



Smart Helmet

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Project Description

- Smart technology and increase protection in Football helmets
- Implement sensors that accurately collect speed and acceleration data
- Sponsored by NAU, Client: Dr. Hesam Moghaddam

Smart Technology

- MR fluid
- Viscoelastic fluid
- Airbag

Black Box Model

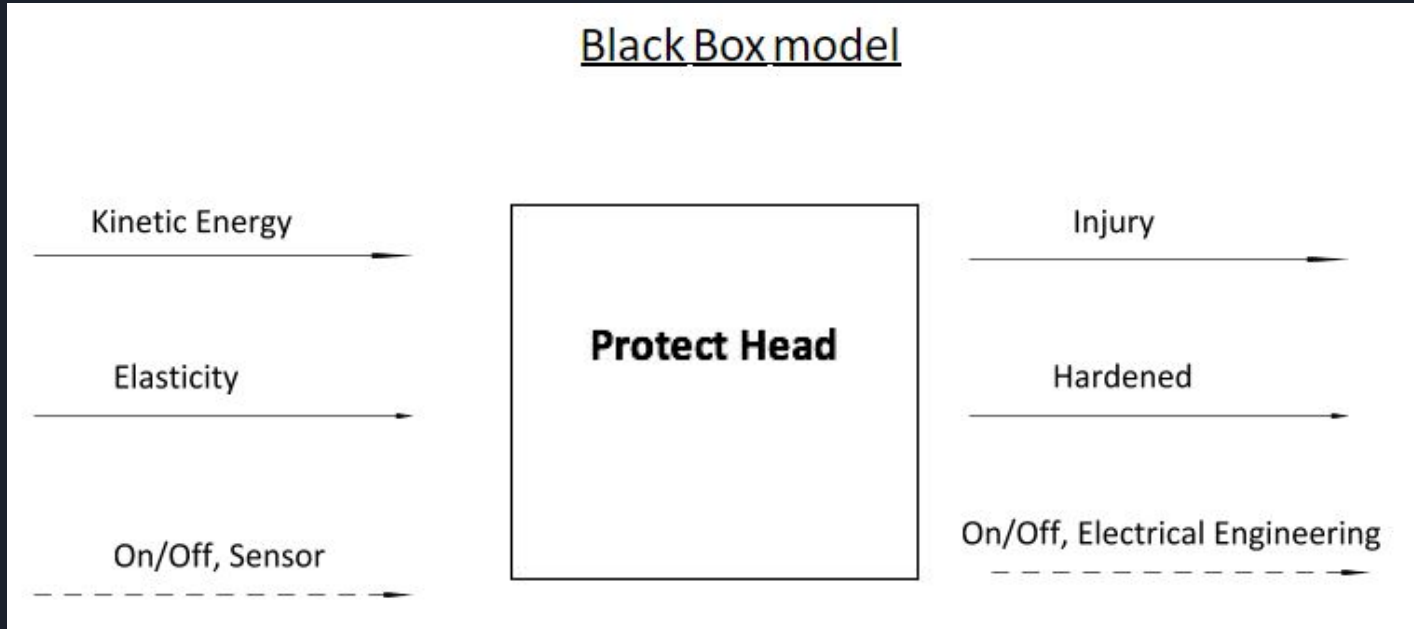


Figure 1: Black Box Model

Function Model

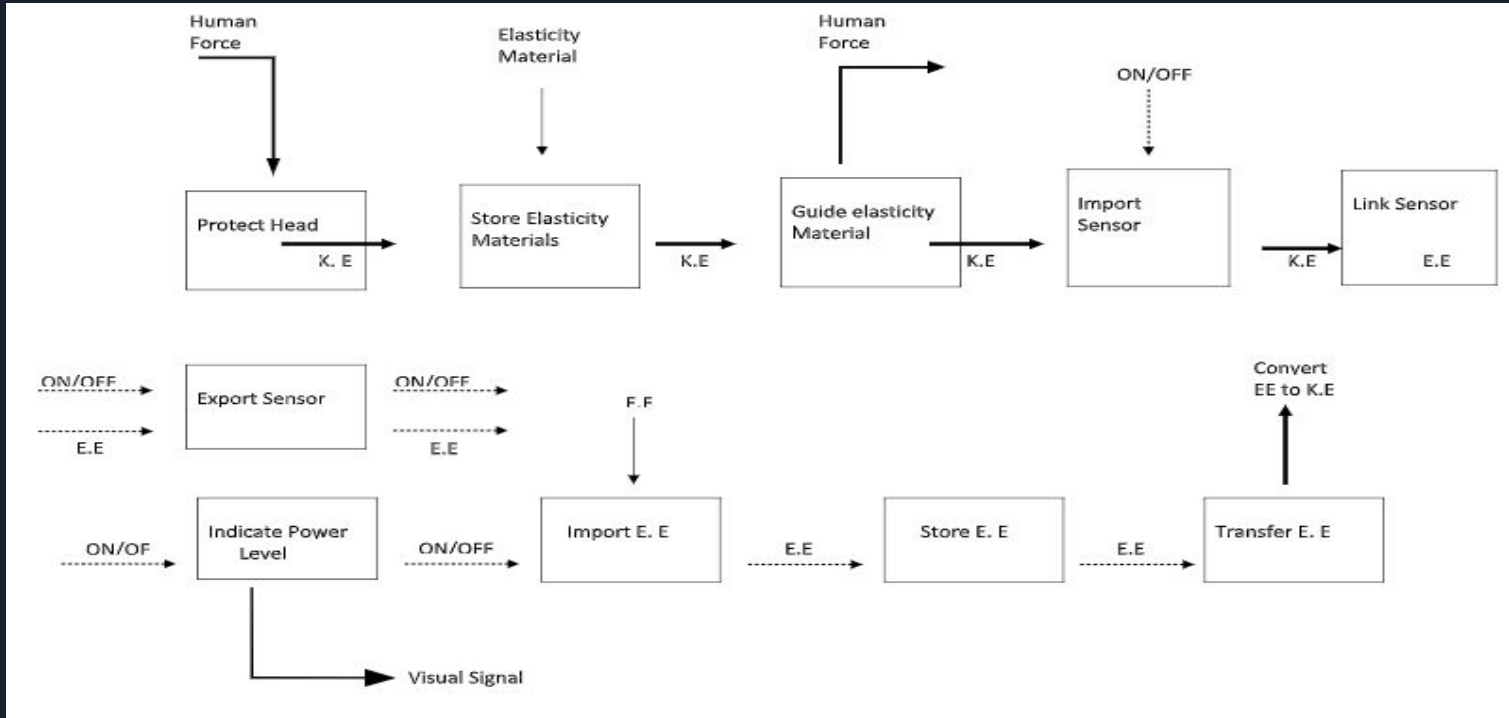


Figure 2: Functional Model

Designs Considered

Table 1: Pugh Chart

Criteria	MR Fluid	Airbag	Transforming	Padding	MR Fluid #2	Transferring	Scupa Diving	Boxing helmet	D30 Helmet	Vibration
Light Weight	D	+	+	+	-	+	+	-	-	S
Affordable		+	S	S	-	+	-	S	+	-
Appearance	A	-	+	+	S	+	+	+	+	+
Safety		+	S	+	+	-	+	+	+	+
Controllability	T	+	-	S	+	-	-	-	-	-
Sensing		S	-	-	S	S	-	-	-	-
Data Collection	U	S	-	-	+	S	S	-	S	-
Sum (+)		4	2	3	3	3	3	2	3	2
Sum (-)	M	1	3	2	2	2	3	4	3	4
Sum (S)		2	2	2	3	2	1	1	1	1

Concept Selection

Table 2: Decision Matrix

		Design Options							
		Magneto-rheological		Electro-rheological		Viscoelastic		Airbag	
Criteria	Weight %	Score (1-100)	Weighted Score	Score (1-100)	Weighted Score	Score (1-100)	Weighted Score	Score (1-100)	Weighted Score
Light Weight	20	20	400	30	600	40	800	50	1000
Affordable	6	40	240	50	300	60	360	50	300
Appearance	5	80	400	80	400	90	450	75	375
Safety	30	90	2700	70	2100	60	1800	60	1800
Controllability	12	90	1080	70	840	10	120	60	720
Sensing	15	80	1200	75	1125	85	1275	80	1200
Data Collection	12	70	840	65	780	80	960	80	960
	100	Total	6860	Total	6145	Total	5765	Total	6355

Schedule

Table 3: Gantt Chart

	Task Name	Start	Finish	Assigned To	Duration	Sep				Oct	
						Sep 9	Sep 16	Sep 23	Sep 30	Oct 7	Oct 14
1	- Meeting 1	09/11/18	09/12/18		1.146d	[Gantt bar]					
2	Client Meeting	09/11/18	09/11/18	M and R	40m	[Gantt bar]					
3	Team Chart	09/12/18	09/12/18		1h 10m	[Gantt bar]					
4	- Meeting 2	09/17/18	09/19/18		2.281d	[Gantt bar]					
5	Shearing ideas	09/17/18	09/17/18		1h 15m	[Gantt bar]					
6	Staff meeting	09/17/18	09/17/18		1h	[Gantt bar]					
7	- Meeting 3	09/19/18	09/19/18		0.281d	[Gantt bar]					
8	pre-presentaion	09/19/18	09/19/18	All	2h 15m	[Gantt bar]					
9	- Meeting 4	09/23/18	09/24/18		2d	[Gantt bar]					
10	review presentation	09/23/18	09/23/18		1h	[Gantt bar]					
11	- Presentation	09/24/18	09/24/18		1d	[Gantt bar]					
12	Project Description	09/24/18	09/24/18	Mana	1d	[Gantt bar]					
13	Background and Benchmarking	09/24/18	09/24/18	Race	1d	[Gantt bar]					
14	Design Requirement	09/24/18	09/24/18	Titus	1d	[Gantt bar]					
15	Customer needs	09/24/18	09/24/18	Omar	1d	[Gantt bar]					
16	Engineering Requirements	09/24/18	09/24/18	Omar	1d	[Gantt bar]					
17	Schedule and Budget	09/24/18	09/24/18	Fares	1d	[Gantt bar]					
18	Conclusion	09/24/18	09/24/18	Titus	1d	[Gantt bar]					
19	References	09/24/18	09/24/18	Titus	1d	[Gantt bar]					
20	- Meeting 5	10/03/18	10/03/18		0.375d	[Gantt bar]					
21	Website check	10/03/18	10/03/18		3h	[Gantt bar]					
22	- Meeting TA	10/08/18	10/08/18		0.125d	[Gantt bar]					
23	Report	10/08/18	10/08/18		1h	[Gantt bar]					

Schedule Continued

Table 4: Gantt Chart Continued

	Task Name	Start	Finish	Assigned To	Duration	Oct				Nov					
						Oct 7	Oct 14	Oct 21	Oct 28	Nov 4	Nov 11	Nov 18	Nov 25	Dec 2	
24	- Staff Meeting 2	10/08/18	10/08/18		0.125d										
25	Giving the team parts to work on.	10/08/18	10/08/18		1h										
26	- Staff Meeting 3	10/15/18	10/15/18		0.125d										
27	Shearing the information of that parts with PhD	10/15/18	10/15/18		1h										
28	- Meeting 6	10/21/18	10/21/18		0.125d										
29	pre-presentaion	10/21/18	10/21/18	all	1h										
30	- Presentation 2	10/22/18	10/22/18		1d										
31	Project Description	10/22/18	10/22/18		1d										
32	Designs Considered (Product)	10/22/18	10/22/18		1d										
33	Design Selected	10/22/18	10/22/18		1d										
34	Schedule & Budget	10/22/18	10/22/18		1d										
35	- Staff team meeting 4	10/29/18	11/02/18		5d										
36	Meeting with professor/ Website check 2	10/29/18	11/02/18	All	5d										
37	- Staff team meeting 5	11/05/18	11/19/18		11d										
38	Analytical Reports due	11/05/18	11/19/18	All	11d										
39	- Presentation 3 final	11/20/18	11/20/18		1d										
40	Project Description	11/20/18	11/20/18		1d										
41	Designs Considered (Product)	11/20/18	11/20/18		1d										
42	Design Selected	11/20/18	11/20/18		1d										
43	Schedule & Budget	11/20/18	11/20/18		1d										
44	- Staff team meeting 4	11/27/18	11/27/18		1d										
45	Discussing the final reoprt	11/27/18	11/27/18		1d										
46	- Staff team meeting 6	12/04/18	12/04/18		1d										
47	Website check 3	12/04/18	12/04/18		1d										
48	Full prototype, BOM, & CAD package due	12/04/18	12/04/18		1d										



Budget

Actual Expense(s)

- Arduino \$60 [7]

Estimated Budget: \$1500

Anticipated Expenses

- Football helmet \$30-664.99 [1],[2]
- MR fluid \$800 [3]
- Battery \$6.99-7.69 [4]
- Viscoelastic \$30-250 [5]
- Laser sensor \$15 [6]



Conclusion

- Include smart technology and sensors to collect data
- Black Box model to understand inputs and outputs
- Pugh chart and decision matrix helped with concept selection
- Currently on schedule according to gantt chart
- Estimated anticipated expenses and so far bought an arduino kit



Questions?



References

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