HOME SECURITY SYSTEM

Eng 405 Milestone 6

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Eng 305

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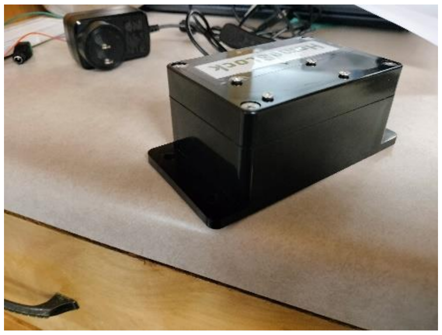
Introduction:

Based on my Design validation test plan Agreement I have 6 total criteria:

- Cost
- Weight
- Lock responding time
- Running Memory Usage
- Size
- Sensor detects Accuracy

And here is its appearance:



Test method

1. Cost
   All required sections will be documented using excel. All data will be stored in the Eng 405 BoM file.
2. Weight
   Using electronic scale OHAUS Scout Series Balance. From datasheet and result they provide in their website. The accuracy or MPE (maximum permissible error) of scale is 0.10%. where:

$$\frac{2 * SD}{N} \leq 0{,}10\%$$

SD — standard deviation. N – Desired smallest net weight

Balance's readability	**d (g)**	**Optimum minimum weight (820d)**
0,01mg	0,00001	0,00820g
0,1mg	0,0001	0,0820g
1mg	0,001	0,820g
0,01g	0,01	8,20g
0,1g	0,1	82,0g

3. Lock responding time
   Two methods are used:
   1. Test with stopwatch. Start at moment when the button clicked; stop at moment sound is heard.
   2. Test with video recording, timer frame by frame.

4. Running Memory Usage
   1. Use system memory to check its running memory check every 5 minute for 5 time with programming running on the front. Android Version 11
   2. Use Phone Check and Test Version 9.5.1.
5. Size
   Measure by metric ruler
6. Sensor detects Accuracy
   Walk under sensor at least 100 times.

Result, process and calculation

Cost

From BoM file:

	Product Cost [$]		**Mass**		**Purchased**	
Qty	**Unit**	**Total**	**Unit [lb]**	**Total [lb]**	**Qty**	**Total Cost [$]**
1	1.831666667	1.831666667	0.039625	0.039625	6	10.99
1	16.99	16.99	0.06	0.06	1	16.99
1	3.695	3.695	0.149375	0.149375	2	7.39
1	10.39	10.39	0.00775	0.00775	1	10.39
1	15.49	15.49	0.3625	0.3625	1	15.49
1	10.99	10.99	0.21875	0.21875	1	10.99
1	5.495	5.495	0.529375	0.529375	2	10.99
4	0.021159574	0.084638298	0.001	0.004	940	19.89

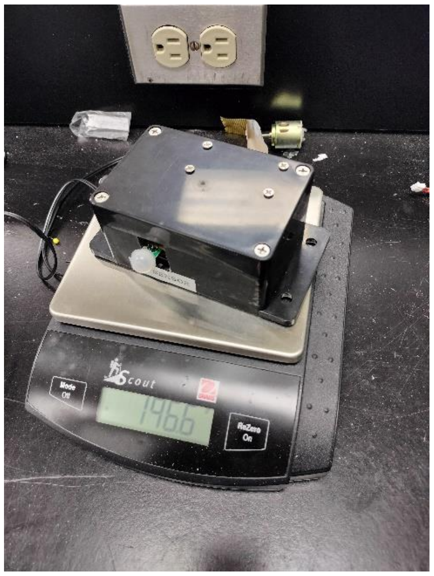
Total mass cost: $103.12

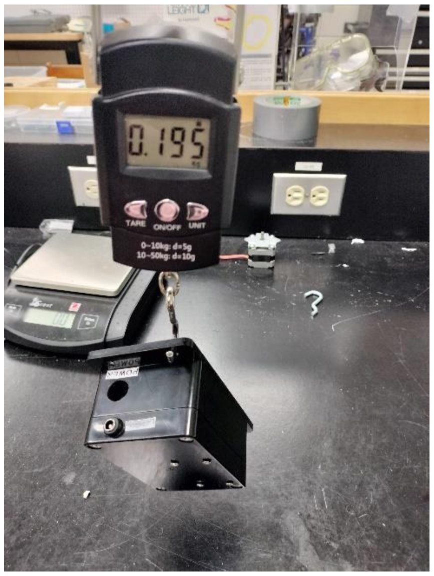
Total product cost: $64.97

All part is in the files include screws.

Pass cost A level

Weight





Test picture file: WeightT1.jpg, and WeightT2.jpg

By OHAUS Scout Series Balance ± 0.10%

Number of times	Result in g	Accuracy
1	196.6	± 0.10%
2	196.6	± 0.10%
3	196.6	± 0.10%
4	196.6	± 0.10%
5	196.6	± 0.10%

By another scale:

Number of times	Result in kg
1	0.200
2	0.200
3	0.195
4	0.196
5	0.195

To ensure accurate measurements, follow these steps for each of the 10 tests:

- Turn off the scale and wait for 1 minute to allow it to stabilize.
- Take 5 measurements using the OHAUS Scout Series Balance with an accuracy of ± 0.10%.
- Take 5 measurements using other scales with a similar accuracy.
- Record the result of each test in the format of X ± 0.10 g, using the same units of measurement for all tests.

The result from the OHAUS Scout Series Balance after taking 5 measurements is 196.6 ± 0.10 g, indicating high precision and reliability. These tests will help to ensure accurate measurements and identify any inconsistencies or errors in the scales used. For another scale: use standard deviation.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i-\mu)^2}.$$

0.1970±0.0025 or 0.197±1.27%

Result of 10 data:
196.9 g± 1.27% g
Pass Weight A Level

Lock responding time:

Relative Files: RespondT.jpg, RespondMP4.mp4

By Stopwatch:

Time Case	s
1	0.25
2	0.16
3	0.19
4	0.26

5	0.24

Result: 0.22±0.043 or 0.22±19.5%

By slow motion video:

Time Case	s	frame
1	0.070	17
2	0.083	20
3	0.075	18
4	0.070	17
5	0.083	20

Result: 0.0762±0.0065 or 0. 0762±8.53% s

Since result have huge difference, I will not use standard deviation for this two. However Both of them:

Pass responding time level A.

Running Memory Usage

In MB connected

6	6	7	5	5	4	6	4	6	3

In MB disconnected

4	3	5	6	5	5	6	4	6	7

As I used MIT App Inventor, I needed to store large amounts of libraries which consumed more MB of memory. However, since my connection and data sending processes had minimal effects on memory usage, I was able to manage the memory efficiently.

Result: 5.15± 1.18 or 5.15±0.22% MB

If Arduino keeps sending data (if Arduino is broken keep sending data 32KB per second), the App will receive it to its maximum capacity and process it simultaneously. The app will crash with a maximum usage running memory 154MB. (Memory overwrite or Pipeline crash)

Pass Running memory Usage Level A.

Size:

Measure by electronic ruler.

Length

In mm	98.53	98.34	99.30	98.64	99.17

Width

In mm	68.33	67.73	68.76	68.43	67.93

Hight

In mm	51.10	50.78	51.06	51.07	50.29

Length
Result: 98.80 ± 0.42 or 98.80 ± 0.42% mm

Width

Result: 68.24 ± 0.40 or 68.24 ± 0.60% mm

Hight

Result: 50.86 ± 0.34 or 50.86 ± 0.68% mm

Pass Size Level A.

Sensor detects Accuracy

Relative file: Accuracy.MOV

With video record the process of passing through door and phone. Wait at least 5 second after every time I go through the door, In more than 100 times test, **the detection rate is 100%**

Pass 6. Sensor detects Accuracy Level A.

Conclusion:

Cost: $64.97.	**Pass A**
Weight: 196.9 g± 1.27% g	**Pass A**
Lock responding time:	
By Stopwatch: 0.22s ± 0.043s or 0.22s ± 19.5%s	**Pass A**
By video: 0.0762 s ± 0.0065 s or 0. 0762 s ± 8.53% s	**Pass A**
Running Memory Usage: 5.15 MB ± 1.18 MB or 5.15 MB ±0.22% MB	**Pass A**
Size:	
Length: 98.80 mm ± 0.42 mm or 98.80 mm ± 0.42% mm	**Pass A**
Width: 68.24 mm ± 0.40 mm or 68.24 mm ± 0.60% mm	**Pass A**
Hight: 50.86 mm ± 0.34 mm or 50.86 mm ± 0.68% mm	**Pass A**
Sensor detects Accuracy: 100%	**Pass A**