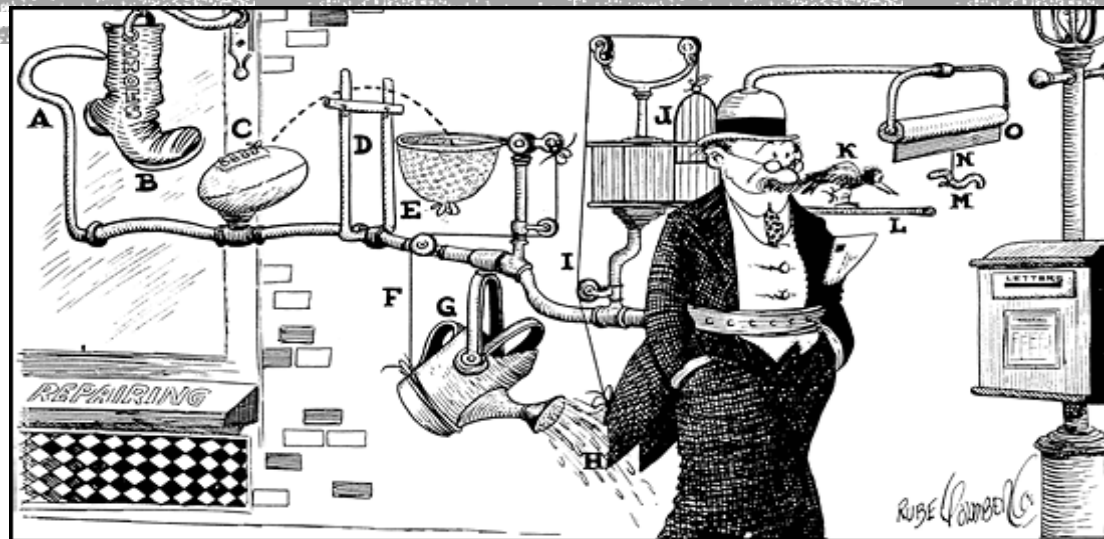


# Rube Goldberg Machine

## Northern Arizona University

### June 28, 2018

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# Topic 1: Project Description

- ▶ The objective is to create a series of Rube Goldberg steps that are efficient, reliable, and resettable.
- ▶ The last step is unidentified until next semester.
- ▶ To accomplish the goal, the steps should involve engineering aspects.
- ▶ Focused ideas: Spring, Fluid, Heat, Gears, Aerodynamics, Sensors
- ▶ There is need to make a prototype for the considered steps by the end of the semester.

# Sponsors and significance of the project

- ▶ The sponsors of the project are Dr. Trevas and the NAU.
- ▶ Final design should satisfy the needs of the clients.
- ▶ The Rube Goldberg machine will be used to teach future students various engineering aspects.
- ▶ It will be used as a form of brainstorming and leisure project.
- ▶ It will mix creativity into Engineering.

# Black box Model

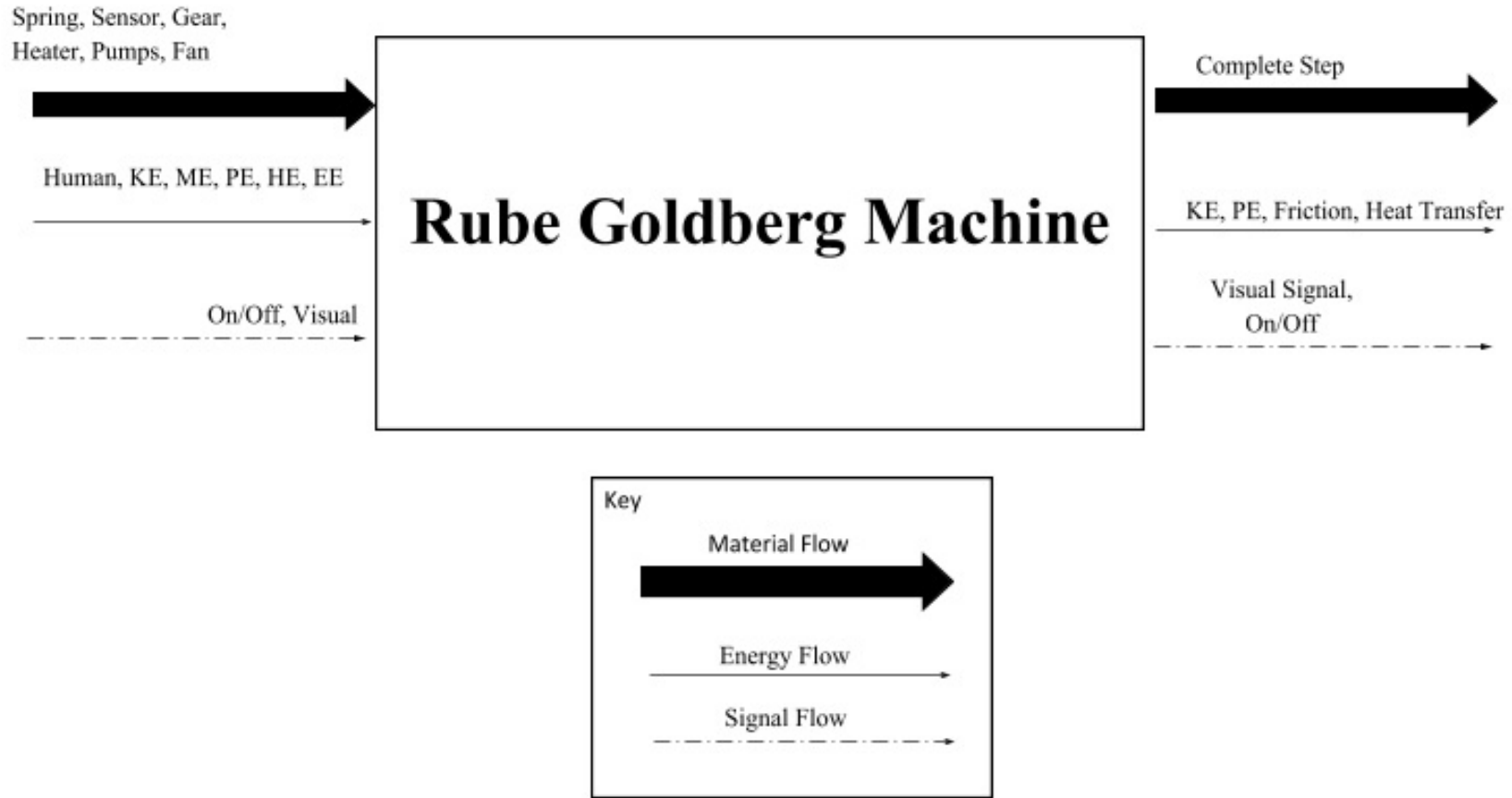


Figure.1

# Detailed Decomposition Model

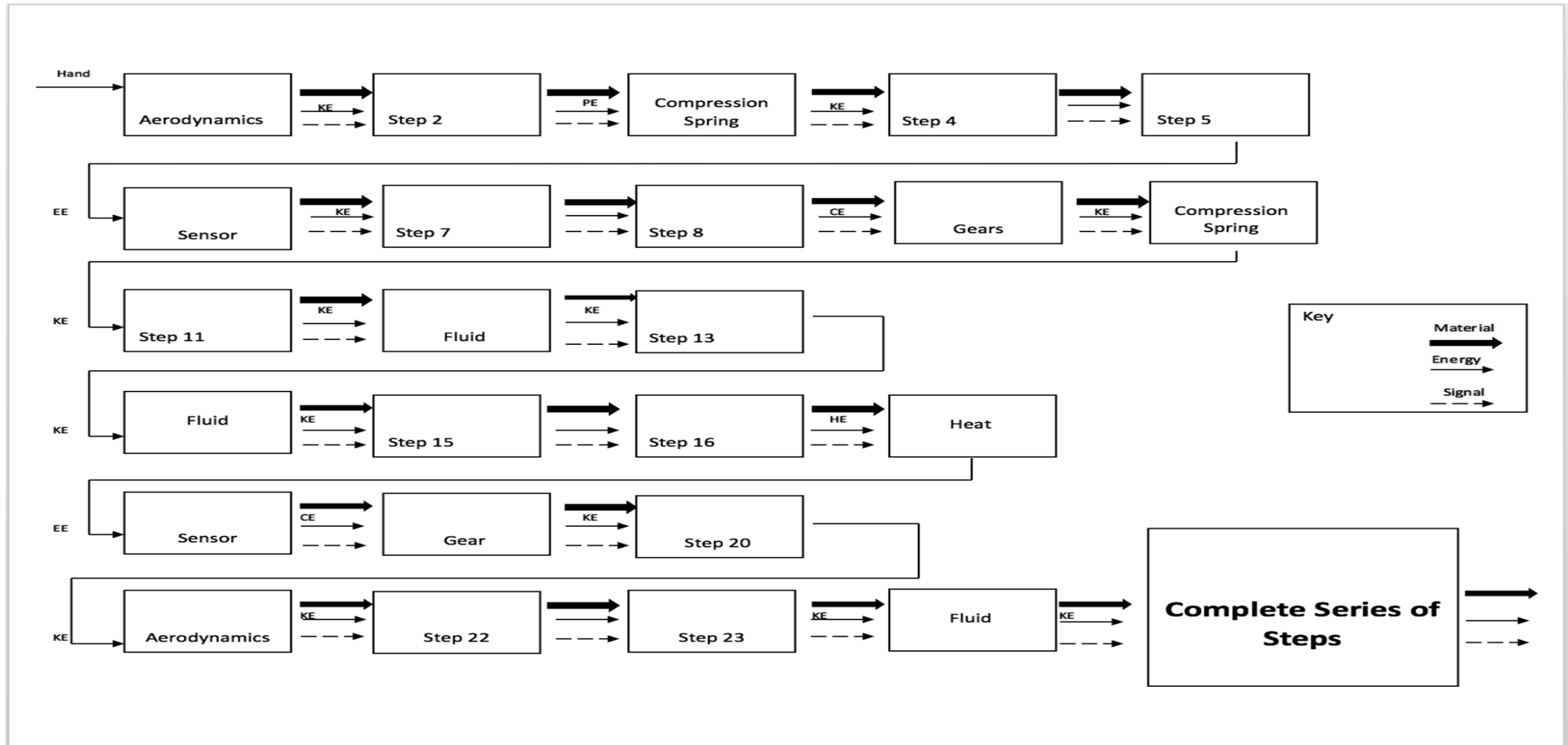


Figure.2

# Topic 2: Designs Considered



Figure.3

**Advantages:** Resettable, Safety, Reliable

**Disadvantages:** Durability may fail, may not be precise on time

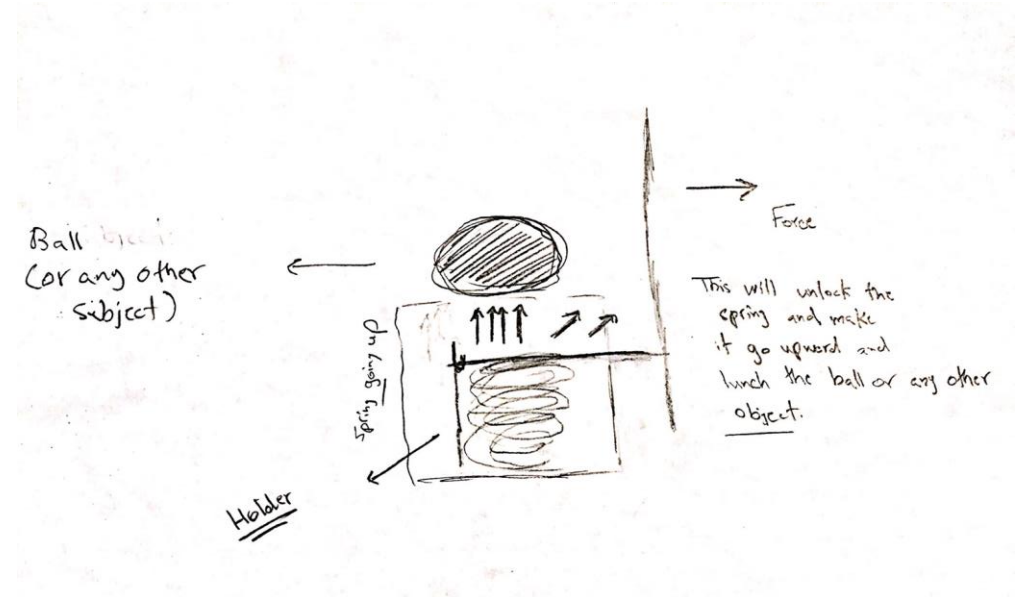


Figure.4

**Advantages:** Safety, Reliable, not expensive

**Disadvantages:** Launching the ball may not be precise, not resettable

# Continued Designs Considered

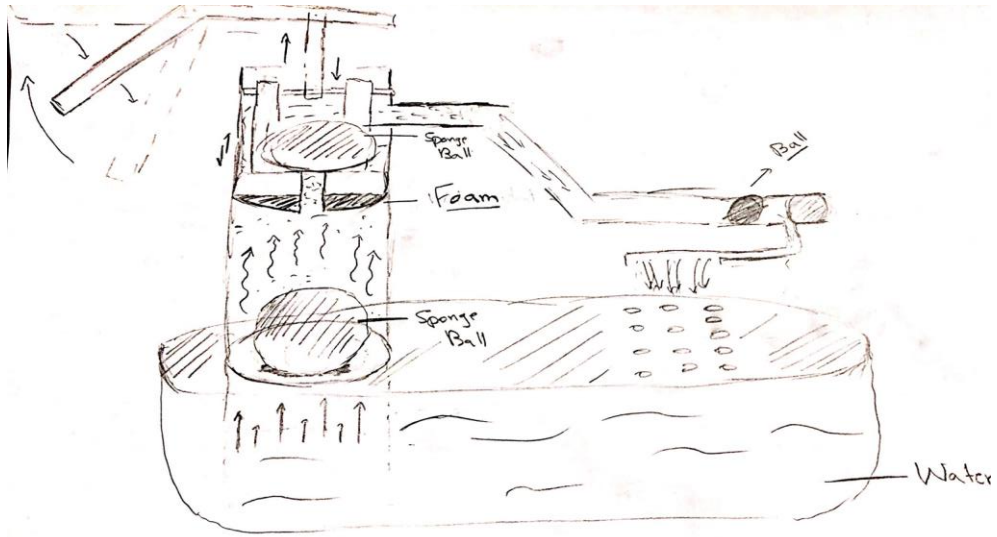


Figure.5

**Advantages:** Resettable, Safety, Reliable, Fun to watch

**Disadvantages:** Timing to pump the water, need a reliable object to pump the water

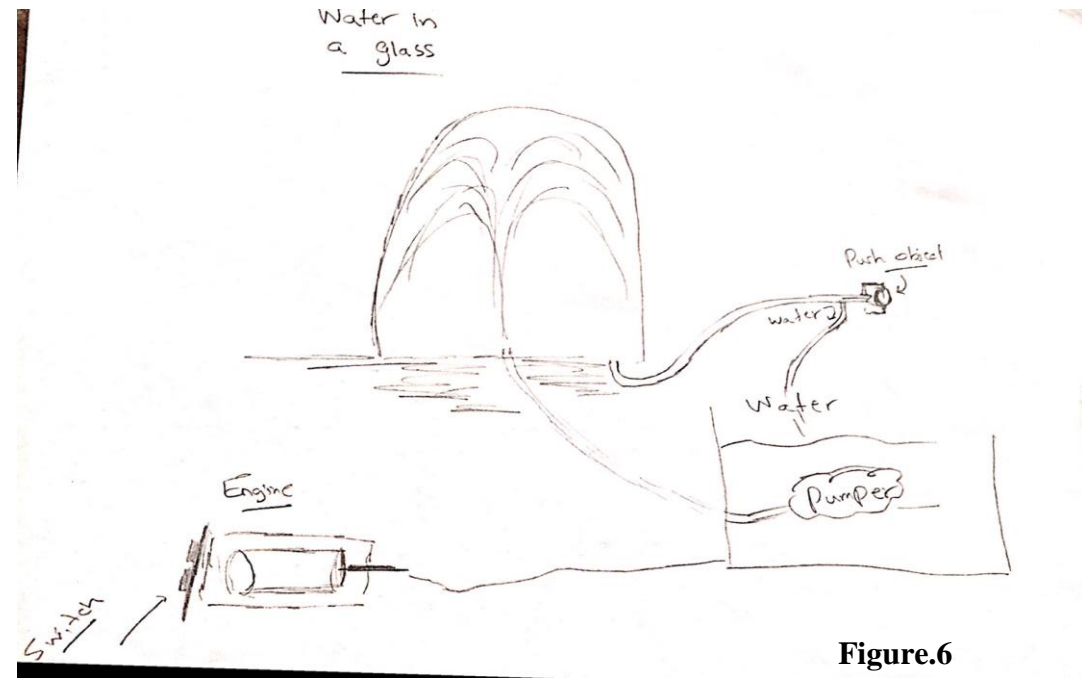


Figure.6

**Advantages:** Safety, Reliable, Fun to watch, Resettable.

**Disadvantages:** Energy may fade fast.



# Continued Designs Considered

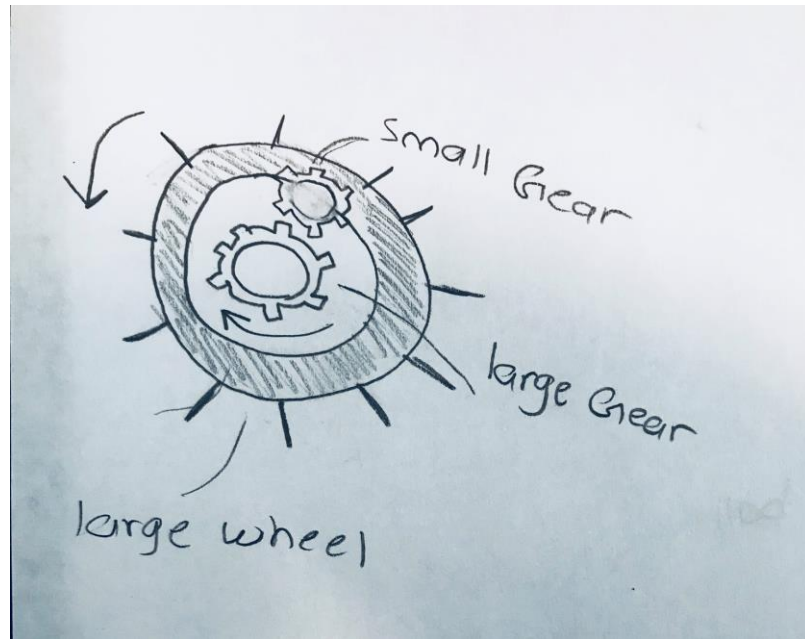


Figure.7

**Advantages:** Restable, Reliable and cost effective

**Disadvantages:** simple and might be not entertaining.

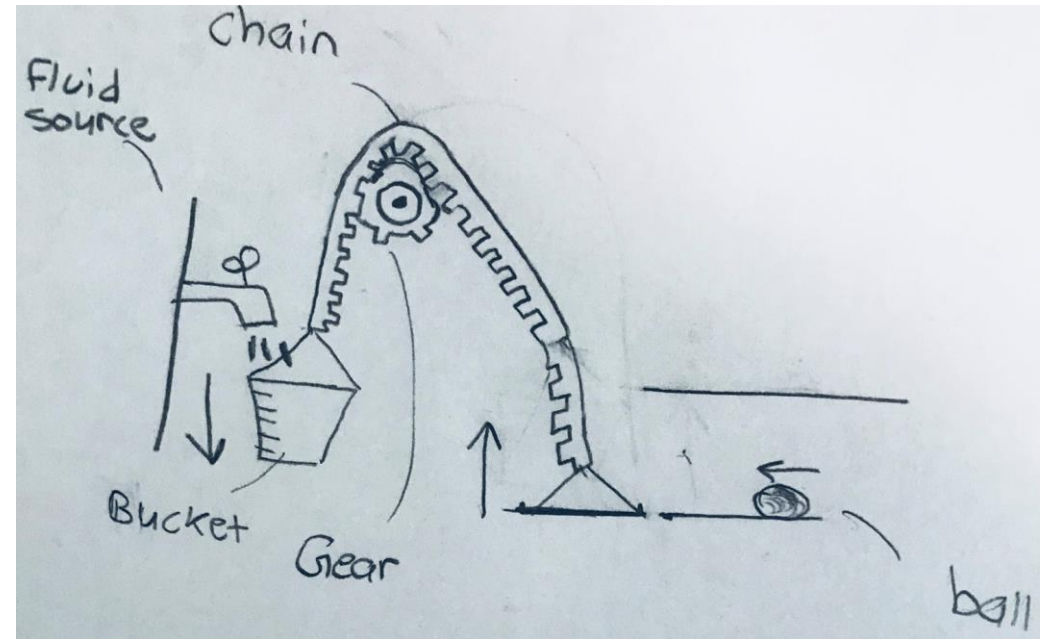


Figure.8

**Advantages:** Entertaining, has a good timing to finish the step.

**Disadvantages:** depends on a fluid source to process, cost intensive.



# Continued Designs Considered

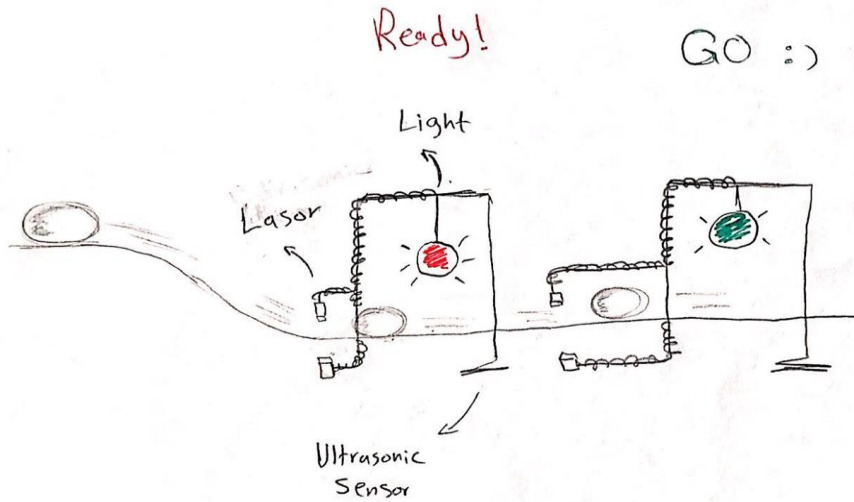


Figure.9

**Advantages:** Creative, Entertaining, attracts audience

**Disadvantages:** The light might delay turning on.

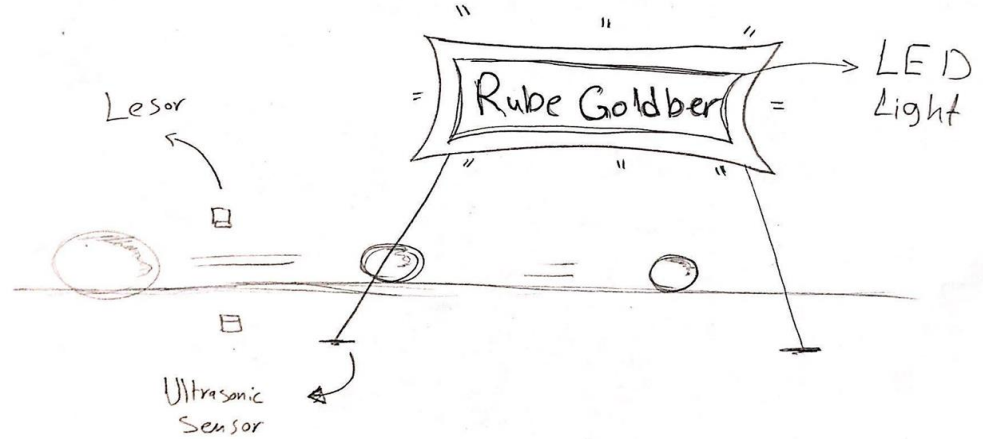


Figure.10

**Advantages:** Entertaining way to end, interesting to watch

**Disadvantages:** Full LED screen might not switch on fully

# Continued Designs Considered

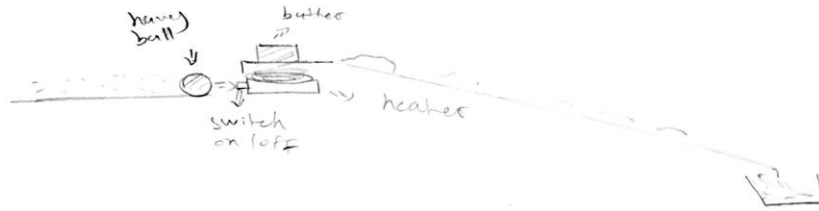


Figure.11

**Advantages:** Cost effective.

**Disadvantages:** Takes time to process, not resettable

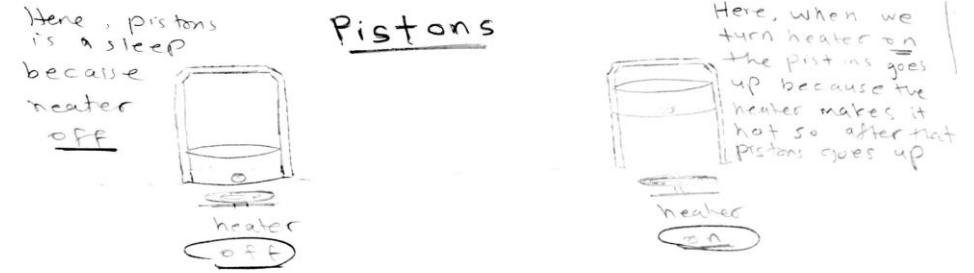


Figure.12

**Advantages:** Fun factor, cost effective

**Disadvantages:** Takes time to process, not resettable

# Continued Designs Considered

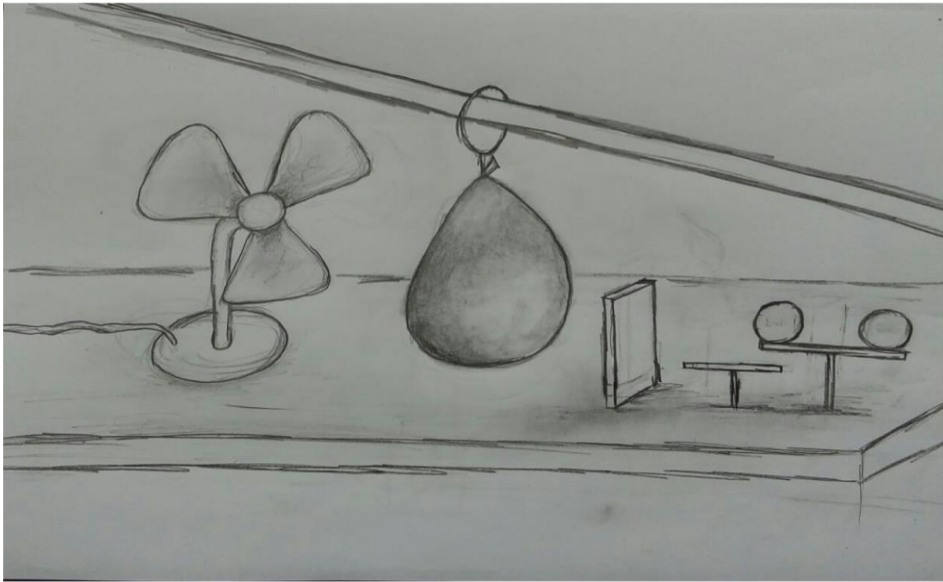


Figure.13

**Advantages:** safety, it has cheap material

**Disadvantages:** Not resettable

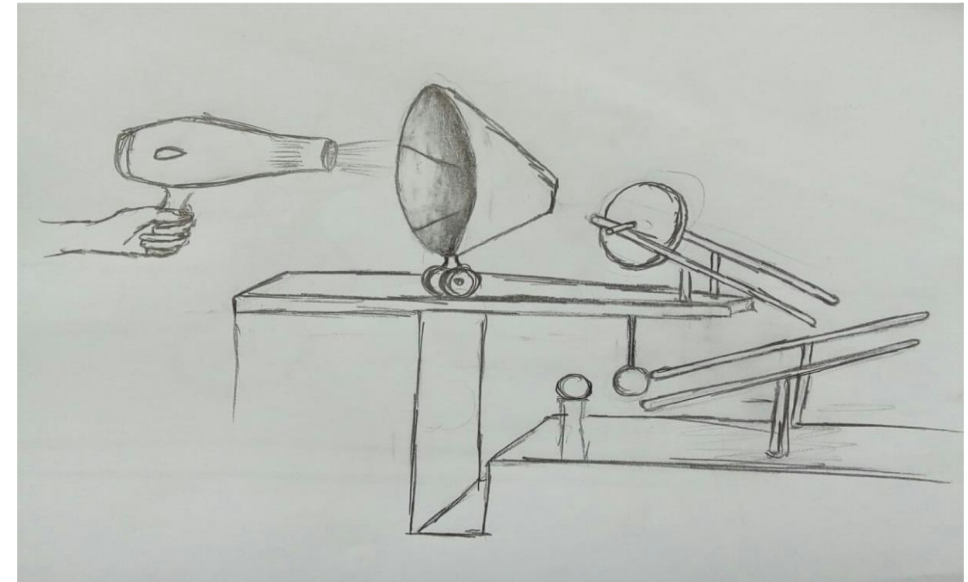


Figure.14

**Advantages:** Safety, different materials makes it fun to watch

**Disadvantages:** Not resettable



# Topic 3: Design Selected

## ER's:

Engineering requirements	Target values
Number of steps	20-75
Process duration	Less than 2 minutes
Size	10 ft x 10 ft
Speed & Sound	Not loud or harmful to others/ Moderate speed to enjoy
Reset time	8 minutes

Table.1

# Decision Matrix

## Key:

Customer Requirements	Weight %
Cost effective	5
Durability	4
Entertaining	2
Reliability	3
Resetable	3
Safety	5
Sound	3
Timing	5
<b>Total</b>	
<b>Designer</b>	

Table.2

# Continue Decision Matrix


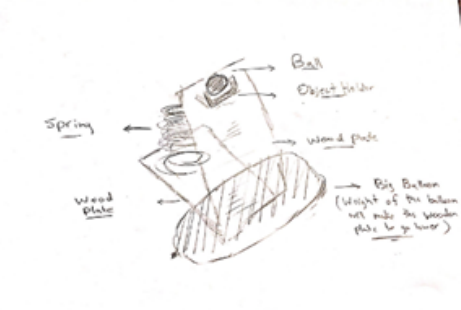
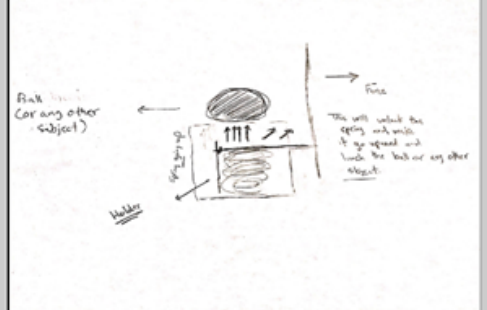
							
		Spring #1		Spring #2		Spring #3	
Customer Requirements	Weight %	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Cost effective	5	3	15	3	15	5	25
Durability	4	3	12	2	8	3	12
Entertaining	2	3	6	2	4	3	6
Reliability	3	4	12	2	6	4	12
Resetable	3	3	9	2	6	3	9
Safety	5	5	25	4	20	5	25
Sound	3	3	9	4	12	3	9
Timing	5	2	10	2	10	4	20
<b>Total</b>			<b>98</b>		<b>81</b>		<b>118</b>
<b>Designer</b>		<b>Naser</b>		<b>Naser</b>		<b>Naser</b>	

Table.4

# Continue Decision Matrix

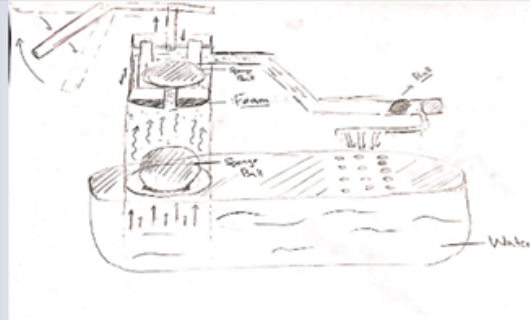
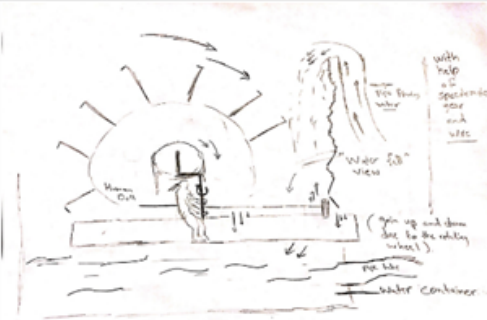
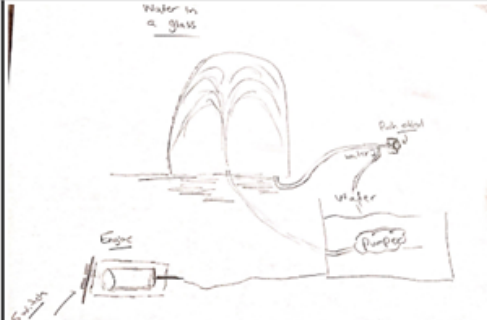
	 <p><b>Fluid #1</b></p>		 <p><b>Fluid #2</b></p>		 <p><b>Fluid #3</b></p>	
<b>Customer Requirements</b>	<b>Score</b>	<b>Weighted Score</b>	<b>Score</b>	<b>Weighted Score</b>	<b>Score</b>	<b>Weighted Score</b>
Cost effective	4	20	3	15	4	20
Durability	4	16	4	16	4	16
Entertaining	3	6	4	8	4	8
Reliability	3	9	3	9	3	9
Resetable	4	12	4	12	4	12
Safety	5	25	5	25	5	25
Sound	3	9	3	9	4	12
Timing	4	20	4	20	4	20
<b>Total</b>		<b>117</b>		<b>114</b>		<b>122</b>
<b>Designer</b>	<b>Yousef</b>		<b>Yousef</b>		<b>Yousef</b>	

Table.5

# Continue Decision Matrix

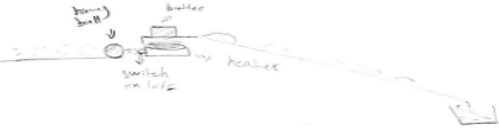

	 Heat #1	Weighted Score	 Heat #2	Weighted Score
Customer Requirements	Score		Score	
Cost effective	3	15	3	15
Durability	3	12	2	8
Entertaining	2	4	2	4
Reliability	3	9	2	6
Resetable	2	6	1	3
Safety	4	20	3	15
Sound	3	9	3	9
Timing	3	15	2	10
<b>Total</b>		<b>90</b>		<b>70</b>
<b>Designer</b>	<b>Fehaid</b>		<b>Fehaid</b>	

Table.6



# Continue Decision Matrix

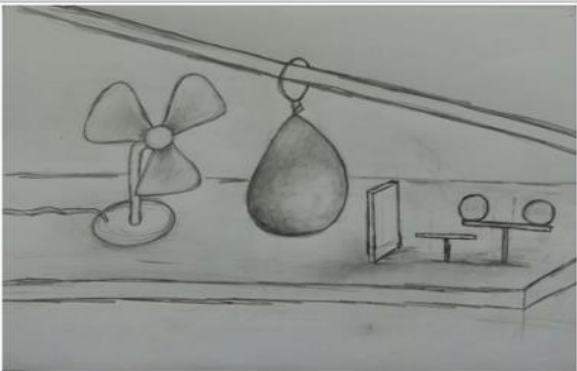
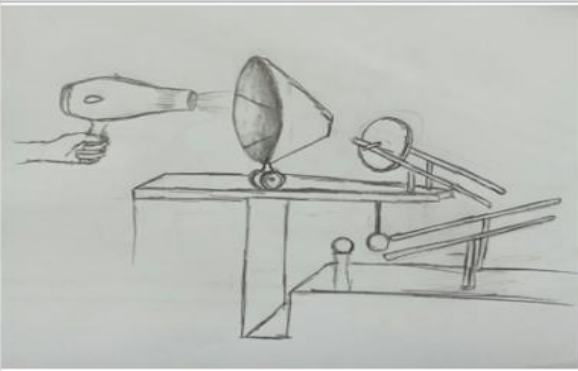
				
	<b>Airodynamics #1</b>		<b>Airodynamics #2</b>	
<b>Customer Requirements</b>	<b>Score</b>	<b>Weighted Score</b>	<b>Score</b>	<b>Weighted Score</b>
Cost effective	3	15	3	15
Durability	2	8	2	8
Entertaining	3	6	3	6
Reliability	3	9	2	6
Resetable	1	3	1	3
Safety	5	25	5	25
Sound	3	9	3	9
Timing	3	15	3	15
<b>Total</b>		<b>90</b>		<b>87</b>
<b>Designer</b>	<b>Hamad</b>		<b>Hamad</b>	

Table.7

# Continue Decision Matrix


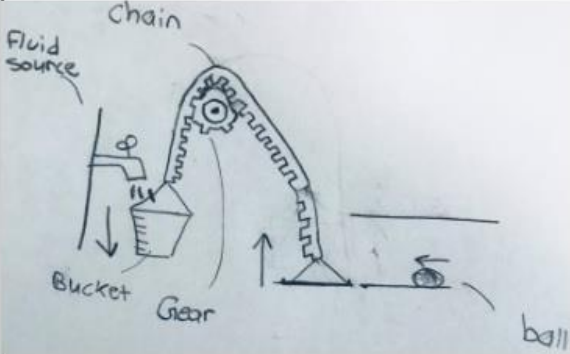
A	O	P	Q	R
	 <p><b>Gears #1</b></p>		 <p><b>Gears #2</b></p>	
Customer Requirements	Score	Weighted Score	Score	Weighted Score
Cost effective	5	25	3	15
Durability	4	16	5	20
Entertaining	2	4	5	10
Reliability	4	12	4	12
Resetable	4	12	4	12
Safety	4	20	4	20
Sound	3	9	4	12
Timing	2	10	3	15
<b>Total</b>		<b>108</b>		<b>116</b>
<b>Designer</b>	<b>Mohammad</b>		<b>Mohammad</b>	

Table.8

# Continue Decision Matrix

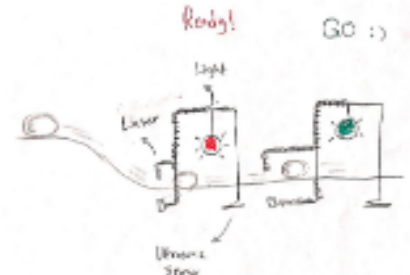
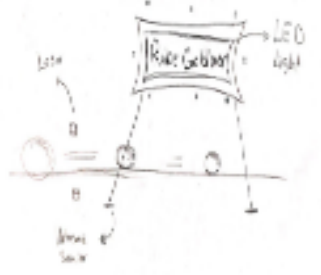

A	S	T	U	V	W	X
	 <p><b>Sensors/EE #1</b></p>		 <p><b>Sensors/EE #2</b></p>		 <p><b>Sensors/EE #3</b></p>	
Customer Requirements	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Cost effective	2	10	2	10	4	20
Durability	4	16	4	16	2	8
Entertaining	5	10	5	10	3	6
Reliability	3	9	3	9	3	9
Resetable	2	6	2	6	4	12
Safety	5	25	4	20	3	15
Sound	4	12	5	15	4	12
Timing	4	20	4	20	3	15
<b>Total</b>		<b>108</b>		<b>106</b>		<b>97</b>
<b>Designer</b>	<b>Abdullah</b>		<b>Abdullah</b>		<b>Abdullah</b>	

Table.9

# Pugh Chart

A	B	C	D
	<b>Ultimate Rube Goldberg Step</b>	<b>Spring #3</b>	<b>Fluid #3</b>
Cost effective		S	+'
Durability	<b>D</b>	+'	+'
Entertaining	<b>A</b>	+'	+'
Reliability	<b>T</b>	S	-'
Resetable	<b>U</b>	-'	+'
Safety	<b>M</b>	S	S
Sound		S	S
Timing		+'	S
Number of Pluses, +		3	4
Number of Minuses, -		1	1
<b>Overall Score</b>		<b>2</b>	<b>3</b>

Table.10

# Pugh Chart cont.

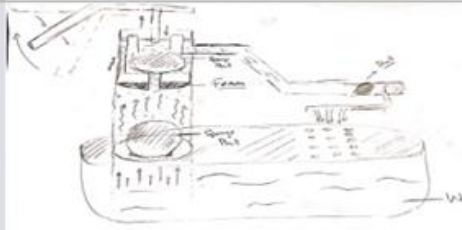
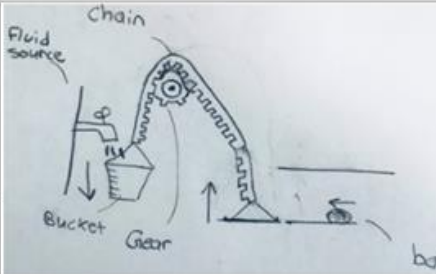
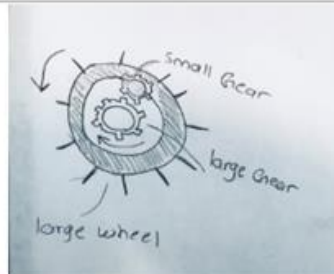
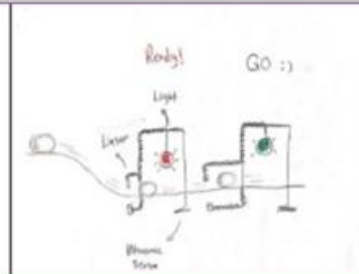
A	E	F	G	H
				
	<b>Fluid #1</b>	<b>Gears #2</b>	<b>Gears#1</b>	<b>Sensors#1</b>
Cost effective	S	S	+'	-
Durability	+'	S	+'	+'
Entertaining	+'	+'	-	+'
Reliability	-'	-	-	S
Resetable	+'	-	S	-
Safety	S	S	S	S
Sound	S	S	S	+'
Timing	S	+'	-'	S
Number of Pluses, +	3	2	2	3
Number of Minuses, -	1	2	3	2
<b>Overall Score</b>	<b>2</b>	<b>0</b>	<b>-1</b>	<b>1</b>

Table.11

# Topic 4: Schedule

- We are currently on schedule

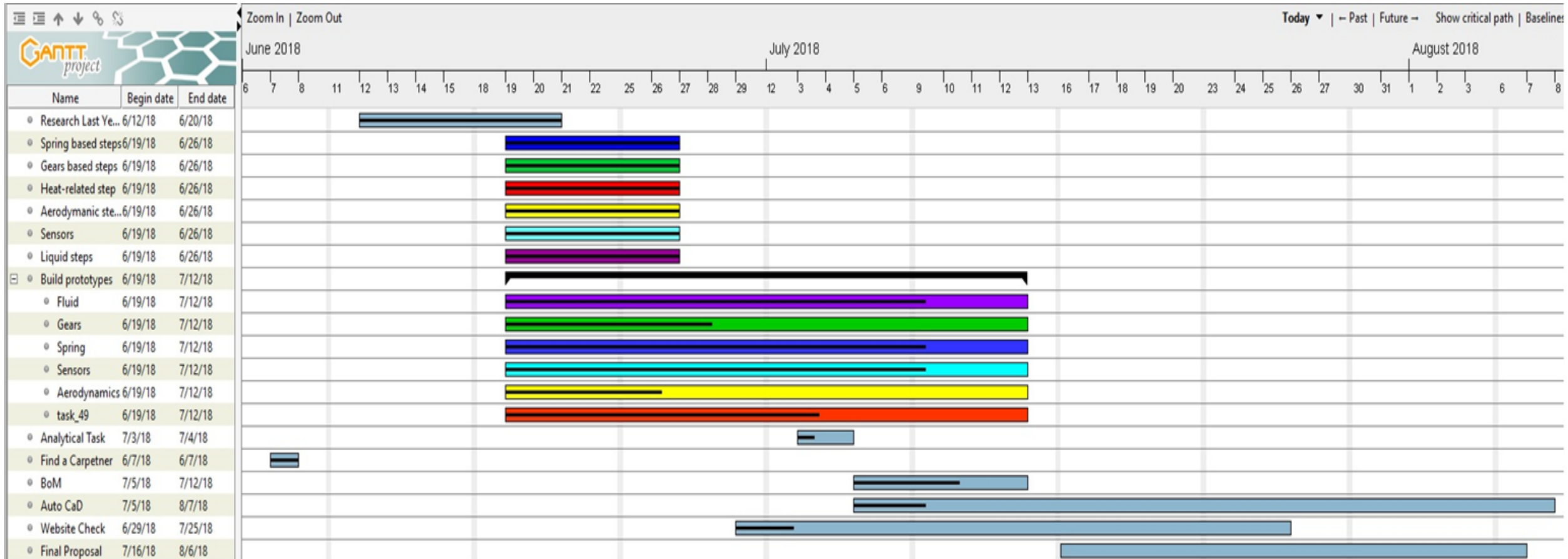


Figure.15

# Budget

- Available budget \$500
- Anticipated expenses \$210.57
- Other Materials refer to unexpected materials or any other object that wasn't planned on being used.

Items	Quantity	Estimated Price \$
Gears	2	14.37
DC motor	1	16.88
Sensors	2	14.99
Servo	1	17.59
Pistons	1	17.5
Heaters	2	20
Beverage Tubing (pipe)	1	5.83
Fan	1	16.99
Hair dryer	1	9.94
Compression Spring	1	10.9
775 DC Motor	1	15
Speedometer gear	1	6.58
5 Galon Water Bottle	1	8
Advanced Drainage pipe	1	6
Other Materials	x	30
<b>Total:</b>		<b>210.57</b>

Table.12

Any

Questions