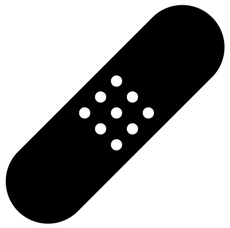


6000 injured

400 killed

50% over 65

*'**injuries or near-falls** that may occur during the journey … leading to anxiety/fear of sustaining further **injury, loss of personal mobility and ultimately social isolation**.'* (Office for Product Safety and Standards, 2021)

*'The flip down sides seats were only a choice when they had **heavy shopping or a shopping trolley or a walker** '*

… They're not very safe to sit in the flip ups …If they jolted they would go forward wouldn't you? You've got nothing to hold, there's nothing to hold on … (Female 63 years)'

(Office for Product Safety and Standards, 2021)

*There is a clear issue with people not having the **free hands or control** to be able to keep themselves stable and safe throughout the journey. Much of this is caused by storage issues, as elderly people often use buses to transport their shopping, or anything else.*
(Office for Product Safety and Standards, 2021)

Initial Research

*An investigative paper from **Loughborough University** researched the current issues elderly people face the most when using public transport. Some important parts of the paper are quoted below, highlighting our real need for **more control and free movement**.*

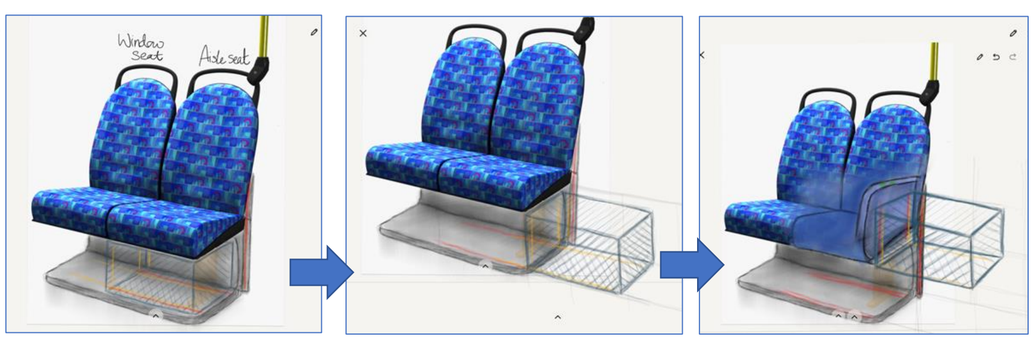
Real need

'Older adults struggle to move about on public transport as their path is often blocked by obstacles on the floor.'

Problem statement

Design a device to store items on the bus so that older adults can move around the bus with increased ease .'

4



1

Seat lifts up
- More storage
- On space taken by rails or moving parts
- Can't sit whilst filling box
- Must move person to retrieve items

2

Tray under chair
- Pulls out in front of chair
- Hits feet
- Quite small
- Runs on rails
- Could be spring loaded

3

Under-carriage storage on coaches
- Lots of space
- Slow to get to
- Requires a lot of movement to access bags
- Not feasible for public busses with a tight schedule

Group Name: PD-56	Requirements List for Bag Holder	Issued on: 09/11/21 Page 1
D/W	Requirements	Responsible/Change made on
D	1. The 'bag holder' shall fit seamlessly under the seat via a simple mechanical mechanism	VH - 12/11/21
D	2. The mechanism shall be easy to manufacture and install across hundreds of buses (>1000 products)	VH - 12/11/21
W	3. No parts of the mechanism shall be visible/accessible to members of the public, and must be child friendly	VH - 12/11/21
W	4. In case of breakage or failure, the mechanism shall not cause any danger and should be completely immobile.	LU - 12/11/21
W	5. While under operation, the mechanism shall recognise any obstruction (e.g. person in the way) and stop its movement.	VH - 12/11/21
W	6. The product shall be easy to maintain and require minimum dis-assembly of the whole mechanism	VH - 12/11/21
W	7. The bag holder shall require minimal costs to manufacture, ensuring the needs are met.	VH - 12/11/21
W	8. The product shall fit seamlessly into the interior of the bus and not be an eyesore to the elderly population.	LU - 12/11/21
W	9. When the bag holder is malfunctioning, the contents of the bag holder shall be accessible externally to avoid bags being trapped.	VH - 16/11/21
D	10. The bag holder shall be able to operate under loads of at least 10kg	VH - 16/11/21
W	11. The bag holder shall have a minimum volume of 0.080m^3 (the assumed space available under a seat).	VH - 16/11/21
W	12. The Device is made of sustainable materials in an environmentally conscious manner	LW – 16/11/21

Office for Product Safety and Standards, 2021. *Ageing Society: Product Design for Older People,* Birmingham: Crown copyright 2021 .
1 – Picture: https://www.sharptruck.com/page-not-found
2 – Picture: https://www.autoaccessoriesgarage.com/img/group/main/37/3722_1_lg.jpg
3 - Picture: https://www.jcbl.com/blog/choosing-best-bus-manufacturer.aspx
4 – Picture: : https://www.turbosquid.com/3d-models/london-bus-seat-obj/945559

a: 1- The ‘bag holder’ shall fit seamlessly under the seat via a simple mechanical mechanism **Geometry**

b: 2- The mechanism shall be easy to manufacture and install across hundreds of buses (>1000 products) **Manufacture**

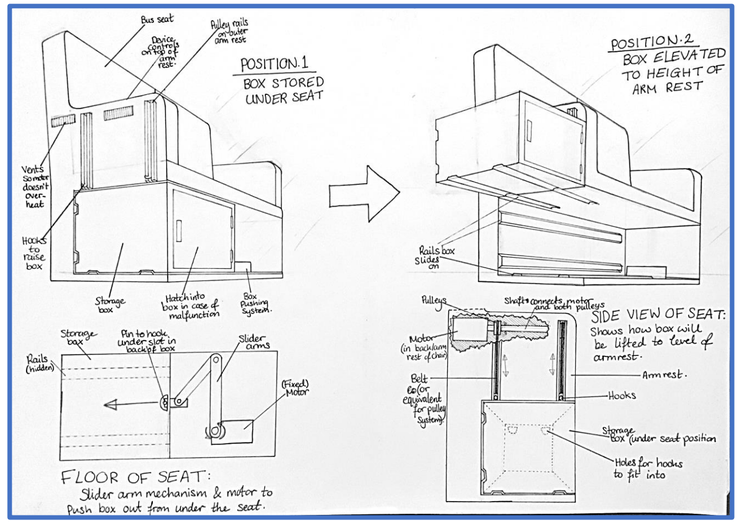
c: 5- While under operation, the mechanism shall recognise any obstruction (e.g. person in the way) and stop its movement. **Safety**

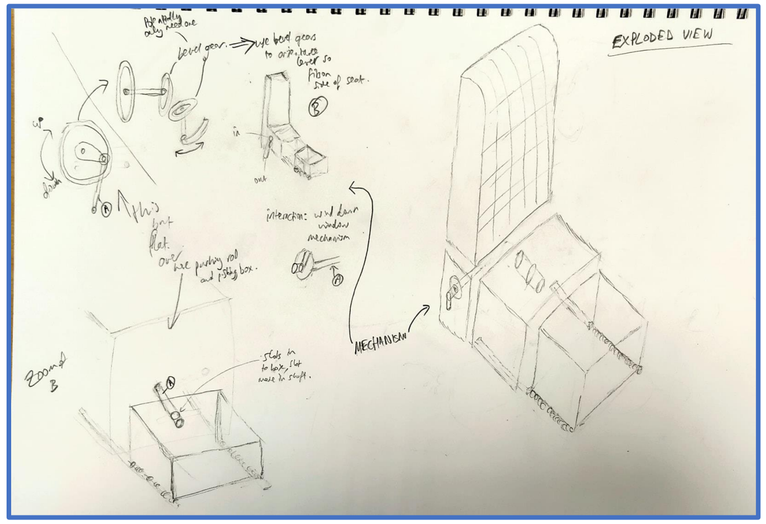
d: 6- The product shall be easy to maintain and require minimum dis-assembly of the whole mechanism to repair **Manufacture**

e: 9- When the bag holder is malfunctioning, the contents of the bag holder shall be accessible externally to avoid bags being trapped. **Ergonomics**

f: 10- The bag holder shall be able to operate under loads of at least 10 kg **Performance**

g: 11- The bag holder shall have a minimum volume of 0.080m^3 **Geometry**





Lani’s Concept:
- Design makes maximum use of the space under the seat and has easy access to bags if mechanism breaks.
- Could be difficult to disassemble if repair is needed due to moving parts and motors.

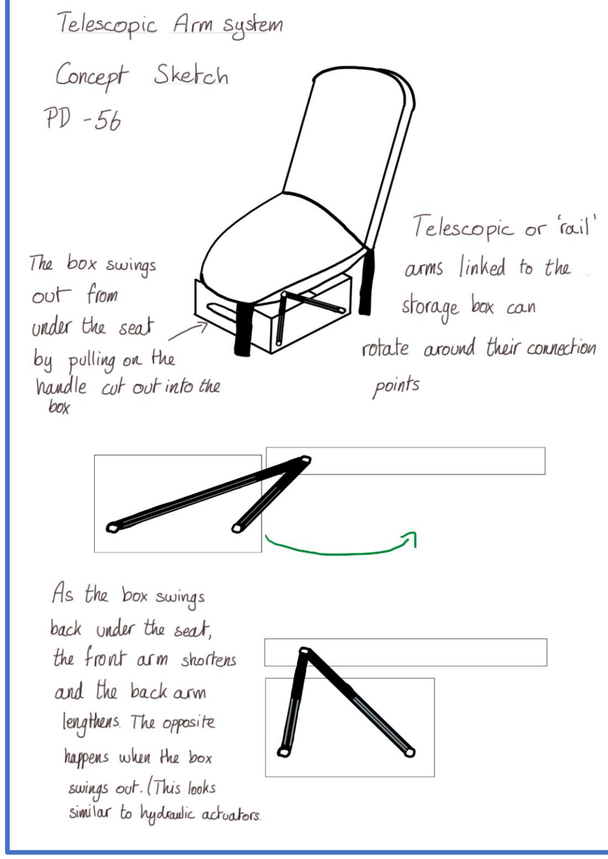
Viren’s Concept:
-The design is very subtle, easy to use, and doesn’t cause any obstructions.
- Repairs would be difficult to make due to complexity of mechanism used, and accessibility to the mechanism would be difficult.

	a	b	c	d	e	f	g	totals
a	-	1	1	1	0	0	1	4
b	0	-	1	1	0	0	0	2
c	0	0	-	1	0	1	1	3
d	0	0	0	-	0	1	1	2
e	1	1	1	1	-	1	1	6
f	1	1	0	0	0	-	0	2
g	0	1	0	0	0	1	-	2

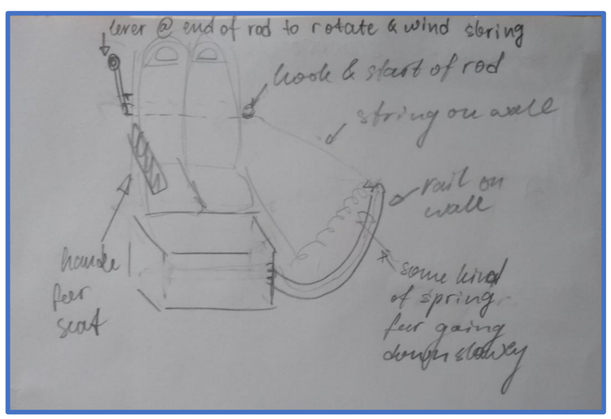
Rank order	Weight
E	4
A	3
C	2
d, f, g, b	1

		Concept 1 - Lani		Concept 2 - Lillia		Concept 3 - Louis		Concept 4 - Viren	
Criteria	Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Performance									
Minimum 5kg load	1	4	4		0	4	4	5	5
Geometry									
Fit under seat	3	5	15		0	3	9	3	9
Minimum volume 0.08 m^3	1	4	4		0	4	4	3	3
Manufacture									
Over 1000 made	1	3	3		0	4	4	3	3
Easy dissassembly and repair	1	2	2			4		2	
Safety									
Stops for obstructions	2	3	6		0	5	10	5	10
Ergonomics									
Bags accessible if mechanism broken	4	5	20		0	3	12	3	12
Weighted score total			54		0		43		42
Rank									
% Total			38.85		0		30.94		30.22

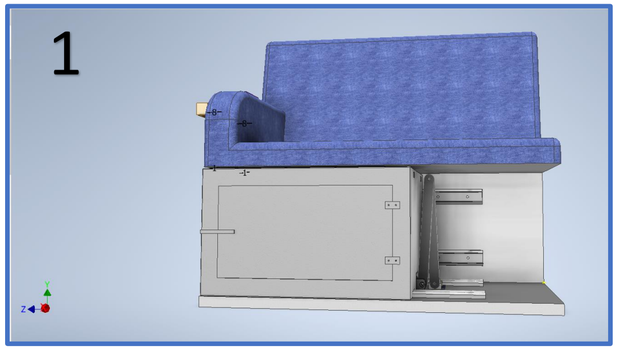
After consideration of the table and analysing possible changes, the most suitable concept has been determined to be Concept 1. As well as its higher score, the different aspects of it regarding performance, geometry, manufacture, safety, and ergonomics have been justifiably better than the alternative approaches. It was concluded that there would be no changes or additions from other concepts as this design is sufficient.

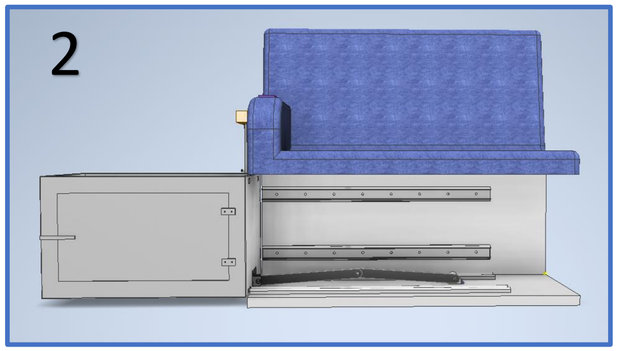


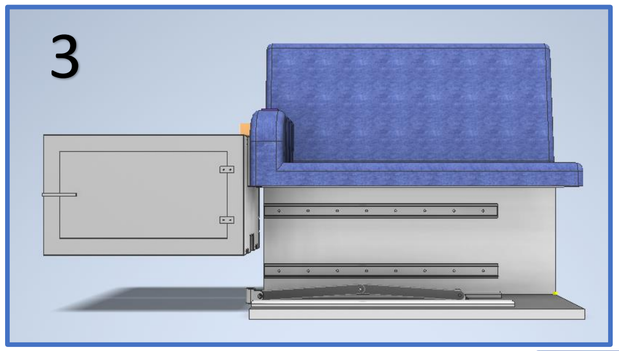
Louis’ Concept:
-Concept very good at stopping for obstructions as it is manually operated (people will not open it up if they are in the way).
- Size of the box may be compromised based on the size of the lever needed to swing it open.



Lilia’s Concept:
- Freedom with size of box and ease of of operation;
- Requires adjustments to the bus interior and additional installments.







Step 1: **STORAGE POSITION**. Box sits flush under seat.

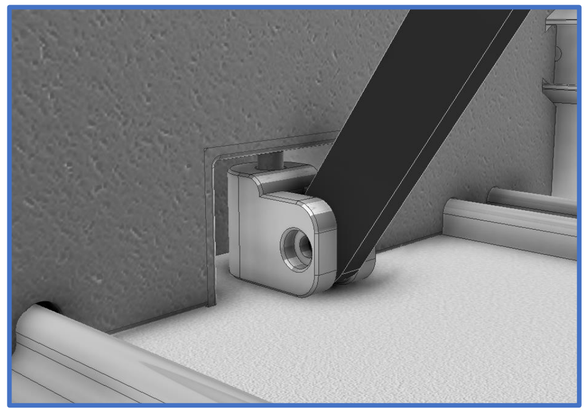
a: 1- The 'bag holder' shall fit seamlessly under the seat via a simple mechanical mechanism Geometry

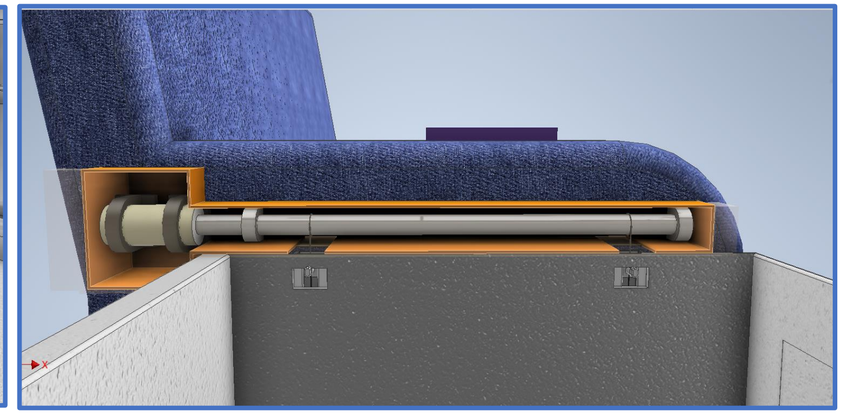
The box has a door on the front for easy accessibility

e: 9- If the bag holder malfunctions, the contents of the bag holder shall be accessible externally to avoid bags being trapped. Ergonomics

Step 2: **EXTENDED POSITION**. Slider crank - consisting of a motor (with mount), two arms, and an *interlocking pushing component* – pushes the box out from under the seat. It is controlled by a coded system that pushes it out past the lifting pins and then backwards a little so the holes in the back of the box lock onto the pins.

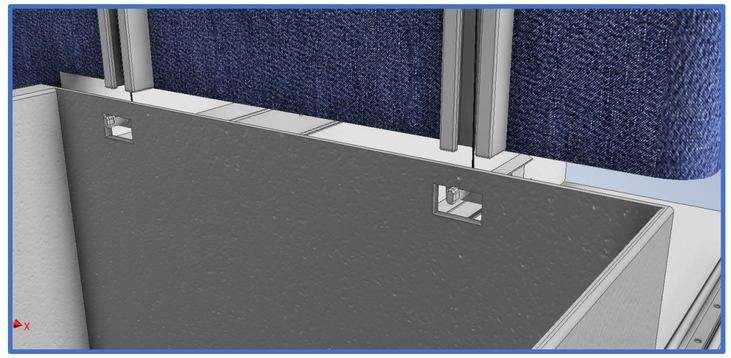
Step 3: **LIFTED POSITION**. Pulley lifts the box (via the pins in the holes in the box) up to a height just below the top of the arm rest. The pulley motor is also controlled by a coded circuit ensuring it is lifted to the correct height.





Interlocking pushing component: Connecting slider arm to pin (in the cut-in in the back of the box). It is fixed to the slider arm with a screw (not shown here) and is connected to the box through only the pin in the hole so that the box can be lifted off it in step 3.

Side view of box in **lifted position** with pulley cover removed to show motor and pulley system (shaft, bearings, and pulley wire).



Pins for pulley are lowered to hook onto holes in back of box after it has been pushed out from under the seat (ready to lift it).

Slider arms position (connecting motor and box) in between **storage position** and **extended position**.

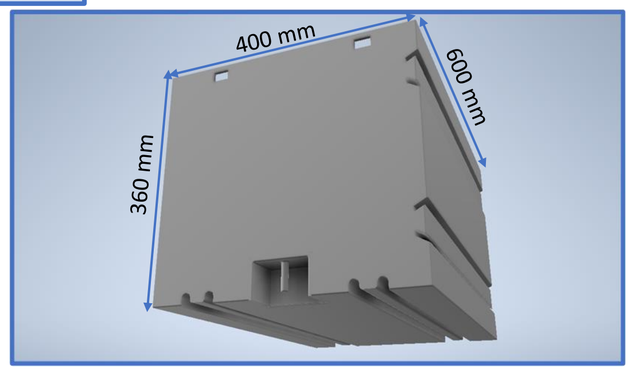
- View of the right hand side (as seen in pictures above) / back of the box.
- Groves for rails (which are attached to the frame of the chair) on the back side and bottom of the box (plastic is thicker here to account for these groves when moulding).

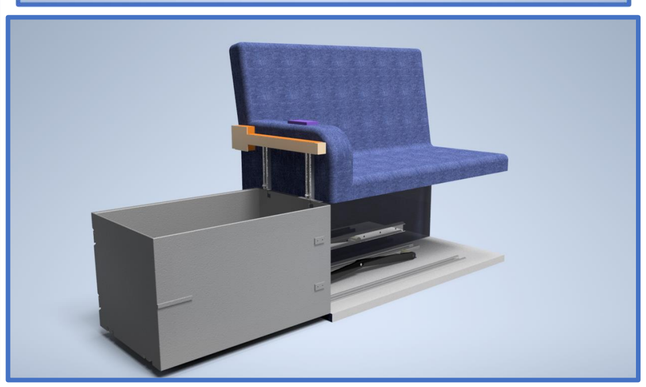
b: 2- The mechanism shall be easy to manufacture and install across hundreds of buses (>1000 products) Manufacture

- Two holes in top equally spaced for lifting pins to fit into.
- Cut-in and pin at bottom to slot into *interlocking pushing component*, allows for box to be pushed forward and then lifted off the *interlocking pushing component* when it is lifted by the pulley.
- Dimensions of box: 600 mm x 400 mm x 360 mm

f: 10- The bag holder shall be able to operate under loads of at least 10 kg Performance

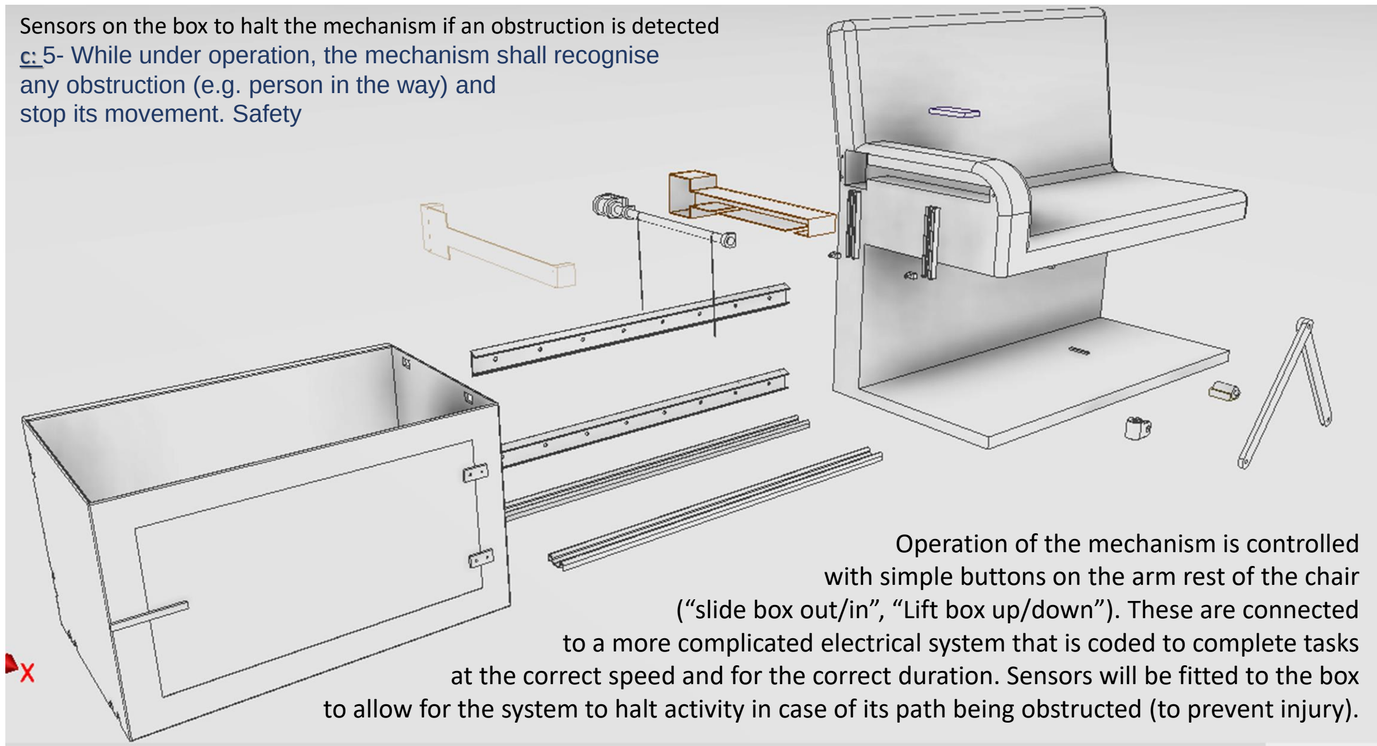
g: 11- The bag holder shall have a minimum volume of 0.080m^3 Geometry





Sensors on the box to halt the mechanism if an obstruction is detected

c: 5- While under operation, the mechanism shall recognise any obstruction (e.g. person in the way) and stop its movement. Safety



Operation of the mechanism is controlled with simple buttons on the arm rest of the chair ("slide box out/in", "Lift box up/down"). These are connected to a more complicated electrical system that is coded to complete tasks at the correct speed and for the correct duration. Sensors will be fitted to the box to allow for the system to halt activity in case of its path being obstructed (to prevent injury).