Engineering Analytics (ESE1007)

Seminar 4

Normalization

Normalization Transformation

- In statistics and applications of statistics, normalization can have a range of meanings.
- In the simplest cases, normalization of ratings means adjusting values measured on different scales to a notionally common scale, often prior to averaging.
- In more complicated cases, normalization may refer to more sophisticated adjustments where the intention is to bring the entire probability distributions of adjusted values into alignment.

Normalization Transformation

- **Standardization transforms** data to have a mean of zero and a standard deviation of 1. This standardization is called a z-score, and data points can be standardized with the following formula:

$$z_i = \frac{x_i - \bar{x}}{s}$$

- **Rescaling data** to have values between 0 and 1. This is usually called feature scaling. One possible formula to achieve this is:

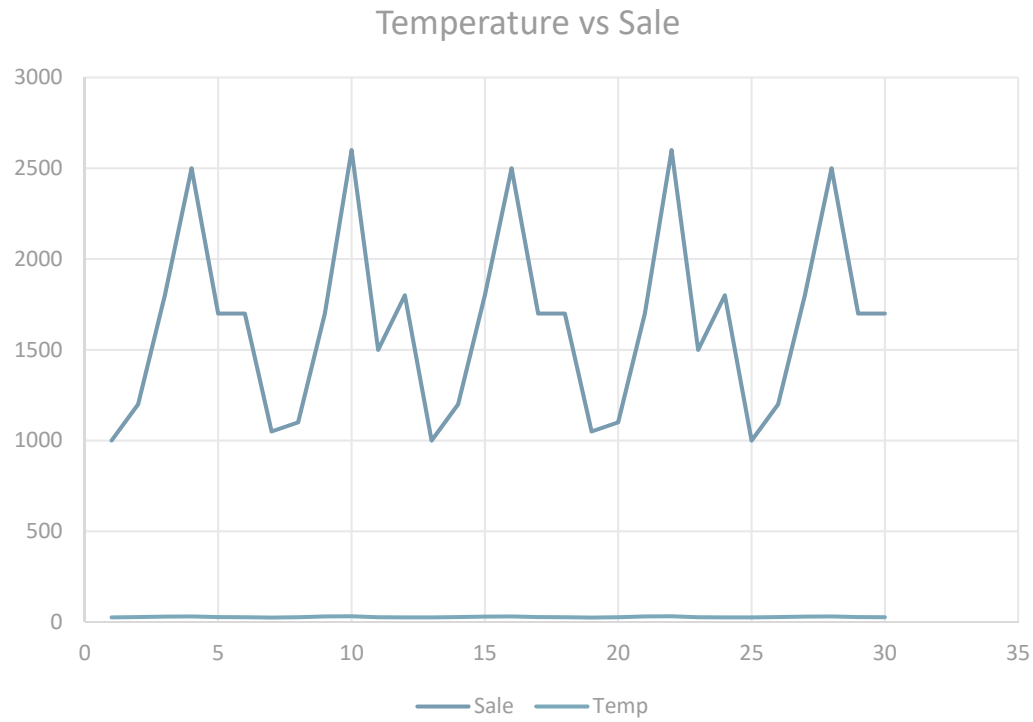
$$x_{new} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

How to Normalize Data?

https://www.youtube.com/watch?v=7DQMAXaiXmk&gl=SG&hl=en-GB

Example 1: Fictional Sale of an Ice-cream Shop

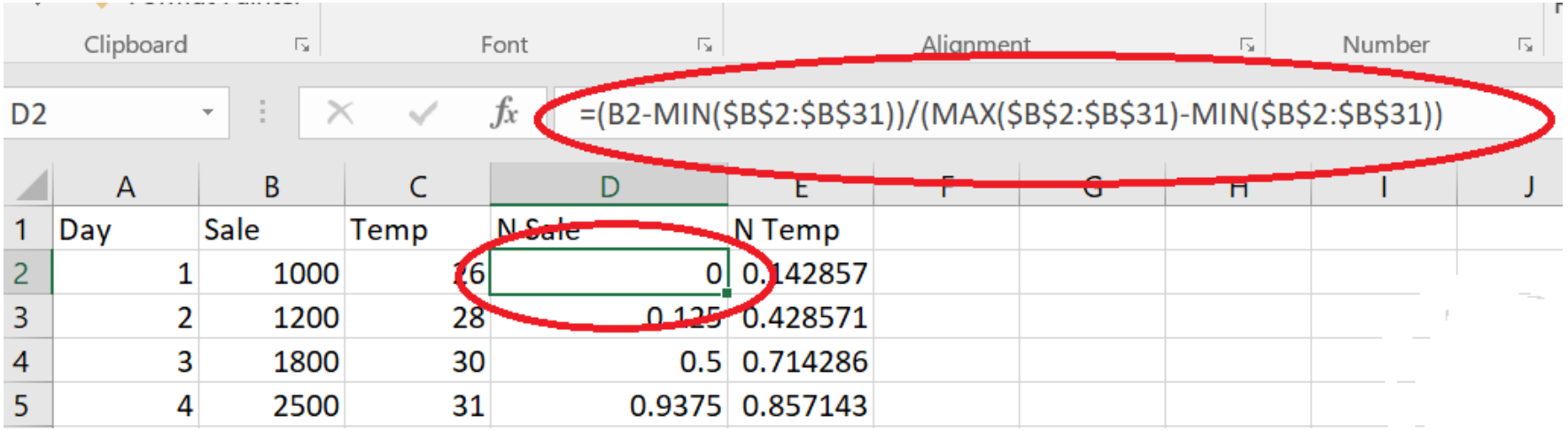
Day	Sale	Temp
1	1000	26
2	1200	28
3	1800	30
4	2500	31
5	1700	28
6	1700	27
7	1050	25
8	1100	27
9	1700	31
10	2600	32
11	1500	27
12	1800	26
13	1000	26
14	1200	28
15	1800	30
16	2500	31
17	1700	28



Want to find answer to the question:

- What is the relationship of sale vs temperature?
- Due to difference in magnitude, temperature appears to be a straight line

Rescaling the data



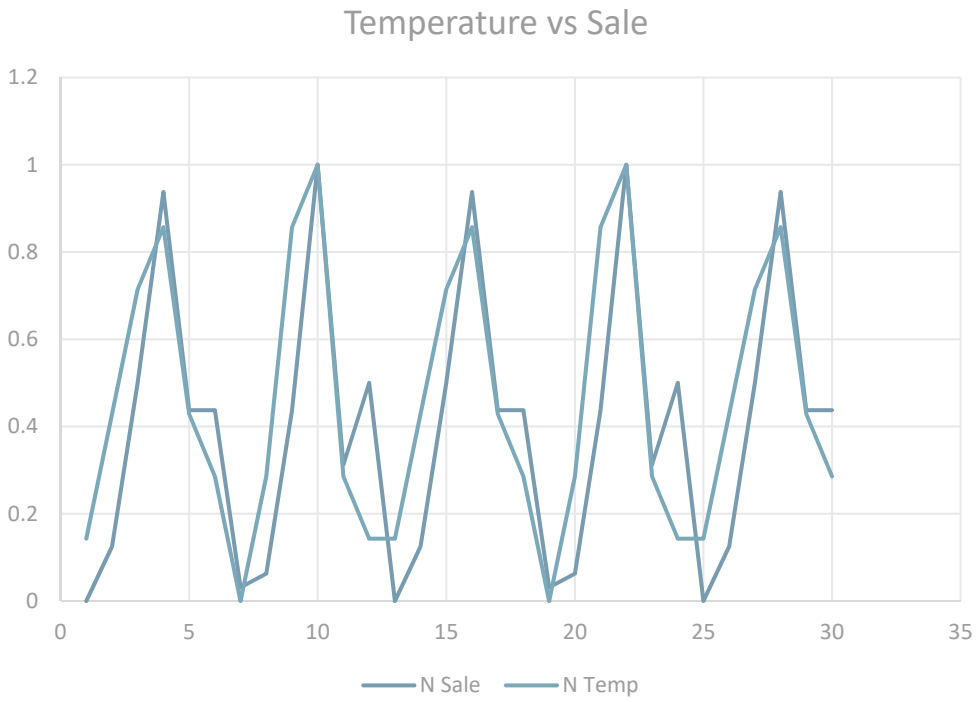
	A	B	C	D	E	F	G	H	I	J
1	Day	Sale	Temp	N Sale	N Temp					
2	1	1000	26	0	0.142857					
3	2	1200	28	0.125	0.428571					
4	3	1800	30	0.5	0.714286					
5	4	2500	31	0.9375	0.857143					

$$x_{new} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Rescale the sale and the temperature data by the scaling formulae to scale both data to 0 to 1.

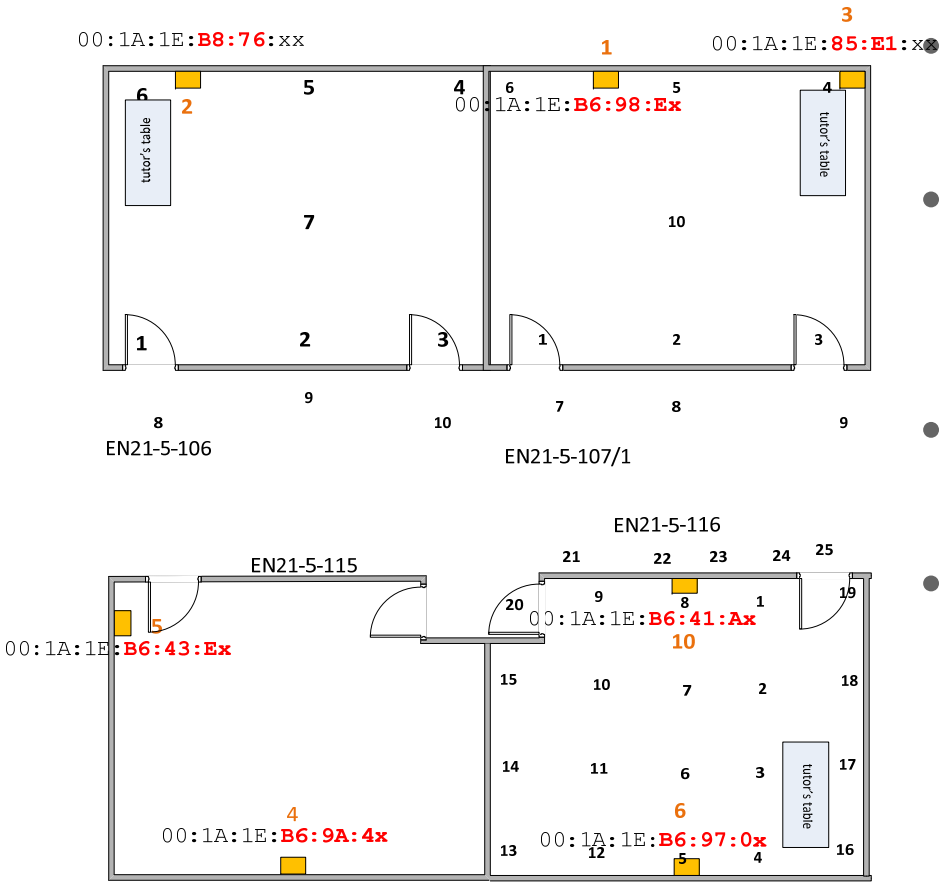
Rescaling the data

Day	Sale	Temp	N Sale	N Temp
1	1000	26	0	0.142857
2	1200	28	0.125	0.428571
3	1800	30	0.5	0.714286
4	2500	31	0.9375	0.857143
5	1700	28	0.4375	0.428571
6	1700	27	0.4375	0.285714
7	1050	25	0.03125	0
8	1100	27	0.0625	0.285714
9	1700	31	0.4375	0.857143
10	2600	32	1	1
11	1500	27	0.3125	0.285714
12	1800	26	0.5	0.142857
13	1000	26	0	0.142857
14	1200	28	0.125	0.428571
15	1800	30	0.5	0.714286
16	2500	31	0.9375	0.857143
17	1700	28	0.4375	0.428571



- By applying scaling, we are able to see the relationship between sale and temperature.
- The two attributes are positively correlated (i.e. when temperature goes up, sale also goes up)

Example 2: Indoor Location Detection



- Each room was scanned by a mobile app.
- Different locations with different AP (Access Point) would have different power.
- Different mobile phone would have different gain.
- The power value obtained cannot be compared with different AP and different mobile phone.

Normalization

- Normalization is the pre-processing of capture power to a standard scale regardless of AP gain and mobile phone RF gain
- In reality, the users would be using mobile phone from various manufacturers (even the same manufacturer and model do not guarantee the same gain)
- A standard score normalization method is deployed:

$$\boldsymbol{P_n = (P - \mu)/\sigma}$$

Where P_n is the normalization power, P is the captured power, μ is the mean of the power and σ is the standard deviation at the location .

- With this, the bias cause by AP gain+ Mobile Phone RF gain would be remove
- Only the different cause by distance from the AP would remain

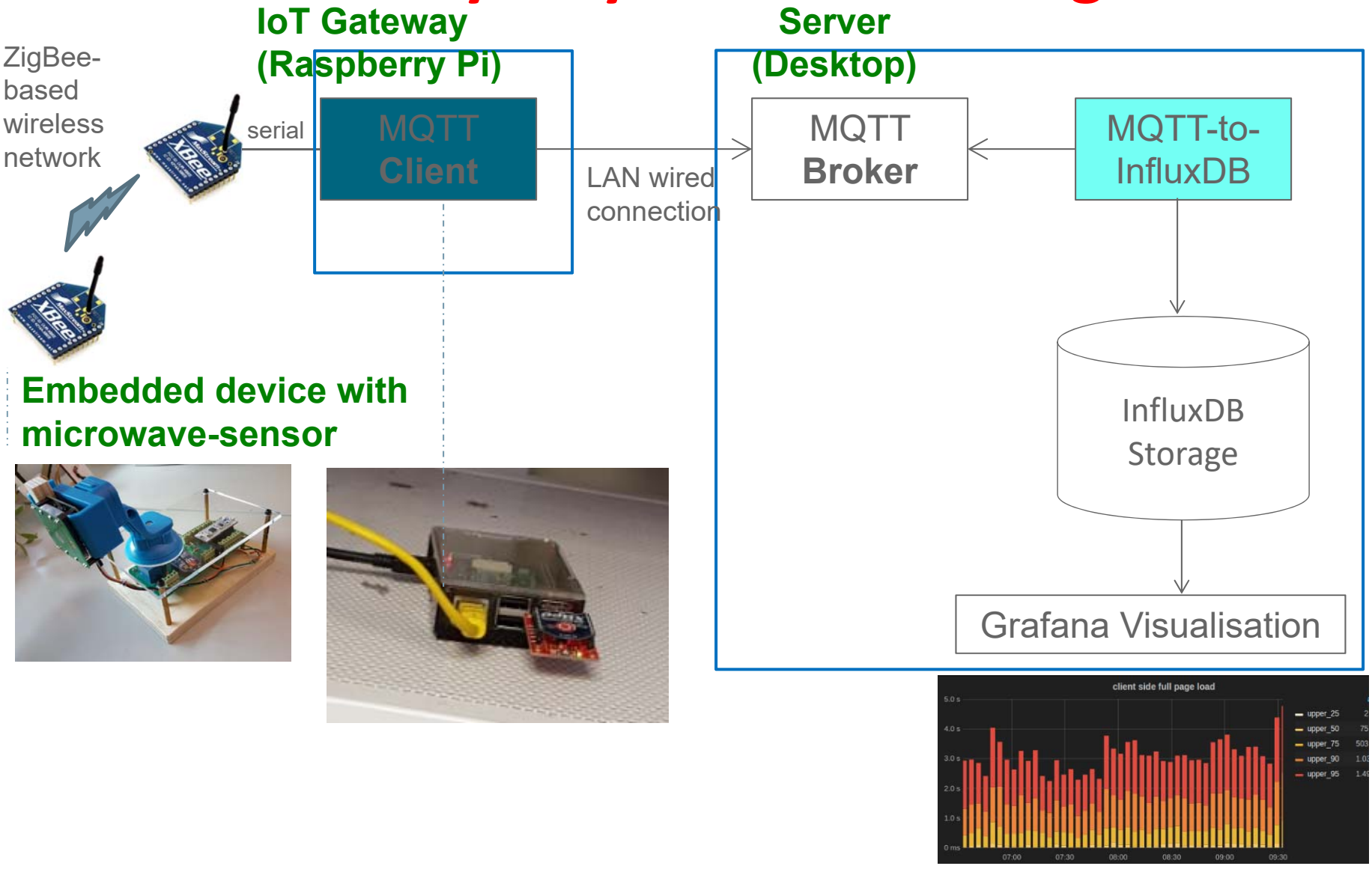
Briefing on Lab 4 Exercise on RemoteEye

Article in Straits Times on 10 April 2016:
'When I die, I want someone to know': Fear of dying alone increases among elderly folk

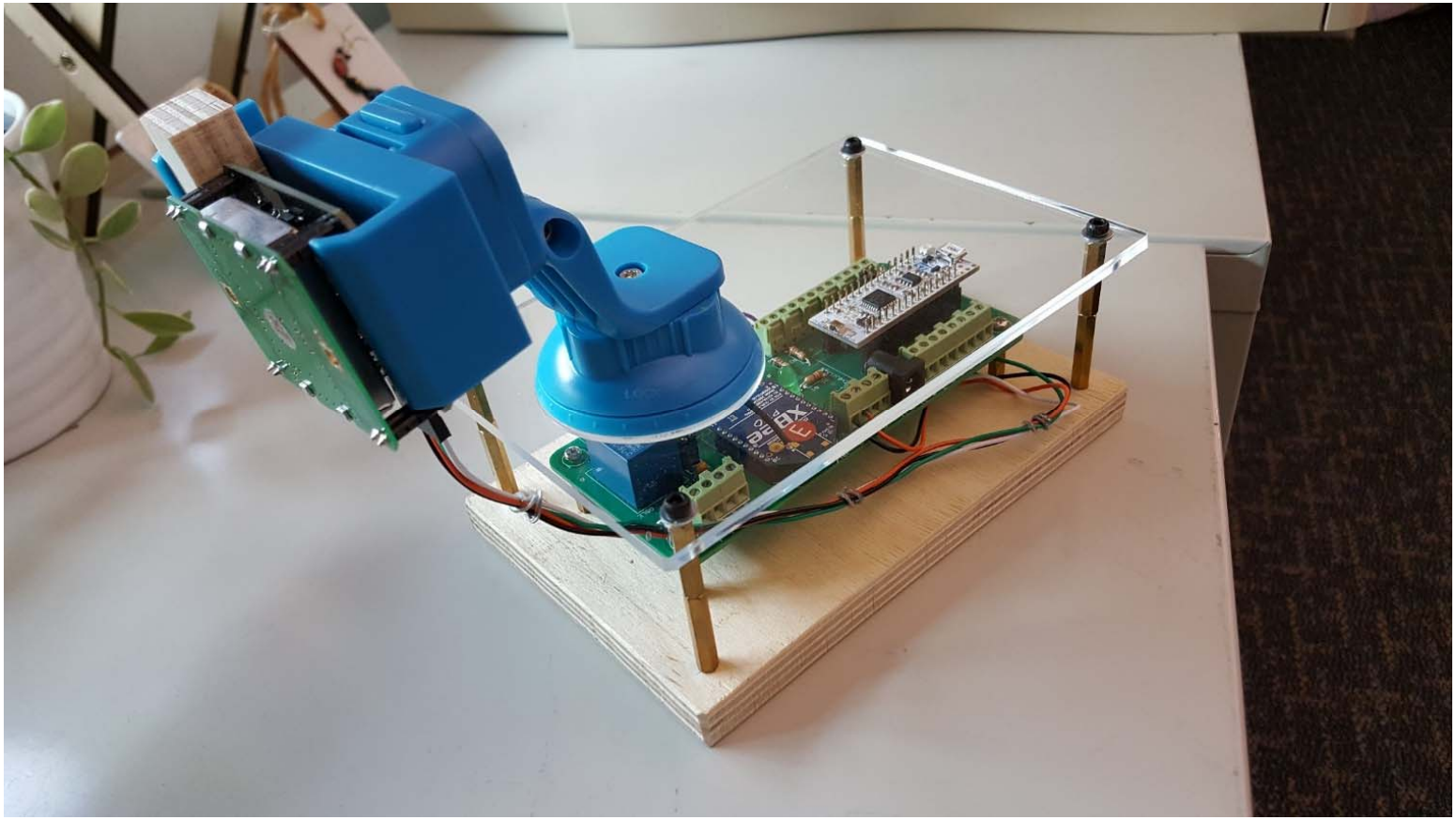
- **Motivation:** Elderly people who live alone are at risk of passing on without neighbours knowing. An article in the Straits Times on 10 April 2016 highlighted this social issue (Figure 1).

- **Scope:** In this proposed project, non-image based sensors shall be used to monitor the activities of these elderly people. Data collected from sensors can be used to facilitate activity-aware IoT applications. These applications can enable family members or neighbours to look out for their loved ones or their elderly neighbours.

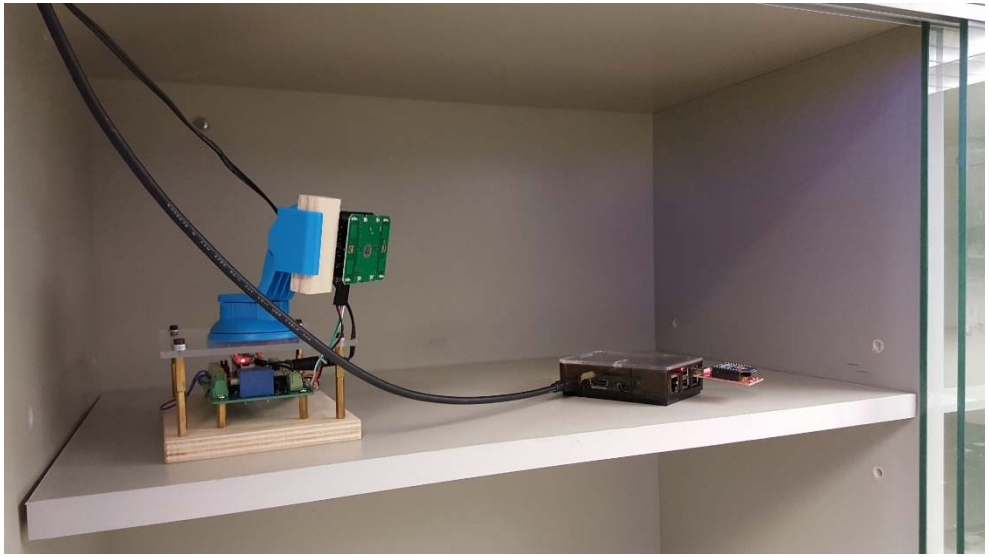
RemoteEye: System Block Diagram



RemoteEye: Hardware Implementation



RemoteEye: Deployment for Test Run



To test run the system, the RemoteEye was installed in one of the labs in EN15-7 to monitor the movement in the lab.