BTP - Smart Bin

Ali Jafri - 2013CSB1030
Pradeep Kumawat - 2013CSB1021
Rehmat Aulakh - 2013CSB1027

Introduction

- Waste segregation is not only an environmentally pressing issue, it is an economic necessity as well. With the rapid generation of wastes we are fast running out of sites for landfills.
- A smart bin is a bin that comes with the ability to indicate that it needs to be emptied whenever it reaches a certain threshold.

Literature Survey

IoT-Based Smart Garbage System for Efficient Food Waste Management- Insung Hong, et al

- Their approach was based on a weight measurement strategy so, when a resident wishes to dump his waste he uses an RFID card to discharge his food waste, his personal card information registered on the RFID card is transferred to the charge management server,which then requests the card company to process the payment depending on weight.
- Base Rate + (Waste Emission□/Waste Emission□)× Past Changeable Rate = Next Month Rate
- Next Month Rate - Base Rate = Past Changeable Rate. [I]

IOT Based Intelligent Bin for Smart Cities - Meghana K C, et al

- For garbage detection, many sensors like weight sensors, IR sensors, etc can be used.
- Since, using weight sensor is inefficient because it doesn’t identify the level of waste in the bin (density).
- A properly covered IR sensor is used, if the threshold level is reached the following information is extracted garbage level, bin location, date and time of event.
- Respective person informed to clean the bin as soon as possible via auto-generated message. [II]

IoT Based Smart Garbage and Waste Collection Bin -S.S.Navghane, et al

- They use a combination of sensors namely weight sensor and IR sensor to indicate its weight and different levels respectively. They send their output ahead when the designated threshold level is crossed.
- Details of this are programmed in the microcontroller (ARM LPC2148) and the controller gives the details to the transmitter module (Wifi module), details of the garbage bin are displayed onto the HTML page in web browser of mobile handset connected to the router [III]

How does our smart bin look?

Smart Bin - Prototype

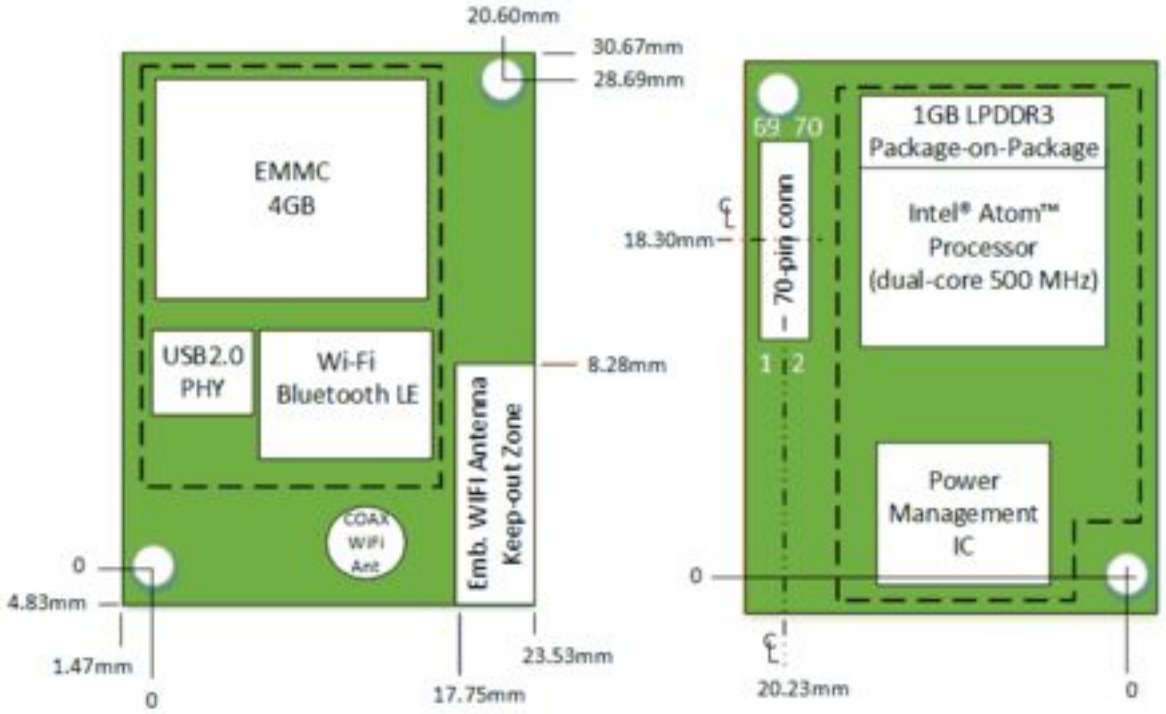
What does it comprise of?

Smart Bin - Components

- Intel Edison (WiFi Module)
- A Bin
- A pair of USB cable
- Garbage*

What is Intel Edison?

Intel Edison - brief



The Intel Edison is a tiny computer-on-module offered by Intel as a development system for Internet of Things devices.

Table 2 Hardware features

Component	Description
Processor	Dual Core IA-32 @ 500 MHz, 32-bit Intel® Atom™ Processor Z34xx Series @ 100 MHz
RAM	1 GB LPDDR3 POP memory (2 channel 32 bits @ 800 MT/sec)
Internal storage	4 GB eMMC (v4.51 spec)
Power	TI SNB9024 power management IC
Wireless	Dual-band (2.4 and 5 GHz) IEEE 802.11a/b/g/n
Bluetooth*	BT 4.0 + 2.1 EDR
Antenna	Dual-band onboard chip antenna or u.FL for external antenna
Connector	70-pin Hirose DF40 Series (1.5, 2.0, or 3.0 mm stack height)
Size	35.5 × 25.0 × 3.9 mm maximum (to be verified)
Power input	3.15 to 4.5 V
I/O	40 general purpose GPIO which can be configured as: • SD card: 1 interface • UART: 2 controllers (one full flow control, one Rx/Tx) • I^2C: 2 controllers • SPI: 1 controller with 2 chip selects • I2S: 1 controller • GPIO: Additional 14 (with 4 capable of PWM)
USB 2.0	1 OTG controller
Clocks	19.2 MHz, 32 kHz

The Methodology?

Methodology

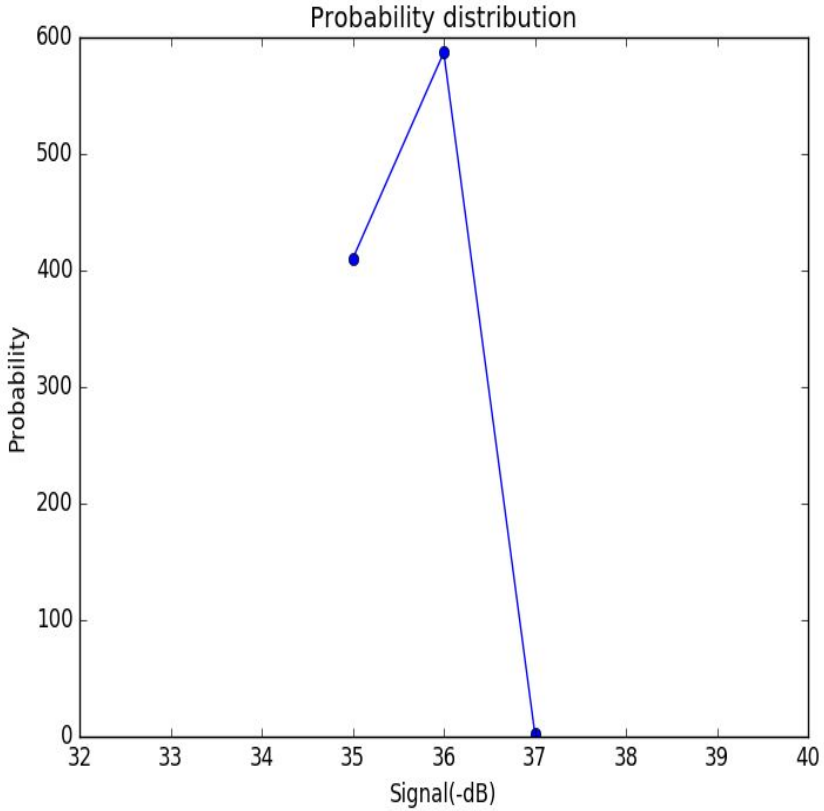
- Two Intel Edison were attached outside the bin opposite to each other as shown in the prototype at a height of 33% from below.
- The function of one Intel Edison was that of a wifi hotspot while that of the other was to connect to that hotspot.
- The main motive of this setup was to analyze the effect on strength of signal due to various substances inside bin which may interfere with the signal.

Methodology...

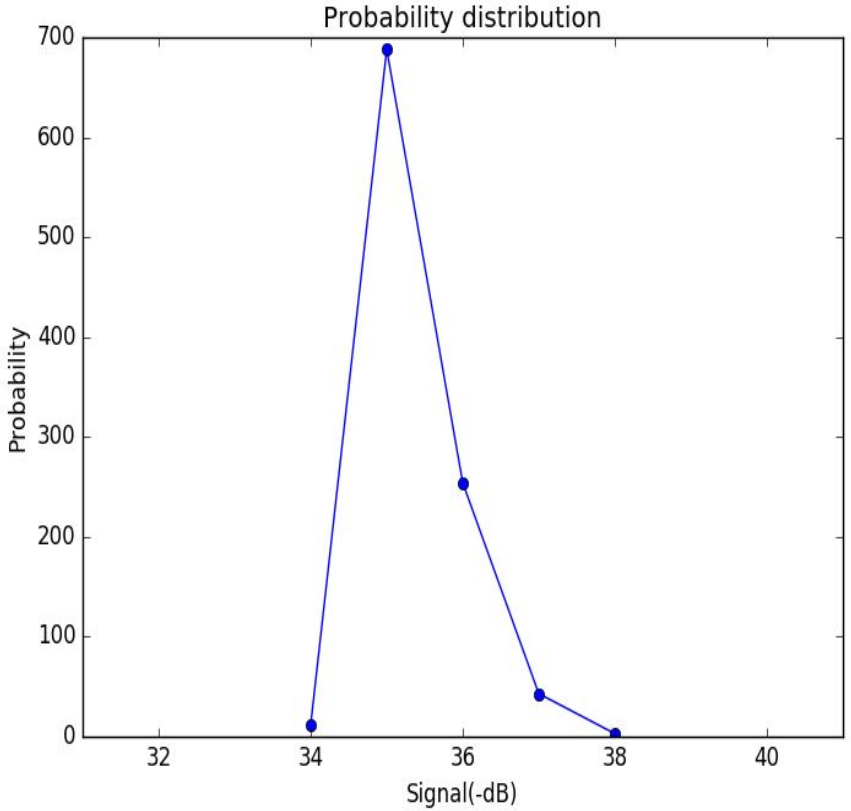
- We collected as much data as we could with substances like Water, Sweet Lemon (mosambi), Clothes, Paper, and random stuff.
- The height of bin filled was to be predicted* and the category of substance inside using the variation in signal strength.

What were our substances?

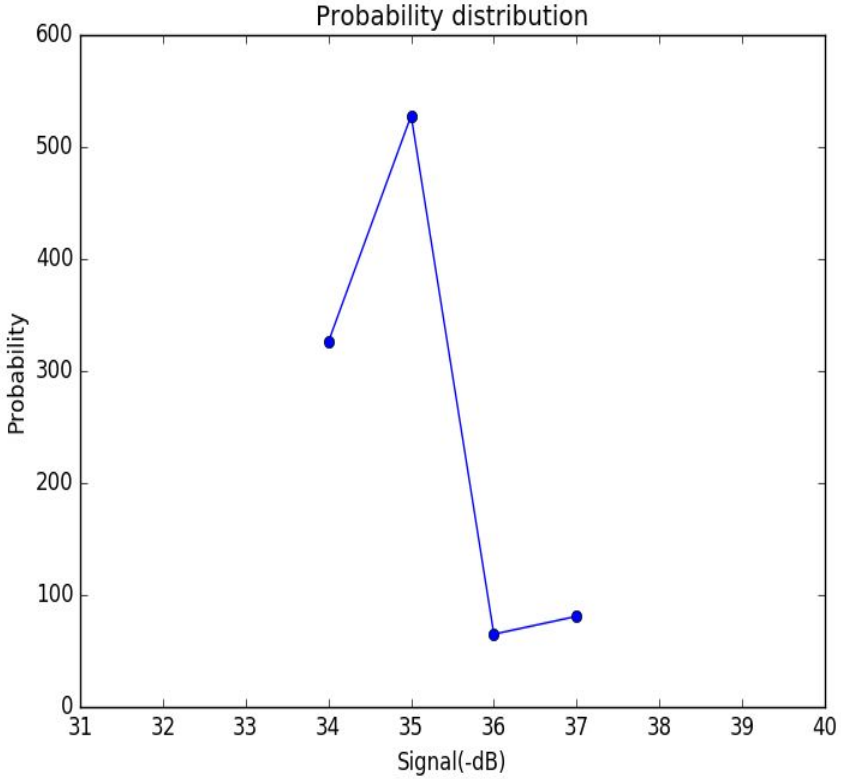
Water


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
32
33
34
35
36
37
38
39
40

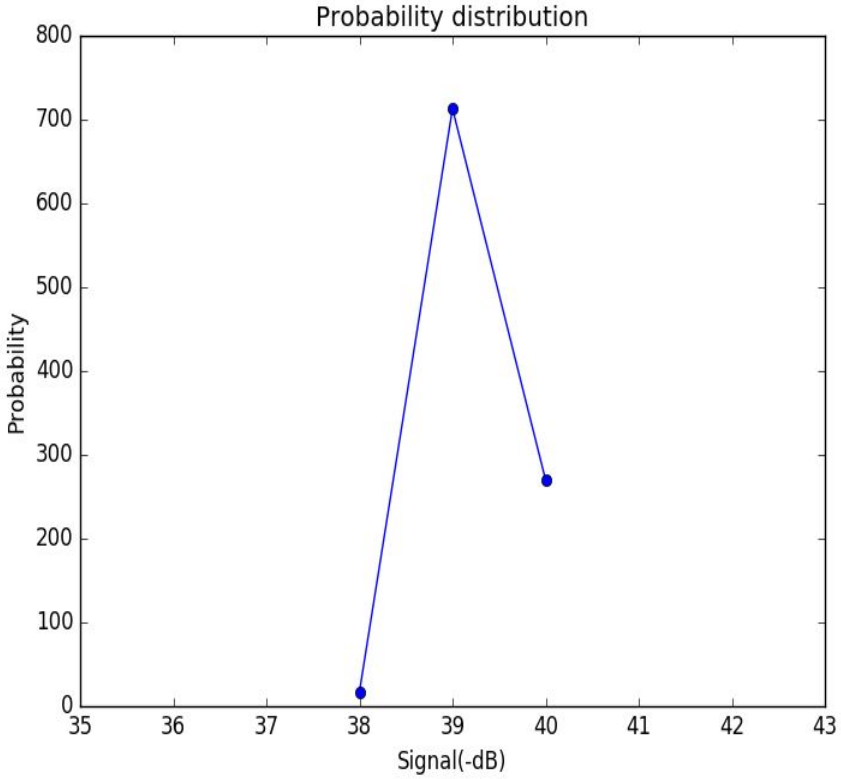
Empty


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
700
32
34
36
38
40

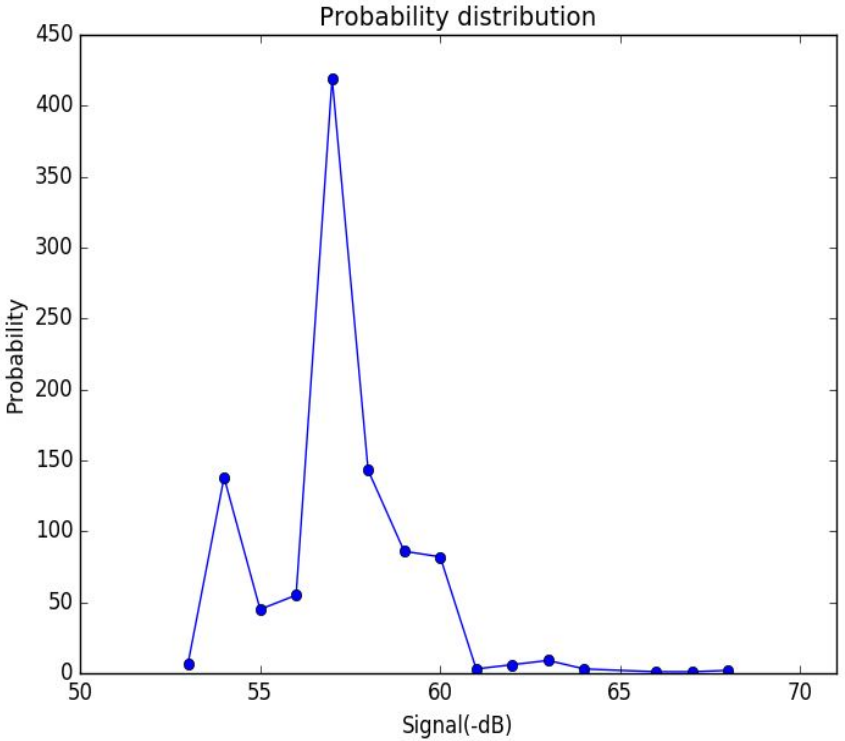
11%


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
31
32
33
34
35
36
37
38
39
40

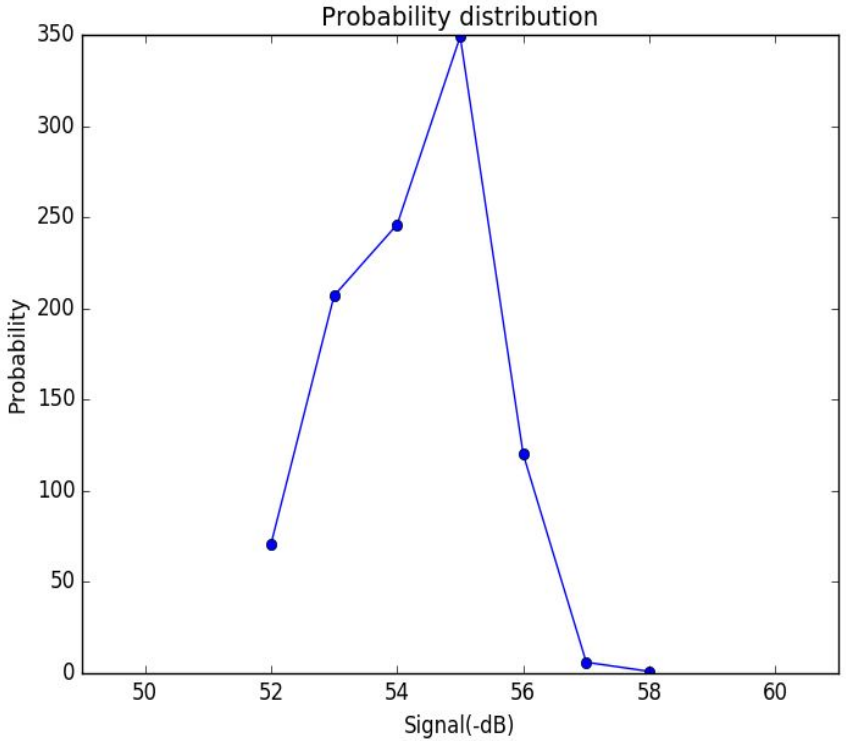
22%


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
700
800
35
36
37
38
39
40
41
42
43

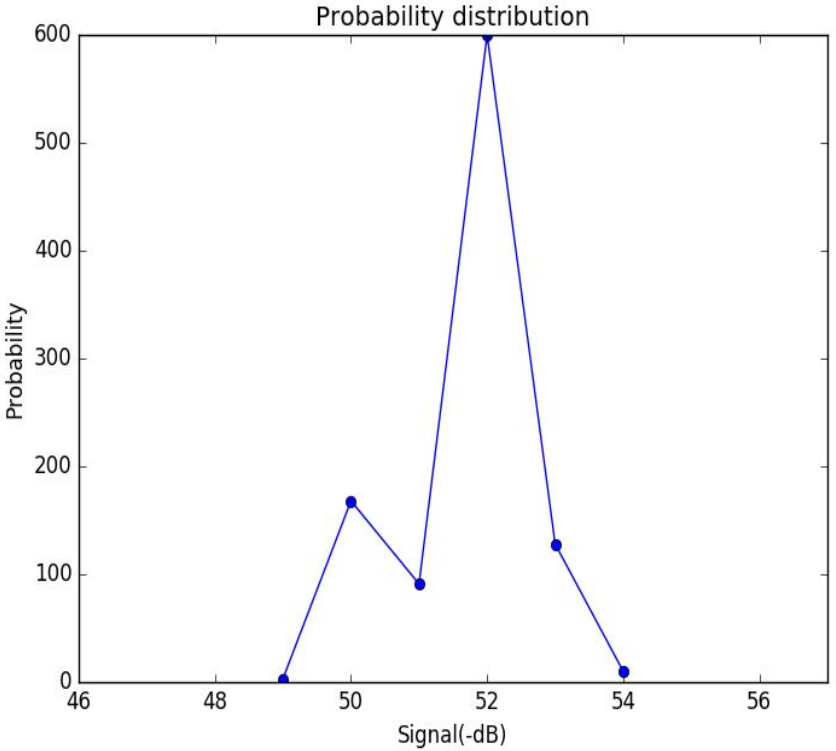
33%


Probability distribution
Probability
Signal(-dB)
0
50
100
150
200
250
300
350
400
450
50
55
60
65
70

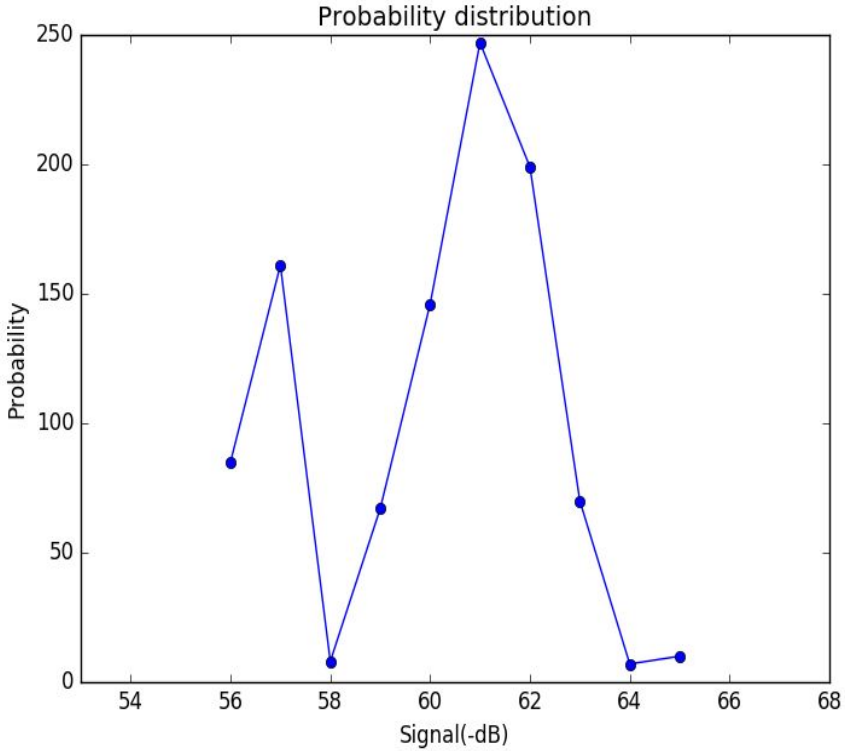
44%


Probability distribution
Probability
Signal(-dB)
0
50
100
150
200
250
300
350
50
52
54
56
58
60

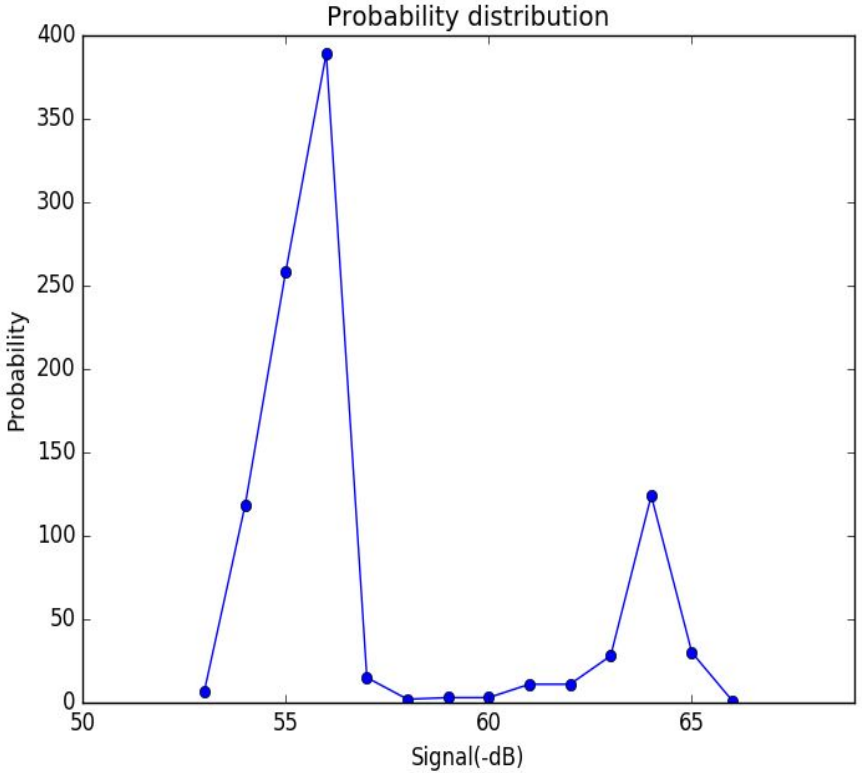
55%


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
46
48
50
52
54
56

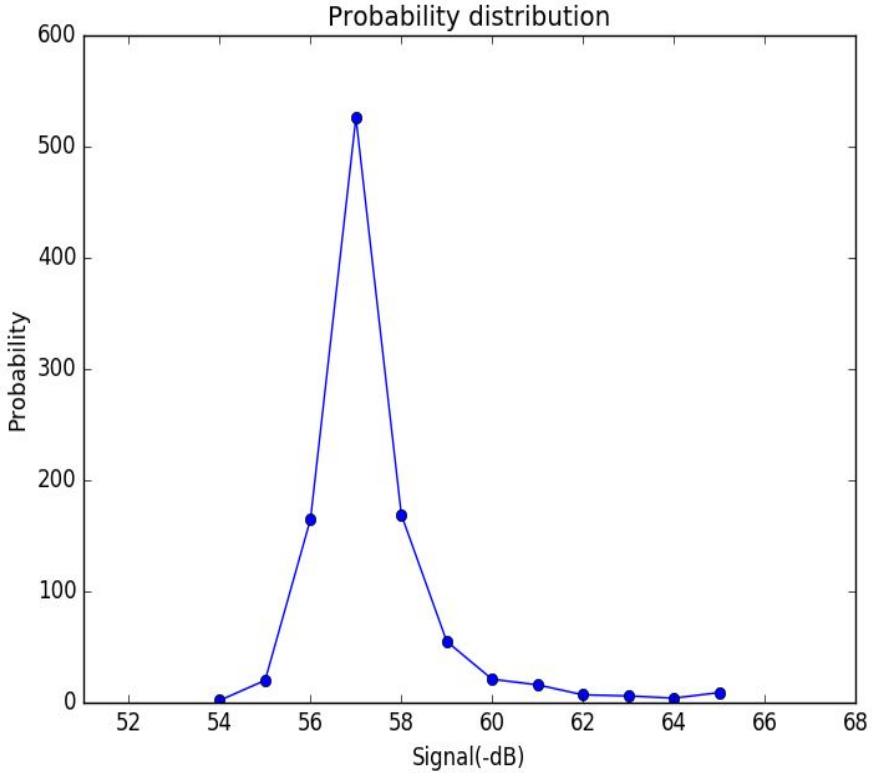
66%


Probability distribution
Probability
Signal(-dB)
0
50
100
150
200
250
54
56
58
60
62
64
66
68

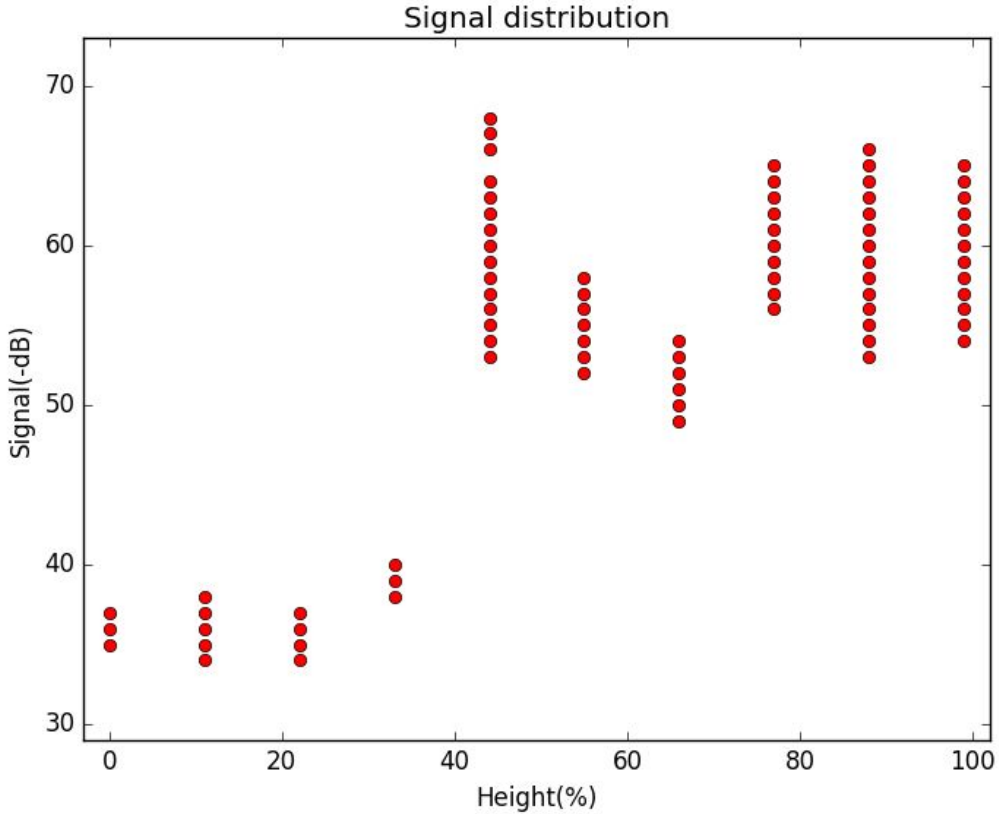
77%


Probability distribution
Probability
Signal(-dB)
0
50
100
150
200
250
300
350
400
50
55
60
65

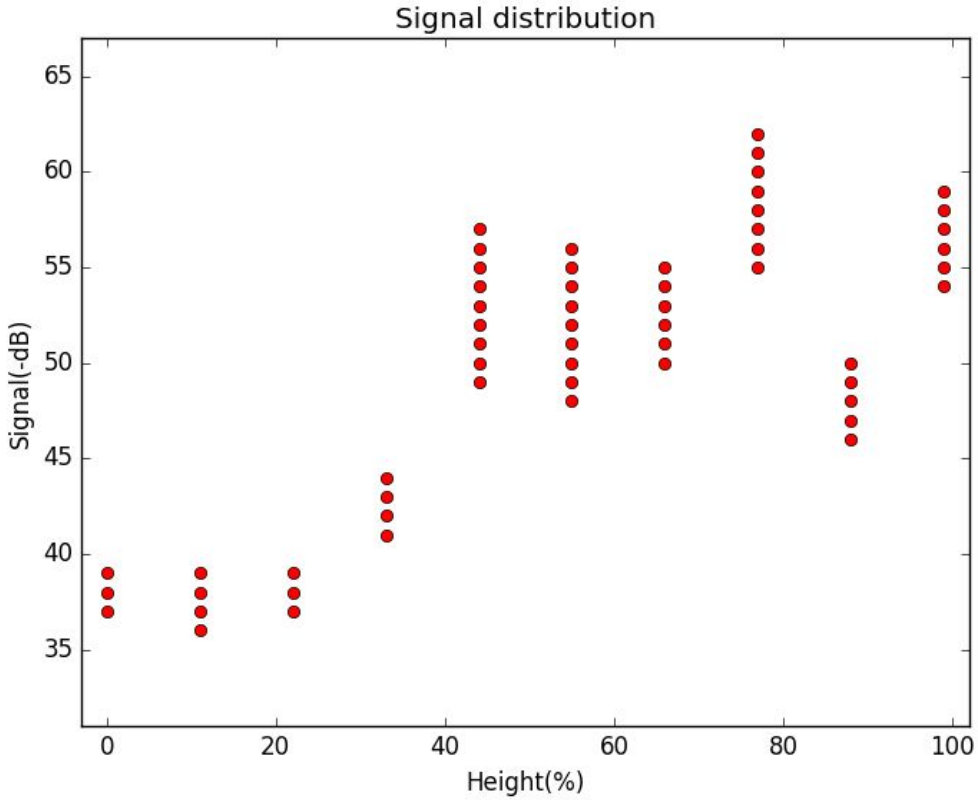
88%


Probability distribution
Probability
Signal(-dB)
0
100
200
300
400
500
600
52
54
56
58
60
62
64
66
68

99%

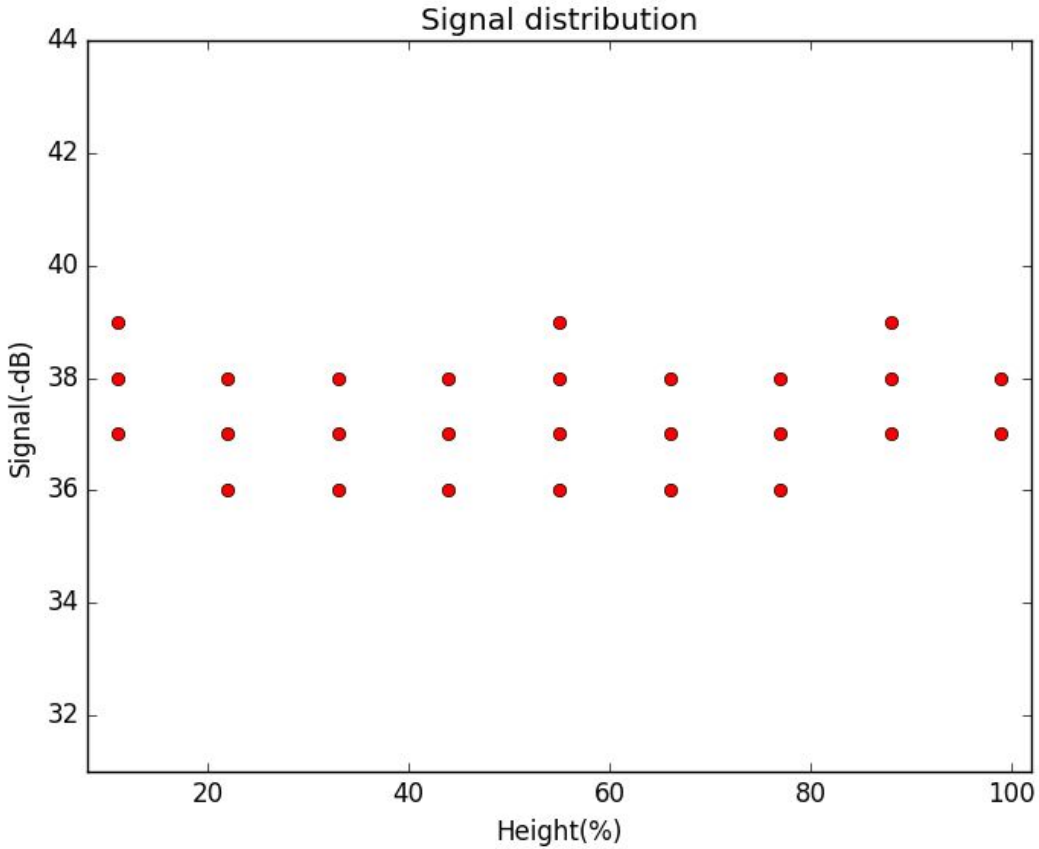


In Room (+ Noise/Interference)

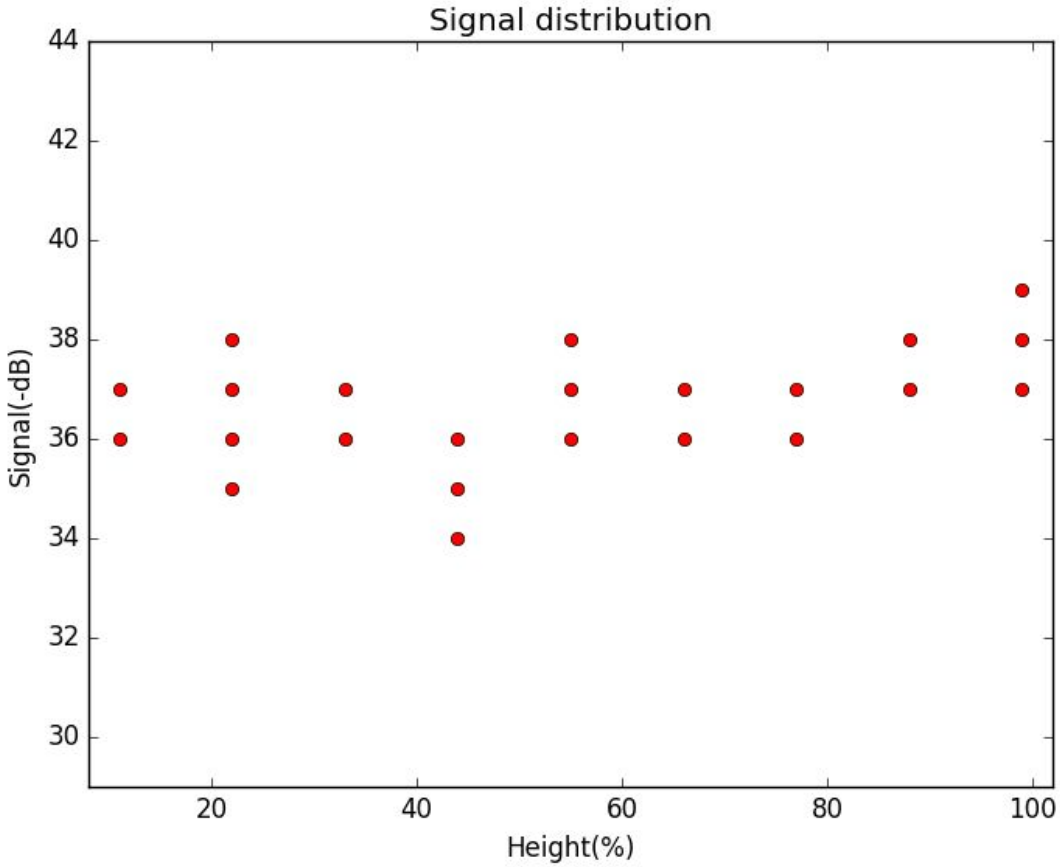


ON ground (- Noise/Interference)

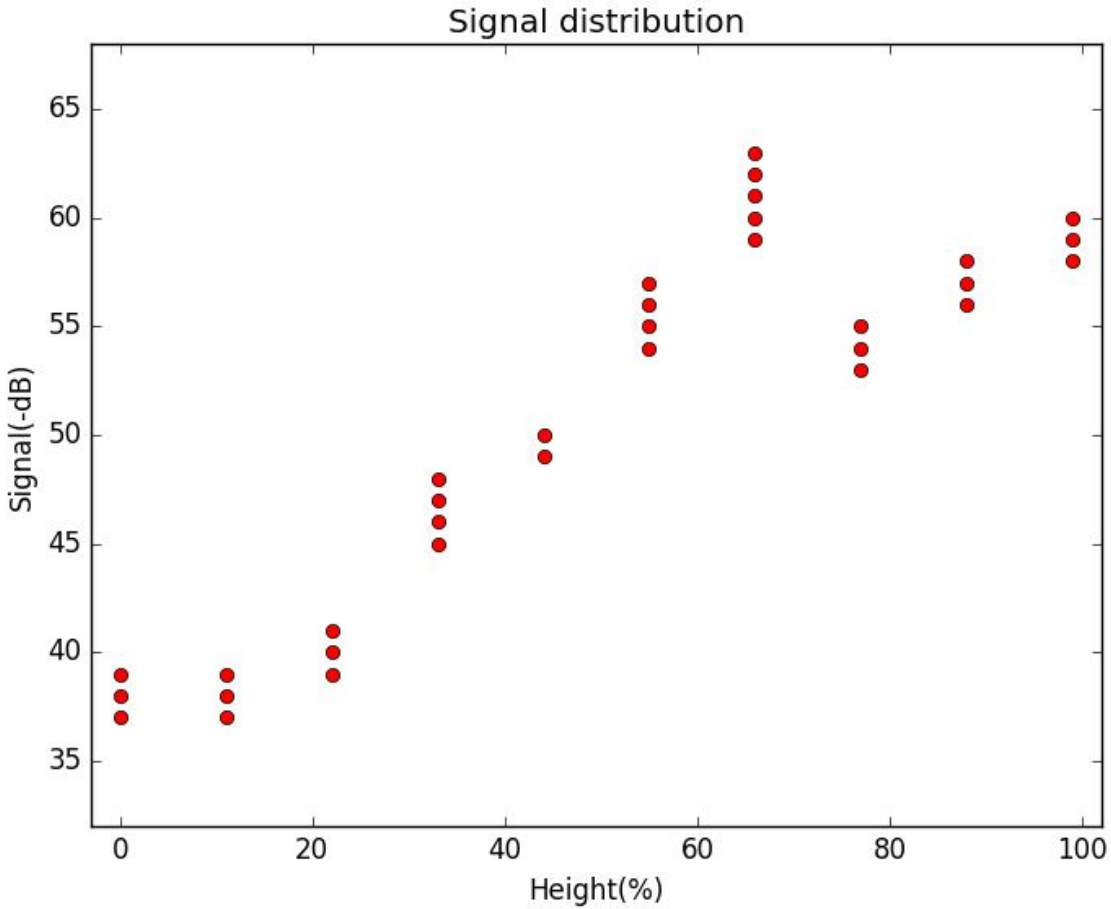
Paper


Signal distribution
Signal(-dB)
Height(%)
44
42
40
38
36
34
32
20
40
60
80
100

Clothes


Signal distribution
Signal(-dB)
Height(%)
44
42
40
38
36
34
32
30
20
40
60
80
100

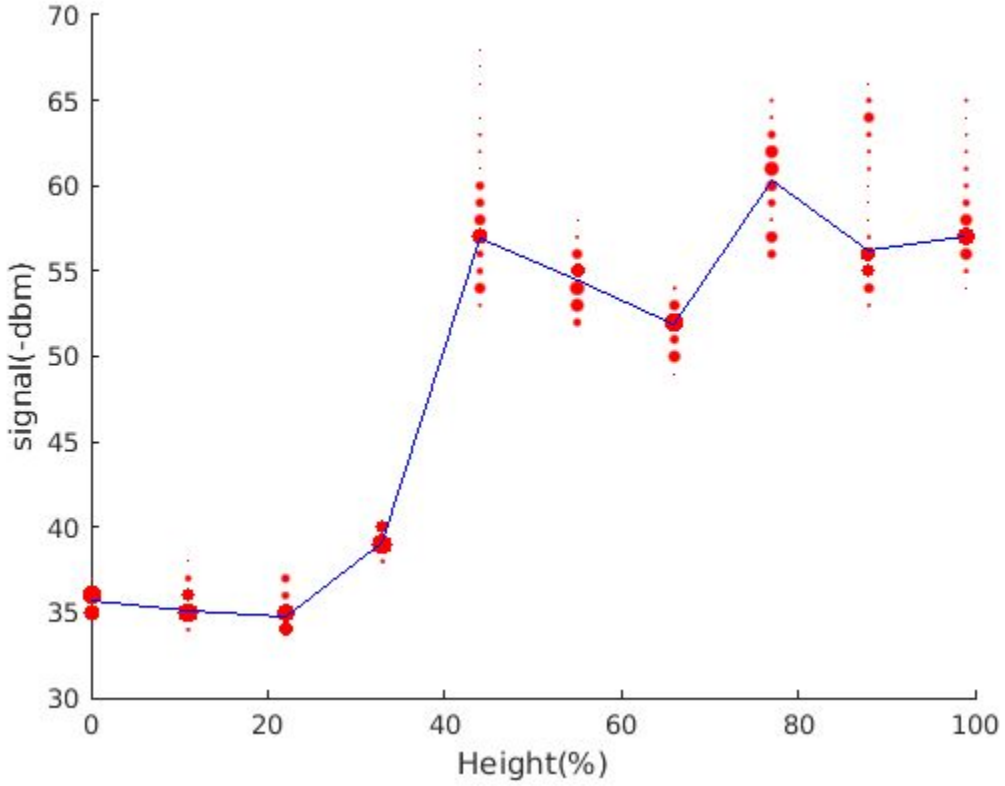
Mosambi - Sweet lime


Signal distribution
Signal(-dB)
65
60
55
50
45
40
35
0
20
40
60
80
100
Height(%)

We'd some data, Now what?

Classification - Artificial Neural Networks

- We started with data collected for water and build up our Artificial Neural Network with H = 4,8,12,16.
- We were able to get max 40% accuracy in predicting the height
- That was below our expectations.

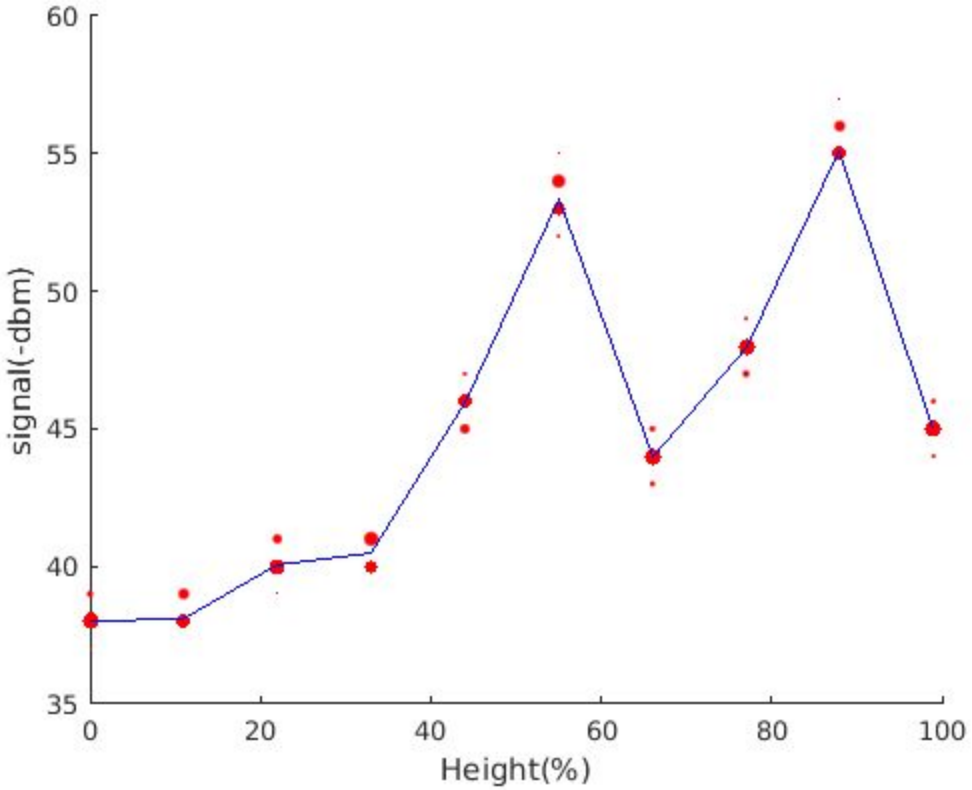


Water

So Did we succeed?

- We thought we were about to succeed and then we performed the experiment with metal.
- With metal we got significant variation in wifi signals and this could have been a dead end to our experiment.

Metal



Metal

Experiments with Arduino

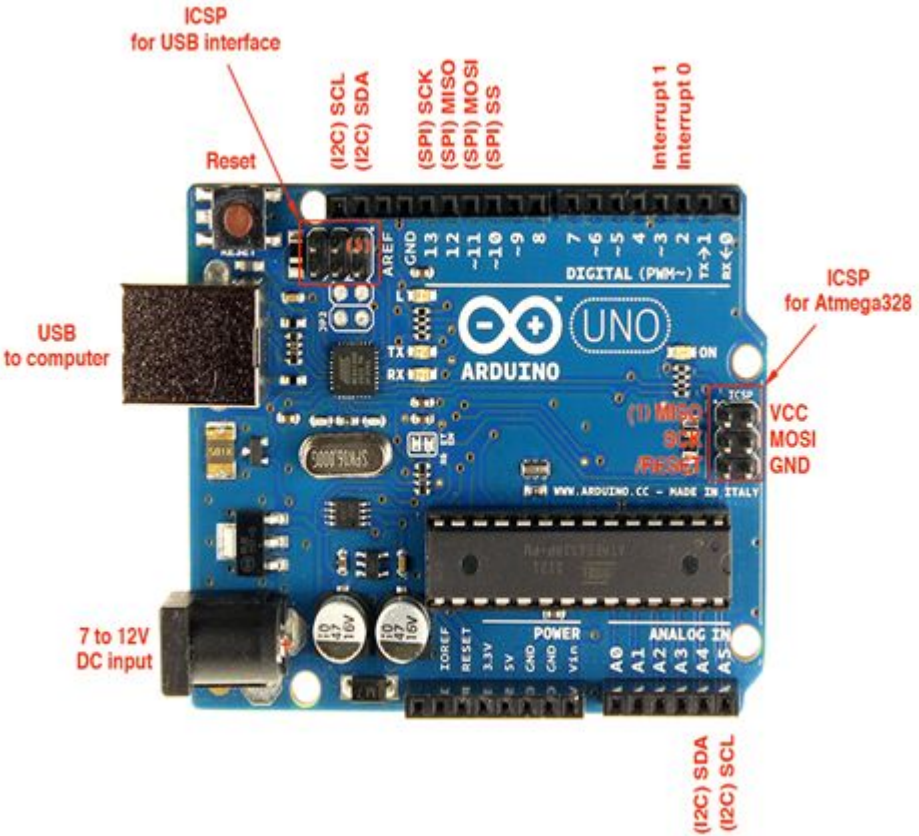
Some Basics of Arduino

```
void setup()
{
  }

void loop()
{
  }
```

```
millis();
#include<libraryname.h>
goto a;

int a;
a=analogRead(A0);
```

```
const int a=5;
float b=4;
int c=8;
```

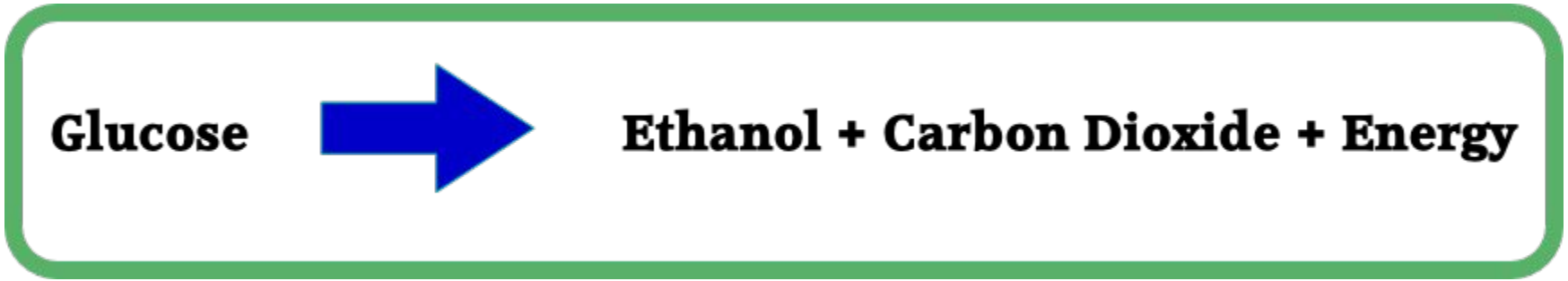
```
void setup() {
Serial.begin(9600);
Serial.print("Hello");   }
```



Why do garbage bins smell so bad?

Principle behind operation

The basic principle of operation over here is as follows

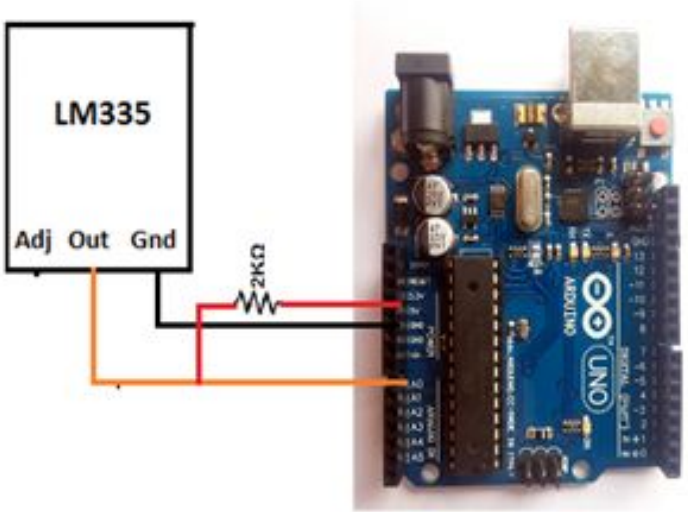


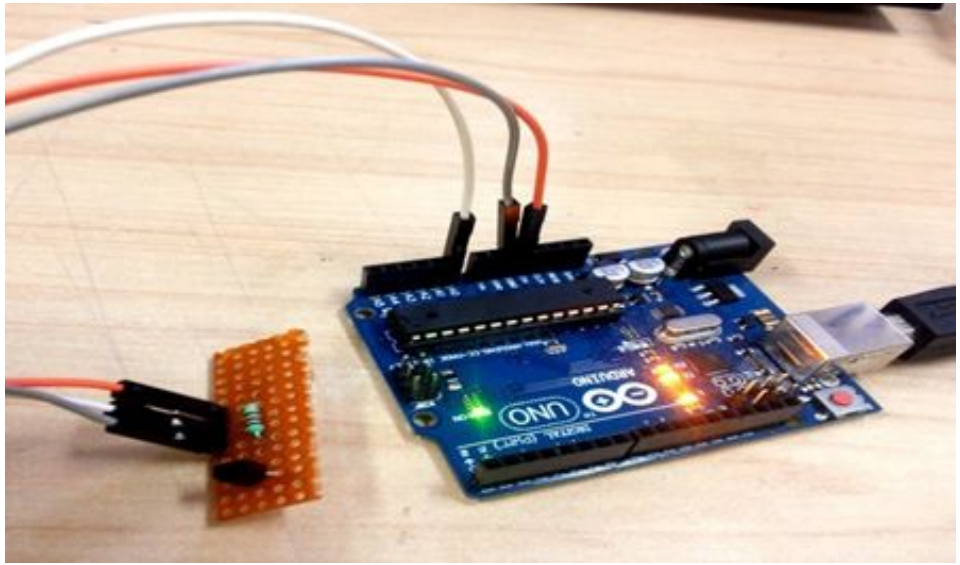
The microorganisms act on garbage & decompose it to release energy for themselves, a lot like in humans, this energy leads to a raised temperature.

Temperature Sensor - LM355

- There are certain sensors like DHT11, LM35, LM34 etc.
- Out of which we chose LM355 because, this sensor gives the output in Kelvin so it can be easily converted to any other standard as per our choice.
- The LM335 gives an output 10mV/Kelvin, meaning if it is reading 2.87 or 2870 mV, so the equivalent temperature is 287K and accordingly we can calculate other values also.

Interfacing LM 355 with arduino

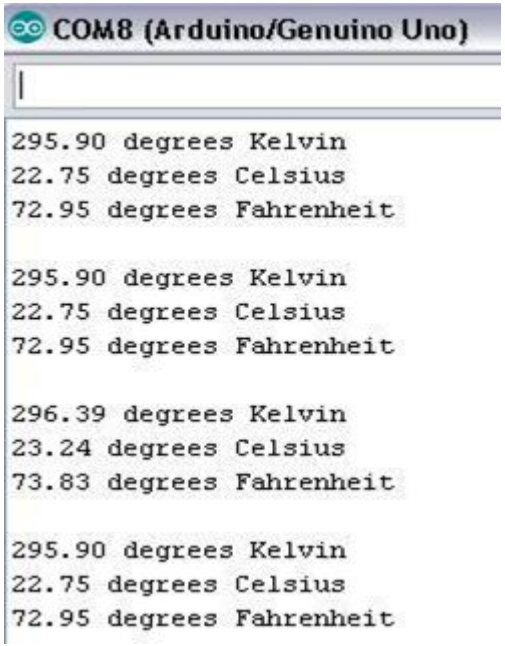




Experimental Setup

- To conduct this experiment we had 4 LM355 modules, because it was essential to maintain the same environmental conditions.
- One each for ambient, inorganic & organic conditions because reading had to be taken simultaneously.
- When organic matter is added temperature first drops slightly (water acts as coolant) then rises until it hits a steady state condition where the water cooling & the heating due to decomposition balances out.
- This is when the reading is taken.

Output obtained



1. Ambient temperature reading.
2. Temperature reading for inorganic waste.
3. Temperature reading for organic waste
4. Temperature reading when emptied

All temperatures are steady state

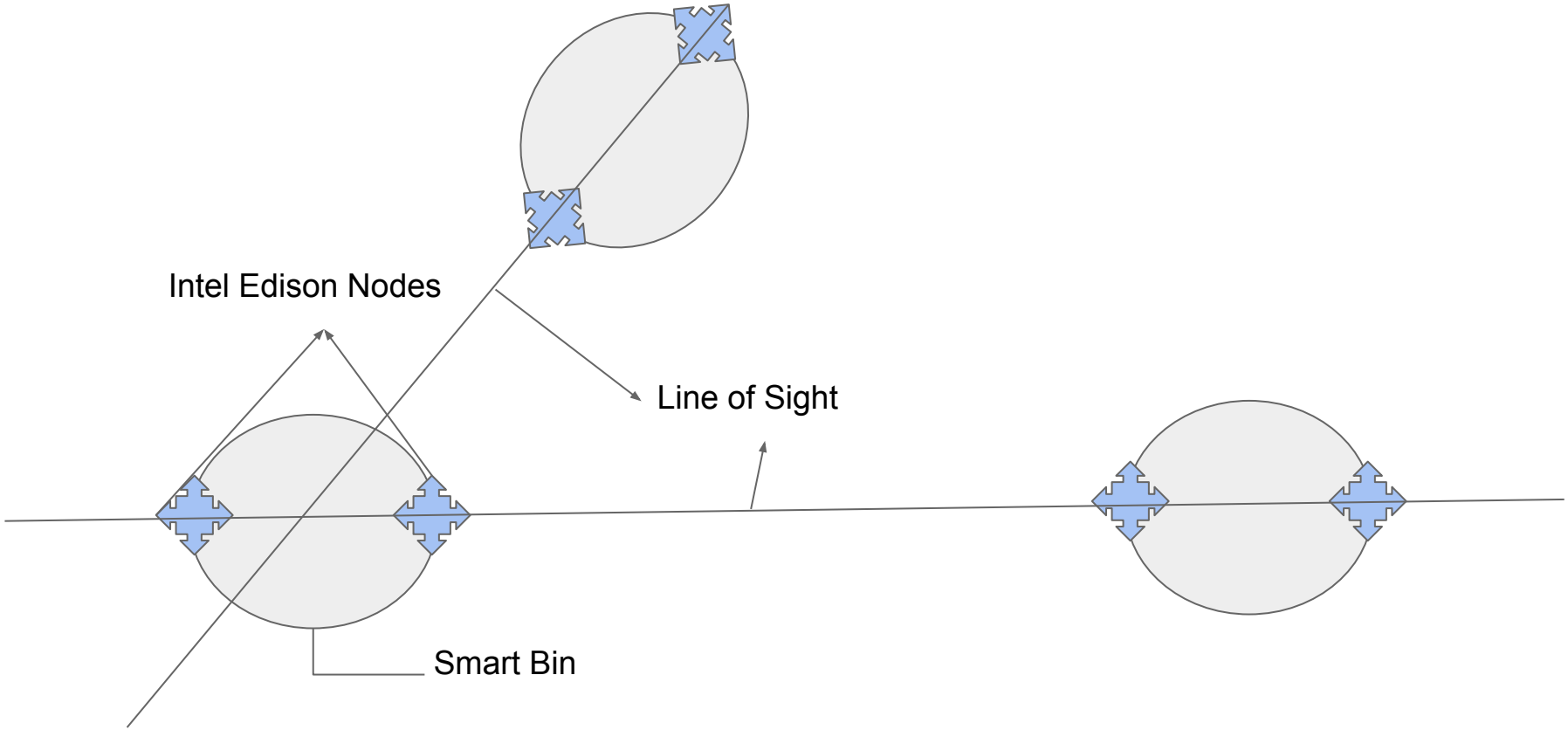
Future Work

Exploring New Avenues

- We are going to explore the effect on temperature a bit more, to find the relation between percentage of organic matter versus impact on temperature raise.
- Additionally gas sensors that check CO_2 levels can be employed these should remain more or less constant for ambient conditions.
- Since we aim to deploy our smart bin in IIT Ropar, we wish to make it economically & environmentally optimized.

Optimisation

Reducing Active Number of Bins to save energy



Reducing Active Number of Bins to save energy

- We aim to choose a cluster head so that minimum number of nodes are awake at a time and thus conserve energy.
- The bin chosen would be such that its intersection with line of sight of other bins would be maximum.
- In this way the other bins would have their nodes in sleep cycle and they would be asked to wake up by sending a wake up signal from the chosen bin’s node.

Suboptimal Connected Graph of Bins* at IIT-Ropar

References

I. Insung Hong, Sunghoi Park, Beomseok Lee, Jaekeun Lee, Daebeom Jeong, and Sehyun Park, “IoT-Based Smart Garbage System for Efficient Food Waste Management,” The Scientific World Journal, vol. 2014, Article ID 646953, 13 pages, 2014. doi:10.1155/2014/646953

II. Meghana K C and Dr. K R Nataraj, “IOT Based Intelligent Bin for Smart Cities,” International Journal on Recent and Innovation Trends in Computing and Communication Volume: 4 Issue: 5

III. S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale, “IoT Based Smart Garbage and Waste Collection Bin,” (IJARECE) Volume 5, Issue 5, May 2016

References...

I. http://akizukidenshi.com/download/ds/intel/edison-module_HG_331189-002.pdf
II. https://en.wikipedia.org/wiki/Intel_Edison