



Project 2

TROLIFT

Designed by Alvin Tay, Eldred Sng, Jing Ying

Problem Statement

Elderly suffering from osteoporosis in Singapore have a high risk of developing chronic disabilities while going about their daily activities.

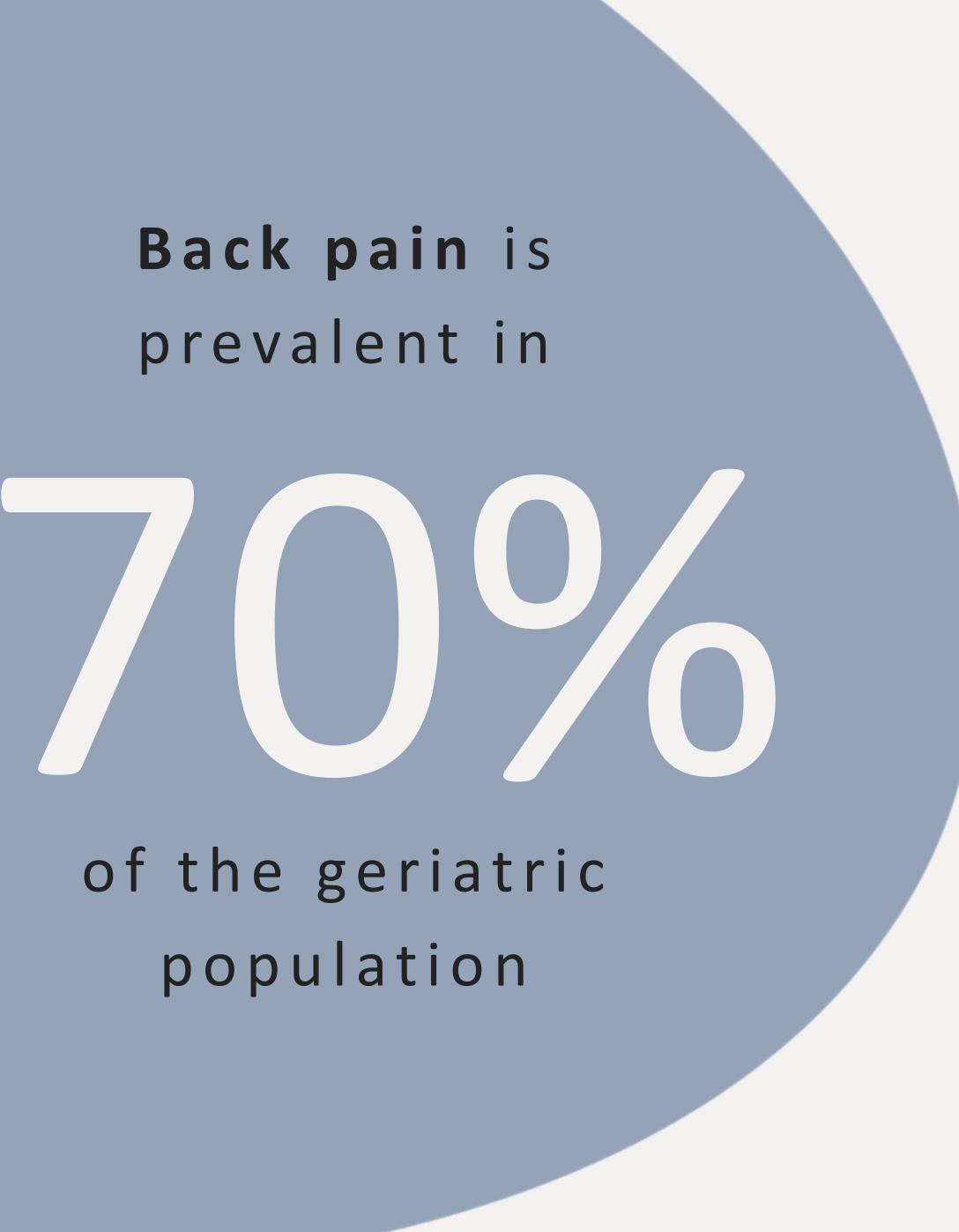
As we age, the density of the bones in our body starts to decrease, resulting in very **brittle** and **fragile** bones.

This condition is known as **Osteoporosis**.

Men and women over the age of

65

are at a higher risk of **osteoporosis**



70%

of the geriatric
population

Back pain is
prevalent in

Elderly suffering from osteoporosis face an **increased risk** of chronic lower back injuries as their weakened bone structure **cannot sustain** normal **weightbearing activities** anymore.



Grocery shopping was identified as a high-risk activity that greatly increased the risk of a **chronic lower back injury**



POV

Osteoporotic elderly need a new way of loading and unloading grocery goods that places less strain on their back, reducing the risk of a chronic lower back injury

HOW MIGHT WE (HMW)

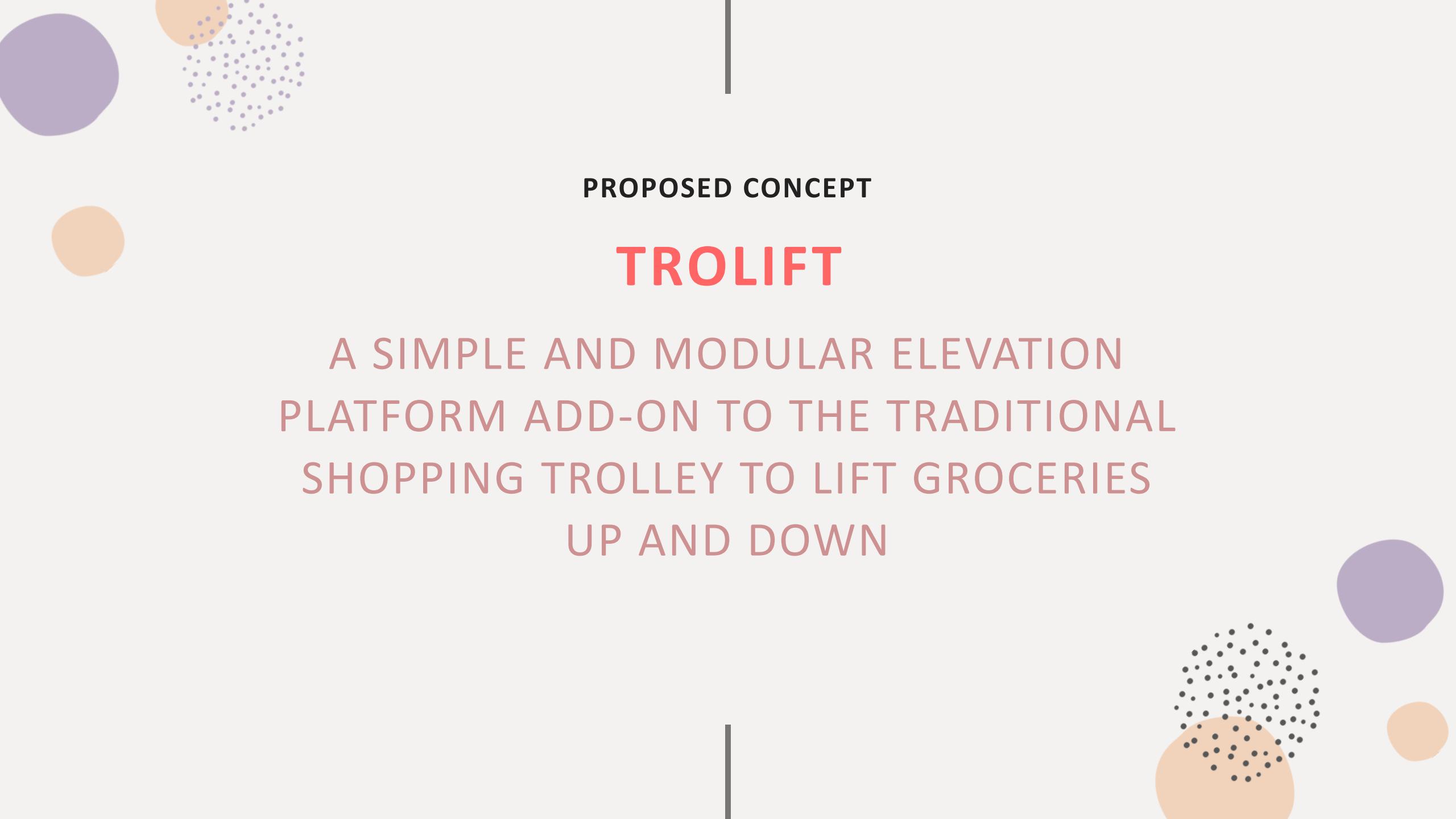


HMW remove the need for elderly to bend down to load and unload groceries on their shopping trolley

HMW make the online grocery shopping an easier and effortless experience



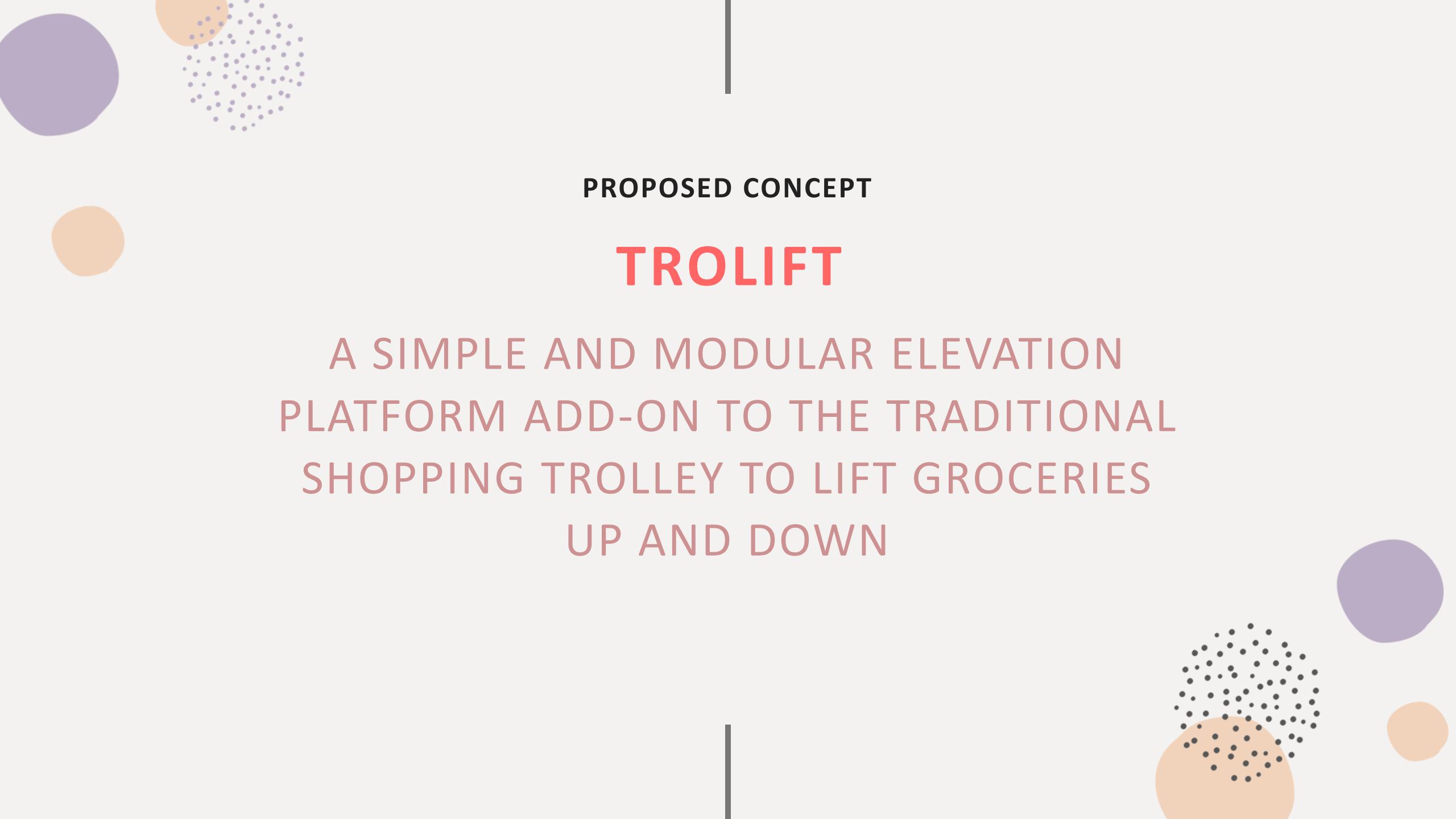
HMW make food delivery a more viable option to immobile or disabled elderly



PROPOSED CONCEPT

TROLIFT

A SIMPLE AND MODULAR ELEVATION
PLATFORM ADD-ON TO THE TRADITIONAL
SHOPPING TROLLEY TO LIFT GROCERIES
UP AND DOWN



VIDEO

PHOTO OF PROTOTYPE

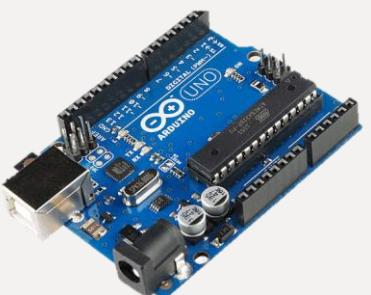


* Note: maximum height does not exceed the height of the trolley to prevent items from overflowing out.

HOW IT WORKS

ARDUINO

Allows for the
programming of the
circuit and motor system



STEPPER MOTOR NEMA17

Results in the pulling of
the metal threaded bar
inwards and outwards.



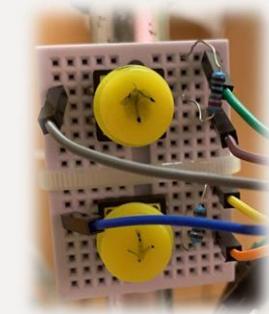
SCISSOR LIFT MECHANISM

Allows for vertical
displacement of load



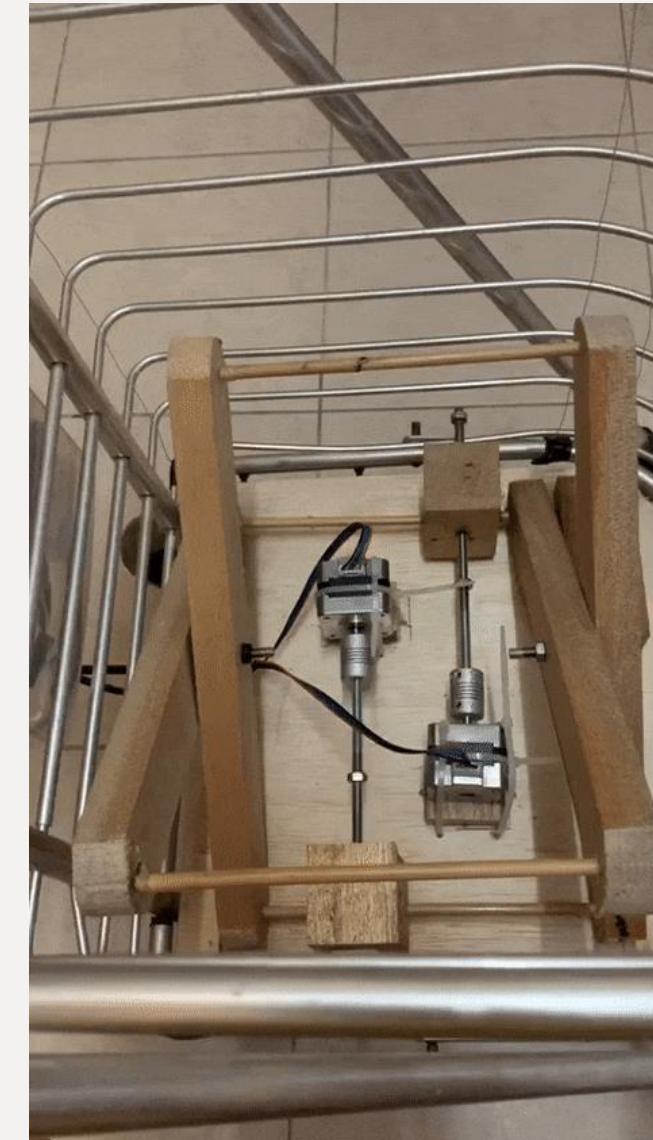
2-BUTTON CONTROL SYSTEM

Allow for **exact** control
over the vertical
displacement of the load –
upwards/ downwards
direction



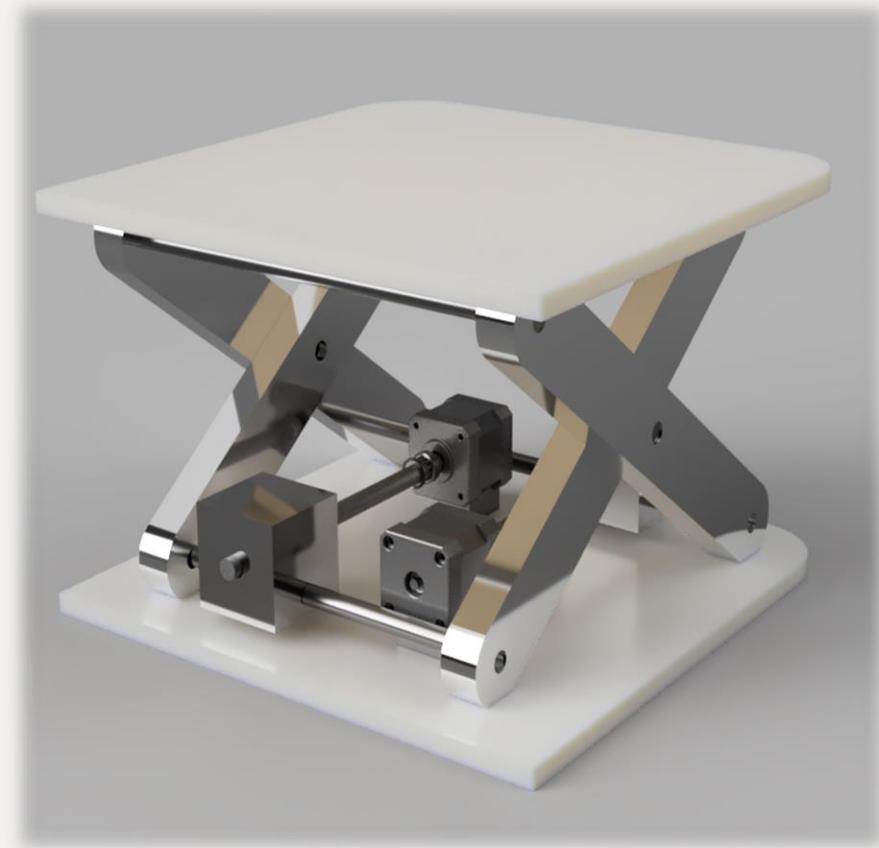
HOW IT WORKS

- While the up button is pressed, the motors will rotate in a clockwise direction
- This turns the threaded bars and pulls the wooden blocks closer to each other.
- The wooden blocks move the arms of the scissor lift structure and increases its vertical elevation
- Vice versa for the downwards direction



VALUE PROPOSITION

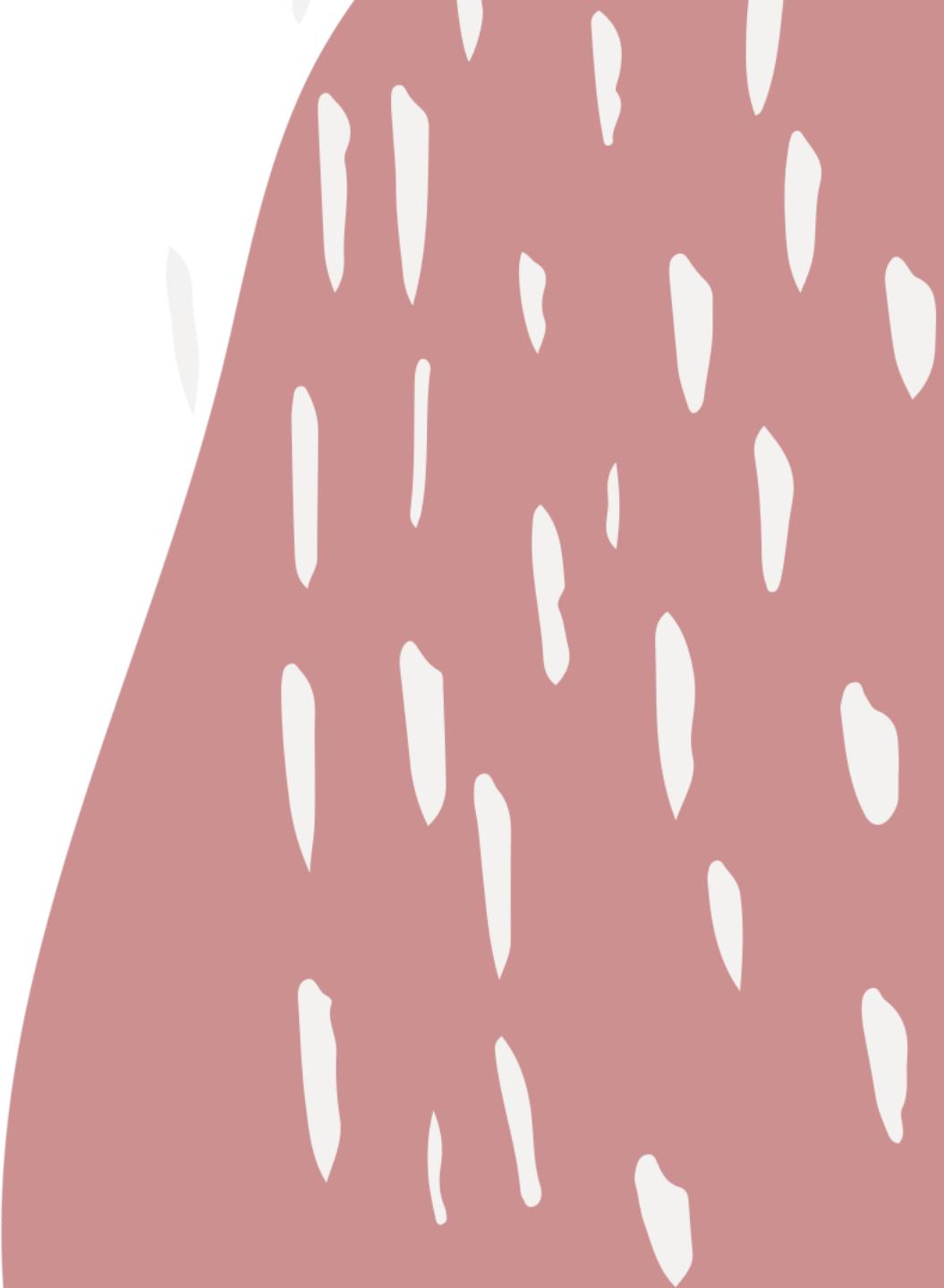
TROLIFT lifts groceries up and down inside the trolley simply with the press of a button, ensuring that you will never need to strain your back again by bending down.



Picture of rendered AutoCAD prototype

THANK YOU

TO EVOLVE WITH ELDERLY IN MIND



Things that users like...

- The elevated platform, which eliminates the need to bend down during loading and unloading
- Simple 2-button control system
- Easy and smart-tech free operation system
- Made of recycled materials - environmentally friendly

Things that users were not clear about...

- The maximum lifting weight
- Cleanliness maintenance
- Safety of the motors
- The removal and installation of TROLIFT
- Retrieval and processing of recycled materials used in the production of TROLIFT

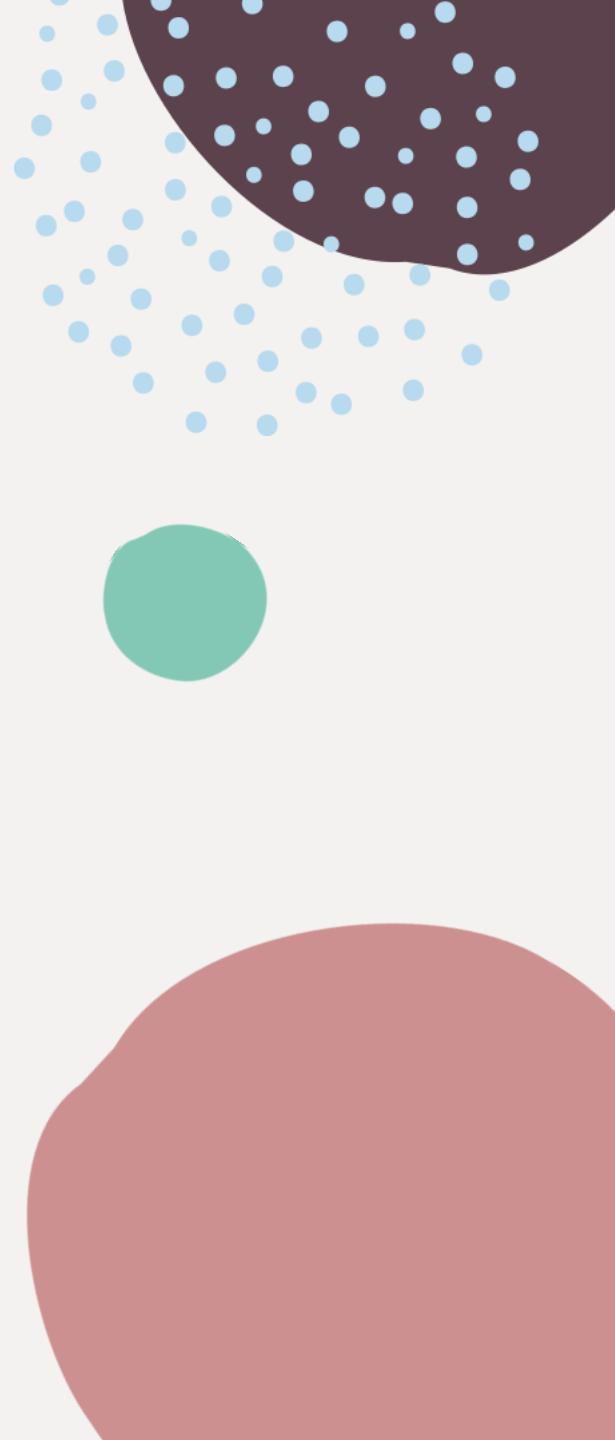
Things that users did not like...

- Speed at which the platform rises
- Bulky and take up space in the trolley, decreasing the amount of space for groceries
- Noise generated by the running of the motors
- External component that holds the circuits and battery

New ideas and opportunities...

- With greater support and budget, compacting the power supply and circuitry system is definitely viable, allowing for easy removal and installation.
- Compartmentalization and proper storage of components will ensure both the safety and cleanliness.
- Collaborations with recycling companies and organizations are possible sources of acquiring processed recycled materials for production.

APPENDIX





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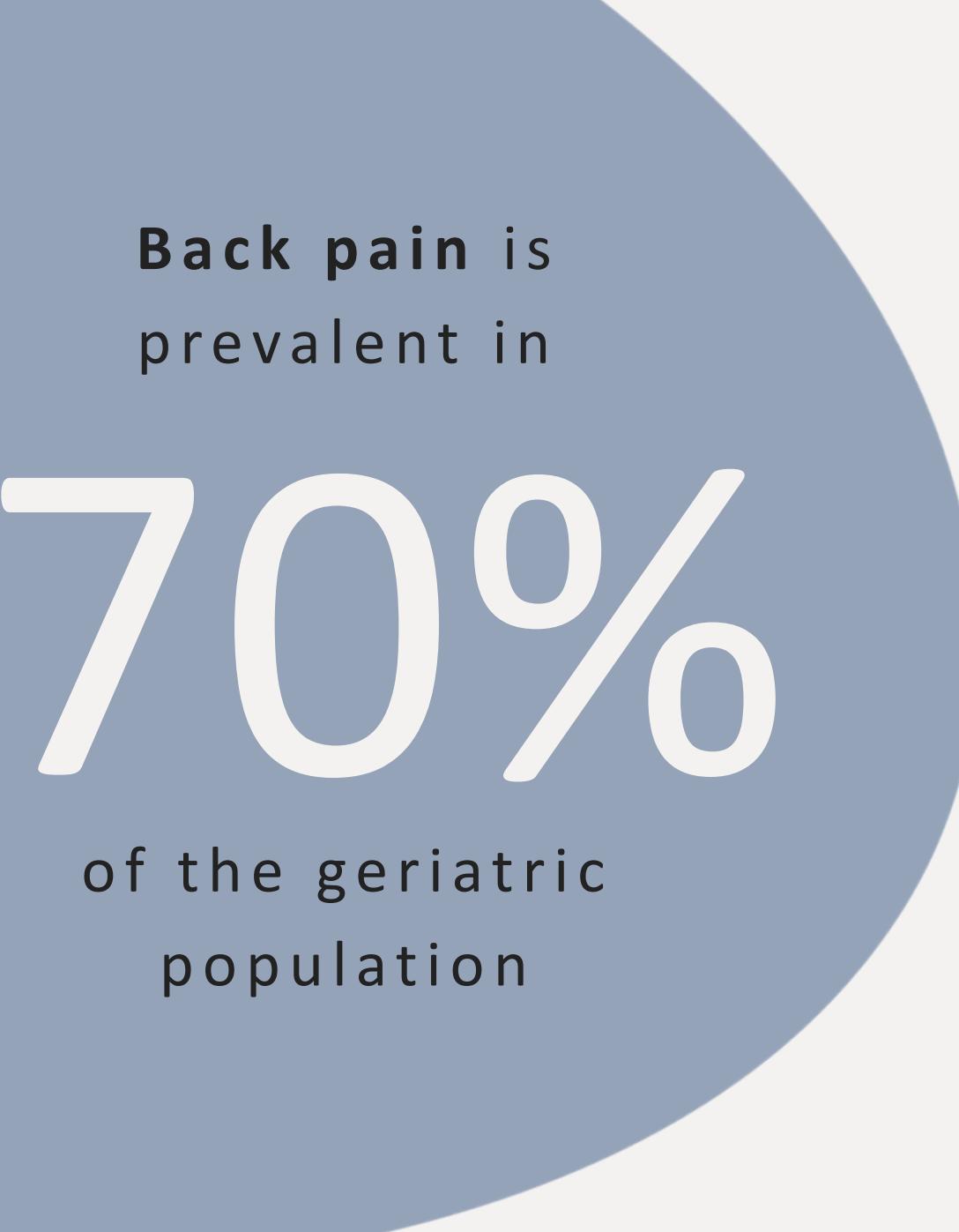
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Grocery shopping was identified as a high-risk activity that greatly increased the risk of a **chronic lower back injury**



TARGET GROUP

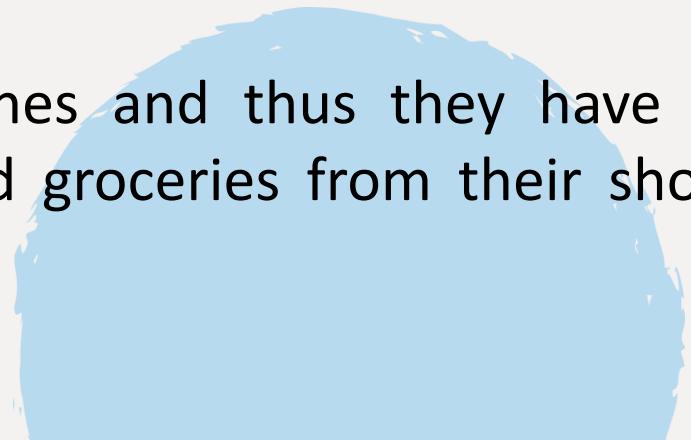
Osteoporotic elderly who frequently go grocery shopping **on their own**

NEED

Osteoporotic elderly needs a way to load and unload groceries **without straining their back**

REASON FOR NEED

Osteoporotic elderly have weaker bones and thus they have to refrain from bending their back to load and unload groceries from their shopping trolley in order to reduce the risk of injury





POV

Osteoporotic elderly need a new way of loading and unloading grocery goods that places less strain on their back, reducing the risk of a chronic lower back injury

HOW MIGHT WE (HMW)

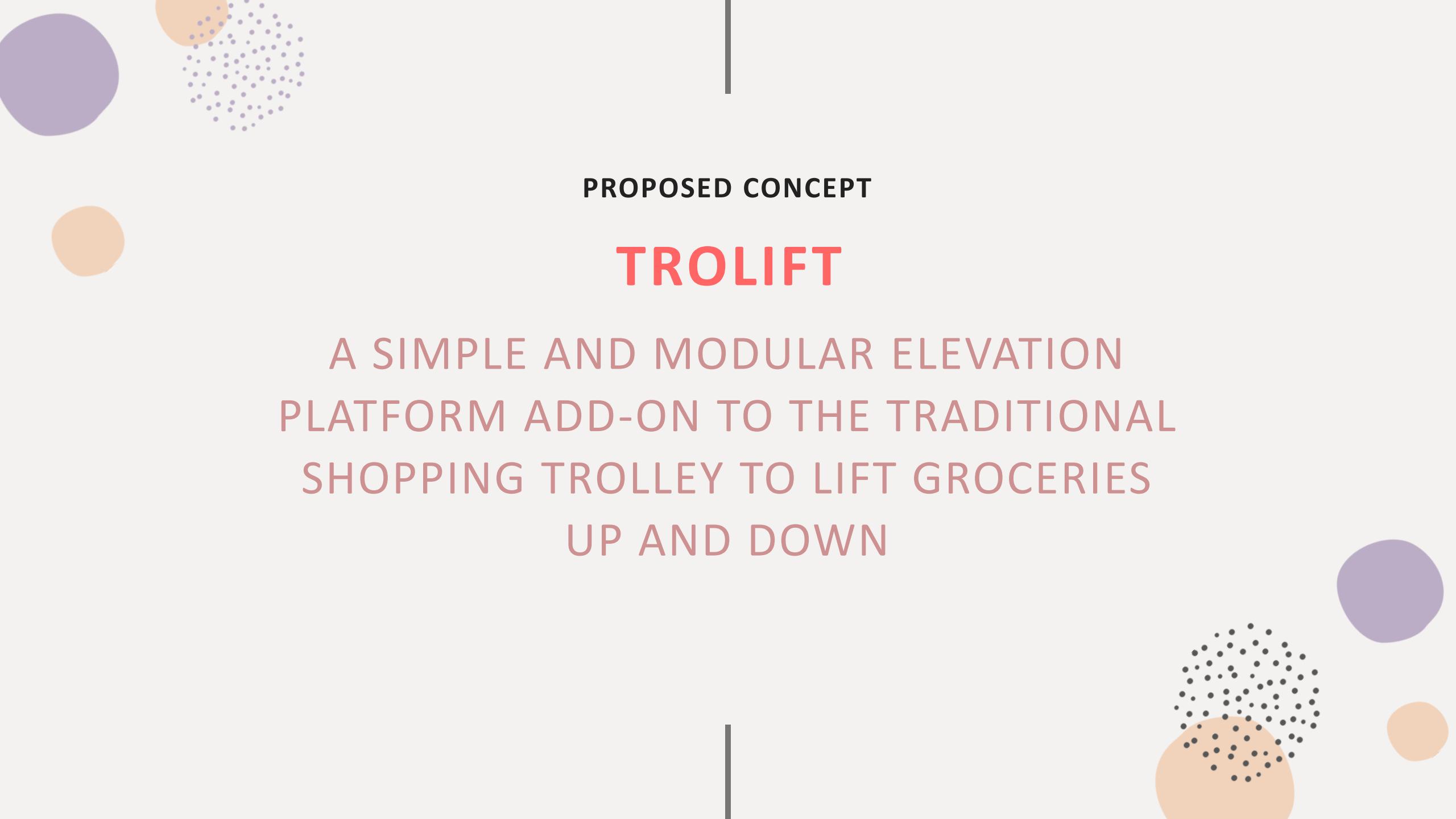


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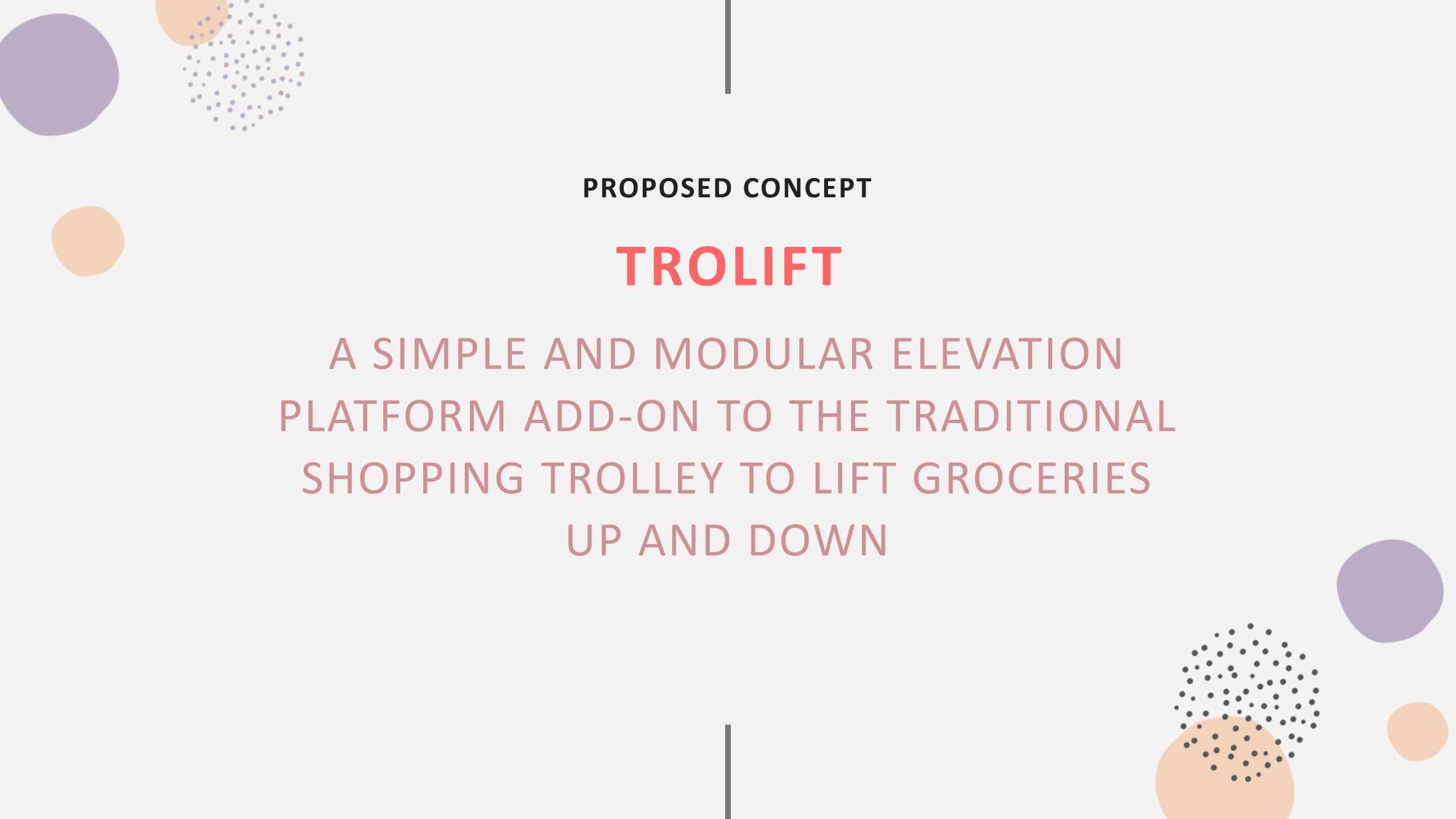
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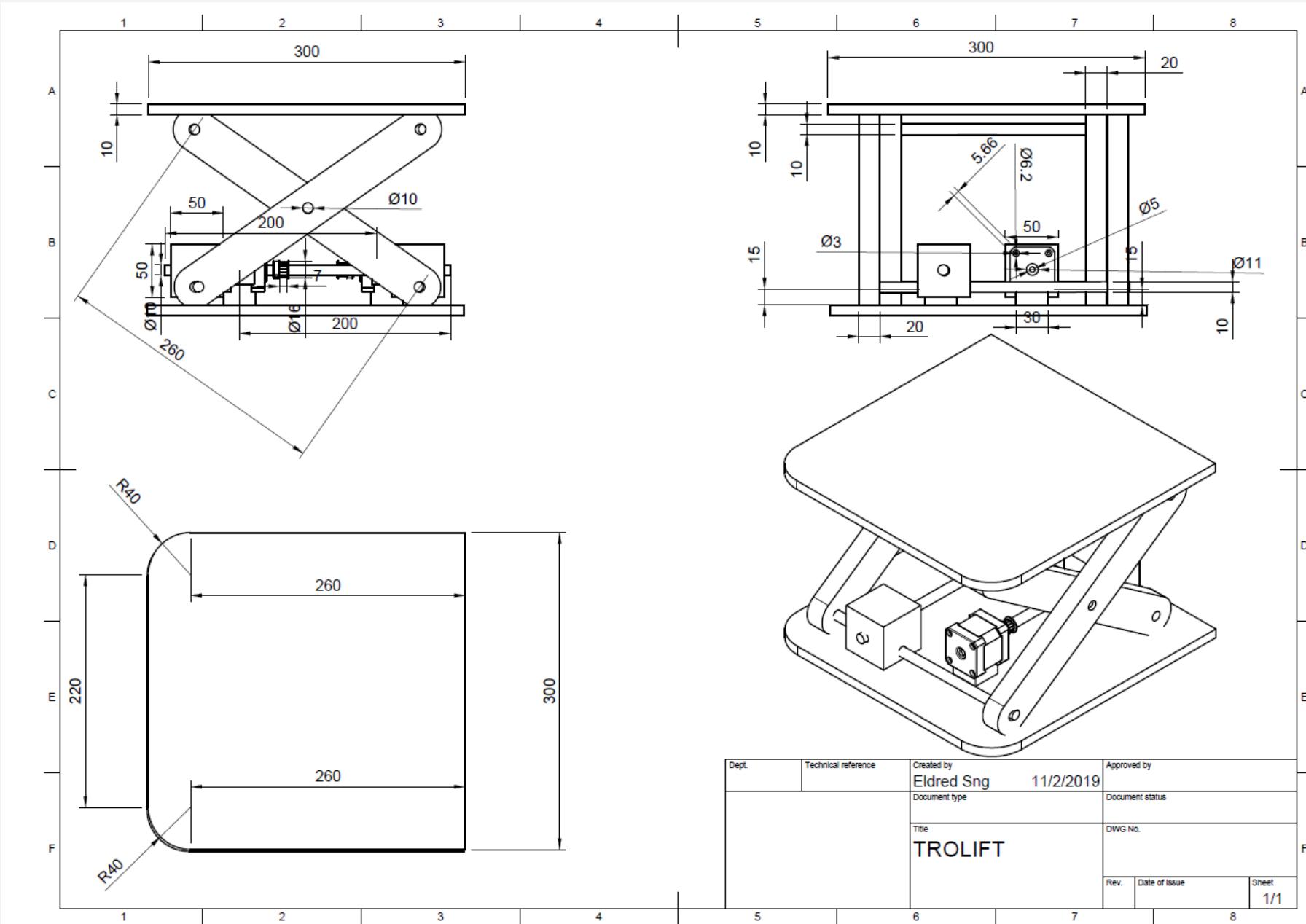
VIDEO

PHOTO OF PROTOTYPE



* Note: maximum height does not exceed the height of the trolley to prevent items from overflowing out.

DRAWING OF PROTOTYPE (AUTOCAD)



HOW IT WORKS

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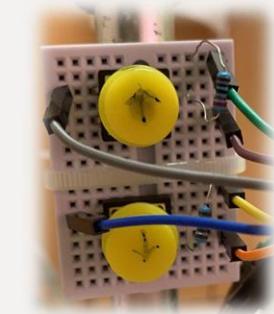
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2-BUTTON CONTROL SYSTEM

Allow for control over the
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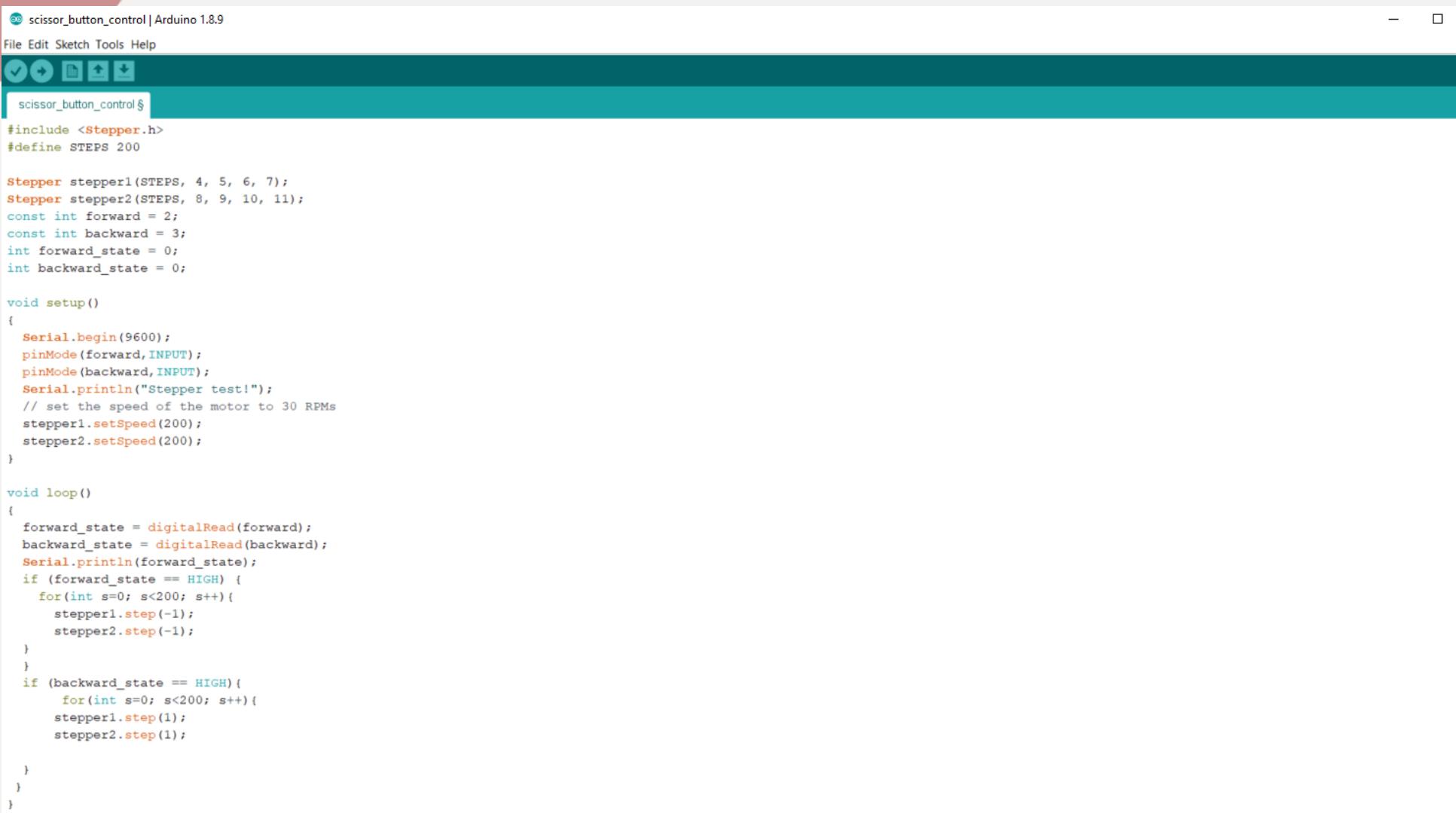


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ARDUINO CODE



The image shows the Arduino IDE interface with a sketch titled "scissor_button_control". The code is written in C++ and controls two stepper motors (stepper1 and stepper2) based on digital input from two buttons (forward and backward). The sketch includes setup and loop functions, and it uses the Stepper library.

```
scissor_button_control | Arduino 1.8.9
File Edit Sketch Tools Help
scissor_button_control §
#include <Stepper.h>
#define STEPS 200

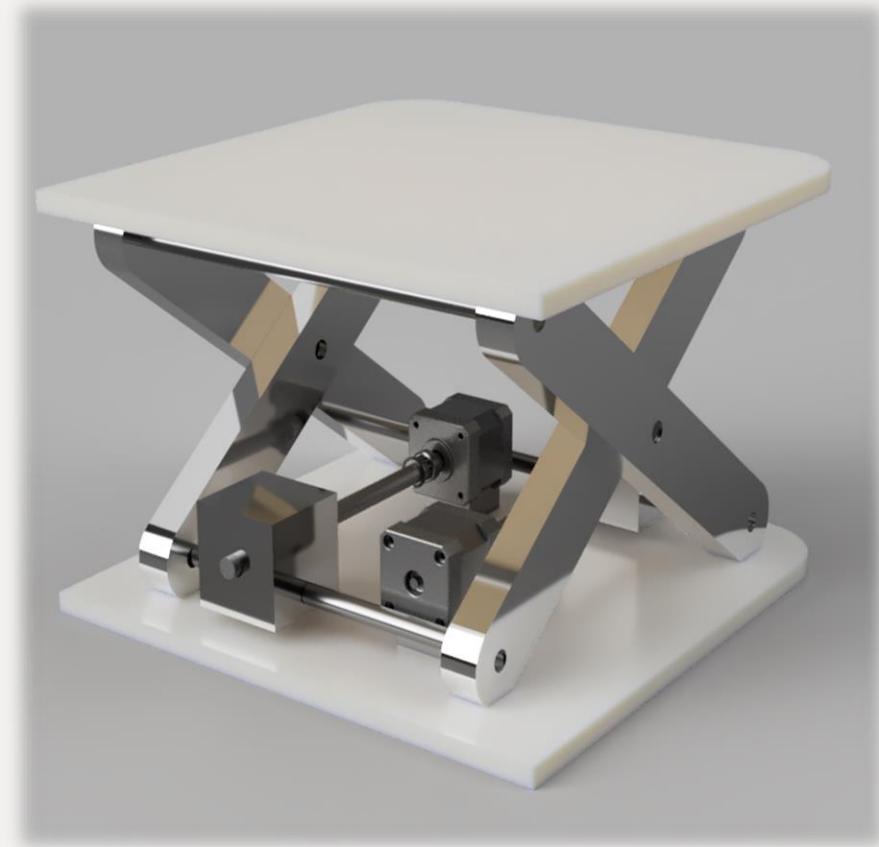
Stepper stepper1(STEPS, 4, 5, 6, 7);
Stepper stepper2(STEPS, 8, 9, 10, 11);
const int forward = 2;
const int backward = 3;
int forward_state = 0;
int backward_state = 0;

void setup()
{
    Serial.begin(9600);
    pinMode(forward, INPUT);
    pinMode(backward, INPUT);
    Serial.println("Stepper test!");
    // set the speed of the motor to 30 RPMs
    stepper1.setSpeed(200);
    stepper2.setSpeed(200);
}

void loop()
{
    forward_state = digitalRead(forward);
    backward_state = digitalRead(backward);
    Serial.println(forward_state);
    if (forward_state == HIGH) {
        for(int s=0; s<200; s++) {
            stepper1.step(-1);
            stepper2.step(-1);
        }
    }
    if (backward_state == HIGH) {
        for(int s=0; s<200; s++) {
            stepper1.step(1);
            stepper2.step(1);
        }
    }
}
```

VALUE PROPOSITION

TROLIFT lifts groceries up and down inside the trolley simply with the press of a button, ensuring that you will never need to strain your back again by bending down.



Picture of rendered AutoCAD prototype



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New ideas and opportunities...

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- Collaborations with recycling companies and organizations are possible sources of acquiring processed recycled materials for production.

Assessment of Technical Feasibility

Components	Technical Readiness Level (TRL)	Remarks
Stepper Motor NEMA 17	9	Widely used in applications such as printers and laser cutters
Arduino Uno	5	Used in Do-it-Yourself projects prototyping and in developing projects. Not used in operational environment.
Motor Drive TB6612FNG	5	Used in Do-it-Yourself projects prototyping and in developing projects. Not used in operational environment.
Power Supply	9	Batteries are widely used in the operational environment
Button Control and Circuit System	4	Self-designed. Used in Do-it-Yourself projects prototyping and in developing projects. Not used in operational environment.
Scissor Lifting Mechanism	9	Widely used in maintenance and transportation work

Technical Feasibility Level (TFL):
Level 4 (Concept validated in lab)

Assessment of Economic Feasibility

Analysis	Remarks
Market and projection analysis	Due to the ageing of Baby Boomers (1946 - 1964) and ageing population, the number of seniors requiring additional care due to chronic illness will increase from 14% to 21% by 2050 [1]. In general, there is a positive outlook in the healthcare industry and elderly assistive products. Furthermore, by exploiting the uprising and strong silver economy, an exponential revenue projection will also be expected.
Competition	Although there is a huge and uprising market for the production of elderly assistive and healthcare products, many solutions are clustered in the area of telehealth, AI, wearables and blockchain [1]. TROLIFT, however, is situated in a relatively untapped area of opportunity for elderly products, addressing specific issues that elderly faced in their daily activities. Hence, relatively low competition will be seen in the present and near future.
Profitability	TROLIFT was built from recycled materials. Materials for the Arduino system can also be easily bought online and in hardware shops. TROLIFT, a low-cost do-it-yourself project, has the potential to grow exponentially with the right support and budget. Low cost of production with high growth potential will definitely warrant high profits and gains.
Sustainability (Business)	TROLIFT was built by a 3-man team in slightly less than 48 hours with recycled materials and easily accessible electronic materials. Thus, proving it as a viability low cost innovation in various aspects in terms of manpower, production time and profitability. Low production cost coupled with high profitability will ensure the viability and sustainability of the business.

Assessment of Operational Feasibility

Analysis	Remarks
Effectiveness	It drastically reduces the need for elderly to bend over during the loading and unloading of groceries, minimizing the risk of back injuries and fractures.
Usability and Affordability	Powered by batteries, it provides elderly a familiar and traditional way of operating devices, free of complicated charging methods. Simple 2-button system is also used for the easy operation of TROLIFT. A reliable and low maintenance add-on to traditional grocery trolley.. Designed using recycled materials and easily accessible electronic materials, it effectively allows for a low cost of production and maintenance and hence affordability.
Sustainability (Environmental)	Built from recycled materials, it provides an outlet for unwanted products to be recycled into materials. Thus, effectively reusing these materials and developing them into new products. As it is made up of recycled materials, repetitive recycling and reusing is also possible. It also produce minimal waste and pollution with its long shelf-life and durability.
Organization and public support	Similar projects such as the ELLE project was able to raise S\$8,009 purely through crowdfunding and gained a total of 36 organizations and individuals to support their project [2]. This effectively proves that projects in such areas experience strong support from both the public and organizations.

Review and Comparison of Existing Solutions

ELLE, a trolley add-on that utilizes a spring mechanism to elevate a movable platform such that senior citizens no longer need to bend and strain their back. However, this project was cancelled due to multiple reasons.



Photo of ELLE [2]

Review and Comparison of Existing Solutions

	TROLIFT	ELLE
Function	Reduce the strain on elderly's back	Reduce the strain on elderly's back
Modular	Add-on	Add-on
Mechanism	Scissor lift mechanism	Spring Mechanism
User Control	Controllable by button	No control
Effectiveness	Aluminum stand provides stability and support for heavy lifting	Springs are not able to support heavy lifting

PATENTS

United States Patent [19]

Clark

4,114,854

[11] Sep. 19, 1978
[45]

[54] SCISSORS LIFT WORK PLATFROM

[75] Inventor: Albert L. Clark, West Bend, Wis.
[73] Assignee: Pac-Craft Products, Inc., West Bend, Wis.
[21] Appl. No.: 805,262
[22] Filed: Jun. 10, 1977
[51] Int. Cl. 2 B60P 1/02
[52] U.S. Cl. 254/122; 214/512;
187/18
[58] Field of Search 214/512; 254/122;
187/18; 182/141, 157

[56] References Cited

U.S. PATENT DOCUMENTS

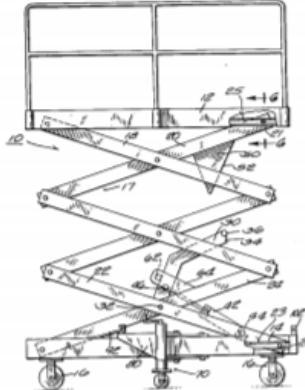
2,533,980 12/1950 Weaver 254/122 X
3,664,459 5/1972 Stephens et al. 187/18 X

Primary Examiner—Albert J. Makay
Attorney, Agent, or Firm—Wheeler, Morsell, House & Fuller

[57] ABSTRACT

A lift with a work platform supported by a scissors linkage on a base includes a single hydraulic cylinder for elevating the linkage. The cylinder is connected between a lower link and a swing arm which is pivotally connected to the linkage. During a first lifting stage the swing arm bears against a cam surface on the uppermost link to cause an initial unfolding action of the upper links. Prior to the arm leaving the cam surface, the arm bears against an abutment on one of the lower links for a second lifting stage to cause unfolding of the linkage from the bottom. This arrangement provides a strong, smooth unfolding of the linkage. The base is provided with outriggers which can be folded against the sides of the base when not in use and which are pivoted to a transverse position for use. Links connecting the outriggers to a guide track enable positive locking of the outriggers in the operative position.

3 Claims, 8 Drawing Figures



Patent for scissor lift mechanism [3]

310-12 SR
7/5/82 XR 4+315+171

*found 310/111
on 3/6/85 PWD*

United States Patent [19]

Schaeffer

[11] 4,315,171

[45] Feb. 9, 1982

[54] STEP MOTORS

[76] Inventor: Ernest Schaeffer, 6234 Kentland Ave., Woodland Hills, Calif. 91367

[21] Appl. No.: 95,068

[22] Filed: Nov. 16, 1979

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 799,302, May 23, 1977, Pat. No. 4,190,779, which is a continuation-in-part of Ser. No. 683,180, May 4, 1976, abandoned.

[51] Int. Cl. 3 H02K 37/00

[52] U.S. Cl. 310/49 R; 310/12

[58] Field of Search 378/254, 138; 310/49, 310/12-14, 156

[56] References Cited

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2,059,518 11/1936 Harley 310/150
3,344,325 9/1967 Sklaroff 310/49 X
3,444,325 9/1969 310/49 X
3,466,518 8/1990 Avlaki et al. 310/49 X
3,502,914 3/1970 Cox 310/49
3,978,356 8/1976 Spiesberger 310/49 X
4,031,419 6/1978 Spiesberger 310/49
4,190,779 2/1980 Schaeffer 310/49 X
4,255,696 3/1981 Field 310/49 X

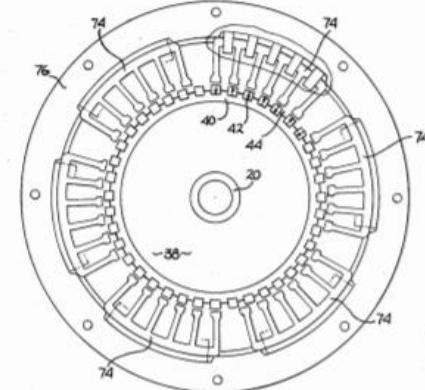
Primary Examiner—Donovan F. Duggan

Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman

[57] ABSTRACT

Improved step motor for providing linear and angular step-wise motion. In certain embodiments the motors utilize a permanent magnet rotor having a multiplicity of equal pitch (equally spaced) permanent magnetic poles of alternating polarity. The stator has a plurality of poles of the same polarity of the rotor being the rotor poles, with each stator pole group being aligned with respect to the other stator pole groups, whereby the poles in the pole groups will successively align with the poles in the rotor in a predetermined sequence upon relative rotation between the rotor and stator. Windings are provided on each stator pole group to selectively polarize the stator poles in the respective pole group in alternate polarity to encourage alignment of the nearest rotor poles therewith. All forms of the invention use one or more stator segments, each of substantially less than 360° in arc length to simplify winding thereof and to make better utility of lamination stock. Linear and rotary devices are disclosed. Permanent magnet embodiments disclosed include multiple permanent magnets making up the rotor poles, and a single permanent magnet having shaped pole pieces. A wound rotor embodiment is also disclosed.

26 Claims, 24 Drawing Figures



Patent for stepper motor [4]

United States Patent [19]

Gabor et al.

[11] 4,321,588

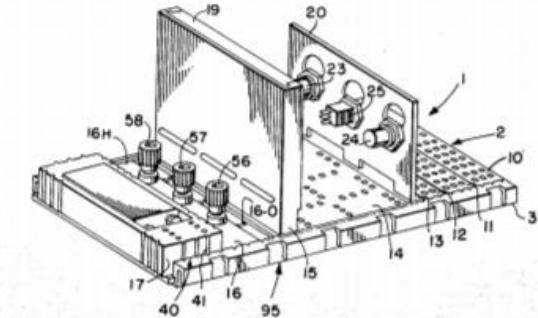
[45] Mar. 23, 1982

Attorney, Agent, or Firm—Maky, Renner, Otto & Boisselle

ABSTRACT

A breadboard assembly to facilitate connecting electrical circuits comprises a breadboard member including a housing, plural electrical contacts in the housing, openings, in at least one surface of the housing for permitting access for connection to respective contacts by a member inserted therein, and a tray for adjustably holding at least one member in operative position therein. The breadboard member may be a terminal strip including in its housing contacts for electrically connecting plural members inserted to engagement therewith, a distribution strip including in its housing one or more contact sets for distributing power to members inserted into engagement therewith, a discrete strip having in its housing contacts arranged in a pattern to accept relatively large size electric or electronic components, a display strip having in its housing an arrangement of contacts for facilitating connections of seven segment alphanumeric displays or the like, a light emitting diode strip having in its housing a contact arrangement that facilitates connections for light emitting diodes, and possibly other types of strips. Means are provided to connect plural trays side-by-side and end-to-end.

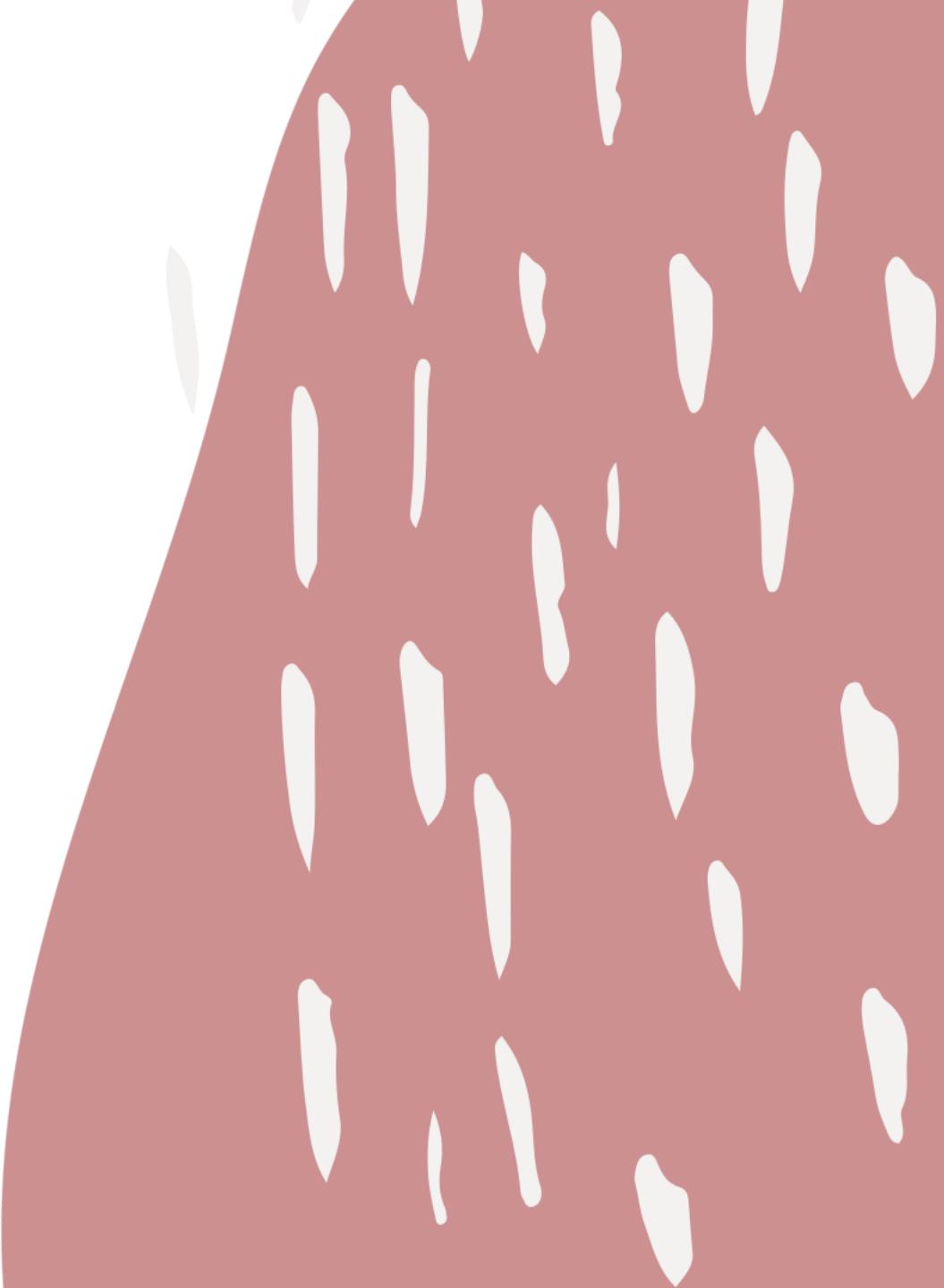
73 Claims, 14 Drawing Figures



Patent for breadboard system [5]

THANK YOU

TO EVOLVE WITH ELDERLY IN MIND



REFERENCES

- [1] A. Meola, "Future demand for elderly care services like assisted living & in-home care are rife for digital disruption," *Business Insider*, 08-Jul-2019. [Online]. Available: <https://www.businessinsider.com/senior-care-market-trends?IR=T>. [Accessed: 03-Nov-2019].
- [2] Key, D. Jing, J. Hui, Shoubo, C. Wei, and Ruolan, "ELLE: self-elevating trolley add-on," *Kickstarter*, 17-Nov-2017. [Online]. Available: <https://www.kickstarter.com/projects/1537107792/elle-self-elevating-trolley-add-on/description#>. [Accessed: 03-Nov-2019].
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- [4] "US4315171A - Step motors," *Google Patents*, 09-Feb-1982. [Online]. Available: <https://patents.google.com/patent/US4315171A/en?q=stepper+motor&oq=stepper+motor>. [Accessed: 04-Nov-2019].
- [5] "US4321588A - Breadboard system," *Google Patents*, 23-Mar-1982. [Online]. Available: <https://patents.google.com/patent/US4321588A/en?q=breadboard&oq=breadboard>. [Accessed: 04-Nov-2019].
- [6] H. H. Ng, "Osteoporosis," *HealthXchange Home*. [Online]. Available: <https://www.healthxchange.sg/bones-joints/osteoporosis/osteoporosis-in-singapore-stats-and-prevention-tips>. [Accessed: 04-Nov-2019].
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- [8] "Low Back Pain: Evaluating Presenting Symptoms in Elderly Patients," *Medscape*, 2007. [Online]. Available: <https://www.medscape.org/viewarticle/567210>. [Accessed: 04-Nov-2019].