GNG2101- Intro. to Product Dev. and Mgmt. for Engineers

Faculty of Engineering – University of Ottawa

Project Deliverable C.1: Conceptual Design

Submitted by

A1-Seat Belt Guide

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1 Introduction

This deliverable's main objective is to come up with concepts to help the client buckle and unbuckle their seatbelt easier. After meeting with the client last week, this week was spent coming up with as many concepts as possible. Each member was tasked with coming up with three individual concepts, then those concepts were graded according to the benchmarking criteria from last week.

Once the concepts have been graded, the two best products will be shown to the client during the next meeting, in order to further eliminate ideas until the team settles on one for the first prototype. Several concepts may be combined into one, making the best of each in order to meet all the client's needs.

2 Functional Decomposition

Main Function: Reduce necessary mobility and force needed to get the male part to the female part of the seat belt

- Reach male part – the customer has limited mobility and therefore needs help reaching the seat belt.
- Pull the male part of seat belt towards the female part – the customer has reduced strength and struggles pulling the seat belt across their body
- Reach female part – the customer struggles to reach the female part of the seat belt while pulling the male part
- Insert the male part into the female part – the customers limited strength makes is difficult to coordinate buckling the two parts together

3 Individual Concepts

Based on the functional decomposition, each team member has come up with 3 concepts.

Dominick Bernard Concepts

Concept 1

An attachment to go with the tool that the client already possesses to reduce the strength required to pull the seat belt from its stationary position.

Figure 5 Concept DB1

Concept 2

A seat belt rail that starts at the front and makes its way back automatically controlled by the press of a button. Once back and snug the seat belt will lock in place securing the passenger for a safe ride.

Figure 6 Concept DB2

Concept 3

Just simply install a 4-point seat belt which will be set to size and easier to put on thanks to the attachment being in the middle in front of the passenger. Bonus is it adds safety.

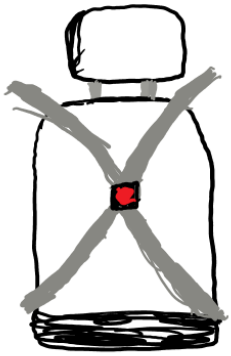

Figure 7 Concept DB3

Julian Ward Concepts

Concept 1

Have a slack line connected to the male part at one end and the female part at the other end. Have an easy clasp at the front that the client can do up once they sit down. The user pushes a button,

the line tightens, and a winch brings the male end closer to the female end. The client plugs in the seat belt by hand, possibly using Seat Belt Buddies.

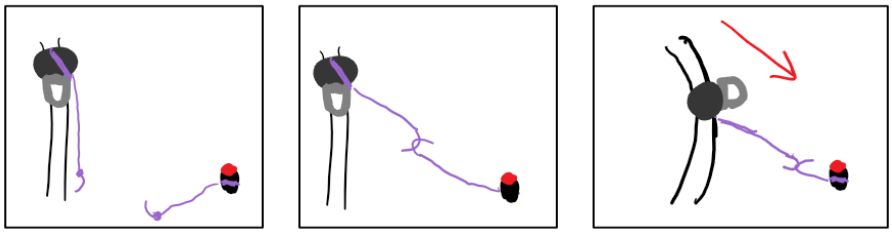

Figure 8 Concept JW1

Concept 2

Similar to the seat belt tensioner, this device would make the female part of the seat belt longer, so the male part wouldn't have to travel as far. It would sit on the user's lap.

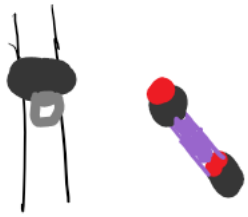

Figure 9 Concept JW2

Concept 3

A handle that attaches to the seat belt with a button that releases the female part of the buckle. The handle helps with grabbing the male portion.

Figure 10 Concept JW3

Haroon Yousaf Concepts

Concept 1

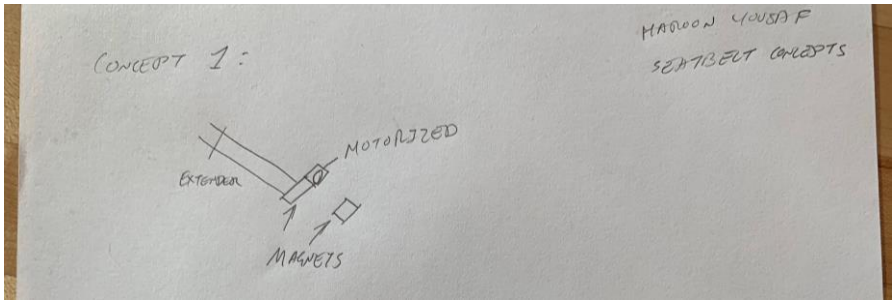

Figure 7 Concept HY1

A motorized male part that slides across the webbing and is attracted to a magnet on the female part. An extender is used to limit range of motion needed.

Concept 2

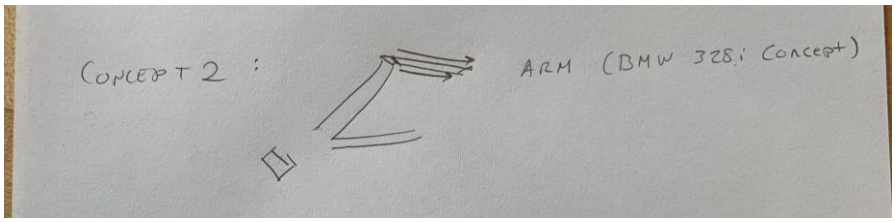

Figure 8 Concept HY1

Inspired by a BMW arm seatbelt extender, this concept consists of an arm that pushes the seatbelt and guides it Infront of the user, allowing easy access. The female portion of the seatbelt is extended allowing the user to buckle in directly on the lap. The arm retracts pulling the seatbelt back, tucking the user in.

Concept 3

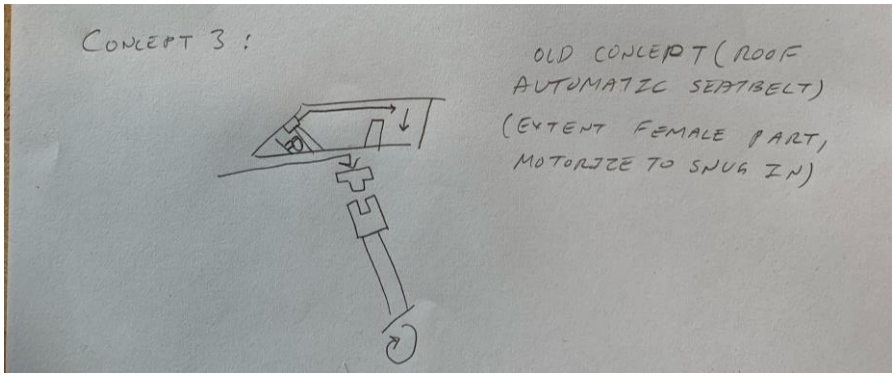

Figure 9 Concept HY1

The seatbelt is directly Infront of the user. The user buckles the seatbelt directly in front of them, the male portion of the seatbelt is in a rail system across the ceiling of the vehicle, guiding the seatbelt back. The female portion is also motorized to allow the user to tuck in and comfortably unbuckle.

Chengwei Zhang Concepts

Concept 1

A clip allows the seat belt to pass through the middle and the end is locked by a device. The other side has a handle that allows the seat belt to be pulled directly through from the other side.

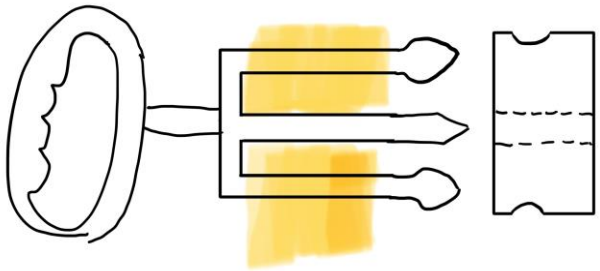

Figure 10 Concept CZ1

Concept 2

Cover the seat belt with a circle of cloth or other material, with a handle for pulling the seat belt from the left to the right. Save the distance from the car to the seat by putting the seat belt on the seat.

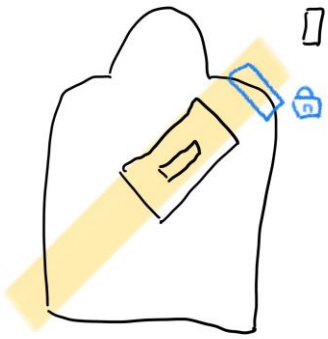

Figure 11 Concept CZ2

Concept 3

Increase the extra length of the seat belt, the male side directly into the female side of the seat, the other side has a lanyard for easy use, set a hook in the front seat, more convenient to pick up

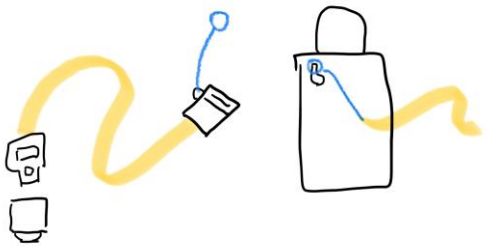

Figure 12 Concept CZ3

Alyce Van Staveren Concepts

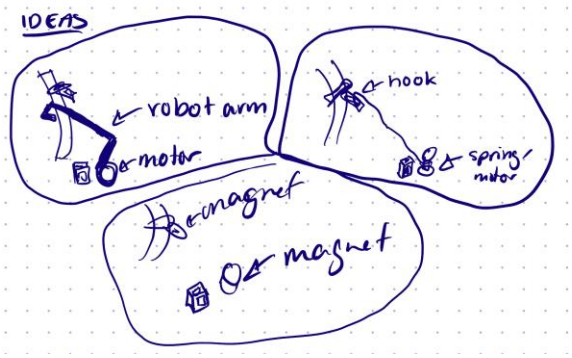

Figure 13 Concepts AV 1, 2, & 3

Concept 1

A robot arm that would scoop the webbing of the seat belt and bring it over towards the buckle, only needing the customer to push the male into the female part.

Concept 2

Somewhat like a fishing rod with a motor – it hooks onto the male part and brings it over to the female. The customer would need to un attach the hook in order to finish buckling up.

Concept 3

A large magnet that can be turned on to attract a smaller magnet on the male part.

4 Decision Matrix

We used the product target specification developed in the last deliverable to judge the concepts. The decision matrix is organized such that 1 is non ideal and 5 is ideal (ex. 1 = high cost, 5 = easy to use).

Table 1 Decision matrix comparing the design concepts

	Cost	Ease of use	Versatility	Size	Durability	Weight	Force to buckle	Aids mobility	Reduces arm travel	Ease to install	Total
DB1	4	3	4	5	3	5	5	1	1	4	35
DB2	1	5	2	1	3	1	5	5	5	1	29
DB3	3	3	3	3	4	3	4	4	4	2	33
JW1	2	4	3	4	3	4	3	4	4	2	33
JW2	4	3	4	3	4	4	1	3	4	5	35
JW3	3	4	3	4	3	3	3	3	2	4	32
HY1	4	3	2	4	3	2	4	2	3	3	30
HY2	4	5	4	2	3	3	5	4	5	3	38
HY3	1	2	2	1	2	1	5	3	4	1	22
CZ1	1	1	2	3	4	3	1	3	2	3	23
CZ2	4	3	3	4	2	5	3	3	3	4	34
CZ3	1	5	2	3	4	3	4	3	4	5	34
AV1	1	5	4	1	2	1	5	5	5	1	30
AV2	4	4	4	4	3	4	5	5	5	4	42

AV3	5	2	4	5	3	5	4	5	5	4	42

Example thought process for cost, force to buckle and reduces arm travel:

Cost: AV1 is a robot arm. The mechanism required for the robot arm – such as the casing material, wiring, and programming is all expensive and requires a lot of time. Our target price is 15-60$ and the robot arm would cost around 150$.

- Casing – CAD design – 3hrs
- 3D Printing – 100$
- Wiring – 30$, 1hr
- Programming – 2hrs, 30$

Total: 150$ and 6hrs of dedicated work. This solution is therefore not ideal and is granted a score of 1

Force to buckle: CZ1 is a handle attached to the webbing and allows for easier reach. The handle does not reduce the amount of force needed to pull the seat belt. The following values are approximations using a 2011 Ford edge back seat seatbelt, a five-pound and ten-pound weight for comparison and a fork used as the attachment.

- Force to pull seat belt no attachment – 5lbs
- Force to pull seat belt with attachment – 5lbs

0% reduction in force. This solution is not ideal and is granted a score of 1

Reduces arm travel: DB1 is an attachment that reduces the force needed to pull the seatbelt. It does not impact the distance required for a person's arm to travel. The following values were determined using a 2011 Ford Edge, with the distance measured using a string that follows the path a hand would take. The string starts in the middle of the seat, wraps around the latch plate (male part) and goes across the seat to stop at the buckle.

- Distance without attachment - 88 inches
- Distance with attachment – 88 inches

There is a 0% reduction in distance. The solution is not ideal and is granted a score of 1

5 Group Design

In order to get the best feedback possible from the client, rather than presenting many concepts, we chose our best three which not only scored the best but also seemed the most feasible.

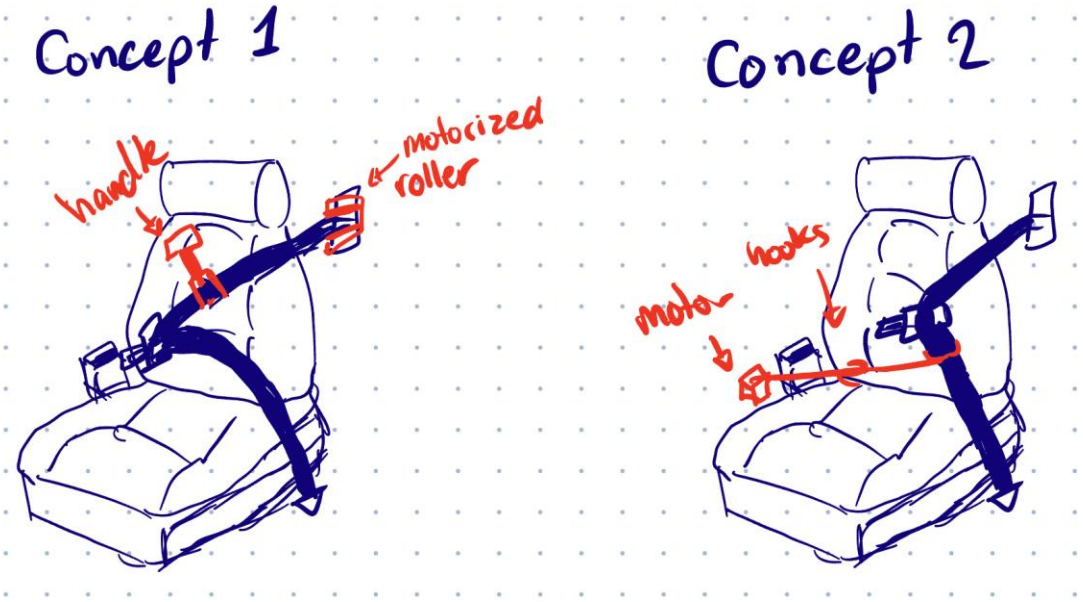

Figure 14 Final chosen design concepts

Concept 1

Concept 1 combines the likes of Dominick Bernard first concept and Chengwei Zhang Second concept. These two concepts complement each other perfectly as concept DB1 eases the force required to pull the seat belt while Concept CZ2 eases the mobility required to secure the seat belt. It would be a low-cost product of high versatility and low complication of any sorts.

Concept 2

Concept 2 is simply the idea of having a sort of motor-powered tensioner pulling the male end of the seat belt towards the female part, both concept AV2 and JW1 present this sort of idea. This concept would be very easy to use requiring very little force or mobility thanks to a small motor doing the load of the work.

Both concepts could be viable options, client feedback will help with making a good decision for the direction in which we go for our final concept.

6 Conclusion

All the deliverables share a common goal of producing a product that will meet the clients' needs. Mobility issues are a big problem for many people and the client is relying on a well thought out solution that helps combat these issues. Through the development of individual concepts, we were able to get a wide scope of solutions, each targeting a different part of the problem. Through the ranking of the concepts, the advantages of certain ones were able to shine through, and the bare bones of final concepts were developed. The final concepts capitalize on the advantages of different original concepts, coming together to provide a solution that targets all parts of the functional requirements. With the feedback of the client, we will be able to further one of these concepts and flesh out some prototypes.