

Designing educational robots and IoT-based toys for multi native language acquisition

Cultivating bilingual baby or multilingual baby

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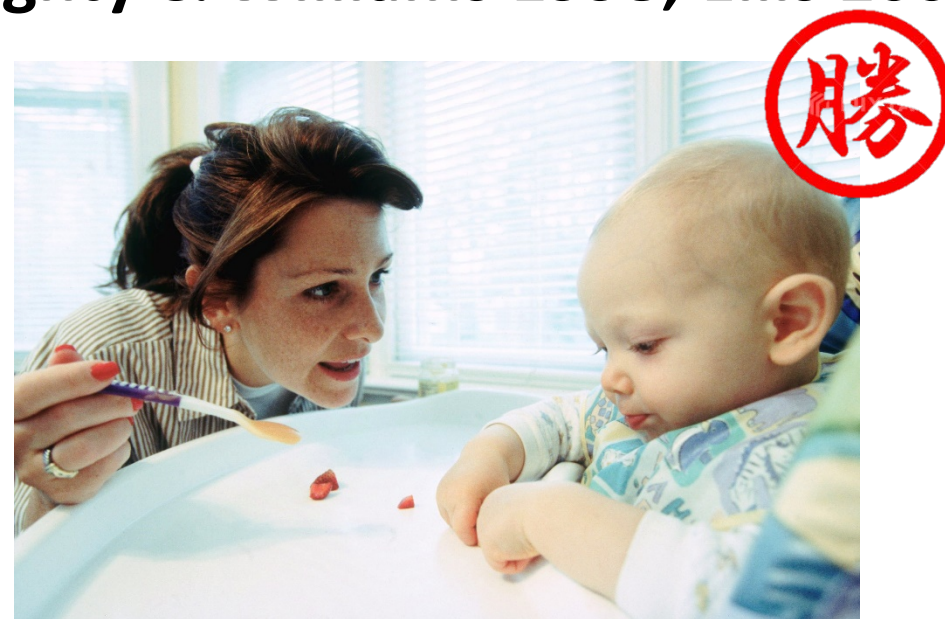
Background



- Language is essential in our daily life. It helps to communicate, shapes ones' thoughts...but it is more than just essential.
- In the era of globalization, language is becoming an important indicator of one's own skills and being multilingual can be extremely beneficial in many ways.

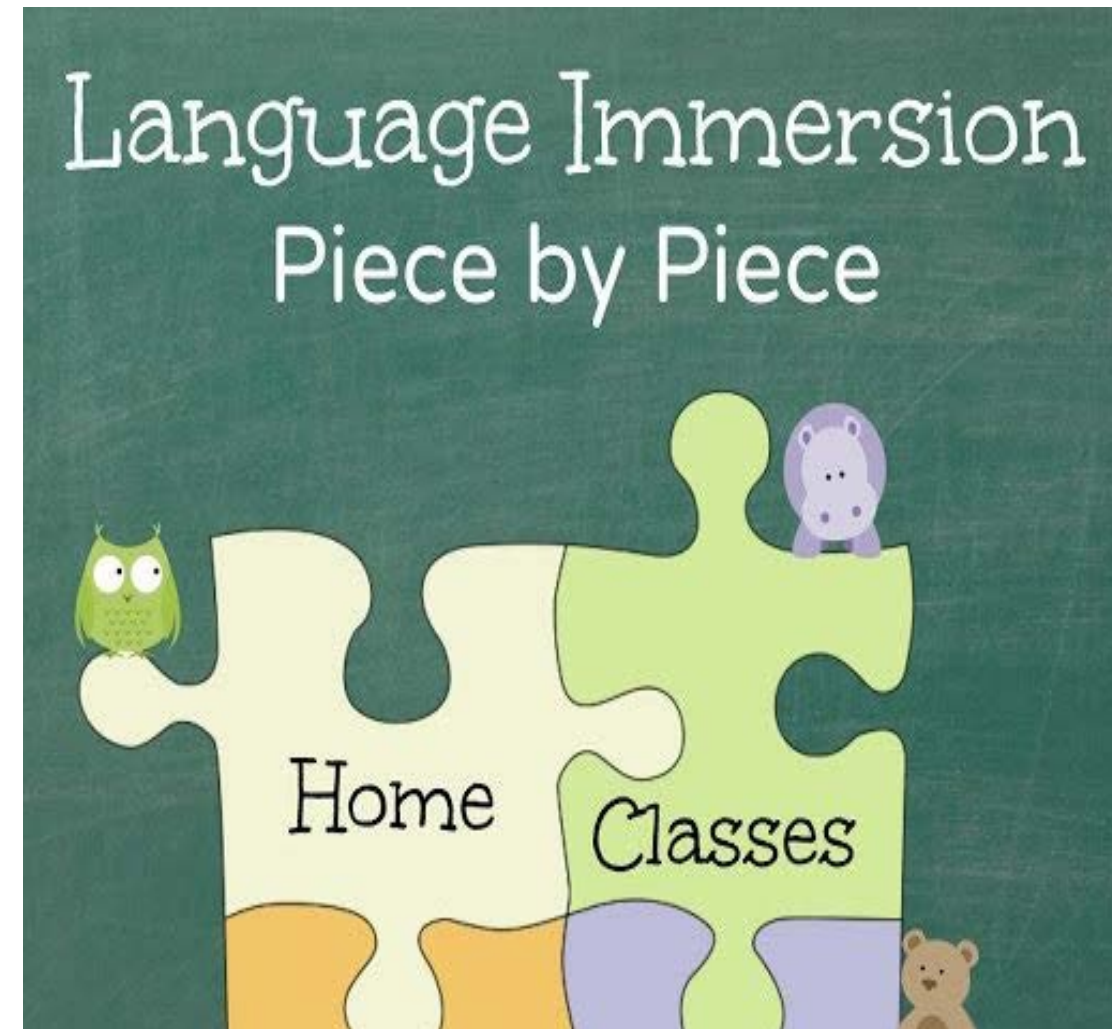


- A large body of research in language education is devoted to learning a foreign or second language, e.g. EFL or ESL.
- However, learning a second language through such a conscious learning process (Krashen 1982; Schmidt 1983) is known to result in less accuracy and proficiency than native language acquiring (Ellis 1994; Doughty & Williams 1998; Ellis 2002).



What is native language and how do we acquire it?

- Native language is a language that a person naturally acquires, a language that children acquire from interacting with older family members, also known as family language (UNESCO, 2003).
- Infants acquire language in a **nature and language immersion environment**, through listening, watching, touching, smelling and playing.



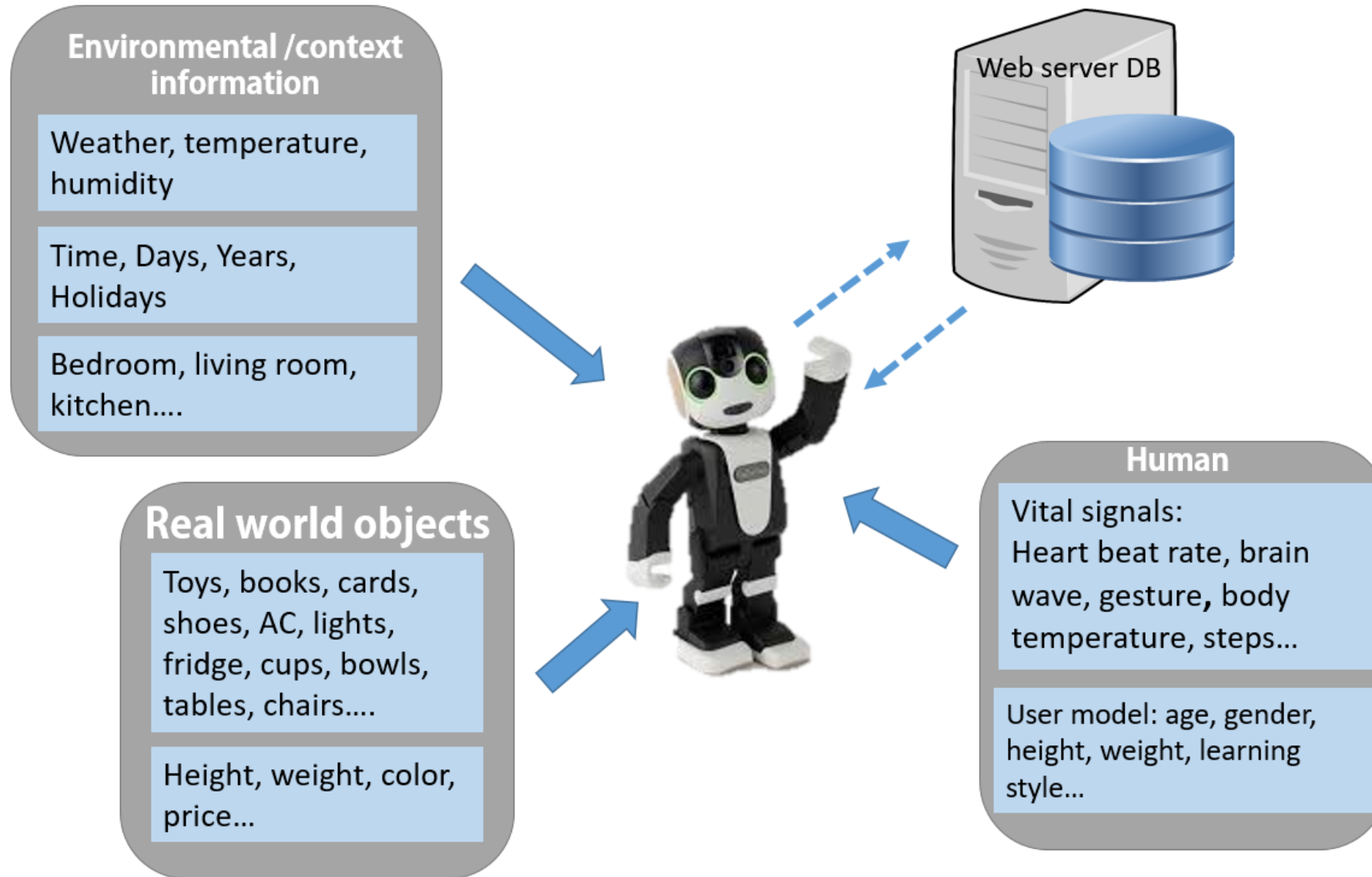
Building a Language immersion environment is essential but challenging

- It is essential to provide a native and a language immersion environment for the kids to build up language skills and to master the language.
- Age 1-3 is considered “the golden window” for language acquisition.
- Due to many limitations, it is difficult to provide a such environment for kids at this age to acquire more than one mother tongue.

This study propose to ...

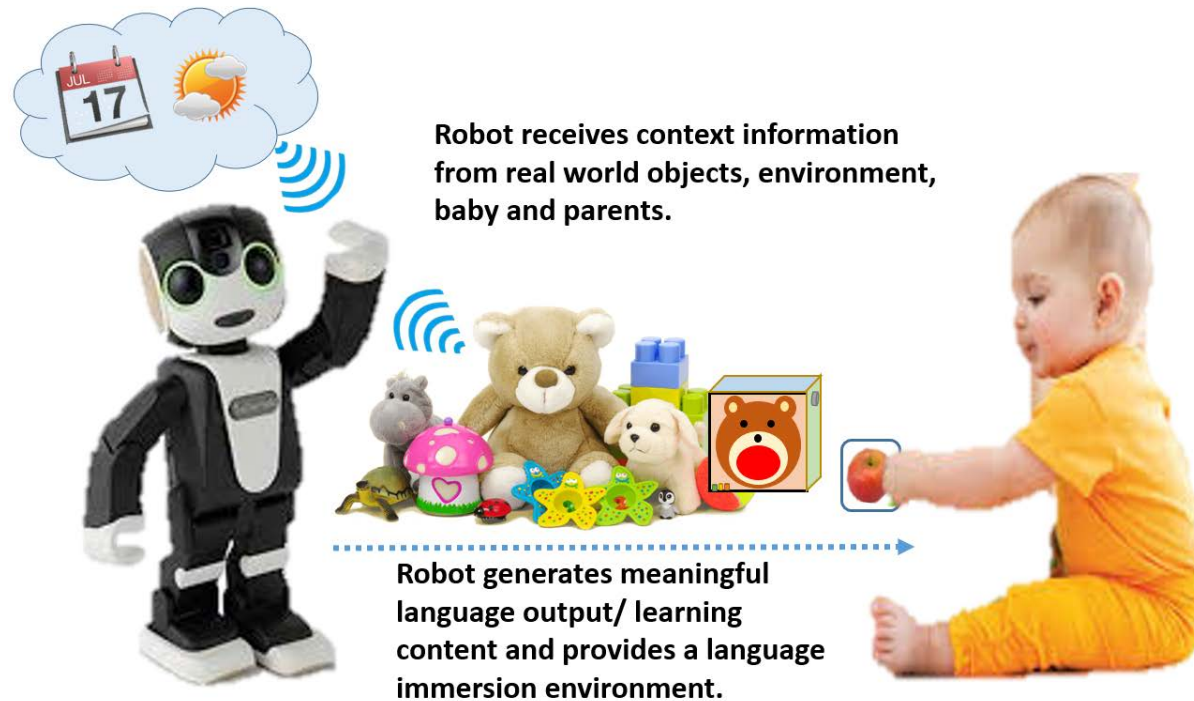
1. create an immersive multilingual environment **utilizing robotic and IoT technology** for toddlers aged 24-30 months, which is the naming explosion period (Lenneberg, 2016).

Robot + IoT-based Toy



2. As studies have pointed out that play is essential to toddlers through play (Goodson & Greenfield, 1975; Mueller & Brenner, 1977; Fien, 1979), **it is proposed that the immersive multilingual environment be implemented in a play scenario at home.**

As children play with their toys, the robot plays the role of a companion, providing linguistic feedback as a parents would do, but in a new language.



Scope

- Age :24-30, naming explosion period (Lenneberg, 2016).
- Scenarios: researcher summarized 11 categories of family activities serving as children's learning opportunity (Dunst, Hamby, Trivette, Raab, & Bruder, 2000).

Category	Activities	Category	Activities
1. Family routines	Household chores, cooking, caring for pets...	7. Playing activities	Art activities, playing board games..
2. Parenting routines	Child's bathtime, bedtime, meal times...	8. Entertainment activities	Dancing, listening to music, watching TV...
3. Child routines	Brushing teeth, washing hands, dressing up,...	9. Family rituals	Family talks, religious readings....
4. Physical play	Riding bike, playing ball...	10. Family celebrations	Holiday dinners, birthdays
5. Literacy activities	Reading books, telling stories, talking walk...	11. Gardening	Planting trees, growing veges...
6. Socialization activities	Family gathering, pinics...		

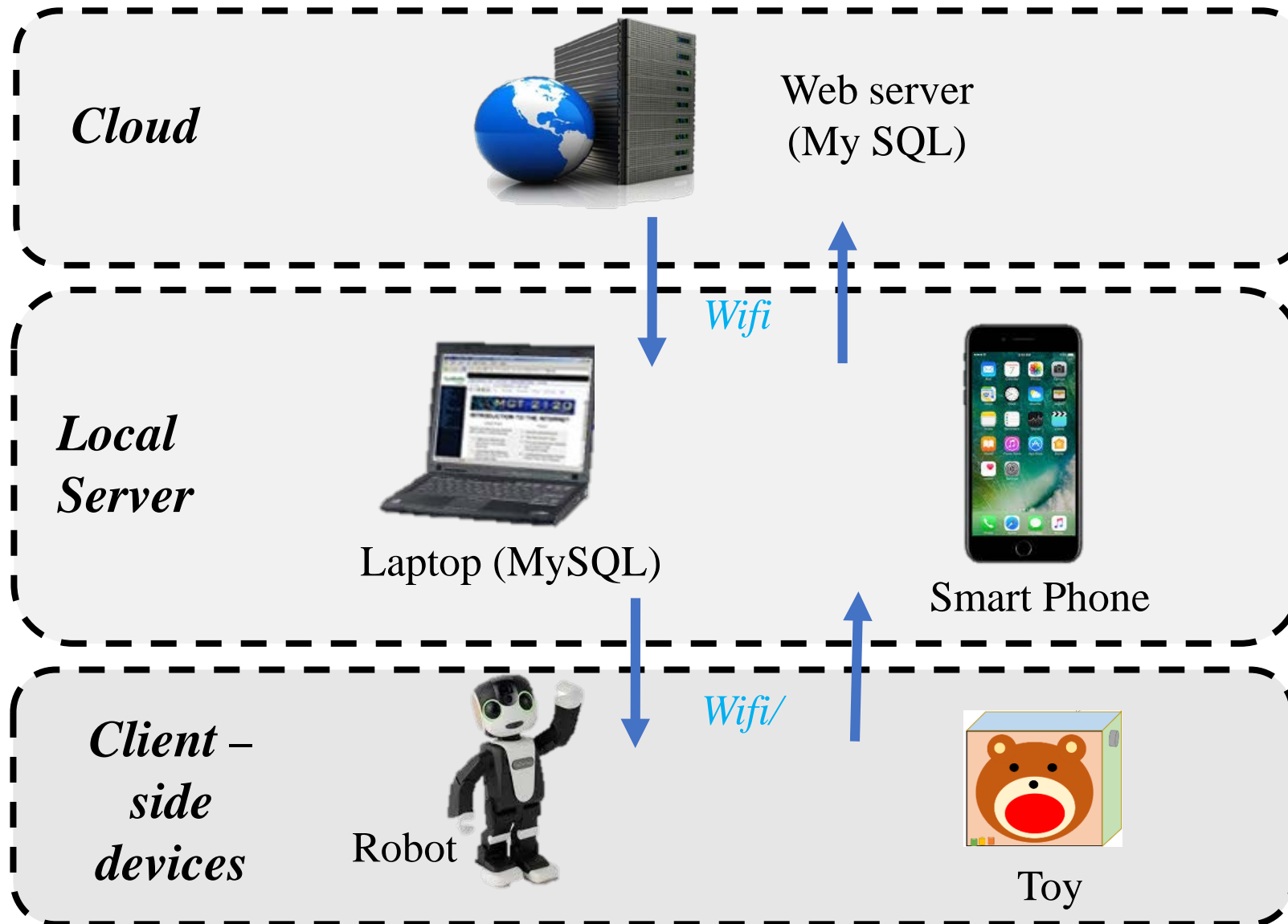
Purpose of this study

1. Develop a context aware robot to provide a language immersion environment.
2. Propose guidelines for future system development.
3. Assess learning performance.

We have developed 3 sets of integrated system of a robot and IoT toys to meet the following educational purposes:

- (1) To enhance early language development for toddlers aged 24-30 months, in a play scenario.
- (2) To offer an immersive multilingual environment by integrating robots and IoT technology, which enables the robot to be context aware so as to provide meaningful language learning content and feedback to the learner.
- (3) To develop an easy-to-use programmable script editor for educators to specify the interactions between the robot and IoT toys and to accommodate the need of creating language learning content according to different scenarios and age differences.

We proposed three layers system architecture



Script editing system 1

Cloud Server

Client

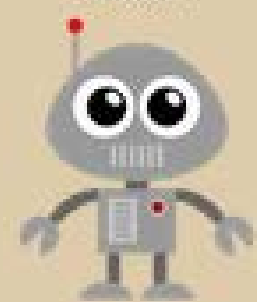
Download

Script Editor.html
&
Content Editor.html

Toy



Robot



Local Server

Download

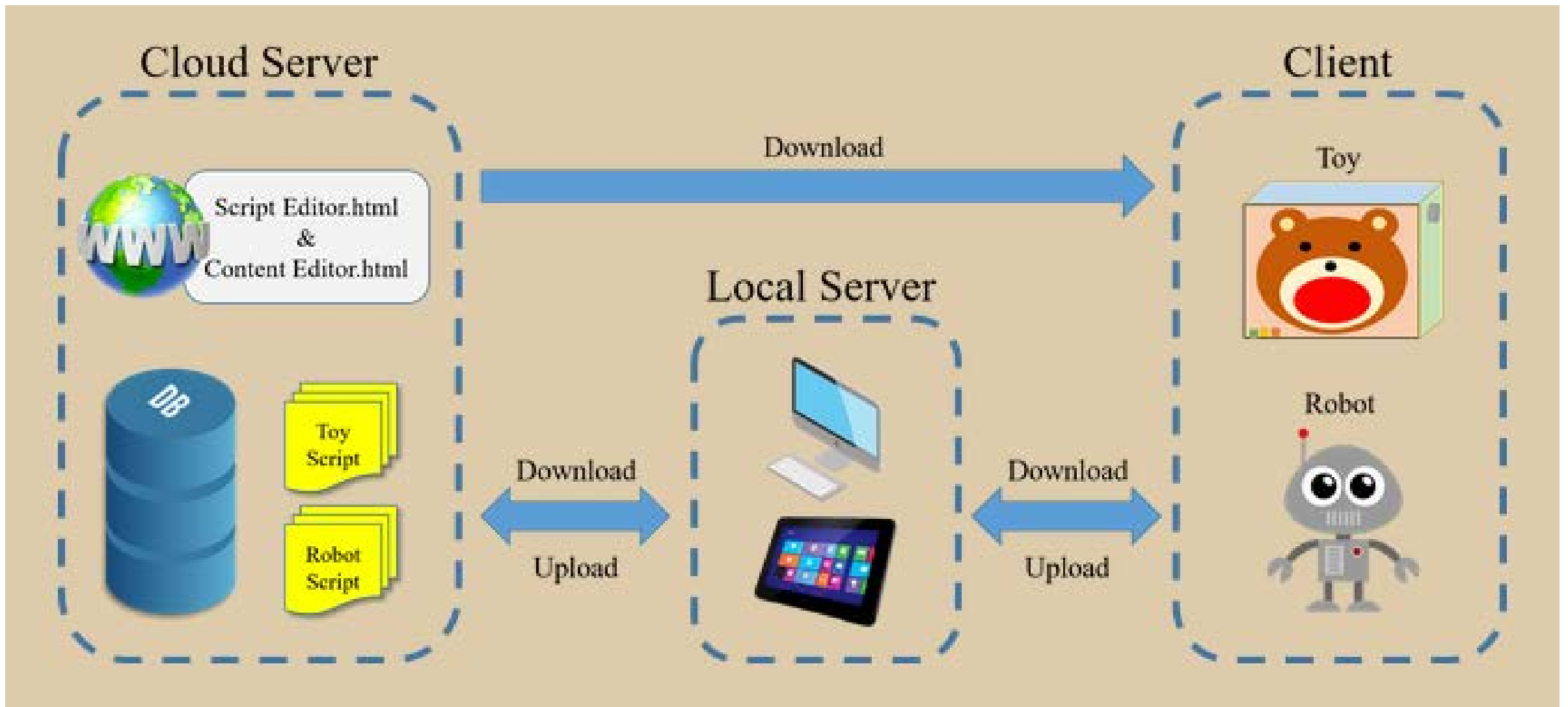
Upload

Download

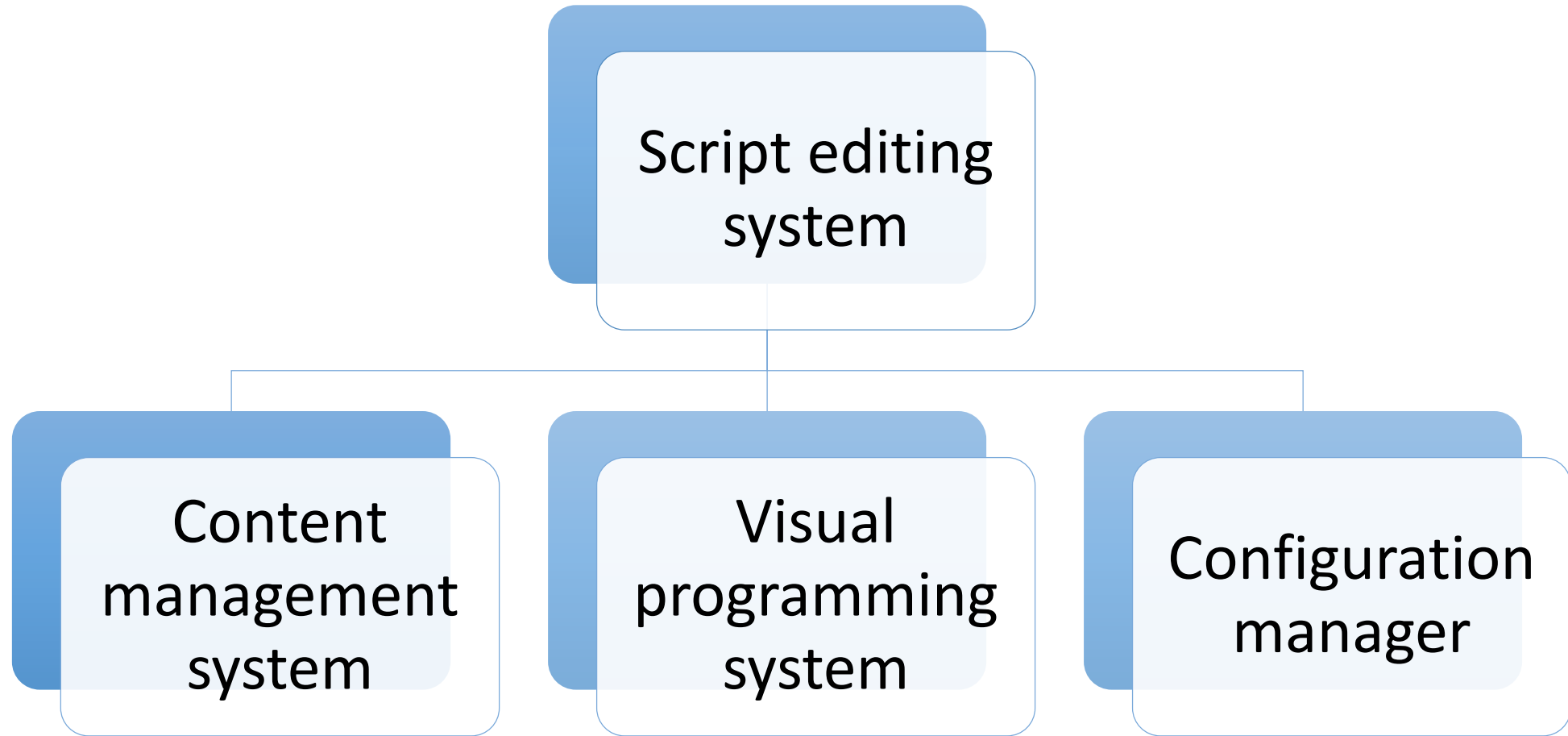
Upload

Toy
Script

Robot
Script



Script editing system



Content management system

素材編輯器

NFC Tag

Music

1

▼

每頁：

10

▼

筆

首頁

上頁

下頁

末頁

Add

Tag UID	Name	
04DBC5FA1C2380	apple	<div>EditDel</div>
0433C6F20D2980	banana	<div>EditDel</div>
047726E29D2980	pineapple	<div>EditDel</div>
0443E6E29D2980	grape	<div>EditDel</div>
04A23332B62880	cat	<div>EditDel</div>
044BDCC2072980	dog	<div>EditDel</div>
04E60672AE4F84	broccoli	<div>EditDel</div>
04E50672AE4F84	potato	<div>EditDel</div>

Visual programming system

The image displays a visual programming system interface with a sidebar on the left and a workspace on the right.

Sidebar (Left):

- 邏輯 (Logic)
- 迴圈 (Loops)
- 運算 (Math)
- 字串 (Strings)
- 清單 (Lists)
- 顏色 (Colors)
- 變數 (Variables)
- 程序 (Scripts)
- 腳本類型 (Script Types)
- NFC讀取器 (NFC Reader)
- 播放音檔 (Play Audio)
- 時間 (Time)
- 裝置溝通 (Device Communication)
- 範例 (Examples)

Workspace (Right):

玩具腳本 (Toy Script):

- play music start.mp3
- 重複 當 真 (Repeat When True)
- 執行 等待讀取NFC卡片 (Execute Wait for NFC Card)
- 如果 讀取到NFC卡片為 04dbc5fa1c2380 - apple (If Read NFC Card is 04dbc5fa1c2380 - apple)
- 執行 say " apple " (Execute say " apple ")
- 傳送 " apple " 到 IP : Your IP (Send " apple " to IP : Your IP)
- 如果 讀取到NFC卡片為 0433c6f20d2980 - banana (If Read NFC Card is 0433c6f20d2980 - banana)
- 執行 say " banana " (Execute say " banana ")
- 傳送 " banana " 到 IP : Your IP (Send " banana " to IP : Your IP)
- 如果 讀取到NFC卡片為 047726e29d2980 - pineapple (If Read NFC Card is 047726e29d2980 - pineapple)
- 執行 say " pineapple " (Execute say " pineapple ")
- 傳送 " pineapple " 到 IP : Your IP (Send " pineapple " to IP : Your IP)
- 結束 (End)

機器人腳本 (Robot Script):

- 本裝置 IP : Your IP (This Device IP : Your IP)
- 如果接收到 " apple " 則執行 say " this is apple. " (If Received " apple " then Execute say " this is apple. ")
- 如果接收到 " banana " 則執行 say " this is banana. " (If Received " banana " then Execute say " this is banana. ")
- 如果接收到 " pineapple " 則執行 say " this is pineapple. " (If Received " pineapple " then Execute say " this is pineapple. ")
- 結束 (End)

Configuration manager

管理介面

Script	Toy Wi-Fi	Robot Wi-Fi	
--------	-----------	-------------	--

Wi-Fi settings

SSID:

Password:

Demo

<https://www.youtube.com/watch?v=jSzRV3L1sqo&feature=youtu.be>

Script editing system 2

母語學習機器人編輯器

內容編輯器

遊戲腳本編輯器

系統設定

遊戲腳本編輯器

名稱
basic learning 進階版

編輯介面類型
Windows Form

編輯介面來源
匯入...

描述
basic learning 進階版

解譯器
...

版本編號
1 . 0 . 0

創作者
Able

建立
刪除

修改
上架

ID	名稱	描述	版本編號	更新日期	創作者
s2017110800...	基本語彙學習	讓幼兒透過觸碰圖卡的方式認識生活中各式各樣的物品與母...	1.0.1	2017/11/08	Able
s2017110921...	basic learning 進階版	basic learning 進階版	1.0.0	2017/11/09	Able

單鍵觸碰
複合鍵觸碰

觸碰感測ID
1

玩具
機器人

新增回應的內容

ID	名稱	類型	描述	檔案格式	大小	時間長度
c201711042048...	cake	voice	cake	MP3	2 KB	00:00:01
c201711042055...	cake2	voice	I like to eat cakes.	MP3	7 KB	00:00:01
c201711042056...	candle	voice	candle	MP3	3 KB	00:00:01
c201711042057...	candle2	voice	There are five candles.	MP3	6 KB	00:00:01
c201711042059...	opening	voice	Welcome back to basic vocabulary learning.	MP3	12 KB	00:00:01
c201711091924...	Ten Little Indian Boys	music	Ten Little Indian Boys	MP3	1,525 KB	00:00:39
c201711092139...	sing	voice	Let's sing together	MP3	5 KB	00:00:01

+
新增

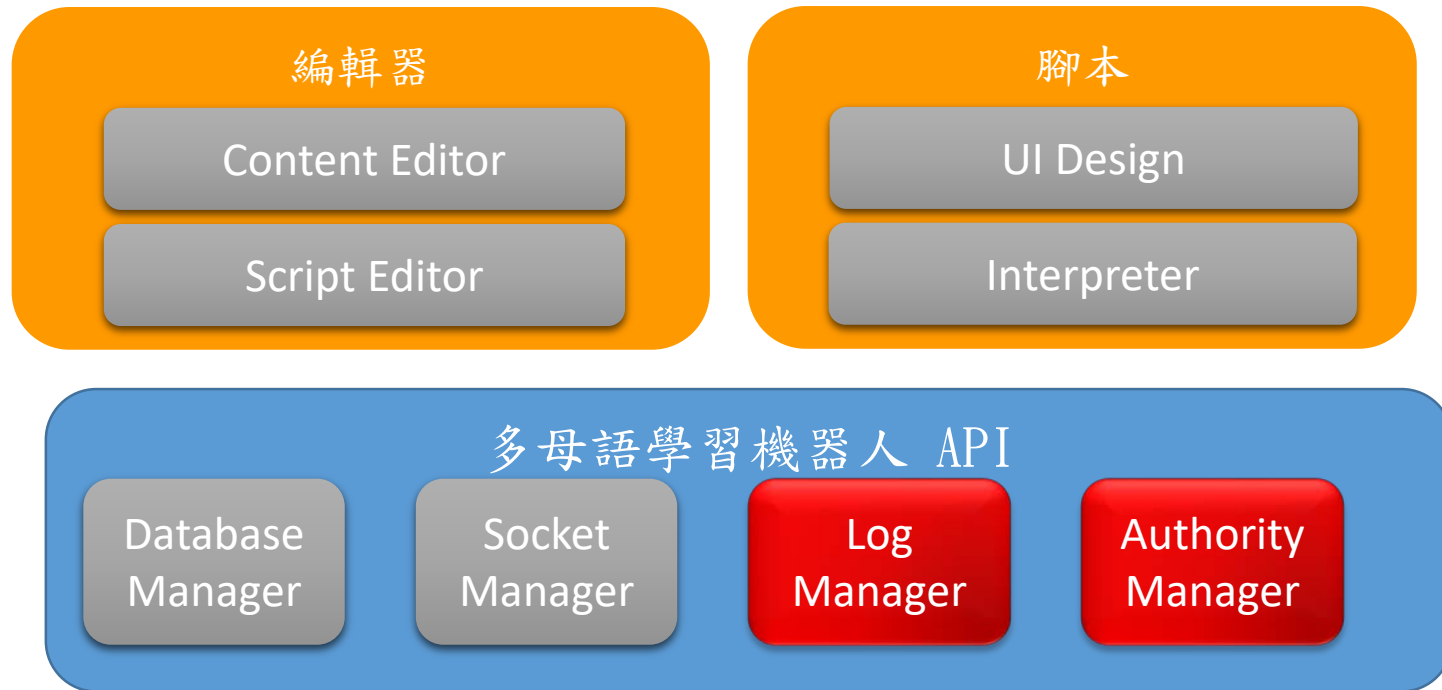
觸碰順序	內容 ID	內容名稱	內容類型	內容描述	檔案格式	大小	時間長度
1	c201711042048...	cake	voice	cake	MP3	2 KB	00:00:01
2	c201711042055...	cake2	voice	I like to eat cakes.	MP3	7 KB	00:00:01

儲存

影片網址






<https://www.youtube.com/watch?v=nLOS9HC8fvM&feature=youtu.be>

Software architecture



Script editing system 3

Form1



Content Editor

Content Voice

Refresh Select All Edit Delete

				CATEGORY	NAME
1	<input type="checkbox"/>	Edit	Del	FRUIT	APPLE
2	<input type="checkbox"/>	Edit	Del	FRUIT	BANANA
3	<input type="checkbox"/>	Edit	Del	FRUIT	MONGO
4	<input type="checkbox"/>	Edit	Del	FRUIT	LEMON
5	<input type="checkbox"/>	Edit	Del	FRUIT	PINEAPPLE
6	<input type="checkbox"/>	Edit	Del	AIR	AIR

Added Create

Clear

1. Content editor
2. RFID tag editor
3. Script editor
4. Log management
5. Configuration management

Content editor

				VOICE_TYPE	VOICE_NAME	VOICE_DATA
12	<input type="checkbox"/>	Edit	Del	WORD	Gusess_praise	You're awesome, you answered all the ans
13	<input type="checkbox"/>	Edit	Del	MP3	Gusess_endSond	D:\MUSIC\RED1.mp3
14	<input type="checkbox"/>	Edit	Del	WORD	New Create	New Create
15	<input type="checkbox"/>	Edit	Del	MP3	New Create2	D:\MUSIC\RED1.mp3
16	<input type="checkbox"/>	Edit	Del	WORD	LEMON	LEMON

RFID editor

Sensors Editor

Card

				UID_1	UID_2	UID_3	UID_4	CATEGORY	NAME
▶ 1	<input type="checkbox"/>	Edit	Del	97	180	128	203	FRUIT	APPLE
2	<input type="checkbox"/>	Edit	Del	39	255	137	171	FRUIT	BANANA
3	<input type="checkbox"/>	Edit	Del	243	54	135	217	FRUIT	MONGO

Script editor

Script : Guess Game ▾

Refresh

Select All

Edit


Delete

				SEQ	EVENT	
▶ 1	<input checked="" type="checkbox"/>	Edit	Del	1	Guess_welcome	▾
2	<input type="checkbox"/>	Edit	Del	2	Guess_start	▾
3	<input type="checkbox"/>	Edit	Del	3	Guess_WantApple	▾
4	<input type="checkbox"/>	Edit	Del	4	Guess_GetApple	▾

Log management

Device SN : 00000000a46ad500| Category : ▾

Script ID : Start Date : 2018年 3月11日 ▾ End Date : 2018年 3月11日 ▾

Query

	DEVICE_SN	DEVICE_NAME	SCRIPT_ID	SCRIPT_NAME	SEQ	CATEGORY	FIEL ^
	00000000ccc2a517	00000000cc...	1	Default	1	ChangeScript	1
	00000000ccc2a517	00000000cc...	1	Default	1	GetScriptData	
▶	00000000a46ad500	MyToy	15	Demo3	2	GetScriptData	
	00000000a46ad500	MyToy	15	Demo3	2	ChangeScri...	15
	00000000a46ad500	MyToy	15	Demo3	3	Timeout	1
	00000000a46ad500	MyToy	15	Demo3	3	ChangeScri...	15

We have designed 3 toys by using 3 types of sensors



1. NFC reader and tags



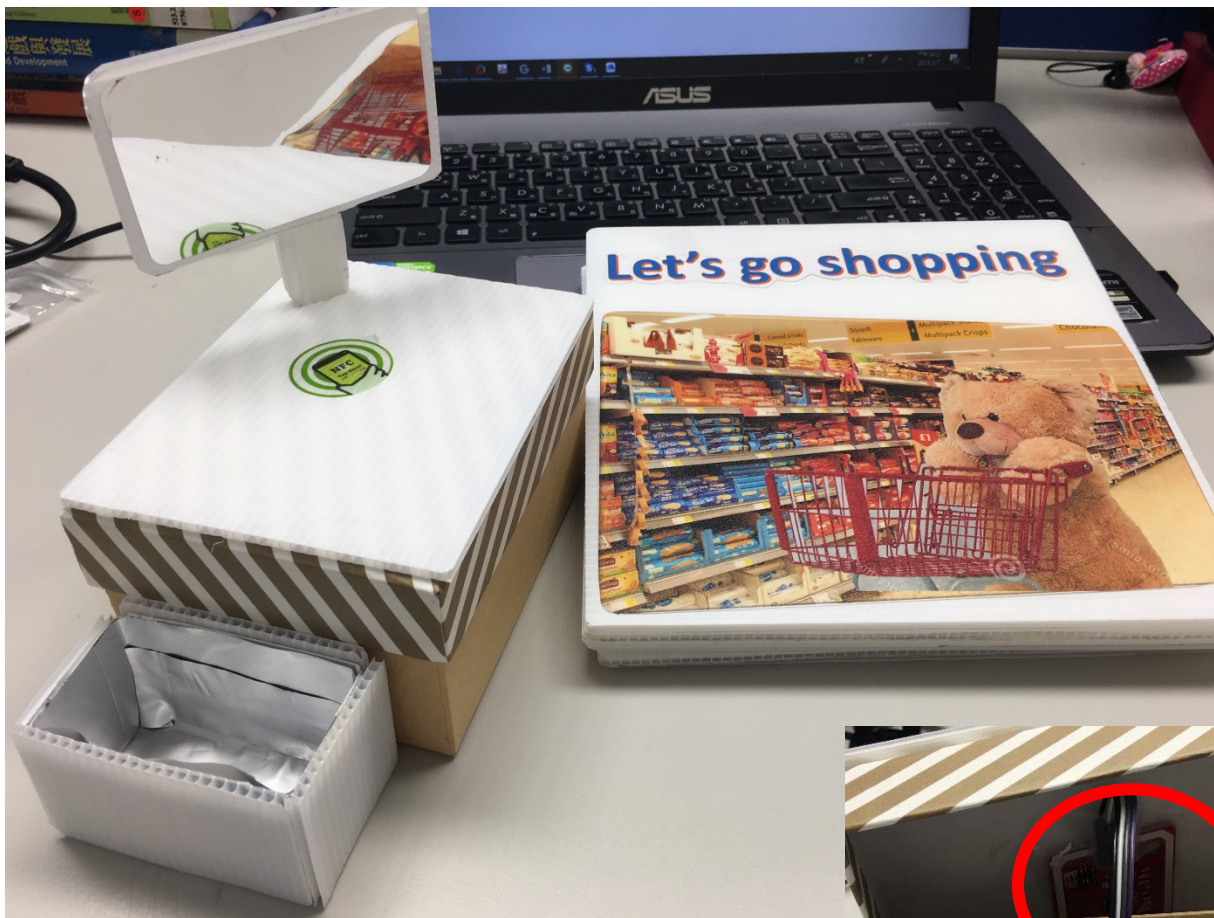
2. Touch sensors



3. RFID reader and tags

1. NFC reader and tags

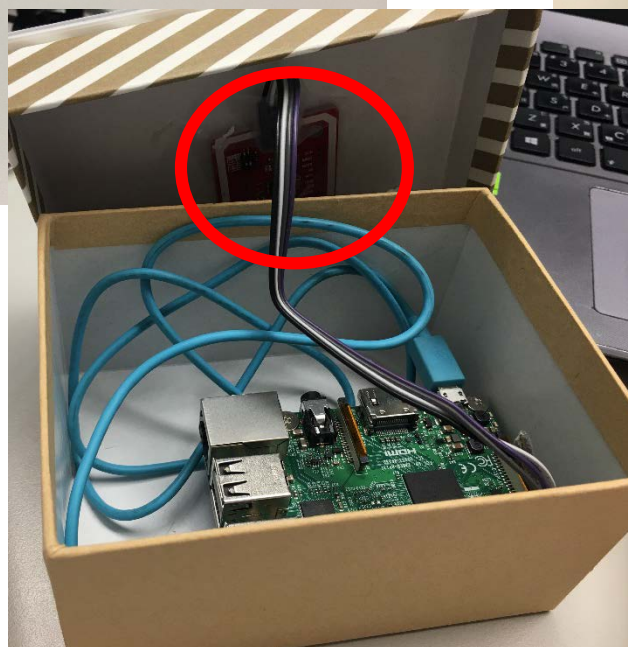




新的腳本是以去超級市場購物為主題。整套玩具包括一本書、一個收銀機以及一個購物籃。



樹梅派，可以從盒子的旁邊直接開關玩具。



NFC reader放在盒子的蓋子內部，當作收銀機的讀卡機



一本書的形狀，可以打開，
共四個頁面。

每一個商品都是獨立的NFC tag，貨
架上也有標商品的名稱以及價格

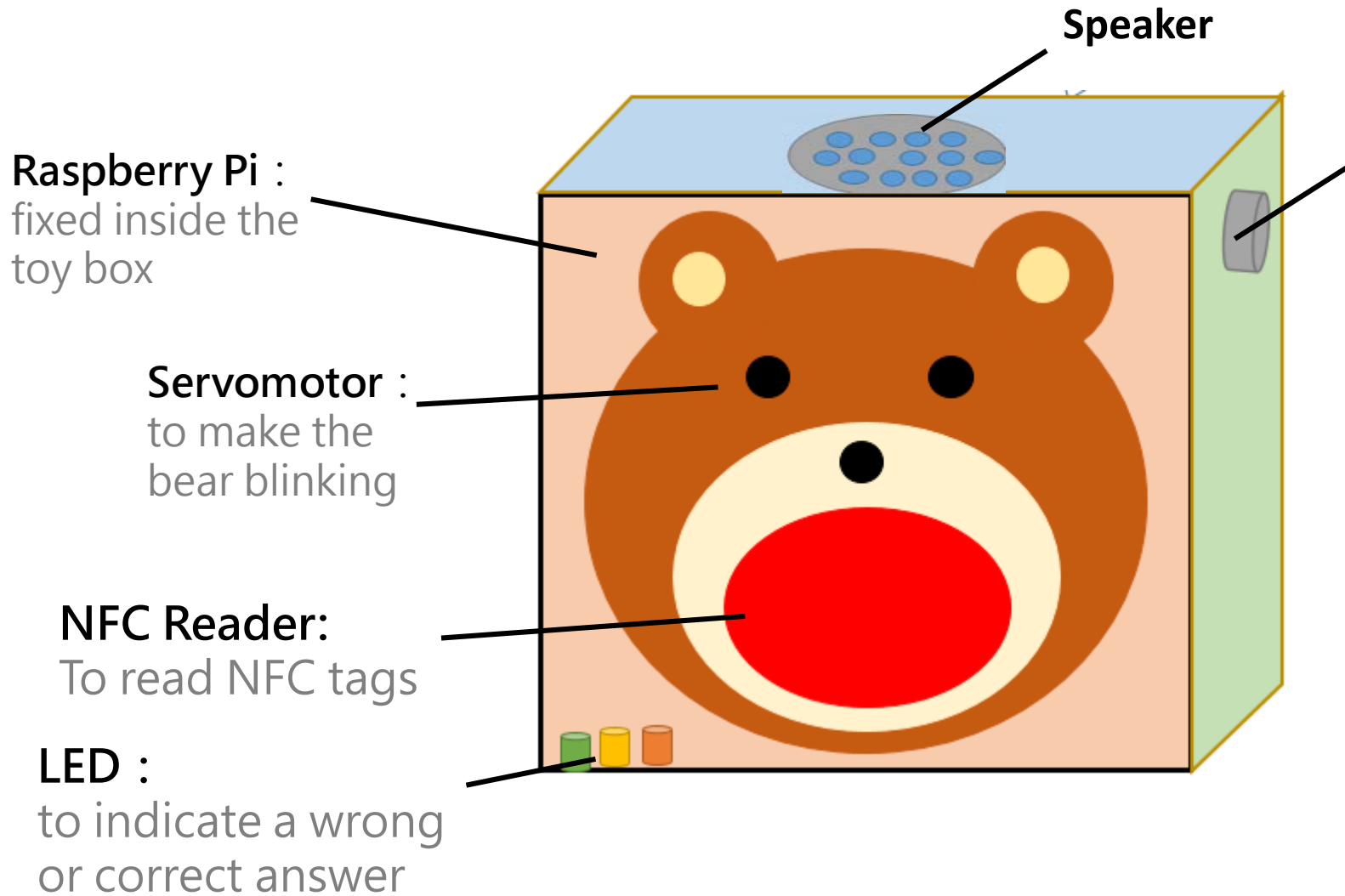


餅乾、早餐以及生活用品、玩具、蔬果

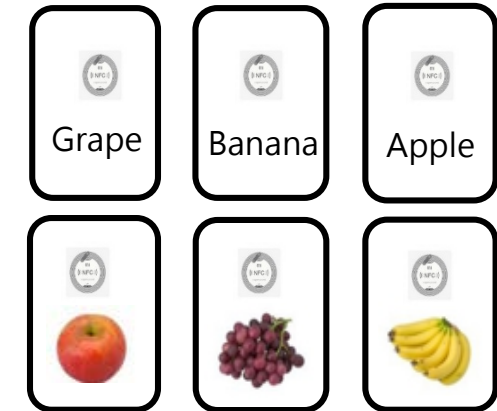


Background。有商品原始圖當背景，讓小朋友玩完玩具以後，可以把圖卡歸回原處。

NFC tag 圖卡，可移動抽取



Power switch



**Cards with NFC
Tag**

Devices and sensors

Device & sensor	Function	Cost (NT)
Raspberry Pi 3 Model B	Computing	\$1800
Lipo Battery Shield	Power supply	\$480
PN532 NFC Module V3	Read NFC Tag	\$400
NFC Tag	Carry the learning content	\$50 /tag
SG90 Servo Motor	Control	\$100
LED	To indicate a correct or a wrong answer	\$3
Bluetooth Speaker	Speaker	\$300

Interaction Design(1/2)

Level 1. from vocabulary to sentence

Trigger	Output
Frist time reads the card	Reads the vocabulary, e.g., “apple”
The second time	Reads a sentence, e.g., “This is an apple.”
The third time	Reads a complex sentence, e.g., “Apple is sweet and sour.”
The fourth time	Play music

Interaction Design(2/2)

Level 2. Quiz

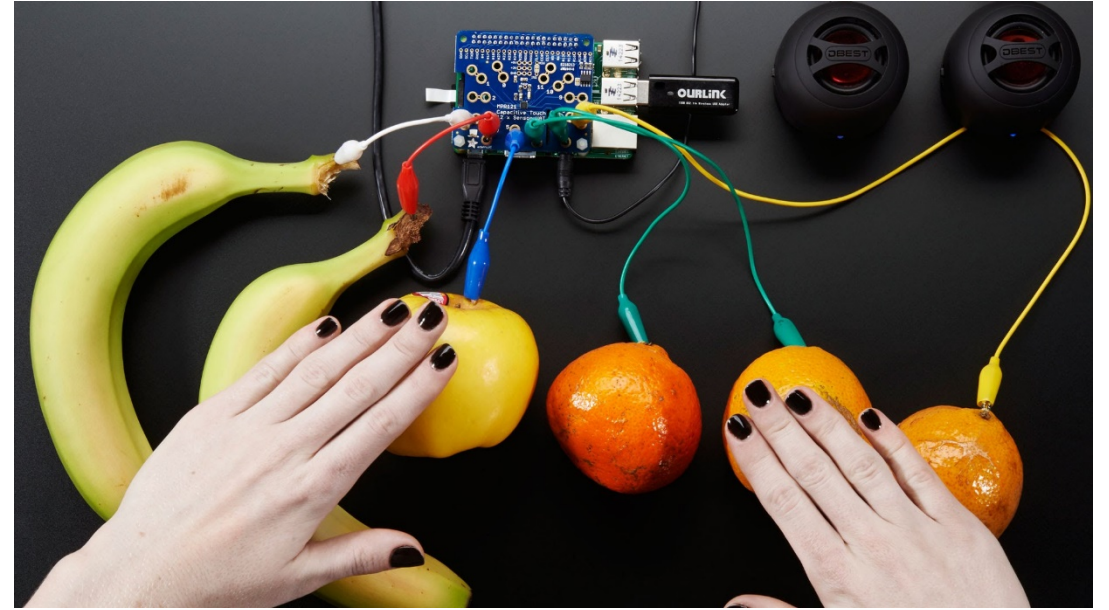
Trigger	Output
Reads the card	Asks questions, e.g., “which one is apple”
	Reply to the answer, e.g., “correct! You are great!”/ “No, this is not an apple, try again.”

Demo

- Video 1 : interaction design, level 1 & 2

URL : <https://youtu.be/PPdsKb1p3FM>

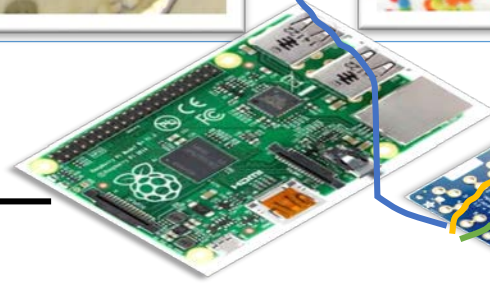
2. Touch sensors



**A picture of a cake,
With a touch sensor
on the back**



Raspberry Pi



Touch sensor board



Learning content

Learn vocabularies by themes
Theme: birthday party

- ✓ 蛋糕 (Cake)
- ✓ 蠟燭 (Candle)
- ✓ 生日快樂帽 (Hat)
- ✓ 禮物 (Gift)
- ✓ 生日快樂歌 (Happy birthday song)



Interaction design (1/2)

Leve I. Learn vocabularies and sentences by touching the sensors

simple
↓
complex

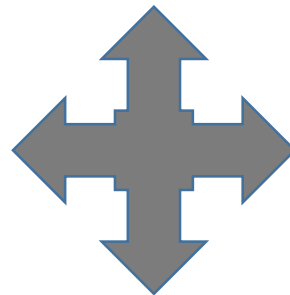
Trigger	Output
Touch the sensor 1 time	Toy box reads the vocabulary, such as “cake”
2 times	Toy box reads a sentence
3 times	Reads another sentence
When all the sensors have been touched	Play “happy birthday song”



Interaction Design (2/2)

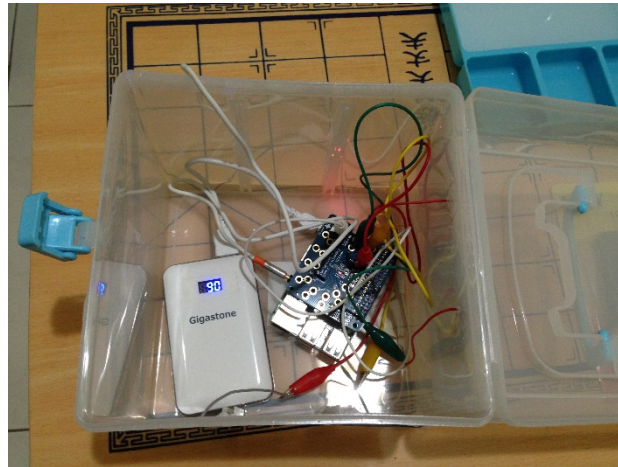
Leve 2. quiz

Trigger	Output
Touch the picture	The toy box asks a question: where is the xxx?
When kids touch the right picture	「Bingo! You are great」
When kids touch a wrong picture	「No, try again」
Got the right answers for 4 times	Play “happy birthday song”



Demo

<https://www.youtube.com/watch?v=6z1PrA2EfBU>



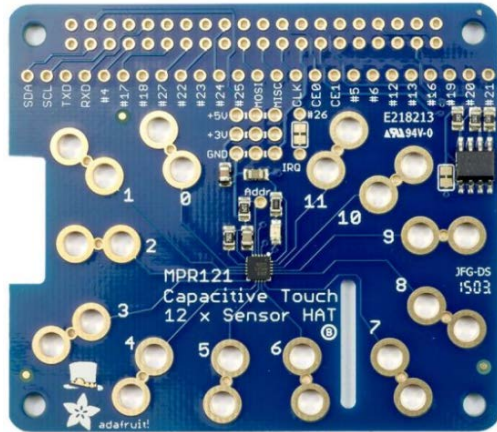
Video 1 : basic level

<https://www.youtube.com/watch?v=SOwWdDG8bPc>

Video 2: quiz

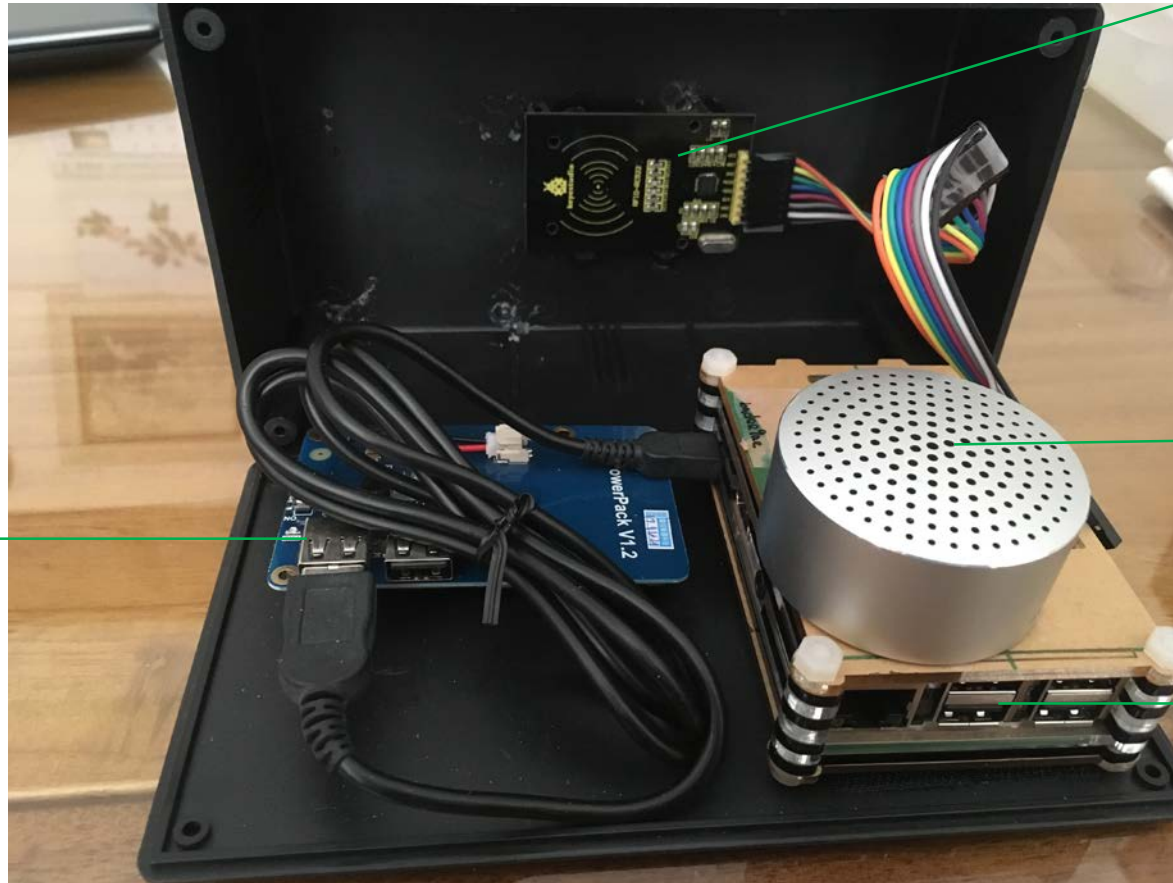
https://www.youtube.com/watch?v=gDp0b-_sHiU

Touch sensor



Name	Adafruit MPR121 Touch Sensor 12x電容式觸控擴展板
introduction	This touch-able add on HAT for Raspberry Pi will inspire your next interactive project with 12 capacitive touch sensors. Capacitive touch sensing works by detecting when a person (or animal) has touched one of the sensor electrodes. Capacitive touch sensing used for stuff like touch-reactive tablets and phones, as well as control panels for appliances, which is where you may have used it before. This HAT allows you to create electronics that can react to human touch, with up to 12 individual sensors.
Size and other information	<ul style="list-style-type: none">• 57mm x 65mm x 3mm / 2.2" x 2.6" x 0.1"• Weight: 10g
Price(US dollar)	\$14.95

3. RFID reader and tags



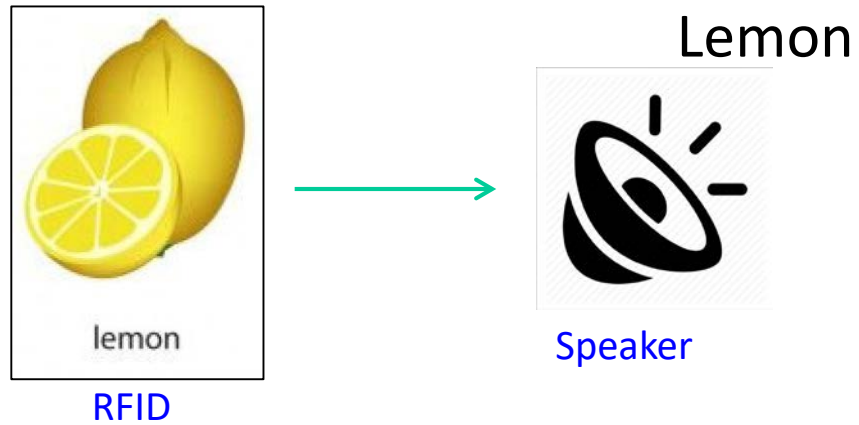
RC522 RFID Module

Speaker

Raspberry Pi

電源

1. Read vocabularies

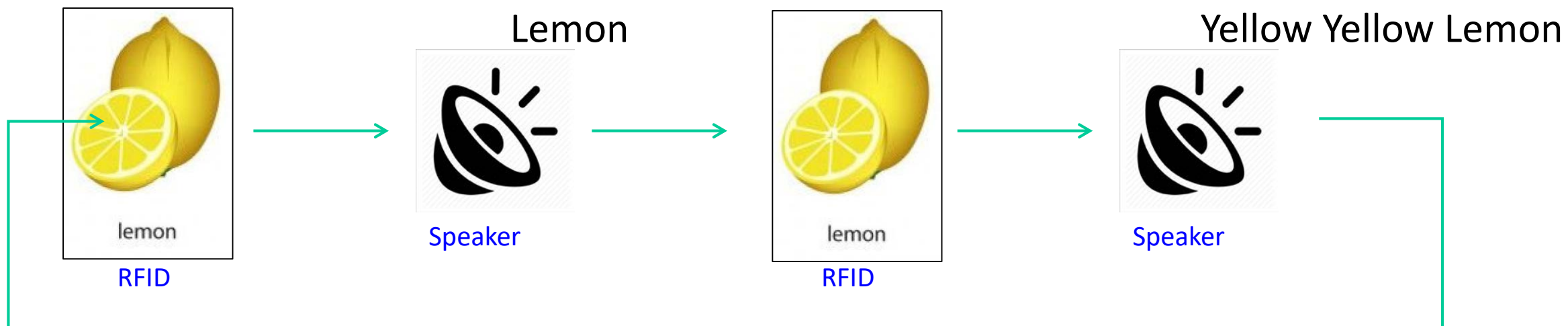


<https://www.youtube.com/watch?v=6eemTowEFZw>

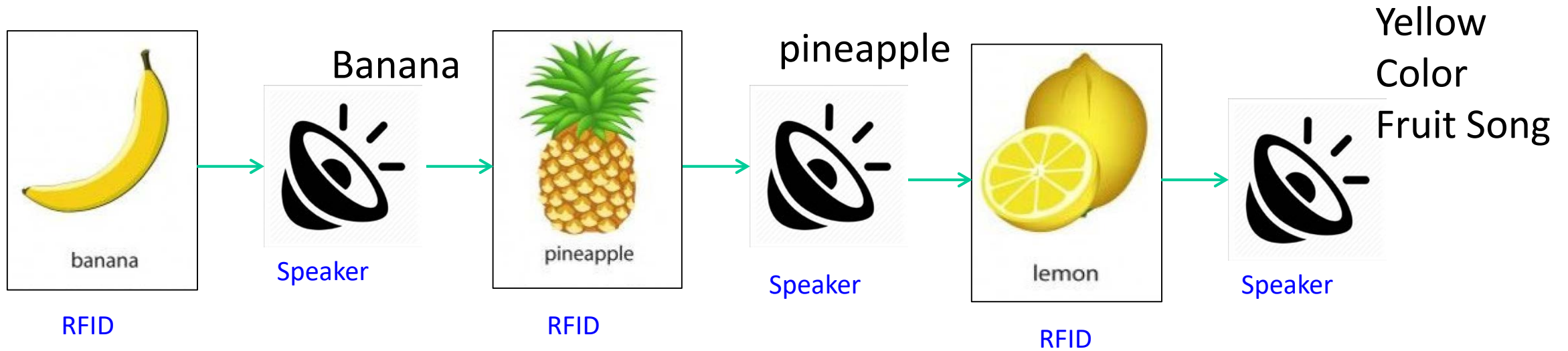


2. Read a same card for the second time

<https://www.youtube.com/watch?v=3C6V3FZmyXk>



3. Play music



<https://www.youtube.com/watch?v=yrsdnN0yXb4>

Components	Function	Price(NT)
Raspberry Pi 3 Model B	Data and logic processing , Database Server	1200
RC522 RFID module	RFID Reader	150
RFID Mifare 13.56MHz	Provide UID	15
Bluetooth Speaker	Voice Player	395
PiBorg BattBorg	DC to DC Converter	450
8xAA battery packs (Contains the battery)	Power	100



Robot is under designing



Components
Raspberry Pi 3 Model B
Bluetooth Speaker
Logit Web camera (with microphone)
External battery for Pi
7 inch digital display for Pi
Power bank

Thank you for listening!


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搜尋

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觀看次數：45

影片管理員







多母語學習機器人

Educational Robot for Multi Native Language Acquisition

以下列身分查看：您本人



 訂閱

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影片

播放清單

頻道

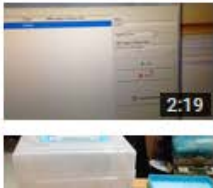

討論

簡介

回訪的訂閱者

新訪客

接下來請看



Touch sensor - interaction editor-version 1 using MangoDB

頻道建立者：Educational Robot for Multi Native Language Acquisition

觀看次數：0 1 週前

Touch sensor - interaction level 1- touch and learn

精選頻道

+ 新增頻道

YouTube 熱門頻道

