ELEC 3300
Project Information Tutorial

Department of Electronic and Computer Engineering

HKUST

by WU Chi Hang

Project Requirement

- In order to align with what you learnt from the course, you are assumed to use the STM32 board provided.

- If you need to use other brand of microcontroller, you need to provide justification why the existing board cannot suit your project purpose.

- The system should mainly controlled by one controller. If in case you have more than one controller, you need to tell us which controller we should focus on.

Project Grading

- Please refer to Course Description lecture notes page 5. All marks are % of total course mark
  - Peer Discussion (4%)
  - Proposal Presentation (6%)
  - Project Interim demo (9%)
  - Project Demo + PPT Presentation (40%)
  - Report (5%)
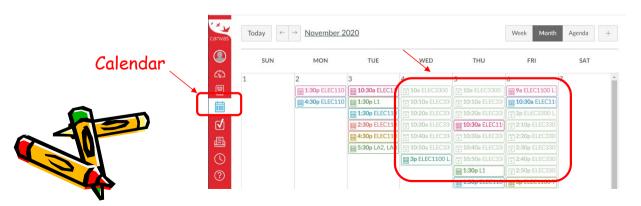 - Peer Evaluation

About Final Demo

- In the final demo, a grading team with NOT LESS THAN 5 persons will use the rubric to grade your project (As what you have done in Peer Discussion Class)
- Your project mark will be Max(Avg 5, Avg 3)
  - Avg 5 – average of the 5 markers
  - Avg 3 – average of the middle 3 markers (i.e. excluding the max and min of the 5 markers)
- We will release the Avg 5 and Avg 3 to you after the demo.

LAB Opening Hour

- There will be sometime slots assigned for you to exchange/borrow things from the LAB.
- The TO will be in Room 3115 **at hours listed in Canvas Appointments.**
- **Please make appointment on Canvas before you come to the LAB**
- **Please keep social distance when you come to the LAB.**

Calendar

Project Expense

- Each **STUDENT** can at most claim ****HKD120** for project expense.
- The reimbursement will be done on the final demonstration date.

IMPORTANT
- You need to submit formal receipts for reimbursement.
- Please be reminded that you need to ask for receipts when you order goods (no matter it is online or by cash)
- Bank statement , delivery notes or web printout will not be accepted by university.

Sample Receipt from Taobao Merchants

Project Expense

- You are REQUIRED to buy your own components / things to build your project.
- If you have urgent need for the components, you can get some components from the lab. See the component list in the course page.
- The cost of components will be deducted from your project money (HKD120/person).

Project Sponsor

- RS Components will support $100/student. (differs from $120/student) from Department.
- If you want to use this part of money, you need to send email to me and I will place order every Friday.
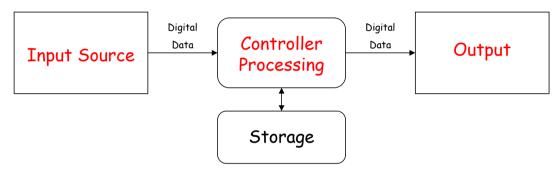
- http://hken.rs-online.com/web/

Logic Levels

- The STM32 is using 3.3V as a Logic High and 0V as Logic Low.
- So, if you want interface with other devices, please note the voltage level.
- We recommend that you are using 3.3V compatable ICs.
- Note that the 74 Series IC that you are using in ELEC1100, those are operated at 5V. In that case, please note the difference in the logic level if it would affect the output/input.

Overview of a Controller System

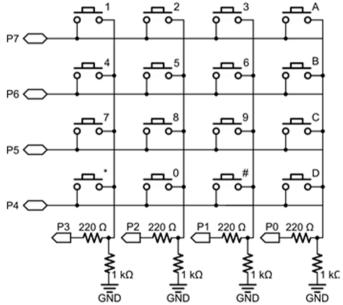| Input Source		Controller Processing		Output
	Digital Data →		Digital Data →	

Storage

You can think that the job of a controller is to process the data from the input and sent to the output. Meanwhile, the controller may need to store the intermediate information.

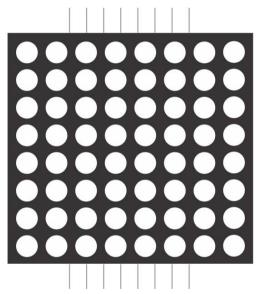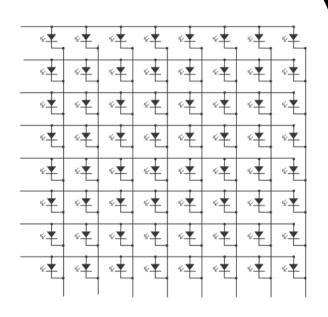What are the typical basic input and output?

Input - Key Pad
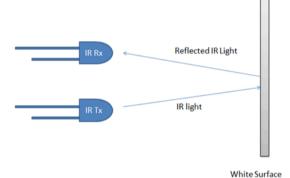
Output - LED Matrix

I/O – Infra Red

IR Rx

Reflected IR Light

IR Tx

IR light

White Surface

Overview of a Controller System

| Input Source | → Digital Data → | Controller Processing | → Digital Data → | Output |

Storage ↕ Controller Processing
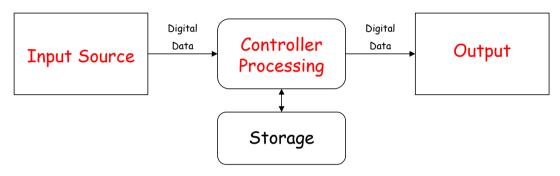
How about input source is and digital image ?
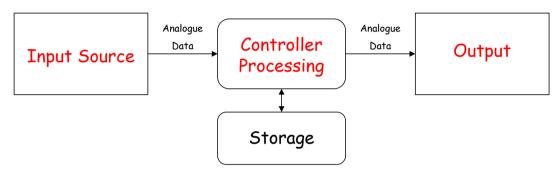
Image

- Consider a 1024 x 768 pixels image, what would be the data size if each pixel is in
  - black and white ? (98,304 bytes)
  - 256-level grey scale ? (786,432 bytes)
  - 24-bit true color ? (2,359,296 bytes)
  - 32-bit true color ? (3,145,728 bytes)
- Can you figure out how you can calculate those data ?

Overview of a Controller System

Input Source		Controller Processing		Output

Analogue Data → Controller Processing → Analogue Data → Output

Storage

What happen if the input source is a sound ?
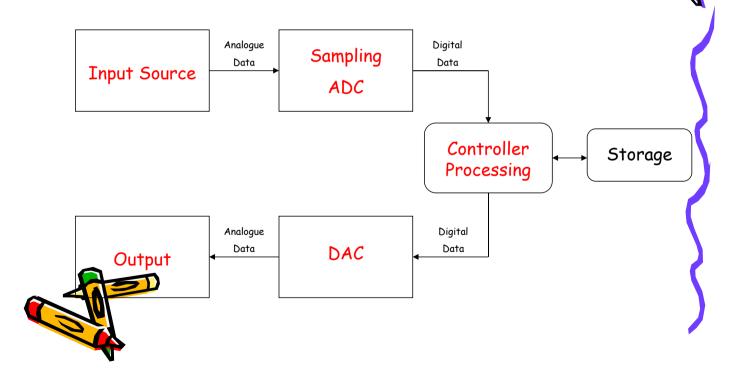
Can the controller process and analogue data ?

Sound

- Sound is originally an analogue signal, what process you need to make the signal digital ?
- Sampling means how fast we take a data (sample).
- Remember from LAB5
- What is the hearing frequency range of human ?
- How does it related to the sampling process ?

Overview of a Basic System

If the input analogue signal, the system will becomes

Input Source	→Analogue Data→	Sampling ADC

Input Source →Analogue Data→ Sampling ADC →Digital Data→ Controller Processing ↔ Storage

Controller Processing →Digital Data→ DAC →Analogue Data→ Output

Sound
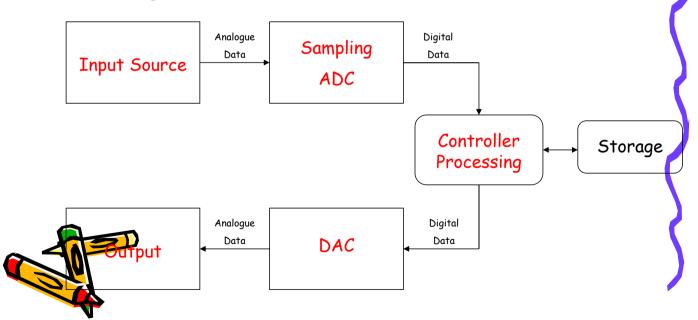
- The quality of sound is based on different sampling frequencies.
- Normal human voice conversation is sampled at mono, 8-bit, 8kHz
- CD is sampled at stereo, 16-bit, 44.1kHz
- Consider a 3 minutes of sound, what would be the data size if it is sampled at
  - Normal human voice conversation ? (1440k bytes)
  - CD quality ? (31M bytes)
- Can you figure out how you can calculate those data ?
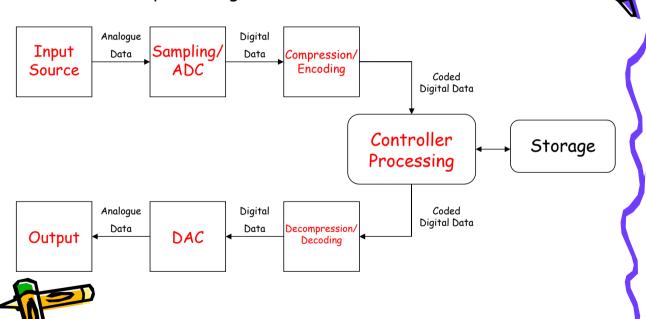
Overview of a Controller System

At this point, we are talking about a RAW data of input.

If we want high quality source, what happened to the amount of data/storage ?

	Analogue Data	Sampling ADC	Digital Data	
Input Source	→	Sampling ADC		

```
Input Source  --Analogue Data-->  Sampling ADC  --Digital Data-->  Controller Processing  <-->  Storage

Output  <--Analogue Data--  DAC  <--Digital Data--  Controller Processing
```

Overview of a Controller System

We can do some processing in order to make the size of data smaller.

Input Source	→ Analogue Data →	Sampling/ADC	→ Digital Data →	Compression/Encoding

Coded Digital Data ↓

Controller Processing	↔	Storage

Coded Digital Data ↓

Output	← Analogue Data ←	DAC	← Digital Data ←	Decompression/Decoding

Image

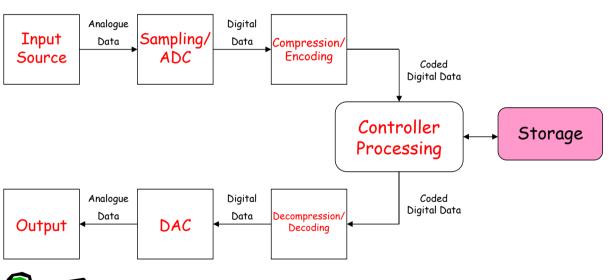- Common file format for image are:
- BMP, JPG, PNG, GIF

Sound Format

- Common file format for sound are:
- WAV, MP3, AAC

Overview of a Controller System

Now we need to understand about the storage part

| Input Source | → Analogue Data → | Sampling/ADC | → Digital Data → | Compression/Encoding |

Compression/Encoding → Coded Digital Data → Controller Processing ↔ Storage

Controller Processing → Coded Digital Data → Decompression/Decoding → Digital Data → DAC → Analogue Data → Output

Storage

- The controller can store the data into any storage like:
  - EEPROM
  - USB Flash
  - SD Card
  - Compact Flash

Storage

- In order to write the data into the storage, the basic thing you need is to know is how to write a byte into the memory by the specified communication protocol.
  - I^2C ← as what you have done in LAB6
  - SDIO
  - SPI ← covered in Lecture

Storage

- In order your storage, especially SD Card, USB Drive to be accessible (read) by your PC, the Storage must have a file system.
  - FAT16/FAT32
  - NTFS
  - exFAT

FAT16/FAT32

- FAT file system is the most common file system in Windows.
  - FAT16 can allow accessing up to 2GB
  - FAT32 can allow accessing up to 2TB
- The basic layout of FAT consists of
  - Boot block
  - File Allocation Table (may have multiple copies)
  - Disk root directory
  - File data area

FAT16/FAT32

- Details for FAT16 can be found here
    - http://www.tavi.co.uk/phobos/fat.html

- Details for FAT32 can be found here
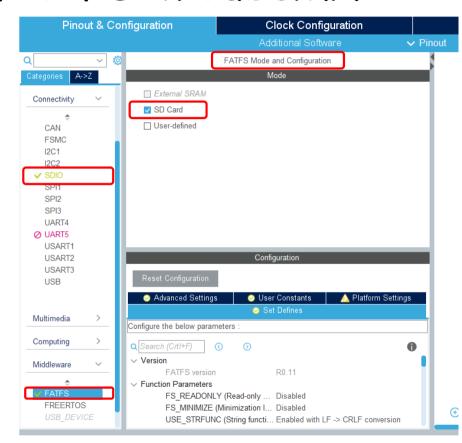   - http://www.pjrc.com/tech/8051/ide/fat32.html

FATFS

- There is a open source middleware to allow STM32 to read a device with FAT File System
- http://elm-chan.org/fsw/ff/00index_e.html
- CubeMX also have imported this into the software
- However, you need to understand how to use the functions by the above link.

FATFS in CubeMX

SDIO FATFS

- Below are two videos that might help

1. STM32F4 Discovery board - Keil 5 IDE with CubeMX: Tutorial 16 SD Card SDIO
   https://www.youtube.com/watch?v=Y5UMTGQDmog

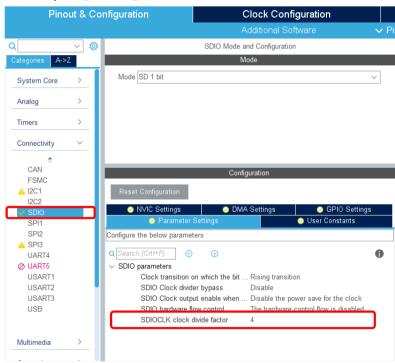2. STM32F4 Discovery board - Keil 5 IDE with CubeMX: Tutorial 22 SD Card SDIO 4 Bits + DMA
   https://www.youtube.com/watch?v=0NbBem8U80Y

SDIO in CubeMX

- If you follow the previous video, please remember to set the parameter of SDIOCLK below
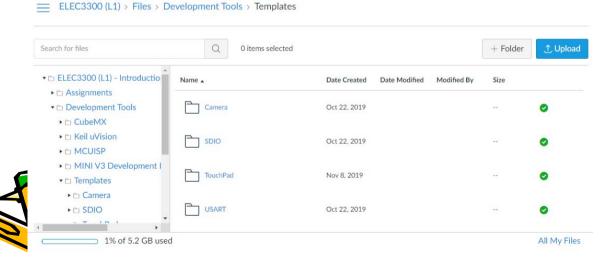
Templates on Canvas

- There are few templates on Canvas for you to test the protocol / device on the STM board.
- The AIM of these templates are for **TESTING ONLY**
- You can use those templates as a starting point, however, if you just use the templates without modifications, it will NOT be counted as your work.
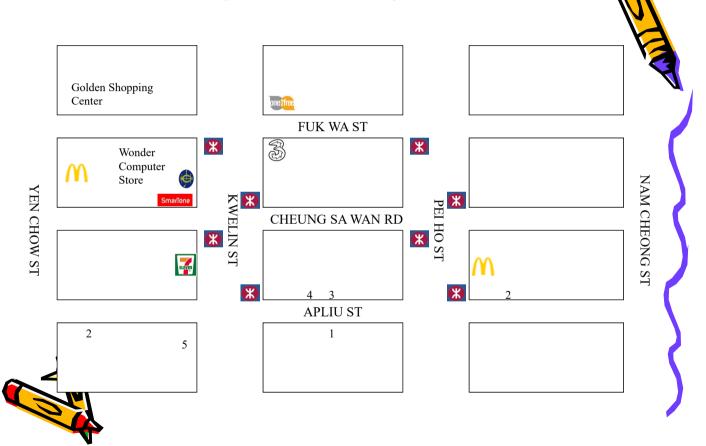
Utilities
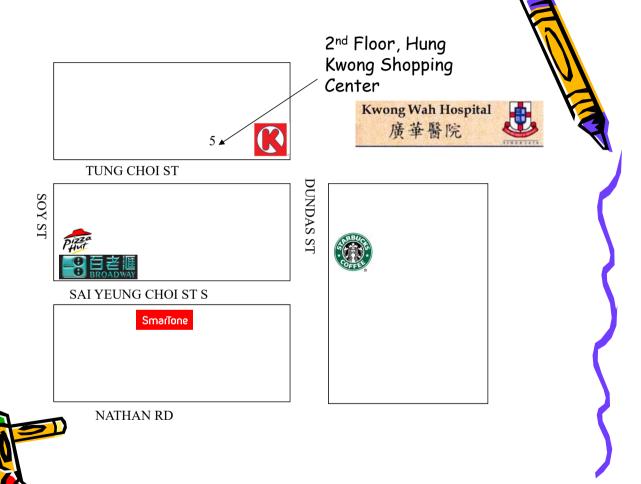
- You may try to use a Hex Editor and Disk Editor to view the file in Hex.
- With the use of Hex Editor, you will be able to view all the bytes in a file and it would be useful for you to understand all the formats.
- A freeware called HxD can be found at
  - http://mh-nexus.de/en/hxd/

Getting Your Components

Golden Shopping Center

FUK WA ST

Wonder Computer Store

CHEUNG SA WAN RD

4　3

APLIU ST

2　　　　5

1

2

YEN CHOW ST

KWELIN ST

PEI HO ST

NAM CHEONG ST

Shop 1: Welfare Electronic Component Ltd http://www.wecl.com.hk/	**Shop 4:** Wing Shun Electronic & Metal Tools Co
Shop 2: Wing Shing Electronic Co.	**Shop 5:** Wo Hing Radio Co. http://www.wohingradio.com.hk/
Shop 3: Cheong Kee Electronic Co.	

2nd Floor, Hung
Kwong Shopping
Center

Kwong Wah Hospital
廣華醫院

5

TUNG CHOI ST

SOY ST

DUNDAS ST

Pizza Hut

百老匯
BROADWAY

SAI YEUNG CHOI ST S

SmarTone

NATHAN RD

IC Master; www.icmaster.com.hk
1/F Efficiency House, 35 Tai Yau Street,
San Po Kong, Hong Kong.
Tel : (852) 2308 1303
Fax : (852) 2397 7055

Yick Tai Radio(HK) Co. Ltd;
http://www.yicktai.com.hk/
Address: Flat F, 10/F. Lladro Centre, 72-80 Hoi Yuen Road, Kwun Tong, Kowloon, Hong Kong
Tel: (852) 2344 8122
Fax: (852) 2345 8855

Getting Your Components

Online method

RS Components	http://hken.rs-online.com/web/
element14	http://hk.element14.com/ (Previously Farnell)
digitkey	https://www.digikey.hk/
LCSC	https://lcsc.com/
Taobao	http://www.taobao.com/index_global.php

Please make sure that you understand the component information when you put your order.

Also, please note that you need to give some time for delivery. (e.g. delivery may be delayed because of 5.1)

Finally...

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