Report

11 June – Monday – Day 1

- Briefing about the overall of the project.
- Introducing to all of the people involving in the project.
- Introducing to the Arduino board.

Arduino UNO Board

SainSmart MEGA Board 2560

- Learn how to solder pieces of wire together.

12 June – Tuesday – Day 2

- Arduino UNO & Arduino MEGA can work with other device.
    - Load Cell – Weighting

SainSmart MEGA Board 2560

        - Connection: needs to use 4 wire and connect it to ADC/Amplifier before connect it to the board.
            - Red – Power 5 V
            - Black – GND
            - Green – Digital output
            - White – System clock

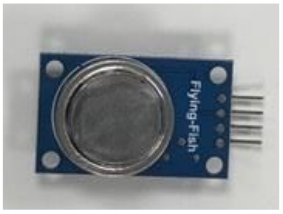
        - This device need additional library “HX711.h” in order to function properly.

    - Ultrasonic – Distance measurement

HC SR04

- Connection: needs 4 wire and doesn't need the ADC/Amplifier.
    - VCC – 5V Power
    - Trig – This pin control the device to send signal, HIGH for sending, and LOW for idle.
    - Echo – By using *pulseIn (echoPin, HIGH)* this pin will determine the duration of the sent signal. And we will use that value to calculate the distance by this equation *distance= duration*0.034/2.*

- Smoke Detection



Flying Fish MQ 135

- Connection: needs 4 wire to connect to a board and doesn't need ADC/Amplifier.
    - VCC – 5V Power
    - GND - Ground
    - DO – Digital Output, this pin either give 1, if there's smoke, or 0, if there's no smoke.
    - AO – Analog Output, this pin output the amount of smoke in the air.

- They can also be connected with multiple device through breadboard.

13 June – Wednesday – Day 3

- A7 Ai Thinker can be used to send SMS to another mobile number but not very reliable.
    - Connection: need to use 4 wires to connect from A7 to Arduino MEGA 2560 board.

A7 Ai Thinker

- URXD – TX3 of MEGA board
- UTXD – RX3 of MEGA board

- 5V – PWR ***we connect the A7 to power socket directly.**
- GND – GND of MEGA board

- The code is as follow

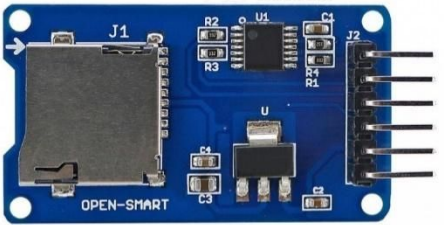
```
Serial.begin(115200);
Serial3.begin(115200);
Serial3.println("AT+CMGF=1");
delay(2000);
Serial3.print("AT+CMGS=\"");
Serial3.print(phone_no);
Serial3.write(0x22);
Serial3.write(0x0D);
Serial3.write(0x0A);
delay(2000);
Serial3.print("Testing A7 SMS");
delay(500);
Serial3.println(char(26));
delay(2000);
```

- Start with AT command to send SMS to a given phone number.
- If the SMS needs to be sent repeatedly, it might cause the board to not sync correctly, and cause the texts to be error.
  - Solved by only begin () the serial when needed to use, and end () when finished transmitting SMS.

- It can also send data collected by other devices connected to the board.
- LoRa32u4 can connect with Serial connection and other devices and communicate reliably.

14 June – Thursday – Day 4

- A7 Ai Thinker's code is changed and optimized to send more reliable SMS.
- Arduino MEGA can now store data in micro SD card and send it via SMS from that same card at later time.
  - Connect MEGA board with the ultrasonic device and GSM as shown earlier.
  - Connect it with micro SD card reader.



Micro SD Card Catalex – Top

Micro SD Card Catalex - Bottom

- Connection: need 5 wires to connect to SainSmart MEGA
  - CS – Pin 53
  - SCK – Pin 52
  - MOSI – Pin 51
  - MISO – Pin 50
  - VCC – 5V
  - GND – GND of MEGA board
  -

SPI	Uno	Mega
SS	10	53
MOSI	11	51
MISO	12	50
SCK	13	52

- In case of connecting to UNO board, the wire need to be like this

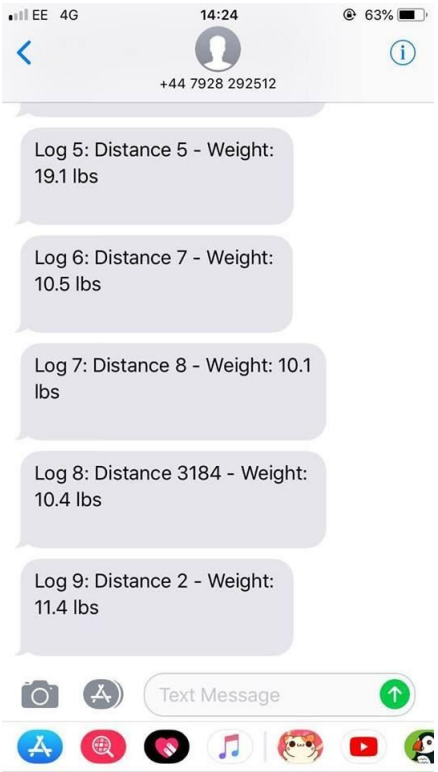
- This code will take all data from the particular file in the micro SD card and store it in the string to be sent later. and/or display on the monitor

```
file = SD.open(fileNameRead, FILE_READ);
while(file.available()){
  char nChar = file.read();
  if (nChar == '\n') totalLog += '\n';
  else totalLog += nChar;
}
file.close();
Serial.println(totalLog);
```

- LoRa32u4 doesn't work like yesterday, it failed to upload to the board.
  - The COM Port keep changing when we tried to upload new code to the board
  - It needs to be manually enter bootloader by double press the RST button after we hit the upload button.
  - New solution can work, but needs a lot of time

15 June – Friday – Day 5

- When setting pin for LoRa32u4, the setPins() the parameter needs to be 8, 9, 2, rather than 1, 9, 2 because the default setPins for LoRa is 1, 9, 2. But we're using other board that use 8, 9, 2 configuration. Now it can run and initialize.
- With 2 LoRa, it can now send data between 2 devices.
- Using A7 with MEGA board and it can continuously send SMS containing data read from other device for hours every 10 minutes without error.

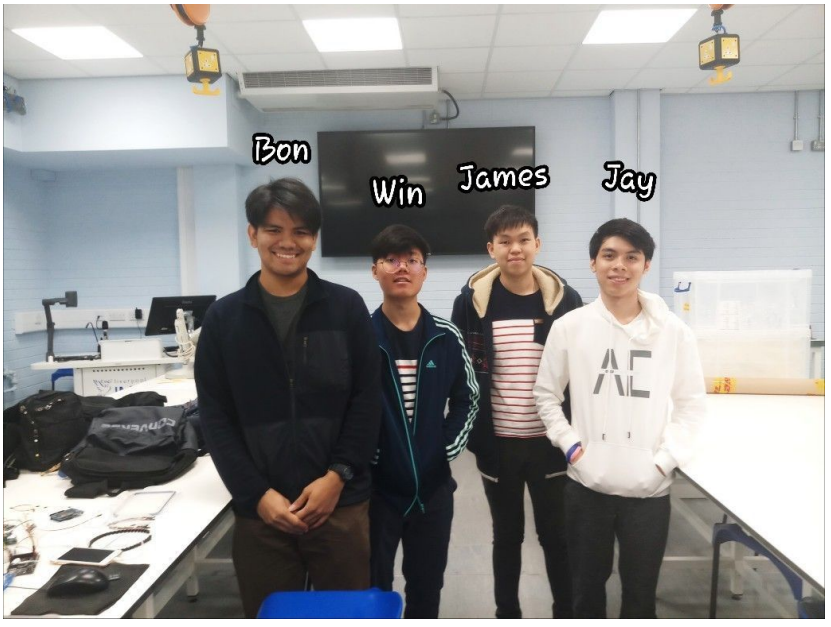


Received SMS

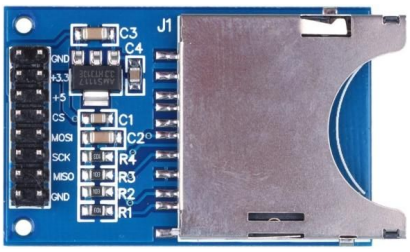
- We have a beer with David and his friends, Chris and Adam, at the Ship & Mitre. Next, we go to have a Thai food with David and talk about how things are in Thailand and UK. Then David take us for a tour around Liverpool and give us a history talk about the city.

18 June – Monday – Day 6

- When using the SD card to read or write to the card, the name of the file can't be longer than **"DISLOG10.txt"**, or the card won't create a new file.



- Hazel helps us took a picture.
- SD Card Slot Socket Reader Module

- 

SD Card Slot Socket Reader Module

  - Use the same connections similar to Micro SD card catalex with 5 V of power, but doesn't work. http://henrysbench.capnfatz.com/henrys-bench/arduino-output-devices/arduino-lc-studio-sd-card-tutorial/
  - The result is the SD card is messed up and the content inside become corrupted.
- I2C soil moisture sensor
  - David will get us another sensor to implement into the whole system.
  - https://tindie.com/products/miceuz/i2c-soil-moisture-sensor/
- E32 TTL 100

E32-TTL-100

  - Connection: needs 7 wire connection between this device and UNO board. According to this website https://github.com/Bob0505/E32-TTL-100

UNO/NANO(5V mode)		E32-TTL-100
D7	<---------->	M0
D8	<---------->	M1
A0	<---------->	AUX
D10(Rx)	<---> 4.7k Ohm <--->	Tx
D11(Tx)	<---> 4.7k Ohm <--->	Rx

  - With 5V of power.
  - We only have 2 antenna, so we can't test the sending side and receiving side at the same time.

19 June – Tuesday – Day 7

- Do the test of how accurate the Ultrasonic sensor can be by making a mark on a table with pencil on centimeters scale.

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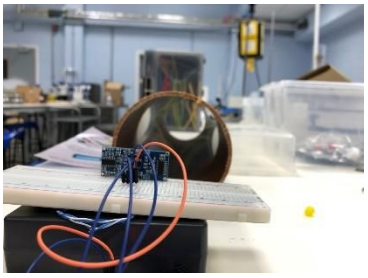
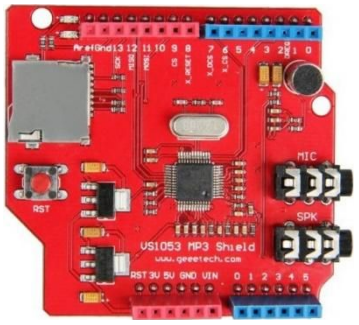
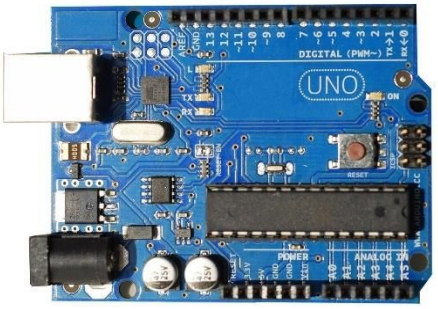


The testing

  - We tried to use the ultrasonic sensor to measure distance through a tube and experience a problem that the object outside the tube can interfere with the sensor. To fix that, we lift the sensor higher and the problem is solved.
  - We tried pushing object inside the tube, and it works as intended.
  - Need to test the sensor with a longer tube in the future to make sure that it works as well.
- VS1053 MP3 Shield





VS1053 MP3 Shield *UNO Board*

  - This shield can play an audio and record audio to/from micro SD card with the socket that it has.
  - It will stay on top of the UNO board and doesn't require any additional cable.
  - The code for testing the shield is from https://elecrow.com/wiki/index.php?title=VS1053_MP3_Shield
  - ```
    #include <SPI.h>
    #include <SdFat.h>
    #include <SdFatUtil.h>
    #include <SFEMP3Shield.h>
    ```
  - ```
    if(!sd.begin(SD_SEL, SPI_FULL_SPEED)) sd.initErrorHalt();
    if(!sd.chdir("/")) sd.errorHalt("sd.chdir");
    ```
  - Header Initialize SD card
  - All mp3 file in the SD card need to be named as "trackXXX", XXX being the number of the song. For example, "track001" or "track002".

20 June – Wednesday – Day 8

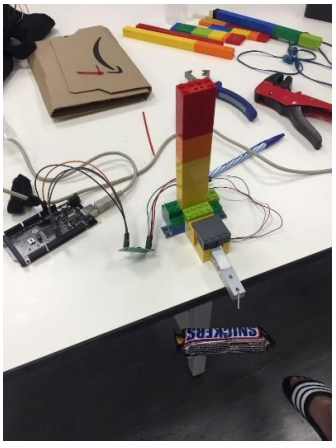
- Using LEGO to create a hand that will hold a LoadCell that attached weighting tube inside a glass with some water in it.
    - The weighting tube will be slightly above the bottom of the glass.
    - The current design can work, but may need to redesign in the future.
    - The LoadCell can't reliably output the weight.
    - Need to get another LoadCell in working condition.
- ET 016 General purpose Temperature Probe

ET 016 General purpose Temperature Probe

    - Connect the temperature dependent resistor to a Digital Multimeter and turn it to resistor mode to observe the change in resistance when temperature change on the metal end of the line.
    - The decrement of temperature cause the resistance to decrease when I put my hand around the metal head.
    - **Need another resistor** in order to read the change in resistance of the sensor when trying to read the temperature in the environment.

21 June – Thursday – Day 9

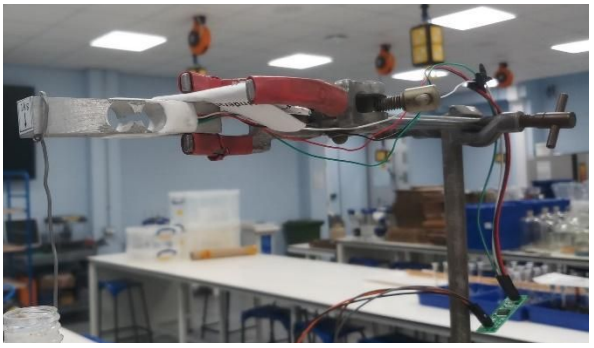
- Fix LoadCell by finding a LoadCell that can work and solder it with the proper wire to make the connection with the board.
- Continue redesign the design to test how to make the LoadCell accurate with LEGO.



LEGO set to hold LoadCell in place

Object with known weight (50 grams) – Snickers, consists of a nougat mixed with caramel and peanuts.

- To make the LoadCell more accurate, we need to put the object on the LoadCell and calibrate it. To do this, we need to use the function `scale.set_scale()` by put the new input inside the function. If the weight output is above the object's weight, we need to decrease the calibration factor until the weight output from the LoadCell is correct, and vice versa. In this case, the calibrator factor for our LoadCell with 50 grams is -2350.



LoadCell is firmly held into place

- Put LoadCell into spot that is firmly held and can withstand some magnitude of weights.
- Put glass and pipe underneath the LoadCell and take a small coil to tie the LoadCell and pipe together, so that the pipe will hover just above the bottom of the glass.
- Adjust the measurement tape to match the floor of the glass.
- After everything is in position fill in the water for 100 ml and measure the weight and height of water.
- Keep repeating this until the water is full.

Water (ml)	Weight (g)	Height (cm)
0	65.5	0
100	53.85	3
200	43.87	11.9
300	33.78	18.1
400	24.17	24.1
500	14.4	30

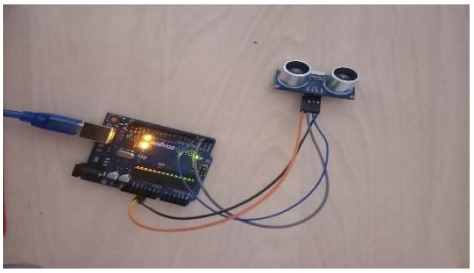
Result

- After we get all the result, we need to calculate an equation to translate weight into height.
  - We get this following equation.
  - y = -0.58*x + 38.45
- More information will be in Excel named waterEquation.

22 June – Friday – Day 10

- According to David Lamb's advice, he said about the next steps of our project that was related to the transmission and storage of data on server so we try to store data that we get from distance sensor (HC SR04) on database called MySQL and finally, we come up with accomplishment.

HC SR04



Connection between Arduino UNO and HC SR04

  - At first, we upload the code of distance measurement into the Arduino UNO.
  - Then, we access Xampp server to store our data. We set up the MySQL by creating new database, selecting database, and creating the table for our data on command line.

Xampp

```
Setting environment for using XAMPP for Windows.
USER@DESKTOP-RE4F4PA c:\xampp
# cd c:\xampp\mysql\bin

USER@DESKTOP-RE4F4PA c:\xampp\mysql\bin
# mysql.exe -u LJMU --password
Enter password: ****
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 59
Server version: 10.1.28-MariaDB mariadb.org binary distribution

Copyright (c) 2000, 2017, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]>
```

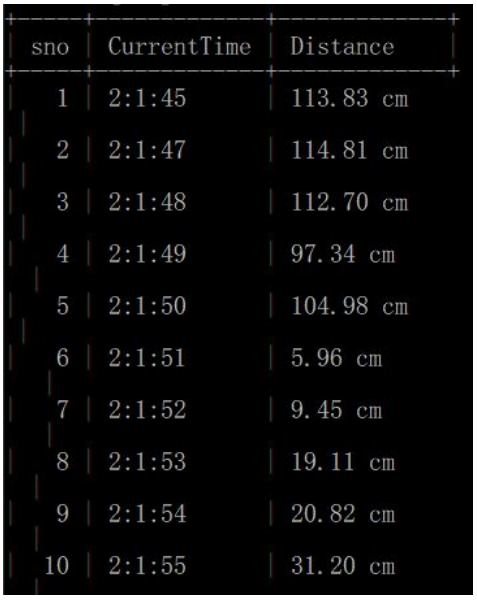
Accessing MySQL on command line

  - After we have finished setting up MySQL, we use Processing 2.2.1 IDE as the intermediary between the Arduino and MySQL. We import BezierSQL library and use normal SQL language to program the Processing IDE.

```
if ( msql.connect() )
  {
      msql.query( "insert into dataDistance(CurrentTime,Distance)values(\""+currentTime+"\",\""+serial+"\")" );
      count++;
      println("id: "+ count);
  }
```

Example of SQL code

- We set the sensor to measure and collect the data for every minute (delay(1000)).
- Finally, when we compile and execute the program, we get the expected result.



sno	CurrentTime	Distance
1	2:1:45	113.83 cm
2	2:1:47	114.81 cm
3	2:1:48	112.70 cm
4	2:1:49	97.34 cm
5	2:1:50	104.98 cm
6	2:1:51	5.96 cm
7	2:1:52	9.45 cm
8	2:1:53	19.11 cm
9	2:1:54	20.82 cm
10	2:1:55	31.20 cm

Result from command line

sno	CurrentTime	Distance
1	2:1:45	113.83 cm
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3	2:1:48	112.70 cm
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5	2:1:50	104.98 cm
6	2:1:51	5.96 cm
7	2:1:52	9.45 cm
8	2:1:53	19.11 cm
9	2:1:54	20.82 cm
10	2:1:55	31.20 cm

Data on our database

- Continue to work with the value mapping for the weight to height measurement by pouring water 25ml water for each iteration to make it more precise.

25 - June - Monday - Day 11

- David Jordan suggests us to use a more formula way to turn weight into height method, so we need to come up with a new equation

  Fb = (Weight in the air) - (Weight in the water)

  - With this equation, we can get the buoyant force by subtracting the weight together.

  Fb = pVg

  - With this equation, we can find the volume of the sunken part of the hanging tube in the pipe, since we already know the buoyant force.

  $V = \Pi r^2 H$

  - With this equation, we can find the height of the sunken part of the hanging tube, since we already know the value of volume.
  - After we get the height of the sunken tube, we turn the value into cm and use that for further development.
- We also optimize the code by grouping code as a function, adding more comment, and adjusting the delay time.
- We also write the document and make the package for our system.

- Following the suggestion from David Jordan, instead of read a single value and send it, we use