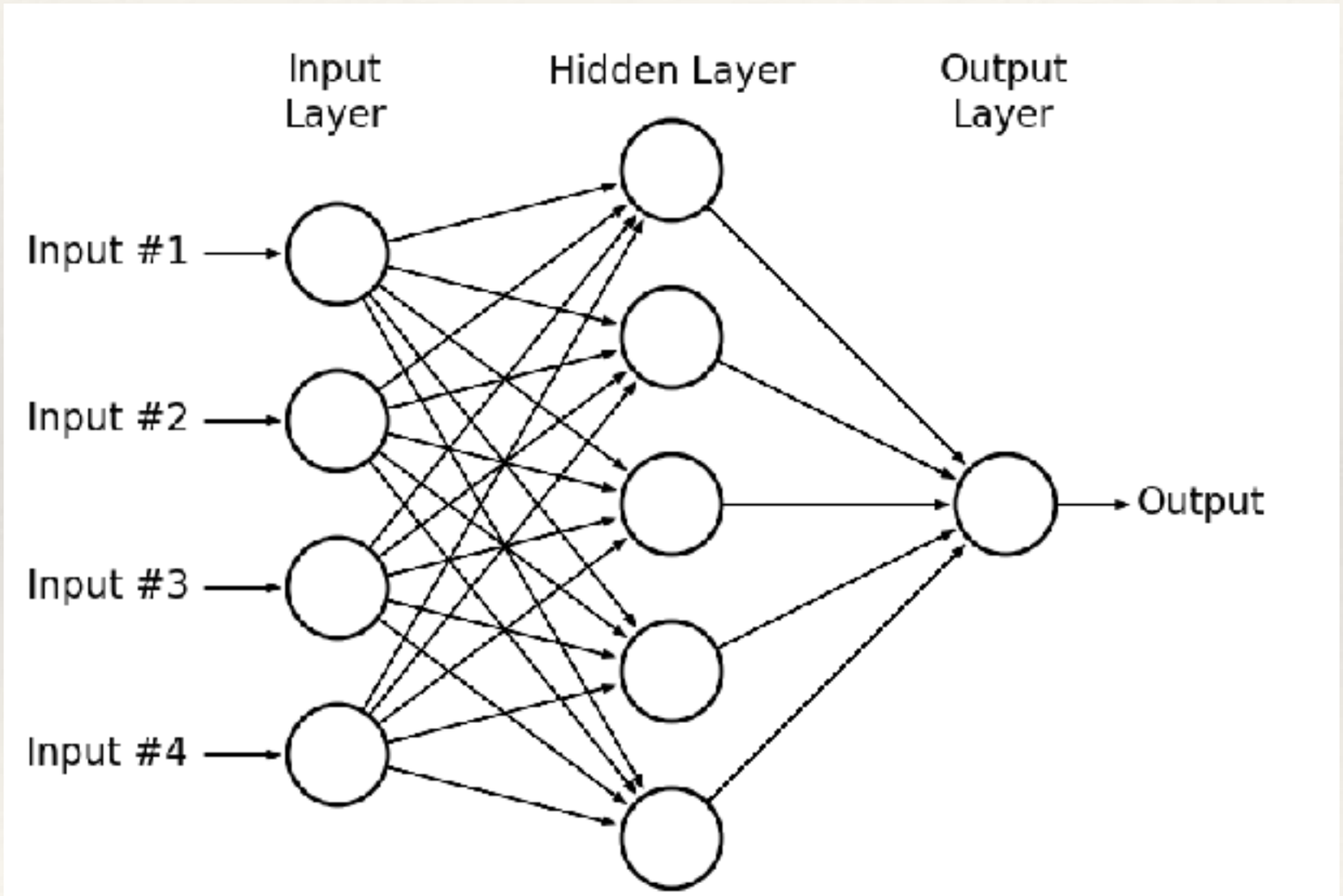
3. Mapping

- How to reduce complexity? e.g. multi-layer structure



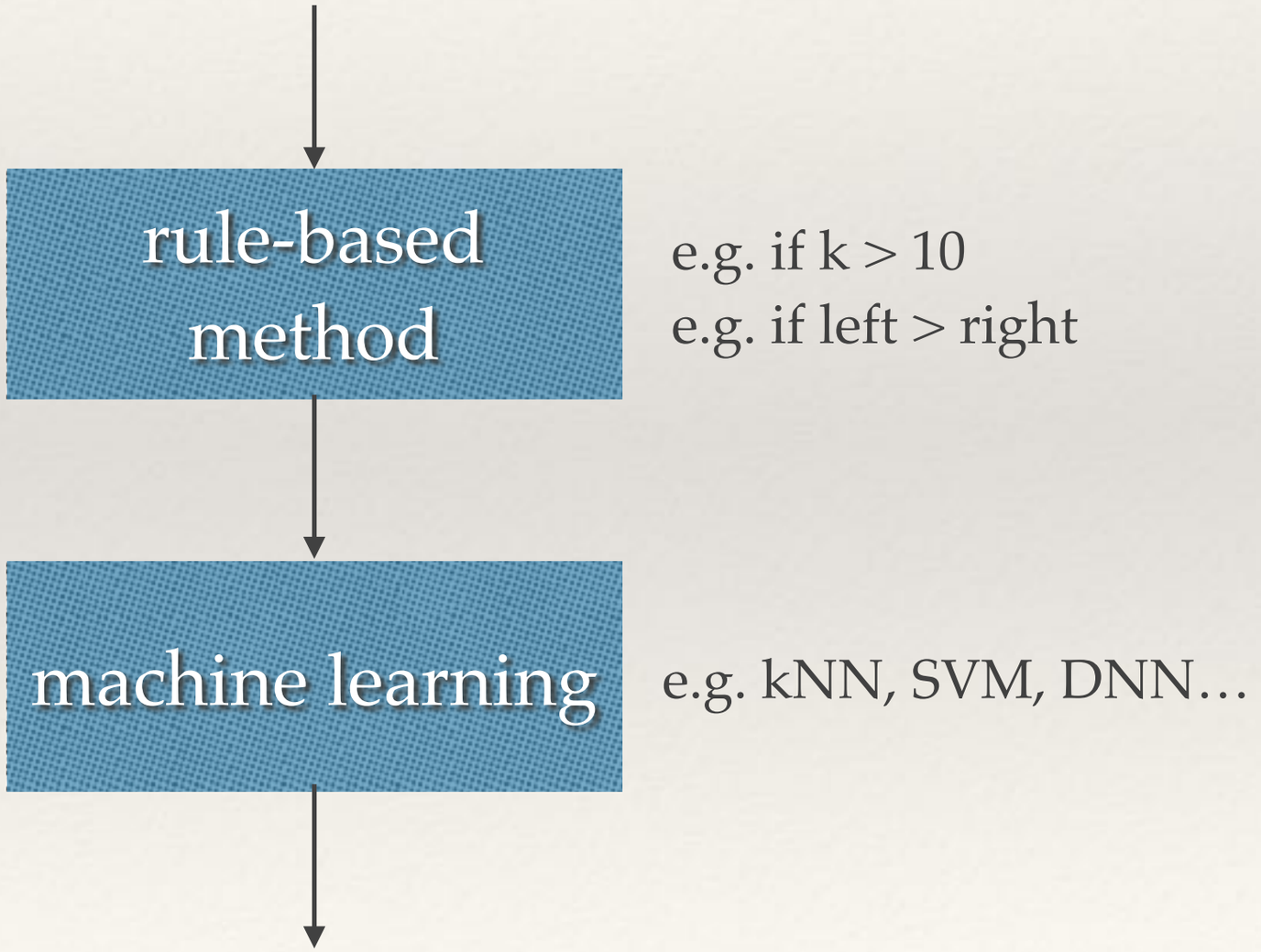
3. Mapping

- How to reduce complexity? e.g. neural network (super popular today)



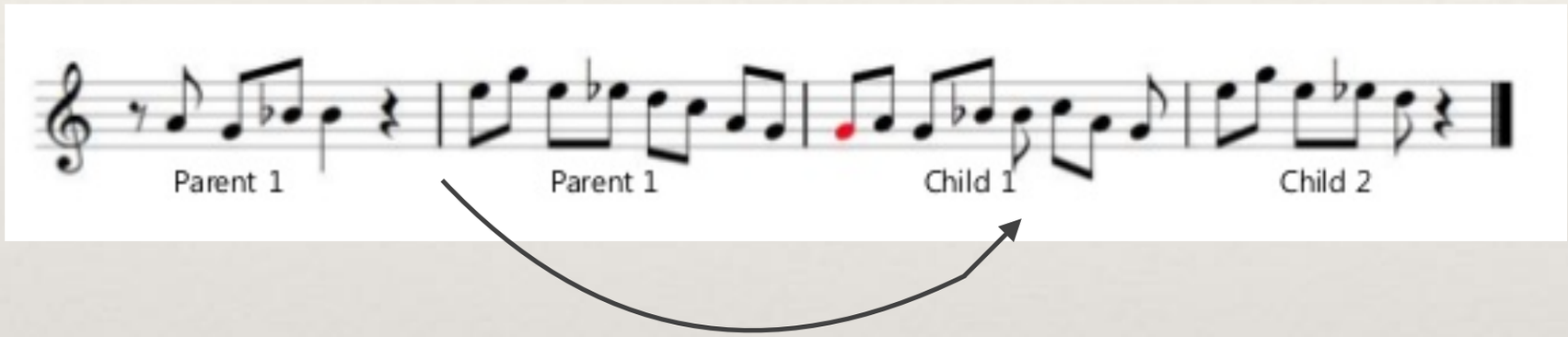
3. Mapping

- How to reduce complexity? e.g. rule based method come first before machine learning.



3. Mapping

- How to reduce complexity? Genetic algorithm



4. User Experience Design

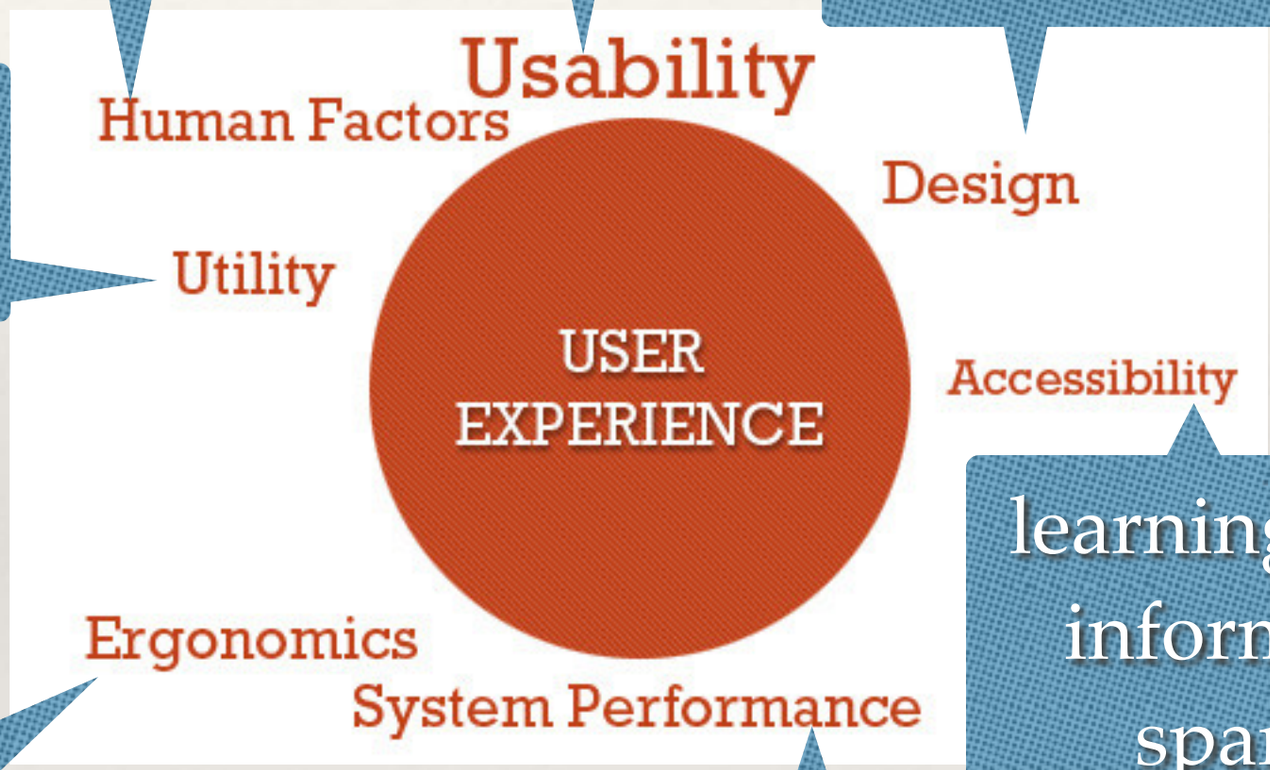
- Experience it, and revise it.

who are your user

case study

focus group

what to address



learning curve, information sparsity

not until you try it, you might not find the ergonomic problem

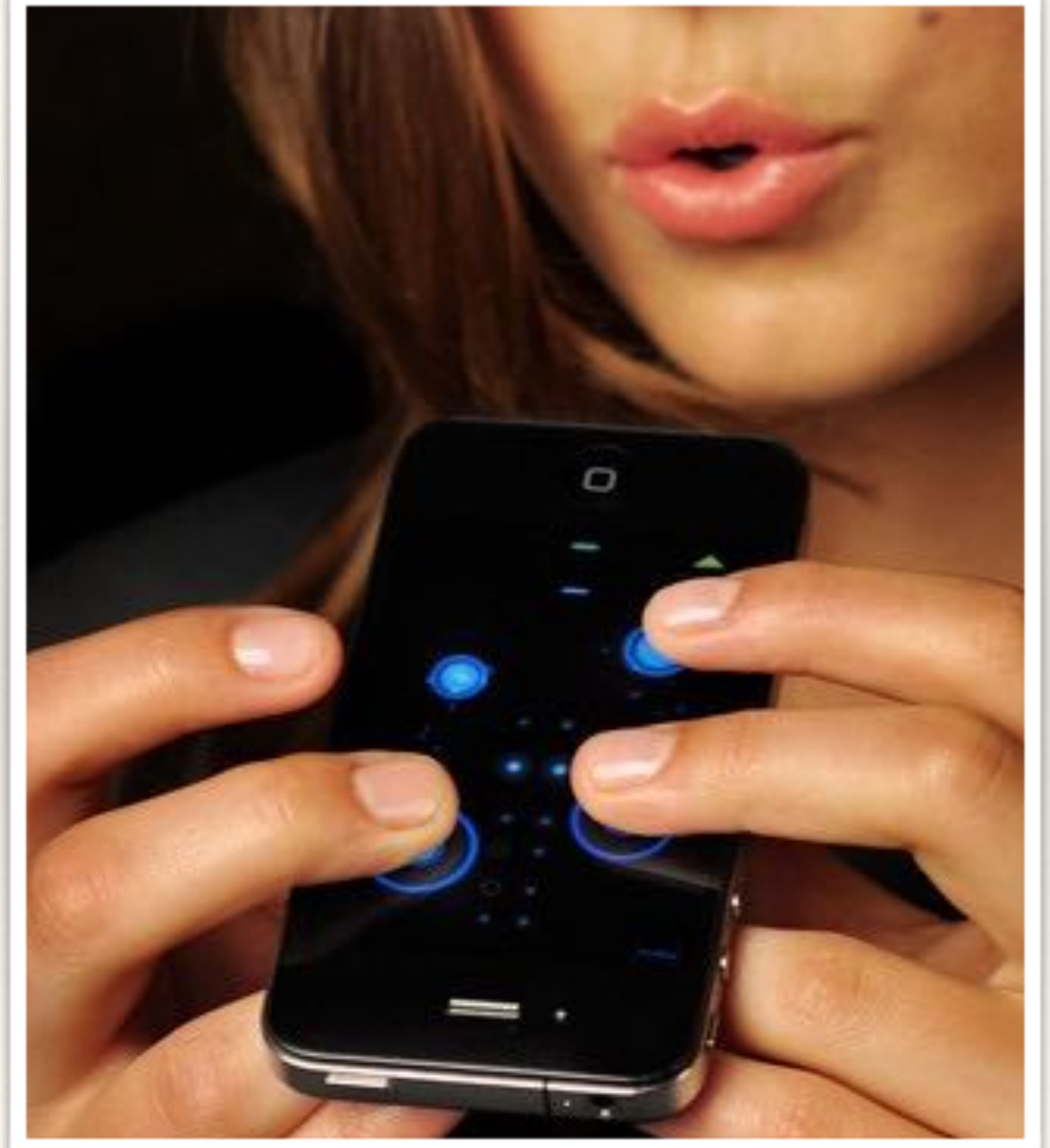
simulator are often wrong (e.g. using different resources)

Part III.

Mobile Audio Interface - Examples

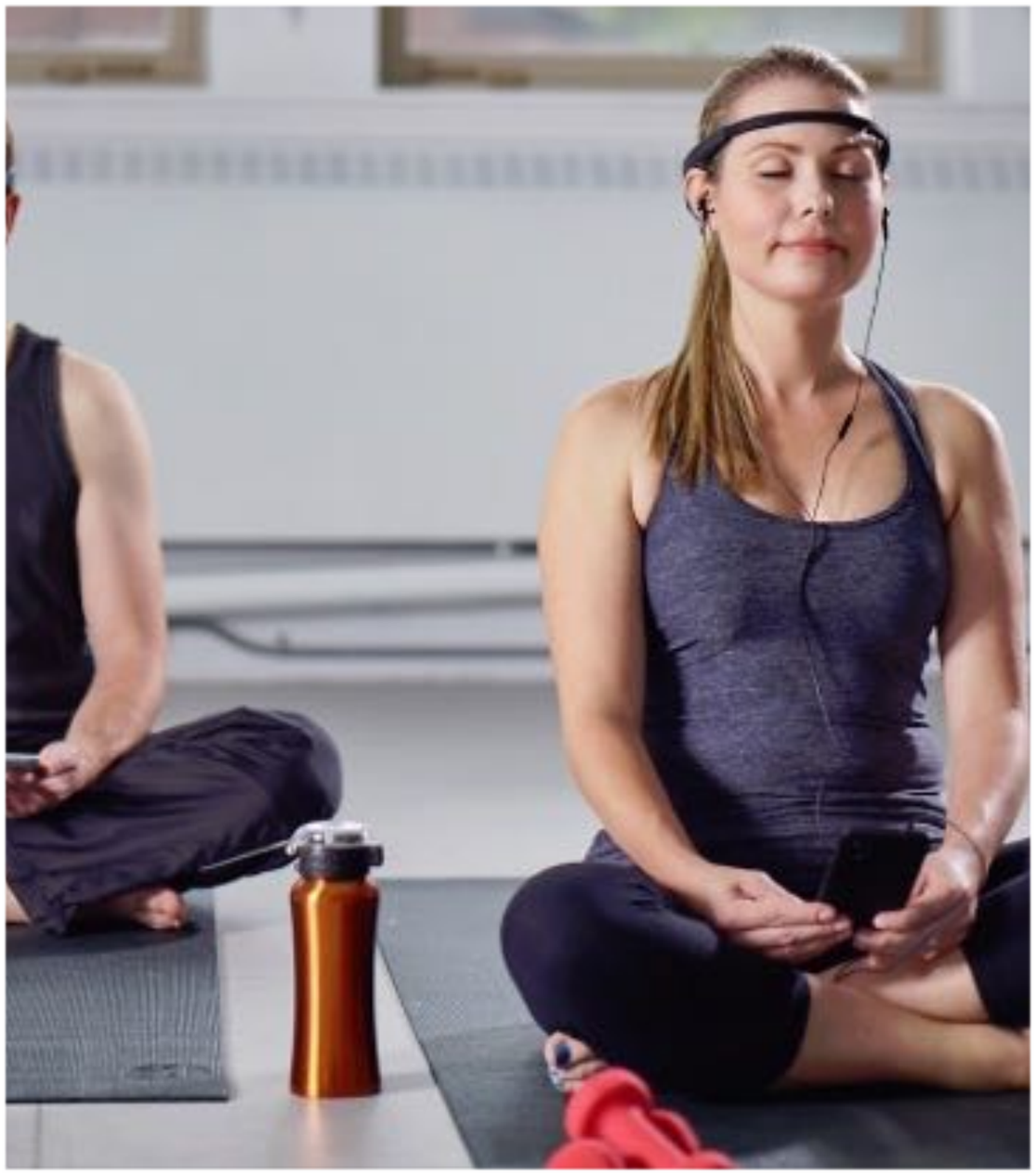
Mobile Audio Interface Examples

- Ocarina app by Smule
  - visual guide
  - imitation of real instrument
  - audio/tactile feedback (reinforcement)
  - sharing result/score with friends



Mobile Audio Interface Examples

- MUSE headband relaxation exercise
  - EEG signal
  - animation feedback
  - training concentration, relaxation

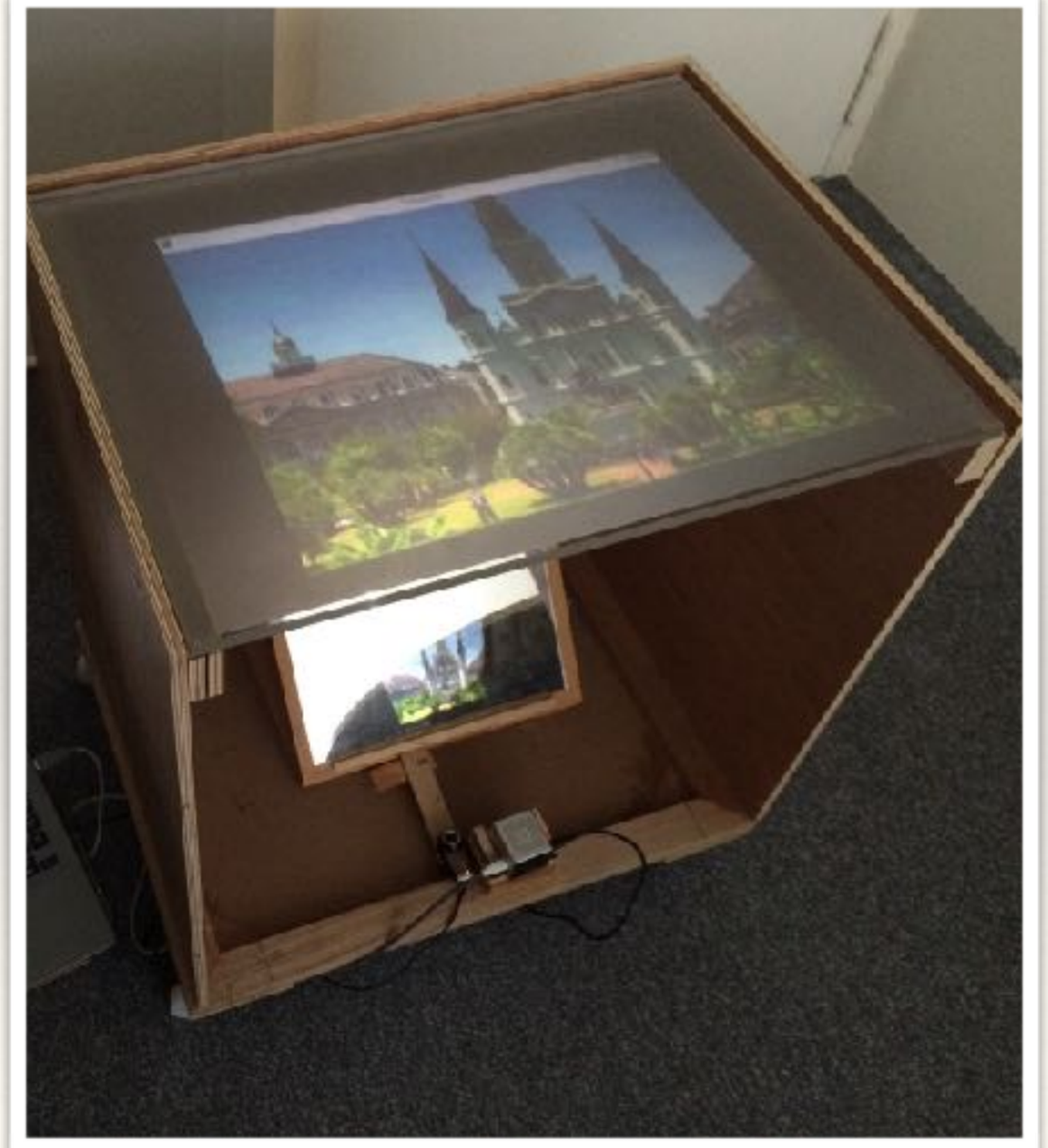


Mobile Audio Interface Examples

- MaKeyMaKey by MIT Media Lab
  - Piano Stairs
  - Banana Piano

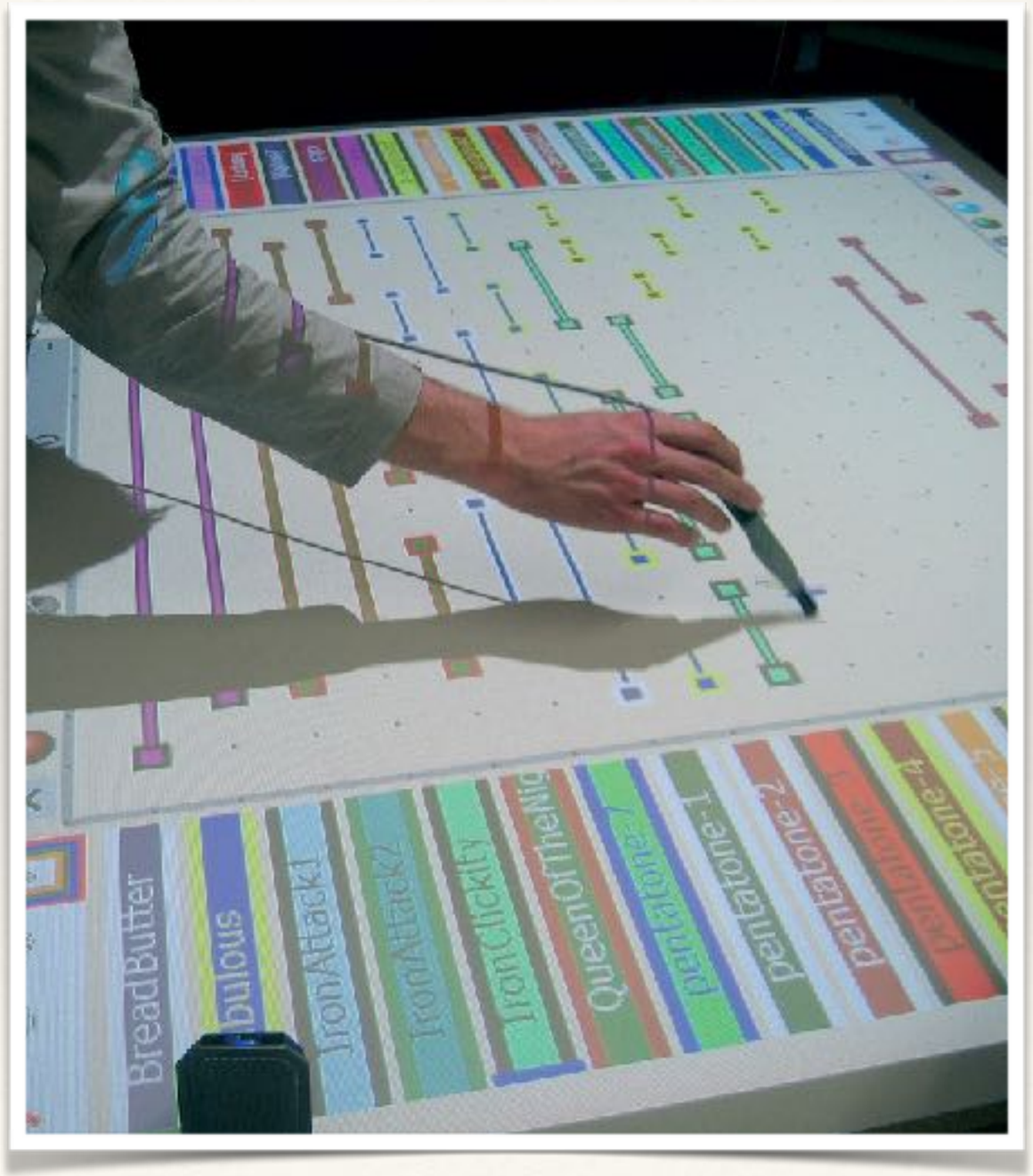
Example of interactive sound creation with smart devices

- Picture music player by Simon
  - handmade multi-touch table
  - capture finger touch by camera (pressure: fingertip size)
  - visual feedback by projector



Introduction of NIME

- Today we actually talked about NIME (New Interface for Musical Expression)



Introduction of NIME

- Computer is not a musical instrument.
- How to create a musical interface to play the computer in a way that is appropriate to human brain and body?

Introduction of NIME

- Here are some common music research fields:

1. ISMIR: music information retrieval
2. DAFx: Digital Audio Effect
3. NIME: The Interface connecting gesture and music

NIME themes

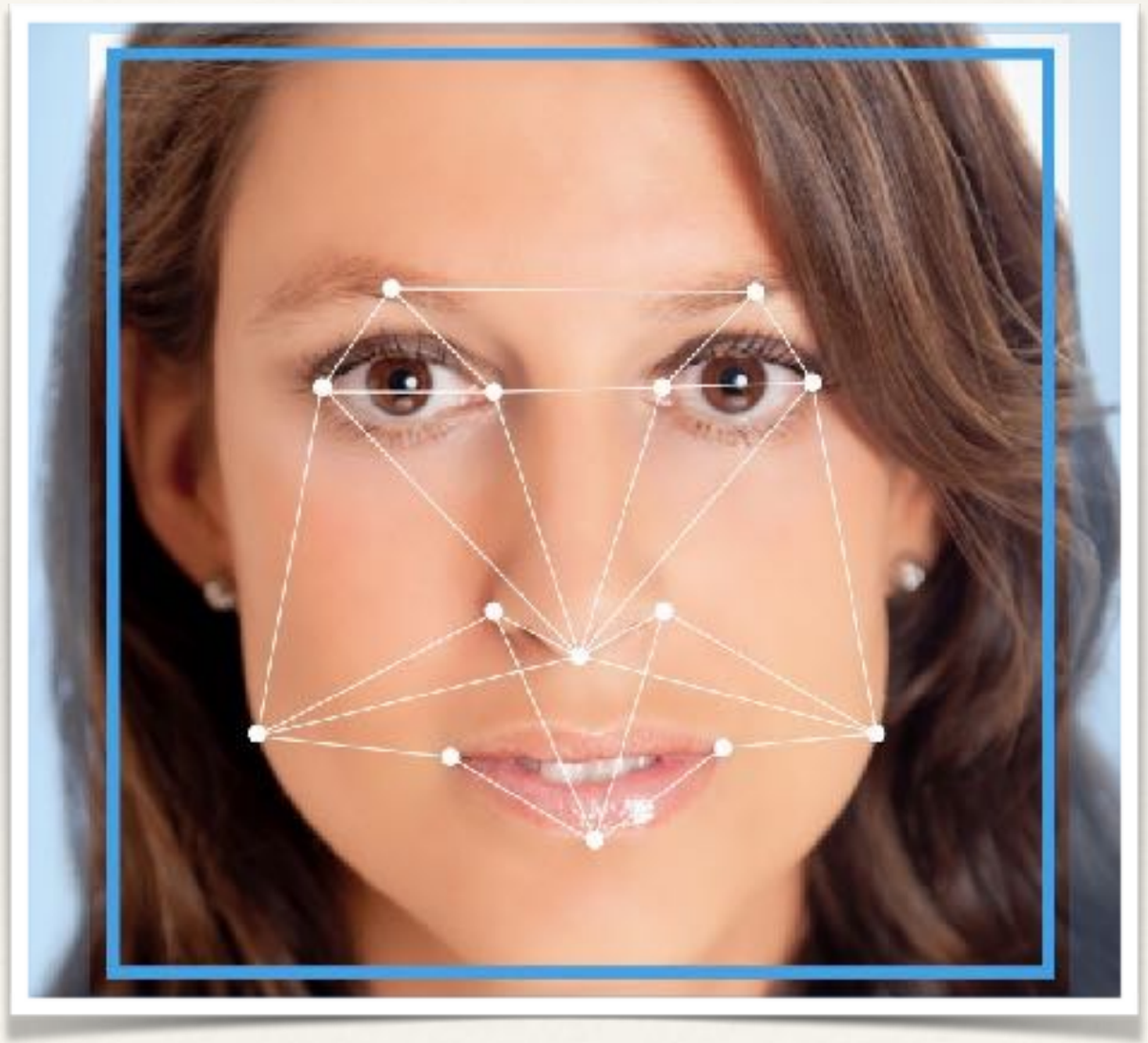
- Digital Musical Instrument

NIME themes

- Interface for musical novices and education (e.g. jamming tool, singing coach, music theory learning game)

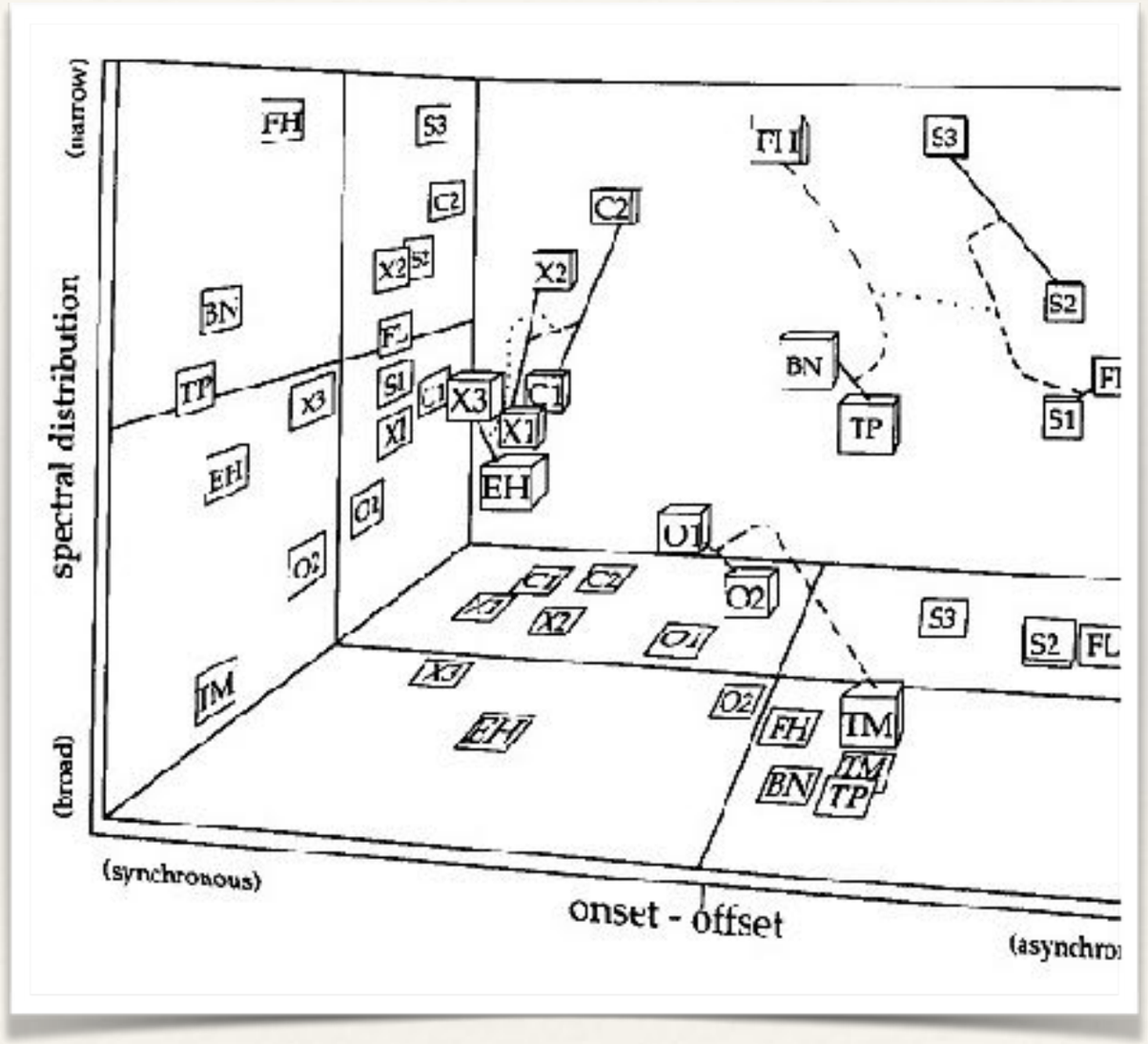
Introduction of NIME

- Visual Interface Design (e.g. music table, facial gesture control, mouth shape as filter parameter, visualization of abstract music concept)



Introduction of NIME

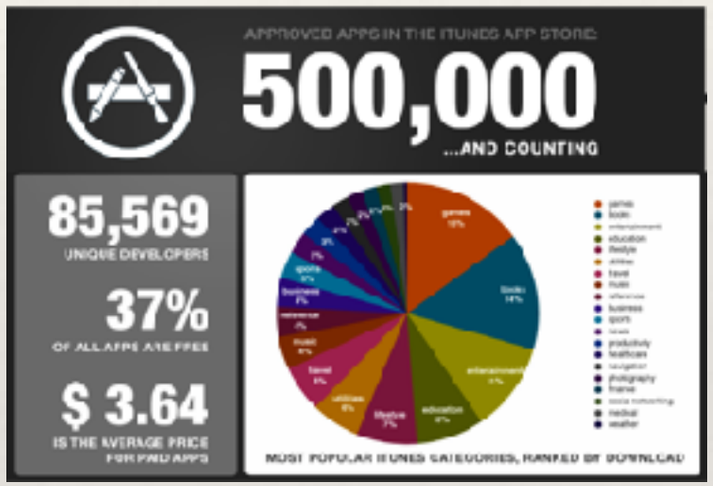
- Performance and composition with new interface (e.g. clustering of timbre for music composer)



Part IV.

Human Computer Interaction Design

…from a business point of view



Let's talk about something PRACTICAL

- Angry Bird: 30+ failure before Angry bird
- Success, is just like gambling: hit or miss (according to Harvard business review)

Let's talk about something PRACTICAL

- Good app: can't guarantee success
- Bad app: will never be success

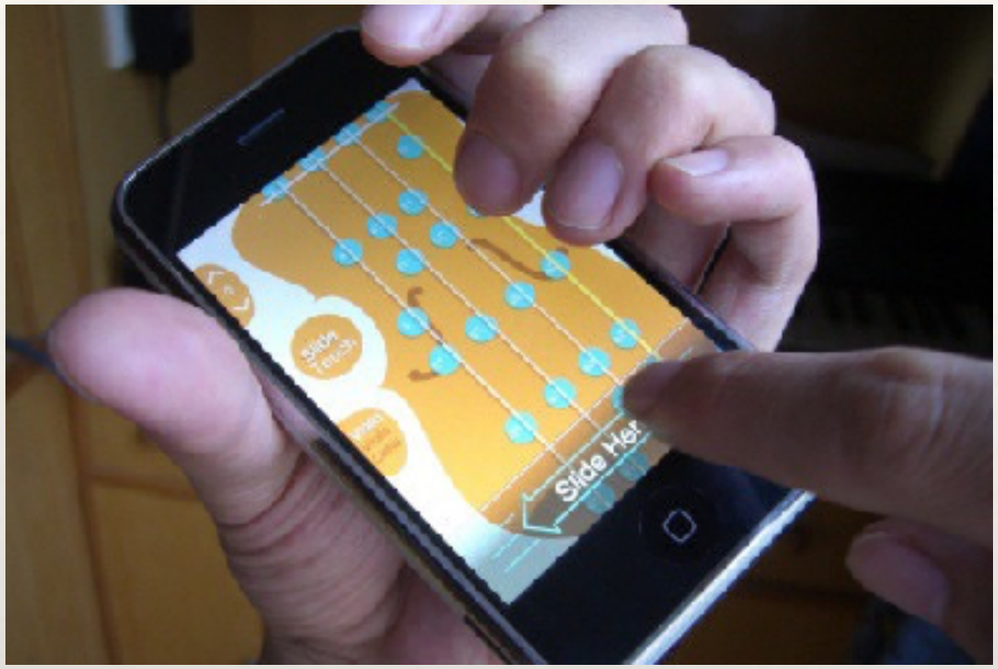
So, what is a **good** app?

To make a good app,
you need a good HCI design

Example - ecViolin

- ecViolin app by Simon: best selling in 2010
- 5 times better sales than my competitors
- Differences: user experience

Let's look at my competitors



- you have to adjust the phone angle to play different strings

- will you play violin like this?

Simon's five rules for mobile HCI design

Our Examples

- ecMTR app by Simon: #1 best selling app in Hong Kong (2010)
- Official MTR app: almost no ranking until I left the market

1. UI design affect speed

What is **SPEED**?

1. UI design affect speed

What is **SPEED**?

- People thought that speed = Processing time only (e.g. CPU, Ram, graphic card…)
- … which is WRONG
- Speed = Processing time + Operational time

CPU, Ram

e.g. time to locate the button, click on it

1. UI design affect speed

- Why Simon won MTR HK
  - My app: 1 click, 1 drag
  - MTR: click, drag, (next page), click, drag, (next page) click… ZZZZzzzz….

2. UI design affect sales

- 26% app: once downloaded, never used again

  Ref: mobile app users are both fickle and loyal study, techcrunch.com

- Why: bad UI

  e.g. according to that user survey:

  - buttons too small (Finger size = 72 x 72 pixel)
  - can't access frequent stuff in one click
  - too much information on a same page

3. Load your app in 7 seconds

- If an app has no response in 7 seconds, people will just delete it
- no matter how great is your app, don't let your customer wait too long at the loading page.

4. Treasure your resources

- Mobile phone have limited resources
- However, many people code mobile app as desktop app

4. Treasure your resources

- Why Simon won MTR HK (2009)
  - Simon: Lazy loading for huge and infrequently used information (e.g. map)
  - MTR HK: preload everything!

load data at the very last moment

5. Goal oriented

- Why Simon won MTR HK (2009)
- Simon: only include last train information of related stations

5. Goal oriented

- Why Simon Wins MTR HK (2009)
  - MTR HK: just copy everything! Complete! Full! Powerful!

港島綫
Island Line

To be effective from 12 June 2011

首班車及尾班車
First and Last Trains

在少於尾班車編定開出時間前5分鐘，乘客或會不能入閘。
Passengers may not pass through the entry gates less than 5 minutes before the scheduled departure time of the last train

詳細資料可見於
Further information is available from
車站客務中心
Station Customer Service Centres
港鐵網址： www.mtr.com.hk
MTR Website
港鐵熱綫： 2881 8888
MTR Hotline

灣仔 Wan Chai	服務時間 Service Hours	0553 - 0111

目的地 Destination	轉車站 Interchange	首班車開 First train	尾班車開 Last train	月台 Platform
往 落馬洲 To Lok Ma Chau	金鐘/旺角/九龍塘/ Admiralty/Mong Kok/Kowloon Tong/	0603	2116	2
往 羅湖 To Lo Wu	金鐘/旺角/九龍塘/ Admiralty/Mong Kok/Kowloon Tong/	0603	2246	2
往 上水 To Sheung Shui	金鐘/旺角/九龍塘/ Admiralty/Mong Kok/Kowloon Tong/	0603	0008	2
往 烏溪沙 To Wu Kai Sha	金鐘/旺角/九龍塘/大圍/ Admiralty/Mong Kok/Kowloon Tong/Tai Wai/	0603	0008	2
往 紅磡 To Hung Hom	金鐘/旺角/九龍塘/ Admiralty/Mong Kok/Kowloon Tong/	0603	0034	2
往 屯門 To Tuen Mun	金鐘/美孚/ Admiralty/Mei Foo/	0603	0002	2
往 迪士尼 To Disneyland Resort	中環/香港/欣澳/ Central/Hong Kong/Sunny Bay/	0603	2352	2
往 東涌 To Tung Chung	金鐘/荔景/ Admiralty/Lai King/	0603	0034	2
往 東涌 To Tung Chung	中環/香港/ Central/Hong Kong/	0603	0034	2
往 荃灣 To Tsuen Wan	金鐘/ Admiralty/	0603	0054	2
往 寶琳 To Po Lam	北角/ North Point/	0611	0101	1
往 康城 To LOHAS Park	北角/ North Point/	0611	0101	1
往 觀塘 To Kwun Tong	北角/油塘/ North Point/Yau Tong/	0611	0101	1
往 中環 To Central		0603	0054	2
往 上環 To Sheung Wan		0603	0054	2
往 柴灣 To Chai Wan		0611	0101	1

5. Goal oriented

- an app should
- solve a problem
- but not including everything in a messy way

"Design is not just what it looks like and feels like. Design is how it works"

–Steve Jobs

Q & A