Engineering Design Challenge

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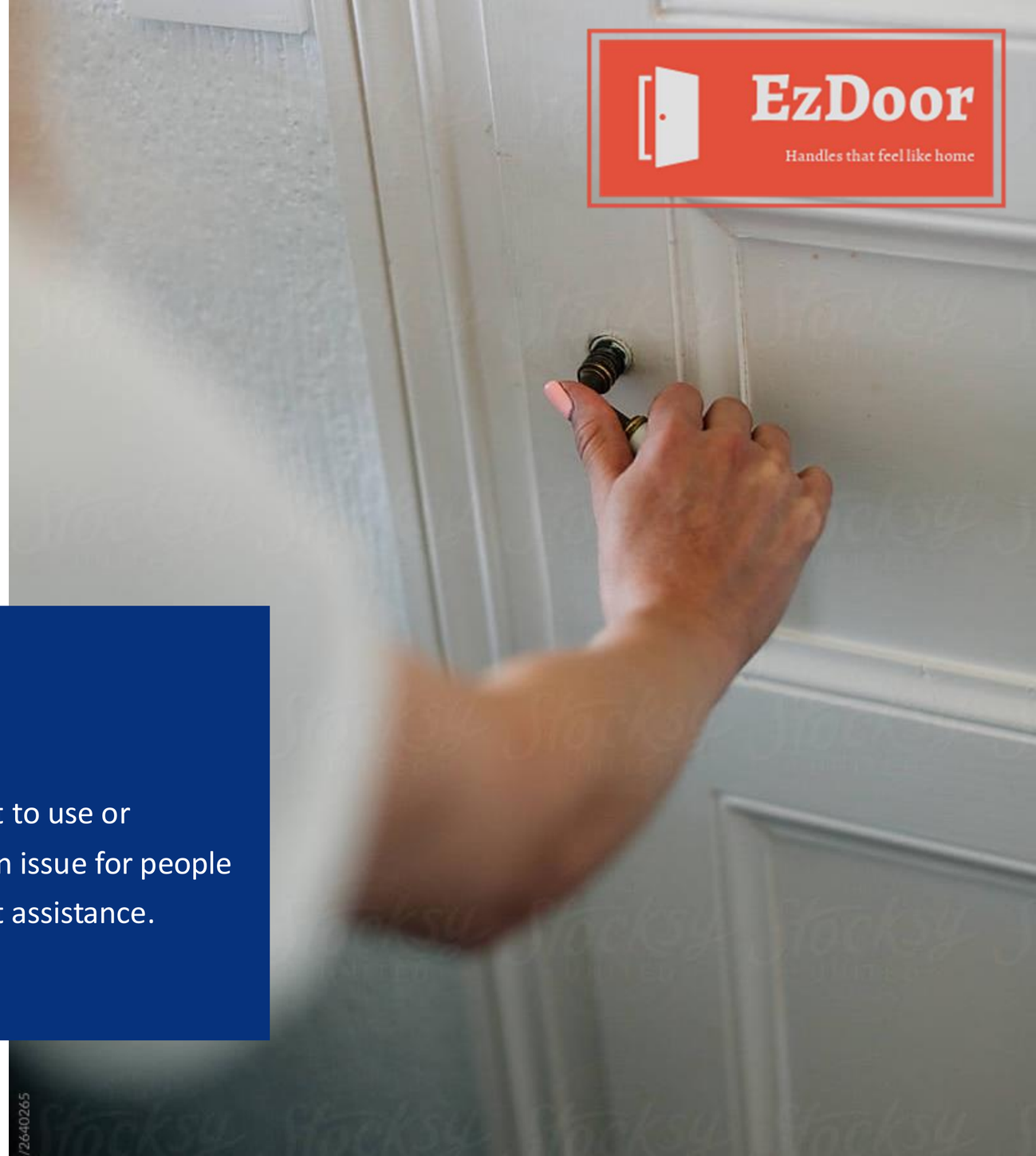
EzDoor
Handles that feel like home

Our problem definition

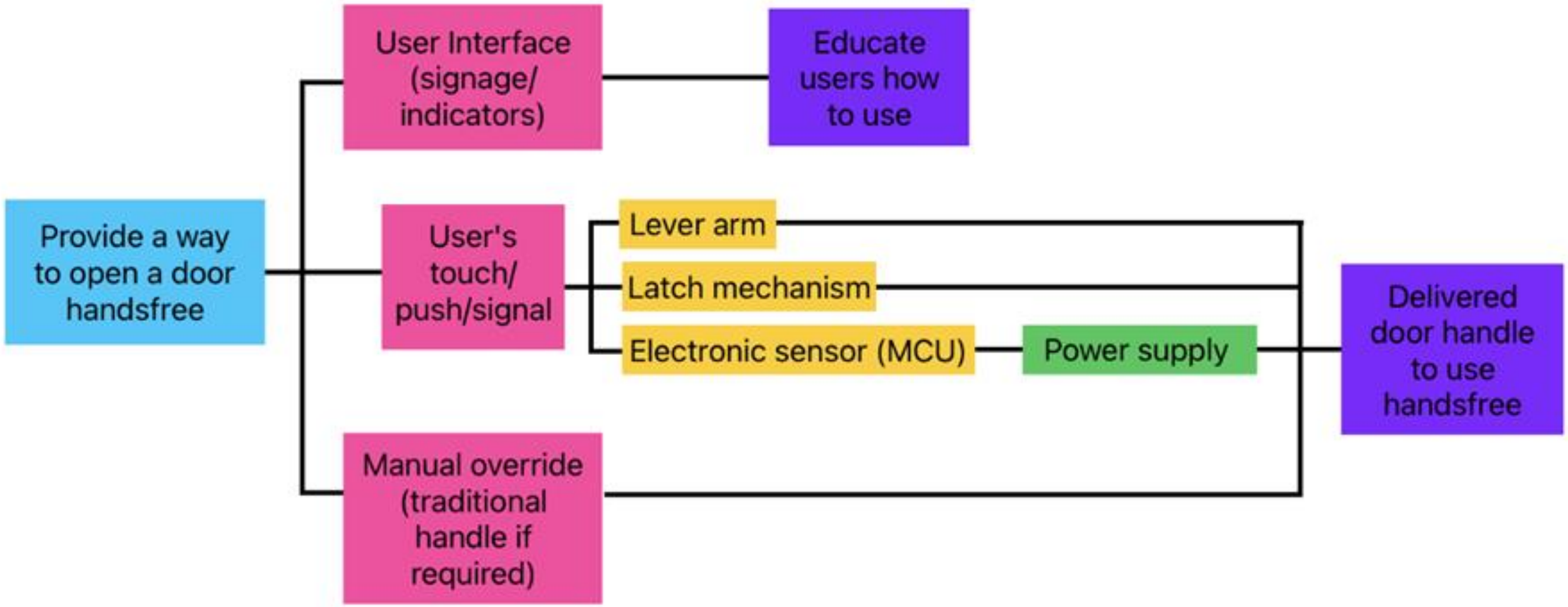
How can we open doors hands free?

Current designs for door handles have become either difficult to use or expensive to buy in situations where handles are unusable; an issue for people with physical difficulties who are unable to use doors without assistance.



Definition of Function

EzDoor
Handles that feel like home



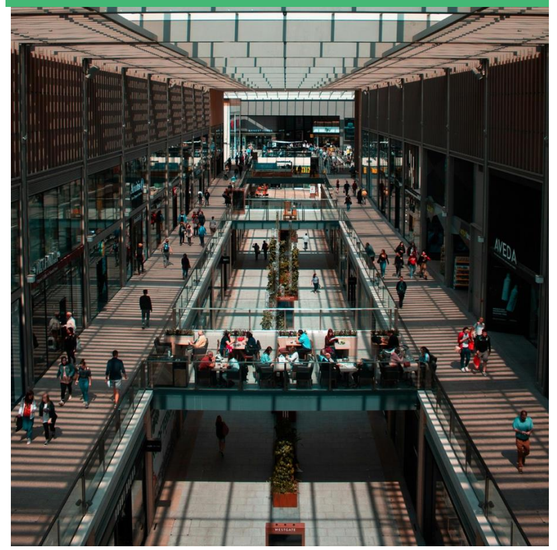
Who are our possible customers?

Customer Market

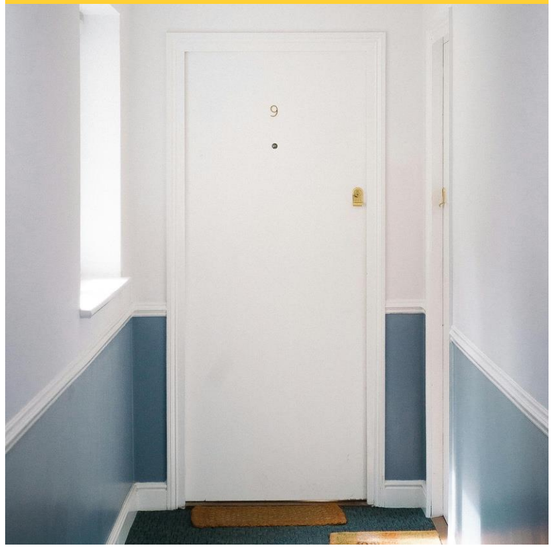
Individuals with Disabilities

Busy Individuals

Commercial Establishments/ Public Facilities



Personal and Organisational Consumers:



https://www.pexels.comt

Market Growth

National Market

Local Market

Proudly Made In South Australia.

International Market

Croc-Pull Hands Free Door Pull

SanitGrasp

Automatic Doors

EzDoor

Handles that feel like home

Design Considerations

What a good door opener design should consider...

Cost

Affordable for both types of consumers – residential & commercial

Functionality/ efficiency

Needs to easily open doors without great strength or force. (User-tested with variety of disabilities)

Ease of use

Easy to use for all ages and abilities. Easy to install/remove

Durability

Withstand constant use in homes, businesses and public spaces.

Security

Should provide adequate security for homes/rooms (i.e. lockable front door for only the residents)

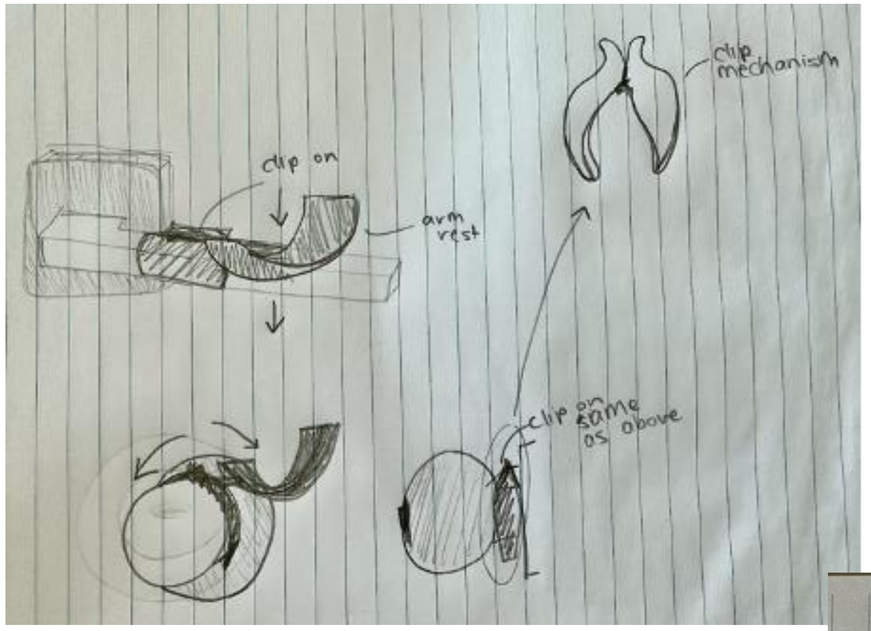
Design Specifications

These design specifications must be followed when considering the design of our automatic door opener. These specifications reflect the requirements of the end user and also consider universal design.

Specification/ requirement	Description	Catagory
Opening force	Maximum force required to open the door of 22.2411N	Ergonomic
Handle length	Maximum handle length of 400mm	Ergonomic
Handle height	Between 900 and 1100mm off the floor	Universal Design
Distance from Door	Handle must be closer than 45mm from the surface of the door	Dimension
Automatic locking	Door must automatically close and lock itself after 5 minutes of opening	Security
Contrast ratio	The contrast ratio of any user interface must be at least 3:1	Ergonomic
User friendliness	End product must be easy enough to be installed by a single person with minimal product knowledge	End user

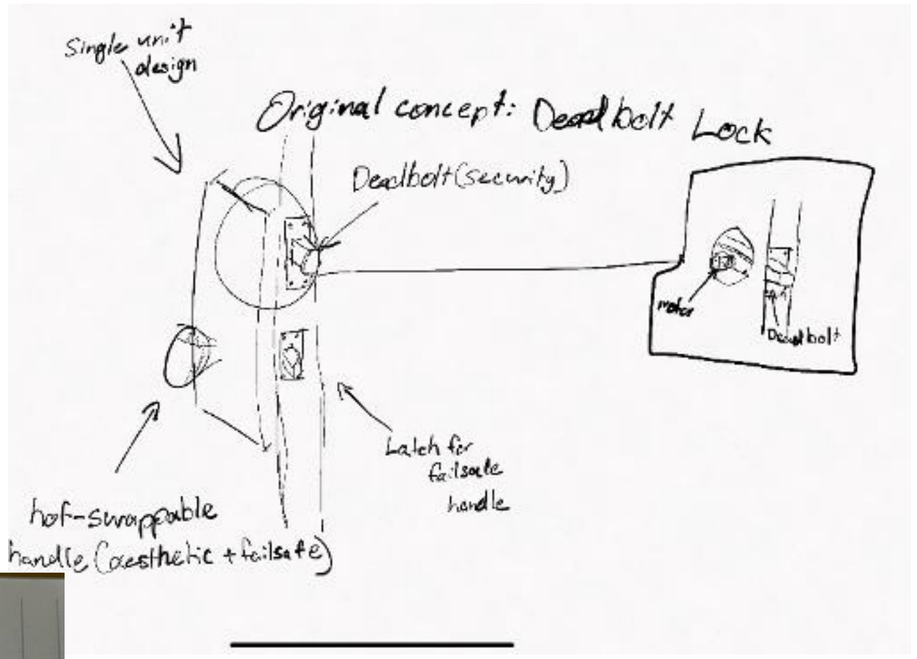
EzDoor

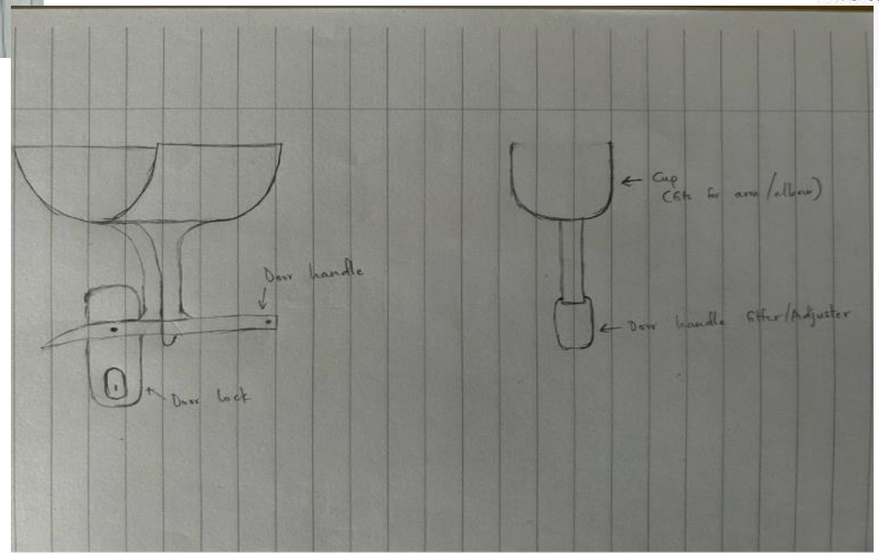
Handles that feel like home



Design 1

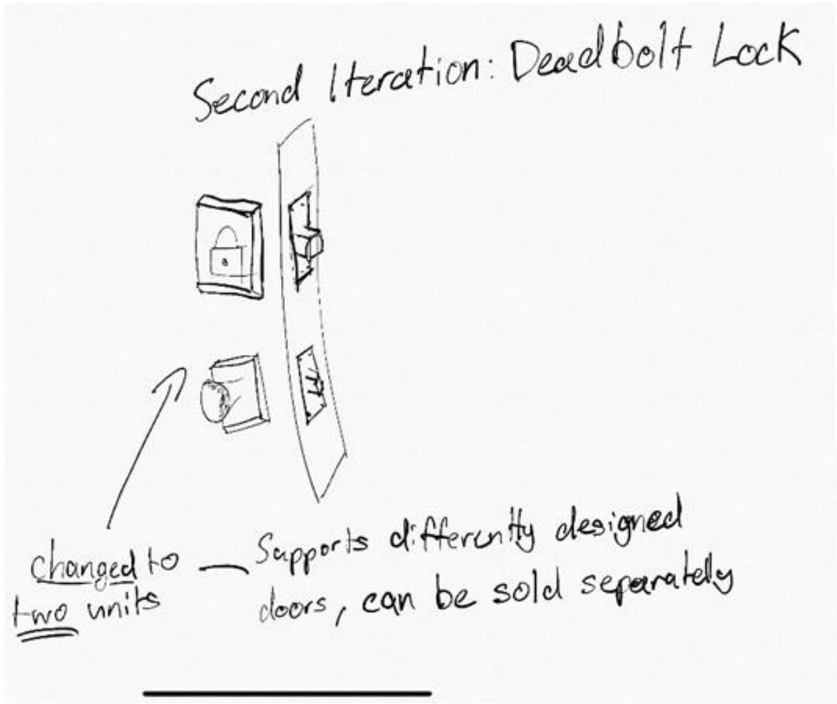
Design 2





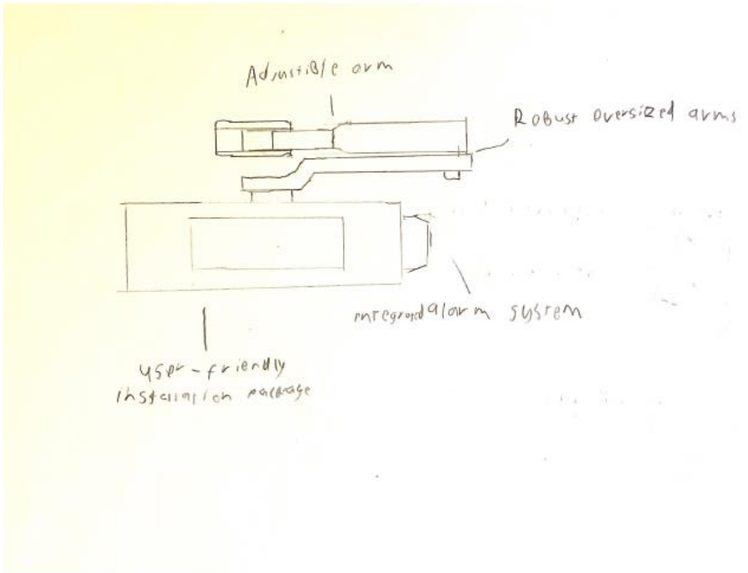
Design 3

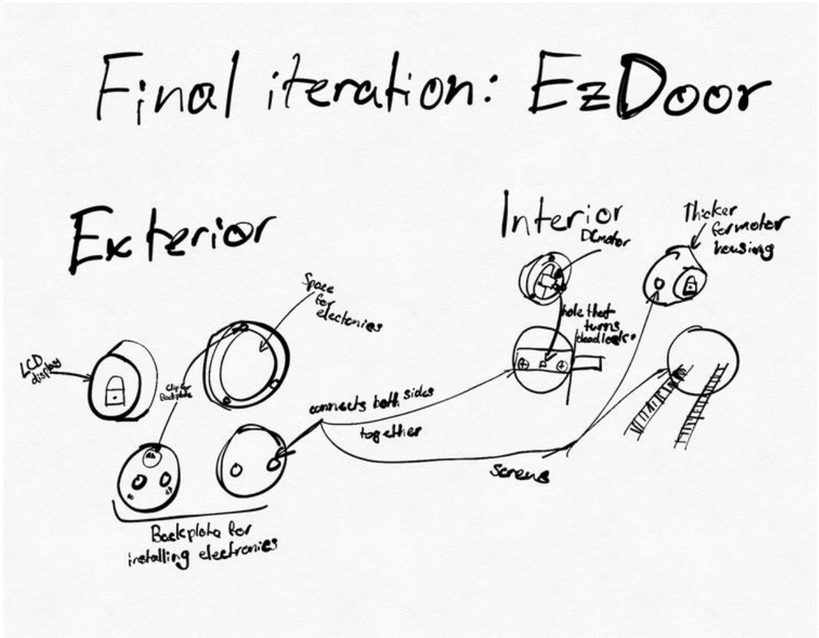
Design Concepts



Design 4

Design 5





Design 6

Design Concepts

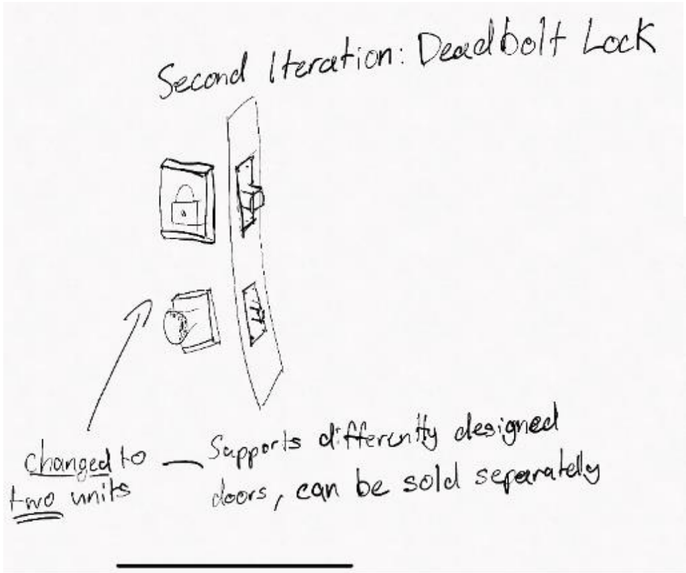
Design Matrix

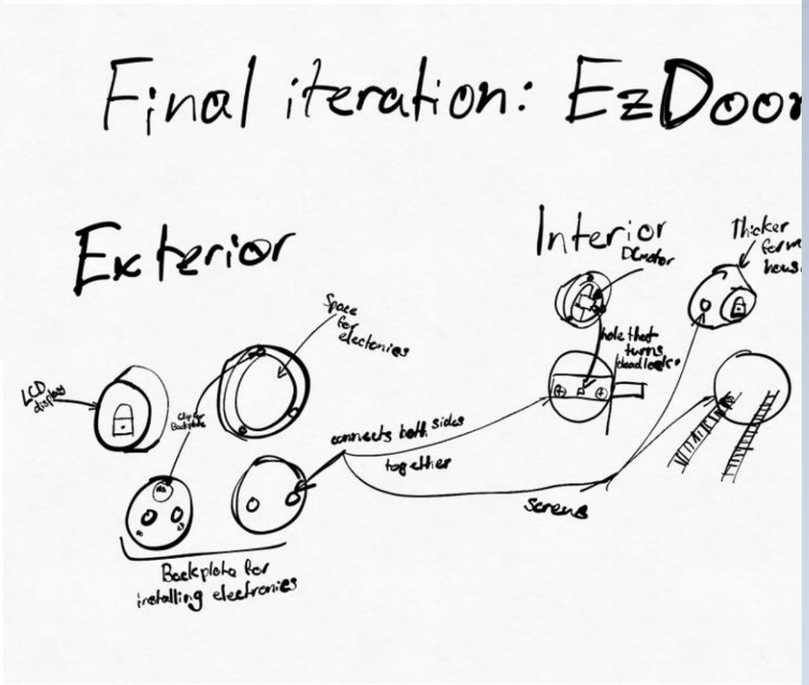
		Design Considerations					
		Cost	Functionality/ Efficiency	Ease of Use	Durability	Security	*Total*
	Weight	**0.1**	**0.35**	**0.15**	**0.1**	**0.3**	1*
Solutions	**Design 1:** Clip Design	4	4	4	3	2	**3.3**
	Design 2:	2	5	4	5	4	**4.25**
	Design 3:	4	3	3	4	2	**3.2**

*A perfect score would be 5 using this weighting, this is just the attribution to the percentage.

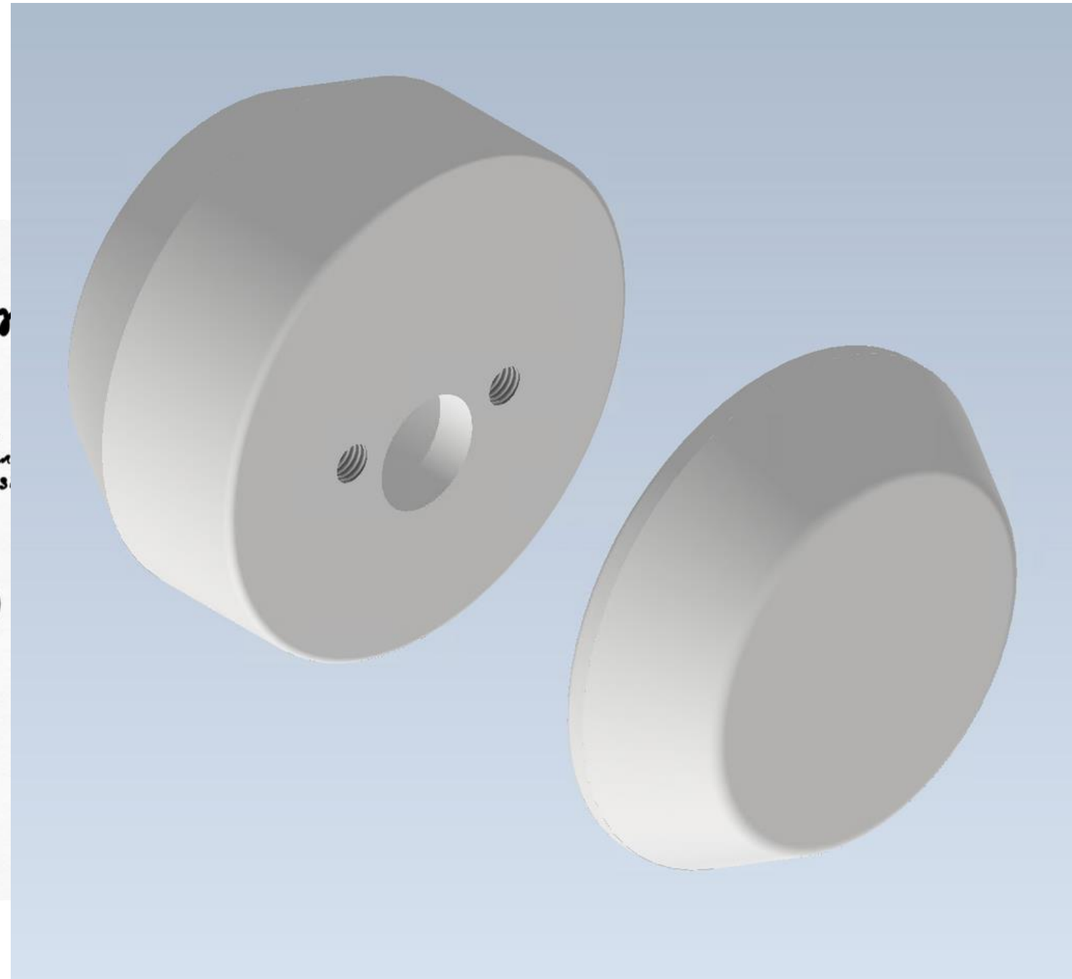
Chosen Design

Iterations of EzDoor lock



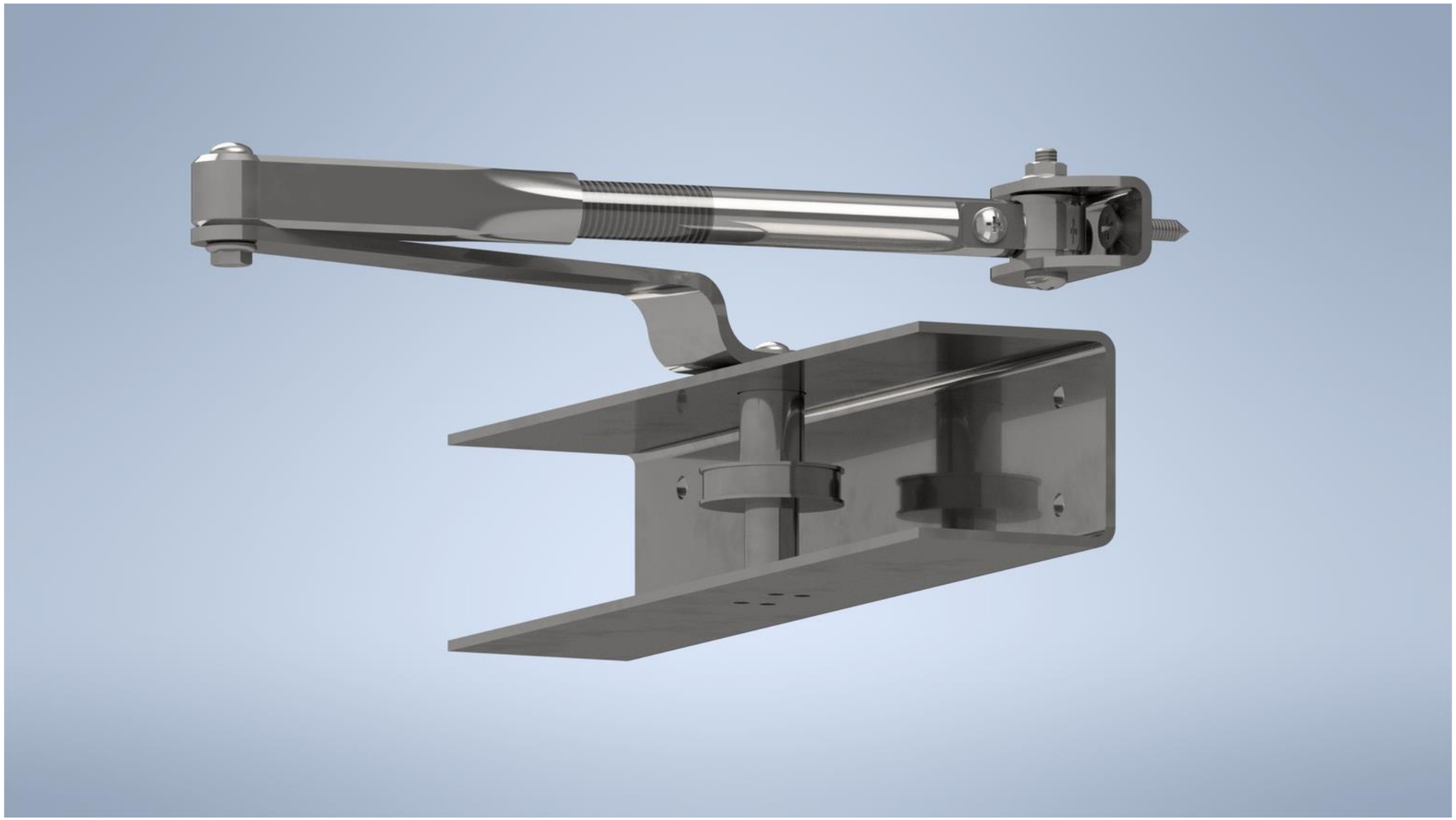


CAD Model of Deadbolt



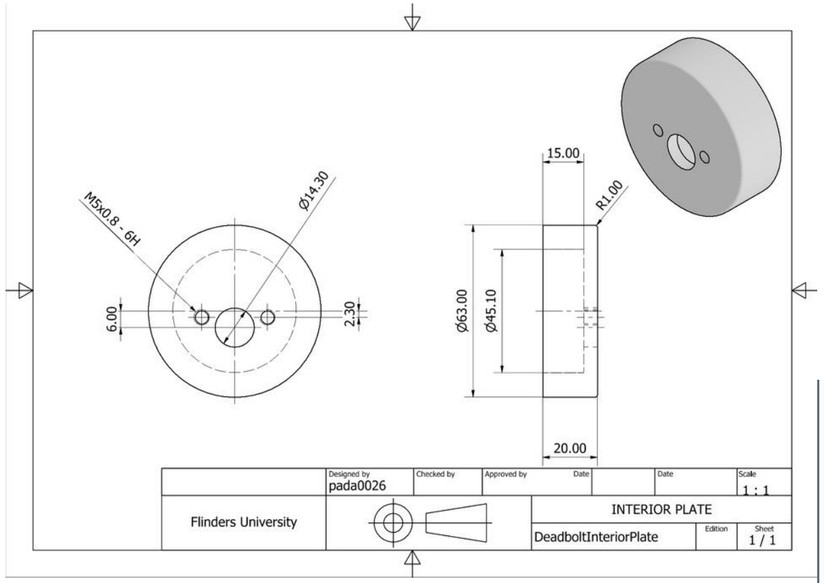
Chosen Design contd.

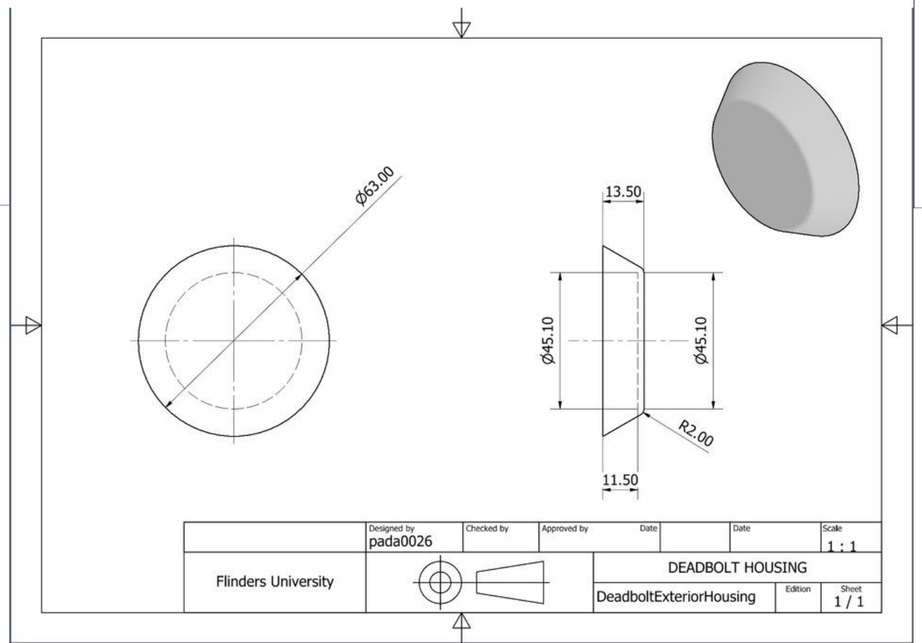
Chosen Design contd.

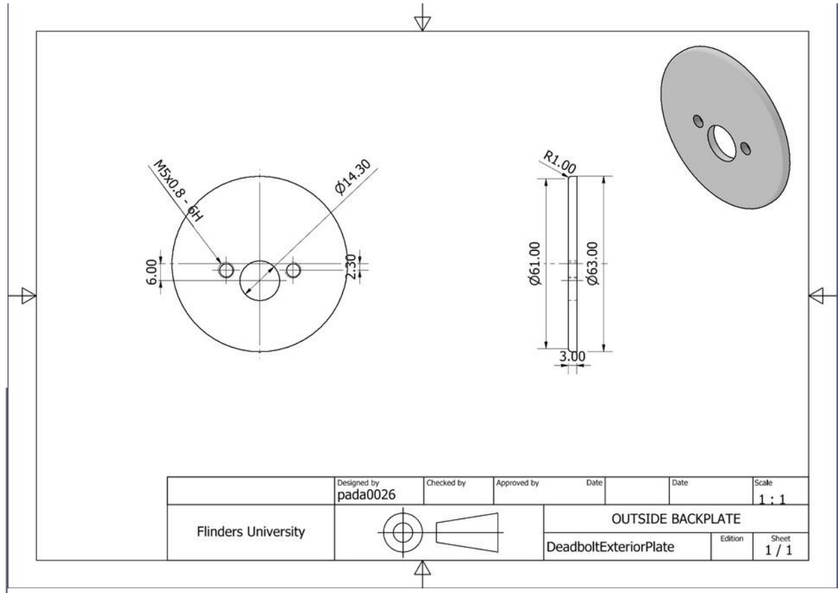


Chosen Design contd.

Technical Drawings:



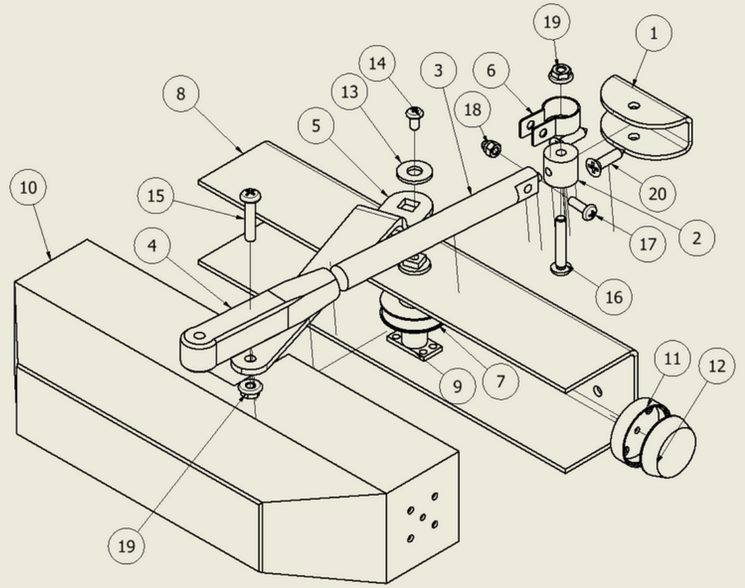




Chosen Design contd.

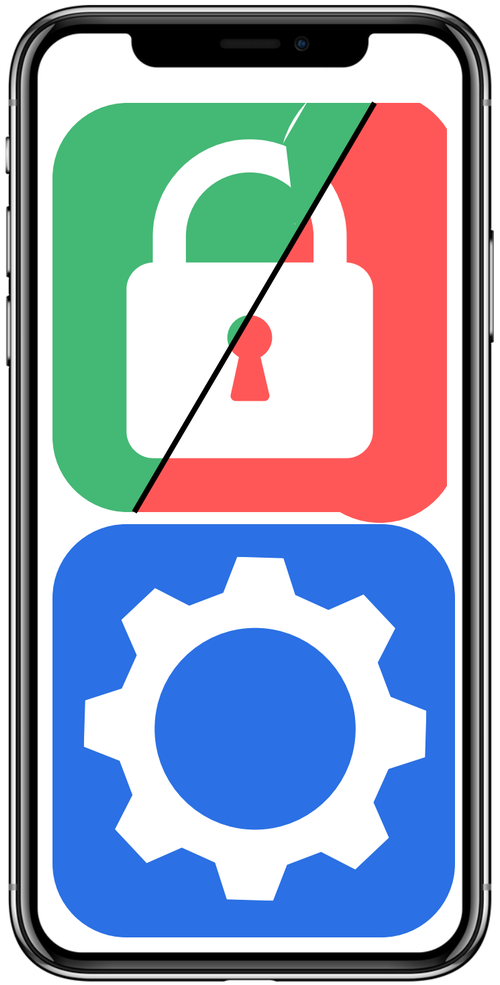
PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	Pintle	Mounts actuator arm to the wall
2	1	Bearing	Allows free rotation about the pintle
3	1	Secondary Arm Thread	Threaded adjuster rod allows mounting flexibility
4	1	Secondary Arm Rotor	Joins the threaded rod to the primary arm
5	1	Primary Arm	Transfers rotational motion into linear motion
6	1	Shaft lock	Locks the arm in place
7	1	Primary Rotor	Transfers the belt driven motion into the primary arm
8	1	Structural housing	Primary structural component of the actuator
9	1	Rotor mount	Mounts the rotor to the structural housing
10	1	Outer housing	Aesthetic housing to hide internal components
11	1	Alarm Housing	Houses the light and electronics of the alarm
12	1	Alarm Reflector	Diffuses the light source
13	1	AS 1237 - 8 mm	Flat metal washers for general engineering purposes (metric series)
14	1	AS 1427 - M5 x 10	Pozidriv ISO metric machine screws
15	1	AS 1427 - M6 x 30	Pozidriv ISO metric machine screws
16	1	AS 1427 - M6 x 35	Pozidriv ISO metric machine screws
17	1	AS 1427 - M5 x 16	Pozidriv ISO metric machine screws
18	1	CNS 4315 - M 5	Hexagon Domed Cap Nuts
19	2	ISO 4161 - M6	Hexagon nuts with flange-coarse thread
20	2	Screw GB/T 951-1986 6 x 25	Cross recessed countersunk head wood screws



	Designed by	Checked by	Approved by	Date		Date	Scale
	Alex Farmer						1 : 2
Flinders University					Door Opener		
						Edition	Sheet 1 / 1

Buddy App Mockup



Universal Design

Equitable Use

The handless design allows persons with hand disabilities to easily interact with door

Flexibility

Buddy-app will provide a multitude of applications and options for the lock and opener

Simple and Intuitive

Pictorial instructions make use of product clear and easy to understand. App UI will remain minimal

Perceptible Information

LCD display clearly shows status of lock, buddy-app will provide auditory status when changed or prompted

Tolerance for Error

Confirmation request when interacting with door lock using app to minimise accidental interactions

Low Physical Effort

By automating the function of the product, the user can interact using a voice assistant, minimising the physical effort

Size and Space for Approach

Wireless operation allows for the product to be placed in any place on the door and still be easily used.

Human Factors

Human Factors

This product was designed for persons with limited hand functionality, allowing them to access their home as easy as everyone else. In addition, the product can be used by anyone, accounting for wheelchair users, those who are deaf and/or blind

Various test regimes to test our design.

Design Testing

Sensor Durability and Reliability

Objective: Ensure the sensor performs in different conditions assuming no loss of Internet connection.

Load: Morning, afternoon, evening, rain, sun, vibration, wind, storm

Repetition: 100+ times

Deliverable: Sensors should withstand different conditions without performance loss.

Functionality Test

Objective: Ensures door mechanism works within specific time frame of 2 seconds, fully wide in 5 seconds.

Load: Test sensor within proximity of <7m and <180 degrees,

Repetition: 100+ times

Deliverable: The door should be fully unlocked wihtin 2 seconds of users unlocking sequence on app. Door should be fully open 5 second after promt.

Various test regimes to test our design.

Design Testing cont.

Failsafe/Contingency Test

Objective: Ensure manual override system works when electronic fails or unavailable.

Load: Disconnect wifi/simulate software error/simulate sensor error.

Repetition: 100+ times

Deliverable: Door will open manually using failsafe handle if wifi, software or sensor failure.

Software Testing

Objective: Ensure no bugs in app/software functions properly (iOS or Android)

Load: Software diagnotstics run.

Repetition: 100+ times

Deliverable: The app should be easily downloadable and functions as intended with no bug issues.

Physical Deadbolt Test

Objective: Deadbolt can withstand physical force to the door.

Load: Applied forces - 5kg, 30kg, 50kg, 100kg, 500kg.

Repetition: 100+ times

Deliverable: The deadbolt should withstand the force of the door being pushed, kicked in robbery instance.

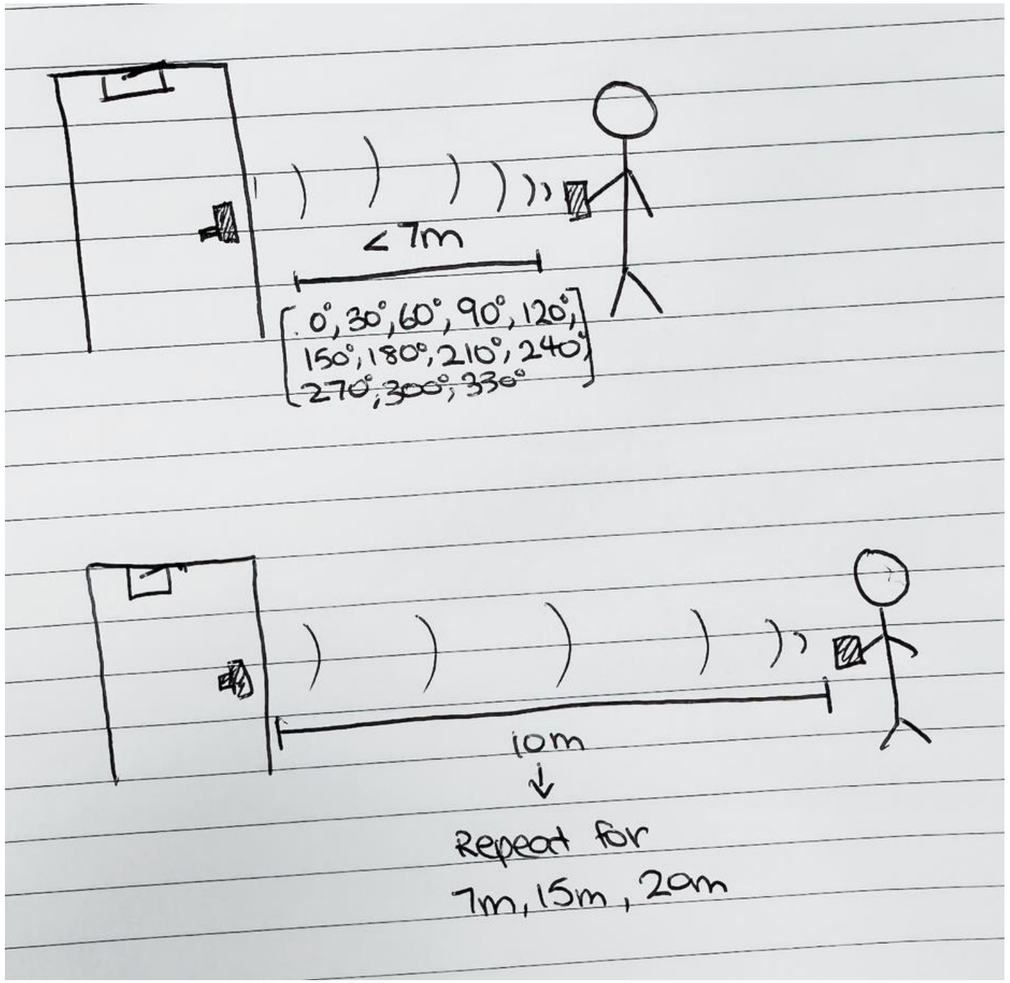
Proximity Test In Depth

Objective: Ensures door sensor connects and prompts user within proximity.

Load: Approach from different distances above and below coverage distance - 20m, 15m, 10m, 7m, <7m and from different angles above and below coverage distance - 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330.

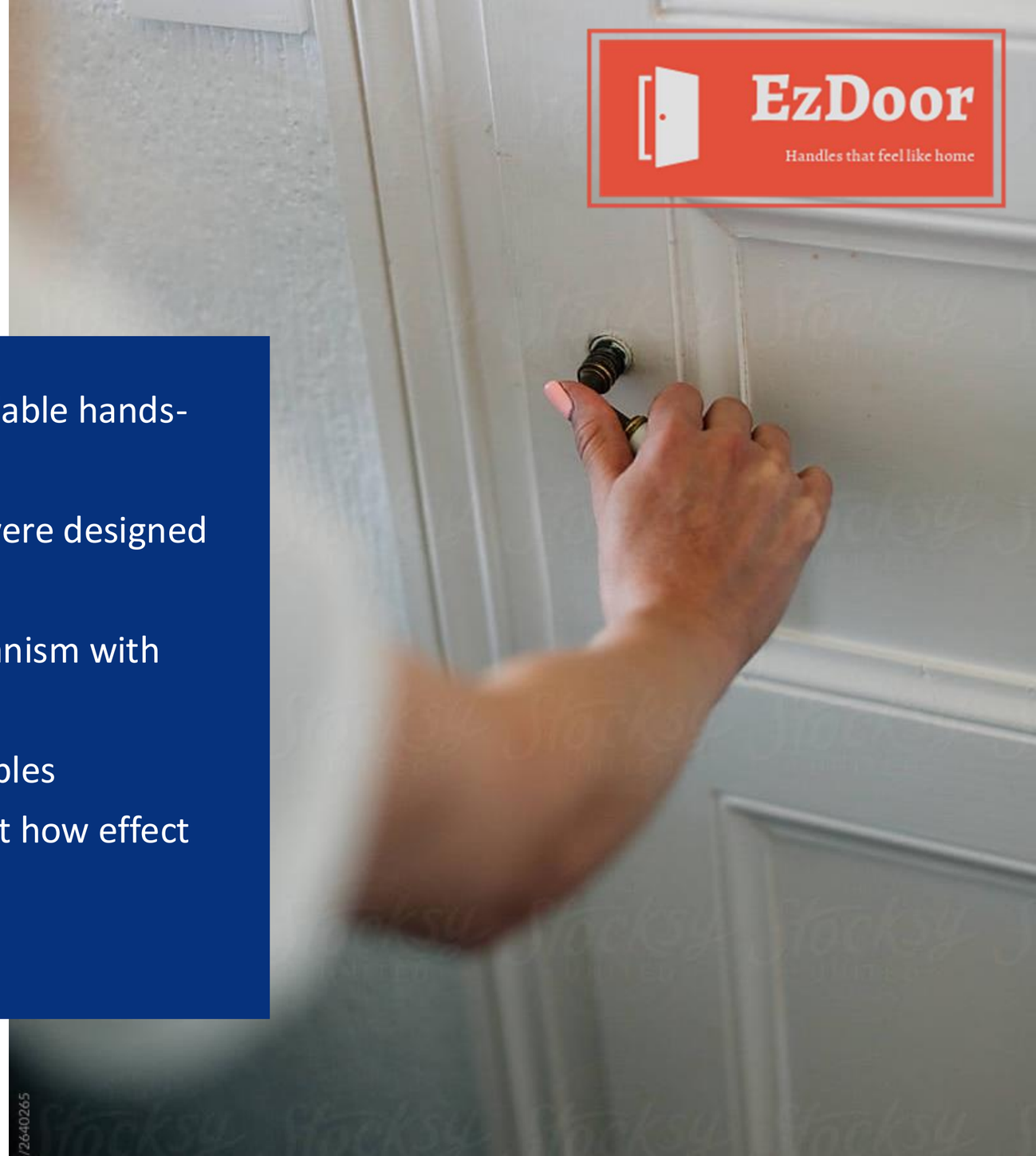
Repetition: 100+ times

Deliverable: Users should recieve prompt less than 7m from door and <180 degrees. User should not get a prompt when outside 7m diameter from the door sensor.



Conclusion

- Currently there are few secure, accessible, affordable hands-free door handle designs
- Various designs both mechanical and electrical were designed and compared
- The final design was chosen - door sensor mechanism with lockable ability with buddy app
- The design aligns with all Universal Design Principles
- 6 test regimes were created and evaluated to test how effect the design is



Questions?

Our Team

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References

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