



King Saud University.

College of engineering.

GE-105: Introduction to Engineering Design.

Semester, 2015.



Digital Advisory Weighting Scale.

Group number 2.

Names

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Introduction:

A healthy diet is one of the best tools to optimize the general health and wellbeing of a person. It can keep the blood pressure, cholesterol levels, and weight under control. In addition to preventing many possible future health issues such as heart diseases and diabetes which are to a high level directly related to the person's eating habits.

Unfortunately, obesity rates increased by almost 3 times in the past 20 years. Not in the developed countries only but also in the developing countries such as the Middle East and China. In Saudi Arabia, a study indicated that 70% of the population suffers from obesity. And 23% of adults are diabetics. (As shown in figure 1)

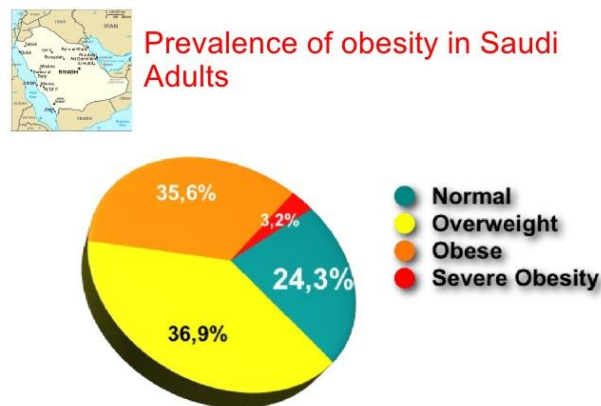


Figure 1: static about the weight in Saudi Arabia

The causes may be attributed to many factors. One of them is the lack of knowledge to the proper diet. The issue here is that there is no single diet that is right for everyone. It depends on the person's weight (Which vary over time) and height and gender. This is why it is important to identify individual needs and preferences and plan accordingly.

Problem statement: Many people find it difficult to determine if their weight is healthy, and how to obtain the best diet by knowing the nutritional values that they need to consume daily.

Primary objective: Design a digital scale that is able to measure the person weight to calculate the nutritional values needed to consume in a day.

Secondary objective: It will calculate the number of calories needed to maintain the weight, decrease it or increase it. In addition to an exercise plan suitable for your situation.

Need analysis:

Need:

- Weight measurement.
- Height measurement.
- Advise the best diet program based on the individual need.
- Safe
- Easy-to-use.
- Low cost.
- to last at least 5 years in normal usage.
- Shouldn't cost more than 150 SR(for manufacturing).
- Low power consumption.

Want:

- Exercise plan.
- Light weight.
- Easy-to-maintain.
- Waterproof.
- 5 years warranty

Future work:

- USB port to connect it with a printer and print out the results.

Targeted market:

- People who want to be healthy and decrease or increase their weight by obtaining a balanced diet.

- Problem definition:

Design a digital scale that is able to measure the person's weight to calculate the nutritional values needed to consume in a day. It will calculate the number of calories needed to maintain the weight, decrease it or increase it. In addition to an exercise plan suitable for your situation. It should measure the weight and height, advice the best diet program, be safe and easy to use and maintain. It has to be light weight (4 kg), low power consumption and portable. And it must be durable, has a display with high resolution, 5 years warranty. It should last 5 years at least in normal usage, advice the best exercise plan. It should not cost more than 150 S.R.

Criteria:

- Low cost.
- Durability.
- Light weight.
- Portable.
- Safety.
- Power consumption.
-

Constraints:

- Cost should not exceed 150 S.R.
- Maximum measured weight is 200 KG.
- Weight of the scale should not exceed 4 KG.
- Size should be 30cm(width)*35cm(length)*4cm(thickness).
- 120-200cm for height measurement.
- Power source should last for at least 2 month before replacing\recharging.

Needed information:

1-Average highest and weight of people.

We found that the world average weight is 62 KG. but to make sure that our product will cover a wider range of countries we looked to the highest average which is 87.4 KG in Micronesia and USA. (as shown in figure 2)

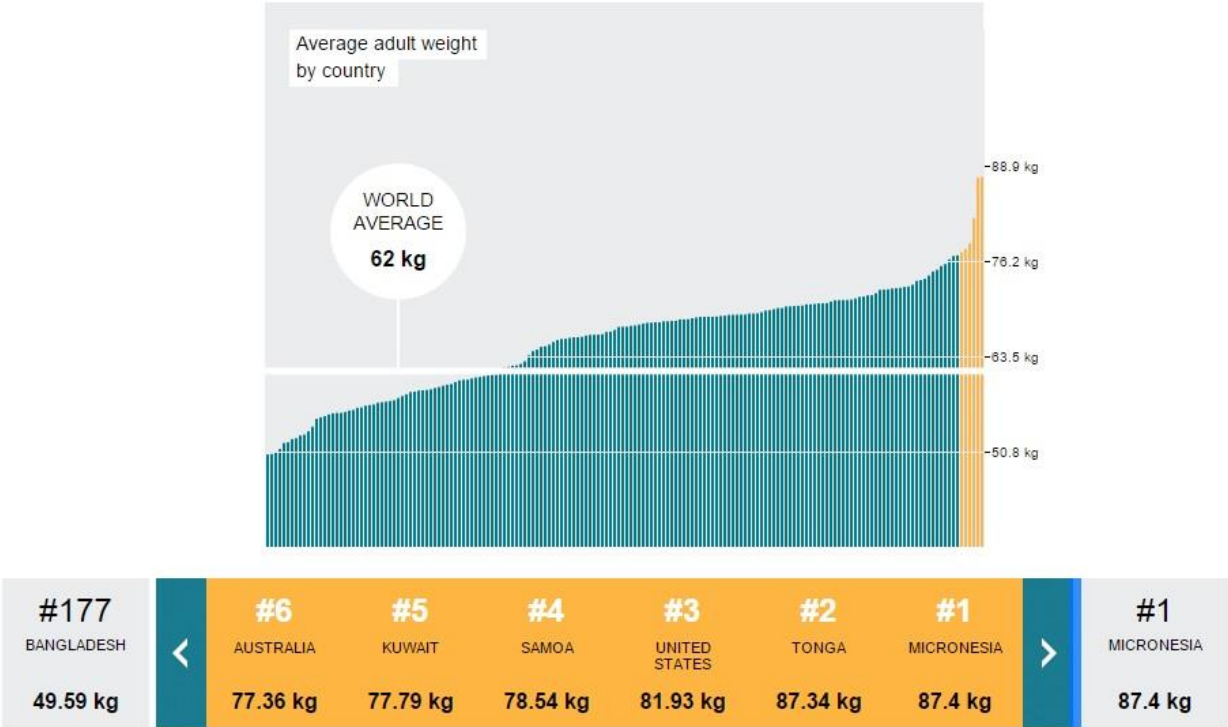


Figure 2 average weight in the world

As for the height, The people of the Dinaric Alps (South Slavs) are the tallest in the world, with a male average height of 185.6 cm.

2-Different types of material based on its mechanical characteristic.

Aluminum: Soft, strong, lightweight, fire-proof and heat-resistant, easy to work into new shapes, and able to conduct electricity. It reflects light and heat very effectively and it doesn't rust. The price is higher than other materials.

Wood: Light weight and does not conduct electricity which makes it safe. But not good with water and hard to form. The price is on the cheap side.

Gold: Extremely malleable. Very ductile and The ability of gold to efficiently transfer heat and electricity is high. The cost is very expensive.

Silver: Malleable, soft and has high density. Similar to gold in mechanical characteristic and cheaper but still very expensive.

Plastic: Low elongation at break and heat resistance, excellent electrical insulating features, not suitable for high centrifugal forces. Very cheap.

Glass: The main characteristics are transparency, heat resistance, pressure and breakage resistance and electrical insulating. Reasonable price.

Steel: alloys of iron and other elements, primarily carbon, widely used because of their high tensile strengths and low costs. But conduct electricity.

3- Sources of power :

Lithium batteries (as shown in figure 3) : It have lithium compounds as an anode.

They stand apart from other batteries in their high charge density (long life) and high cost per unit. Depending on the design and chemical compounds used, lithium cells can produce voltages from 1.5 V to about 3.7 V.

Lithium batteries are rechargeable and widely used in products such as portable smart phone and laptops. Typical capacity is 800-1500 mAh. The price from 10 to 25 \$ US.



Figure 3:sample of a Lithium battery

CR2032 Battery (as shown in figure 4): A CR2032 battery is a button cell battery rated at 3.0 volts. It is commonly used in computers as a CMOS battery, calculators, remote controls, scientific instruments, wireless doorbells, watches, and other small devices. Nominal diameter is 20 mm, nominal height is 3.2 mm and it weighs 3 grams.

Typical capacity is 225 mAh, nominal voltage is. Price from 0.5 to 2 \$ US.



Figure 4:sample of a CR2032 Battery

Electrical outlet:

AC power plugs and sockets are devices that allow electrically operated equipment to be connected to the primary alternating current (AC) power supply in a building. Electrical plugs and sockets differ in voltage and current rating, shape, size and type of connectors. The types used in each country are set by national standards.

AAA battery:

An AAA or triple-A battery is a standard size of dry cell battery commonly used in small electronic devices, such as TV remote controls, MP3 players and digital cameras. Typical capacity is 540 mAh and Nominal voltage 1.5 v it also not rechargeable. The price from 1\$ to 5 \$ US for a pack of 4 batteries.

4- Dimensions of the scale.

Platform dimensions:

- Length: 35 cm.
- Width: 30 cm.
- Thickness: 4 cm.

Height of display screen:

120 cm.

Height measurement (adjustable rod):

120-200 cm.

Digital display size:

6 inches.

5- Display:

LCD (liquid crystal display): Is the technology used for displays in notebook and other smaller computers. LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. It uses backlight to display the pixels which consumes power. The cost is 10-12\$.

OLED(organic light-emitting diode): works without a backlight; thus, it can display deep black levels and can be thinner and lighter and consume less power than a liquid crystal display (LCD). The price is 20-25\$.

TFT (Thin-film-transistor) display: Each pixel is controlled by from one to four transistors. The resolution is low and the technology used is old. It is not able to show colors and modern graphics. Power consumption is low

6- Daily nutritional values needed.

To calculate the daily need of calories we need to know the gender and the weight of the person first. A normal man needs one calorie per kilogram of weight per hour to keep his weight. And a normal woman needs 0.85 calorie per kilogram per hour.

Different nutrient produces different amount of calories per gram the each one should be consumed in a certain percentage of the whole daily diet as follows:

- Carbohydrates produce 4 calories per gram. It should be 50% of your diet.
- Fat produce about 9 calories per grams, and it should be 15% of your diet.
- proteins produce 4 calories per grams and you need 35%.

Body mass index (BMI) is a good indicator of the weight. It is defined as the body mass divided by the square of the body height. The results are shown in the figure:

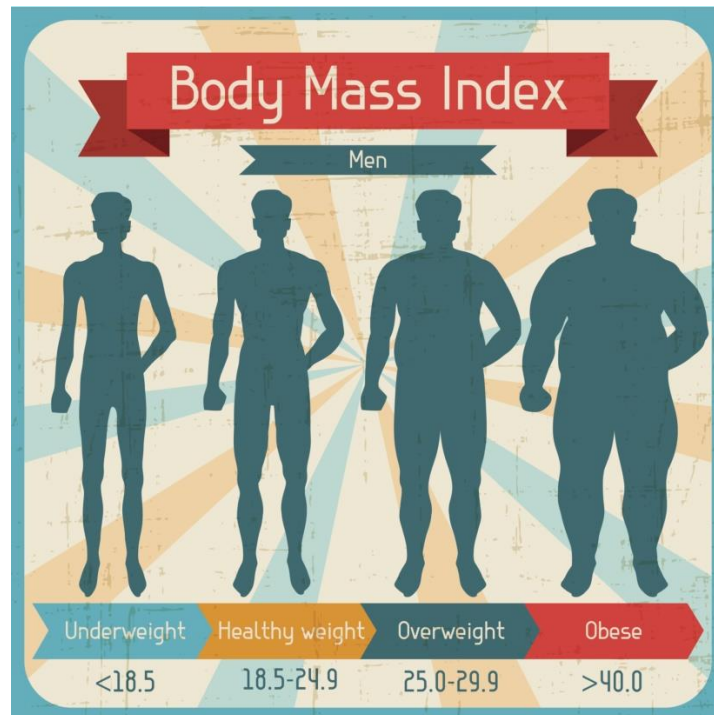


Figure 5 : BMI index.

Morphological analysis:

The important features and means that can be used in our project (as shown in Table 1)

Table 1:Morphological analysis

Feature\Function.	1	2	3	4	5	6
Material for scale	Aluminum	Steal	Plastic	Glass	Silver	Wood
Power source	rechargeable Built-in battery(lithium)	CR2032 Battery	Electrical outlet	AAA battery	Nuclear energy	Solar energy
Display Type	LCD display	OLED display	TFT display			
Control type	Touch screen	analog stick and keyboard	Voice control	Remote control		
Shape of scale	Circular	Square	Rectangular	Hexagonal	Triangle	
Material for stand	Aluminum	Steal	Plastic	Glass	Silver	Wood

Concepts:

We have generated the Morphological analysis into 14 concepts (as shown in Table 2)

Table 2: Our concepts

Concept	Material for scale	Material for stand	Power source	Display Type	Control type	Shape of scale	elimination reason
1	steel	plastic	Lithium battery	LCD display	buttons and keyboard	Hexagonal	PASSED
2	steel	steel	Lithium battery	OLED display	Touch screen	Rectangular	PASSED
3	Glass	Aluminum	Electrical outlet	LCD display	Voice control	Square	Voice control is difficult to use and requires a microphone.
4	steel	Plastic	Nuclear energy	TFT display	Touch screen	Circular	Nuclear energy is almost impossible to generate.
5	Glass	Aluminum	Lithium battery	OLED display	Touch screen	Rectangular	Too expensive because of the screen and the built-in battery and the material used.
6	Aluminum	Plastic	Electrical outlet	TFT display	Buttons and keyboard	Circular	PASSED
7	Wood	Aluminum	AAA battery	LCD display	Touch screen	Rectangular	Wood can't handle moisture.
8	Glass	Glass	Lithium battery	LCD display	Buttons and keyboard	Square	Easy to break because of the glass.
9	Aluminum	Plastic	AAA battery	LCD display	Remote controller	Square	PASSED
10	Glass	Aluminum	CR2032 battery	OLED display	Touch screen	Rectangular	PASSED
11	Aluminum	steel	Solar energy	OLED display	Touch screen	Rectangular	Solar energy is not an efficient source of power because it is used indoor.
12	Silver	Silver	Lithium battery	OLED display	Buttons and keyboard	Rectangular	Too heavy and too expensive
13	Aluminum	Plastic	CR2032 battery	LCD display	Touch screen	Triangle	triangle shape is not practical
14	Plastic	Plastic	CR2032 battery	LCD display	Touch screen	Circular	full plastic body does not look premium

Possible designs:

After that we choose the best 5 concepts in our project (as shown in Table 3)

Table 3: Best concepts

	Material for scale	Material for stand	Power source	Display Type	Control type	Shape of scale
Design 1	Steel	plastic	Lithium battery	LCD display	buttons and keyboard	Hexagonal
Design 2	steel	steel	Lithium battery	OLED display	Touch screen	Rectangular
Design 3	Aluminum	Plastic	Electrical outlet	TFT display	Buttons and keyboard	Circular
Design 4	Aluminum	Plastic	AAA battery	LCD display	Remote controller	Square
Design 5	Glass	Aluminum	CR2032 battery	OLED display	Touch screen	Rectangular

Weight and Rate

Weighting table with two different scenarios: (as shown in Table 4)

Table 4: scenarios and weight

	Low cost	Durability	Lightweight	Safety	Low power consumption
Compromise	20	20	20	20	20
Last a long time	10	40	10	10	30

Rate with compromise scenario: (as shown in Table 5)

Table 5: rate compromise scenario

	Low cost	Durability	Lightweight	Safety	Low power consumption	Evaluation
Weight	20	20	20	20	20	
Design 1	7	6	5	6	6	600
	140	120	100	120	120	
Design 2	8	7	4	6	7	640
	160	140	80	120	140	
Design 3	5	5	7	6	4	540
	100	100	140	120	80	
Design 4	4	4	8	6	6	560
	80	80	160	120	120	
Design 5	6	7	9	8	8	760
	120	140	180	160	160	

Design 5 is the best design.

Rate with long lasting scenario: (as shown in Table 6)

Table 6: rate long lasting scenario

	Low cost	Durability	Lightweight	Safety	Low power consumption	Evaluation
Weight	10	40	10	10	30	
Concept 1	7	6	5	6	6	600
	70	240	50	60	180	
Concept 2	8	7	4	6	7	670
	80	280	40	60	210	
Concept 3	5	5	7	6	4	500
	50	200	70	60	120	
Concept 4	4	4	8	6	6	520
	40	160	80	60	180	
Concept 5	6	7	9	8	8	730
	60	280	90	80	240	

Design 5 is also the best design. It will be our design.

The figure (6 and 7) shows us the sketch of our best design in AutoCAD and Solidwoks respectively:

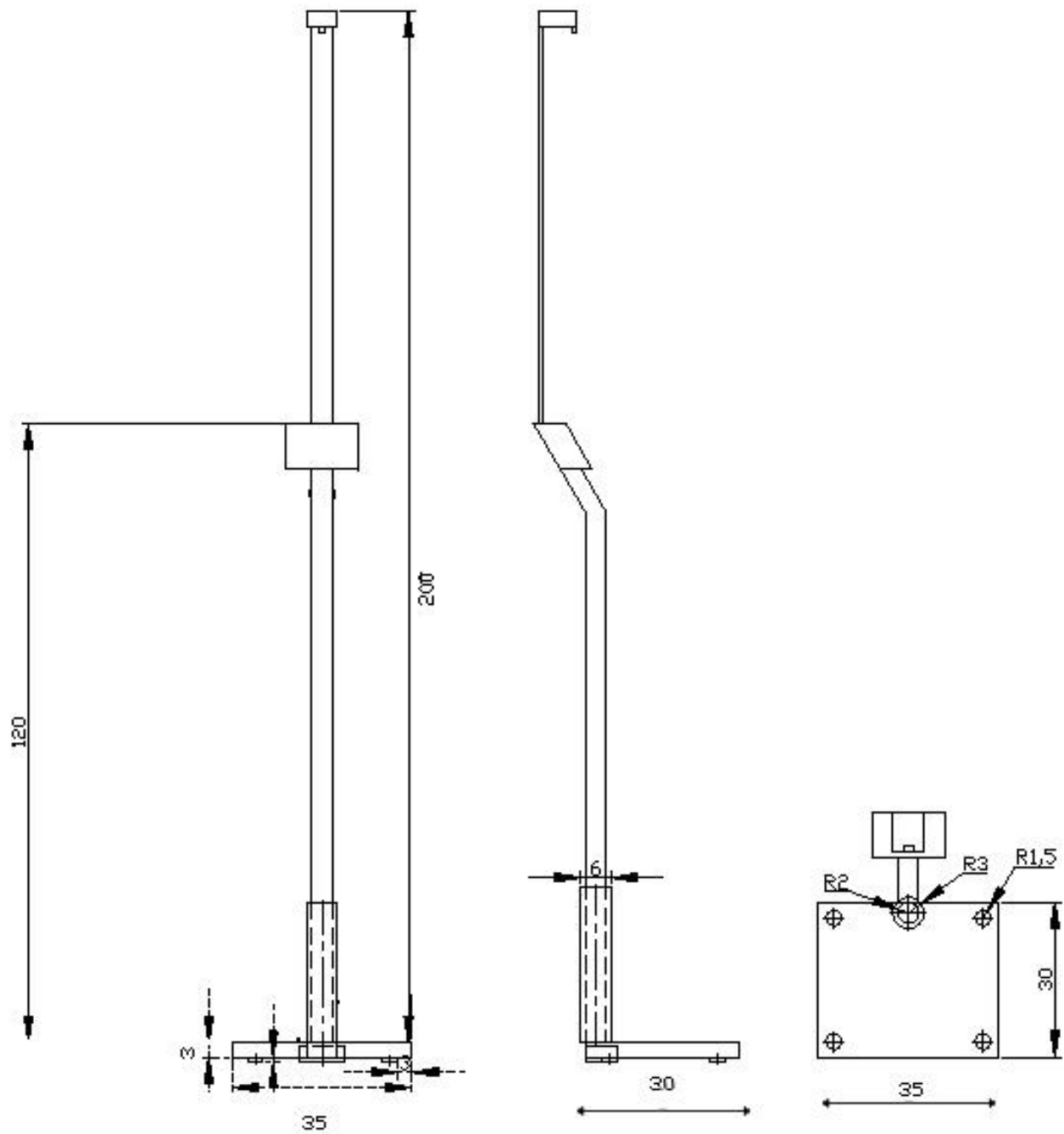


Figure 6:skech of the best design



Figure 7 sketch of the best design in Solid works

Human factors

Anthropometric (static) Factors:

- Scale dimensions (Platform):
 - Length: 35 cm
 - Width: 30 cm
- Maximum stand height 200cm.
- Maximum measured weight is 200 KG.

Ergonomic Factors (dynamic):

- Fast responsive touch screen that does not require a high force to be clicked for easy control.
- Flexible and light stand for easy adjustment when measuring the height.
- Stand height 120cm for easy reach to the screen while standing on the scale.
- Soft touch glass to provide comfort while stepping in and out. It does not store heat or coldness to be comfortable on the feet.

Physiological:

- Display is not too bright for the eyes.
- Display size 6" for clear view to the text and graphs.
- Light and clear color combination for best screen reading.
- Different font sizes.

Psychological:

- Graphical user interface is attractive.
- The software is easy to use and the settings can be easily adjusted.
- The scale design is attractive.
- Using colors as indicators for weight, red for overweight, green for healthy weight and yellow for underweight.

Conclusion:

Choosing a proper diet is not a simple task. Our digital scale will measure the weight and height and uses an advanced software that help people with their daily diets by doing many calculations to find the needed amount of calories and which of them are from fat, protein and carbohydrates. Presented in a high resolution display and a glass scale connected to a solid aluminum stand.

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- 1) <http://www.fitness.gov/resource-center/facts-and-statistics/>
- 2) <http://abbottadult.com.sg/diabetes/healthy-eating?&pc=tr>
- 3) <http://www.telegraph.co.uk/news/earth/earthnews/9345086/The-worlds-fattest-countries-how-do-you-compare.html>
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