

MiceUp: A Novel Mouse for People with Parkinson's

Acceptance and Delivery Review

(05) The Pioneers - Andy Hu, Daiwik Pal, Ansh Tripathi, Justin Wang



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Target Audience

02 **Requirements**
Function and
Physical Needs

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action!

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Motivation

The background is a dark blue gradient. It features an abstract pattern of small squares in teal, orange, and pink, some of which are solid and others are outlined. Thin white vertical lines of varying lengths are scattered across the slide, creating a modern, minimalist aesthetic.

Parkinson's Disease in the United States

- a chronic disorder of the nervous system
- caused by the degeneration of neurons in the brain



~ 930 000

adults currently
diagnosed with PD (2020)

generally affects men more than women

severity of PD increases with age

~ 60 000

additional adults
diagnosed with PD
every year (2020)



~ 1 200 000

expected population
with PD in 2030

Common Symptoms



- tremors and fatigue in the hands and fingers
- muscle stiffness
- motor impairments
- cognitive impairments

Computer Usage

- many individuals with PD have difficulties operating a computer



("Statistics", 2020)
("Demographics", 2020)
("How Common is Parkinson's Disease?", 2019)

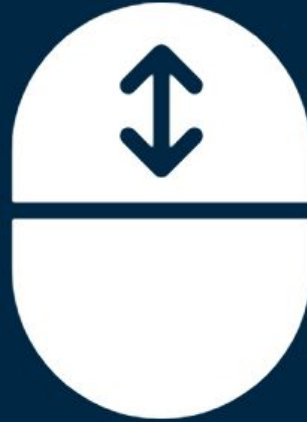
MiceUp: A Novel Mouse for Persons with Parkinson's

Objective

- develop a novel computer mouse
- functionality
- adaptability
- ease of use

79%

of PWPs reported the importance of computer usage in daily life



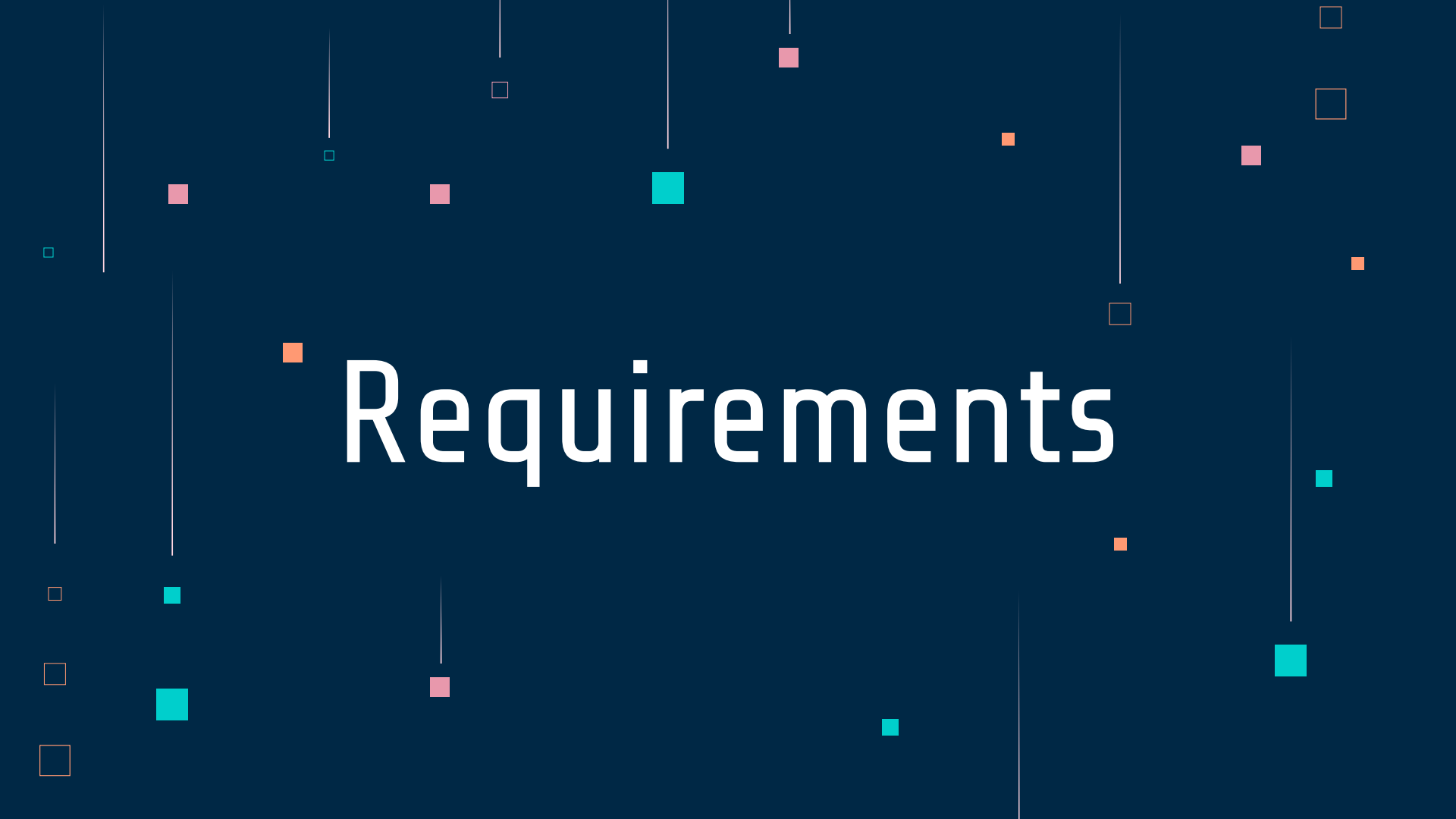
Audience

- individuals who have challenges in computer usage due to symptoms of PD

77%

of PWPs reported difficulty in operating computers



The background is a dark blue gradient. It features several thin, vertical white lines of varying lengths scattered across the frame. Interspersed among these lines are small squares in three colors: light blue, light orange, and light pink. Some squares are solid, while others are outlined. The overall aesthetic is modern and minimalist.

Requirements

Level 3 Requirements

#	Criteria:	Priority:	Type:
1	The total cost for materials used in the device shall be less than \$75.	Level 3	Cost
2	The device shall be aesthetically pleasing.	Level 3	Physical
3	The device shall be able to be implemented with minimal external software.	Level 3	Functional
4	The device shall be universal for all systems and operating systems.	Level 3	Functional
5	The device shall have a system of visual or auditory indication for mouse actions.	Level 3	Functional



Level 2 Requirements

#	Criteria:	Priority:	Type:
1	The device shall be ergonomic for a wide range of hand sizes, being optimized for medium hand sizes of height 17-20 cm and width 8.5-10 cm.	Level 2	User-Oriented
2	The device shall be portable and if applicable, weigh at least 0.2 kg and no more than 1 kg.	Level 2	Physical
3	The device shall be durable and be able to withstand prolonged 30 N vertical forces applied in the conventional direction of usage.	Level 2	Physical
4	The device shall have a sufficient level of friction along the bottom surface such that it does not slip uncontrollably during usage.	Level 2	Physical
5	The device shall be intuitive for the user to install and use (has a user's manual).	Level 2	Functional
6	The device shall be resistant to accidental mouse clicks caused by the symptoms of Parkinson's Disease.	Level 2	Functional
7	The device shall be sensitive to all intentional user movements, including rotational and translational motion.	Level 2	Functional

Level 1 Requirements

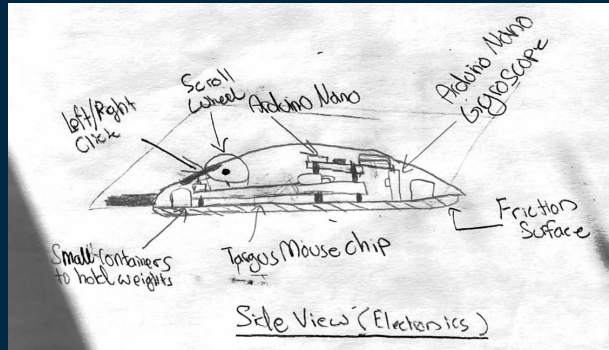
#	Criteria:	Priority:	Type:
1	The device shall be safe to use and not worsen the symptoms of Parkinson's Disease.	Level 1	Physical
2	The device shall be novel.	Level 1	Functional
3	The device shall be specific to people with Parkinson's.	Level 1	Functional
4	The device shall be able to accommodate basic motions such as precise clicking, scrolling, and dragging.	Level 1	Functional

The background is a dark blue field decorated with a pattern of small, semi-transparent squares in teal, pink, and orange. Thin, light-colored vertical lines of varying lengths are scattered across the image, some intersecting the squares. The overall aesthetic is modern and minimalist.

PDR Designs

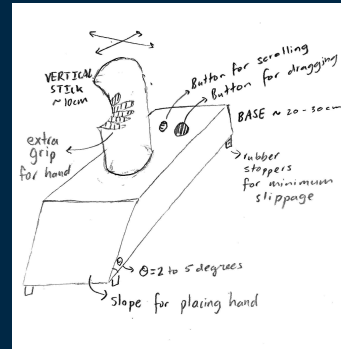
Designs at PDR

Design #1: Adaptive Mouse



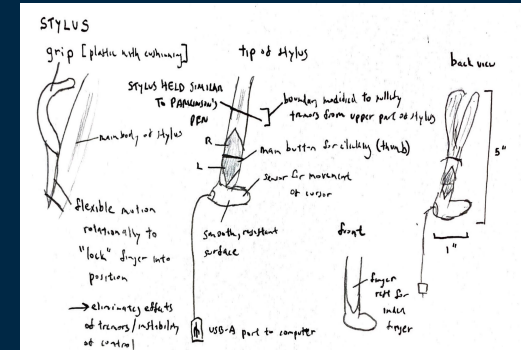
- Mouse design
- Novel movements using the gyroscopic sensor

Design #2: Joystick



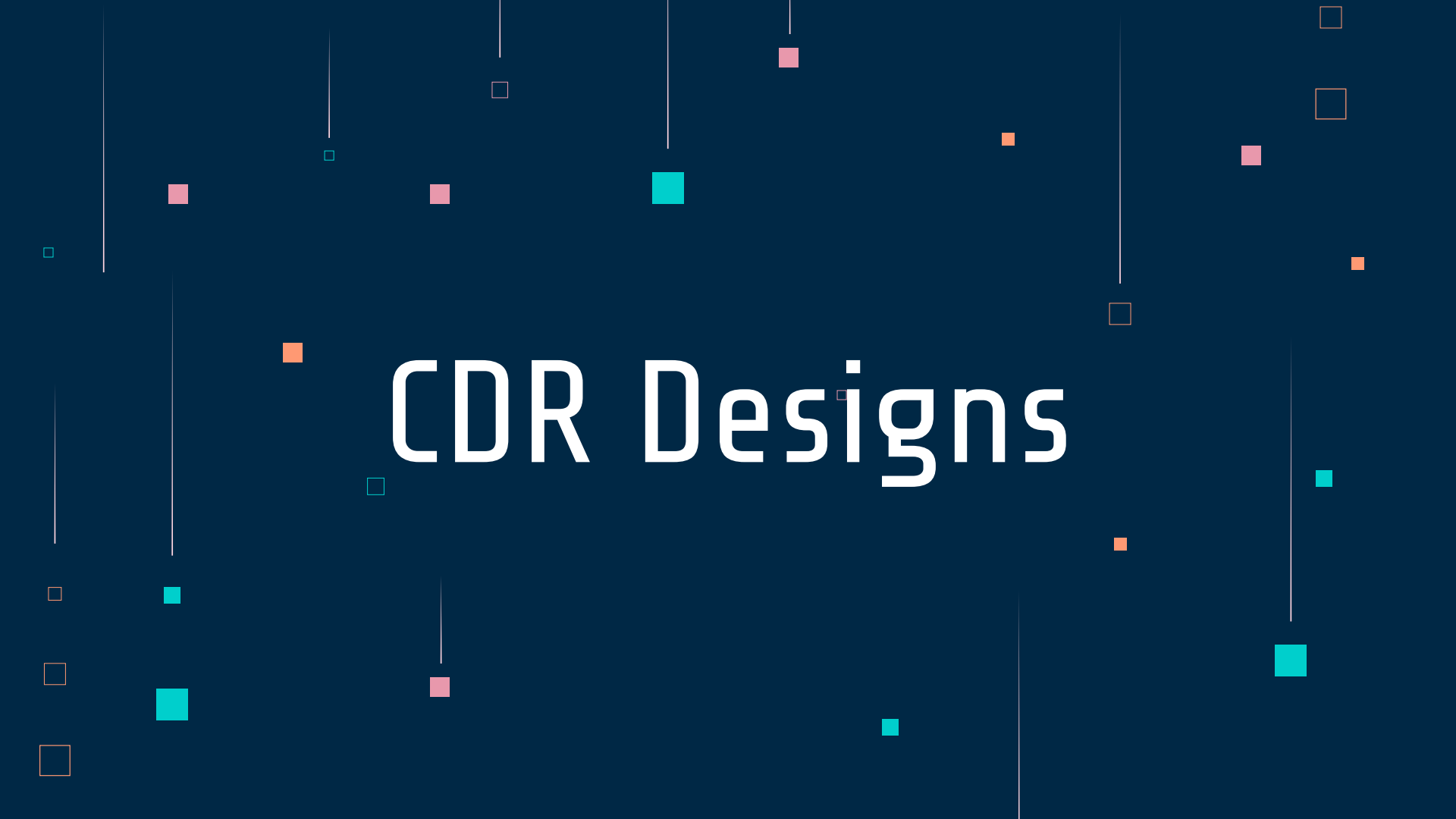
- Joystick design
- Ergonomically better
- Higher learning curve

Design #3: Stylus

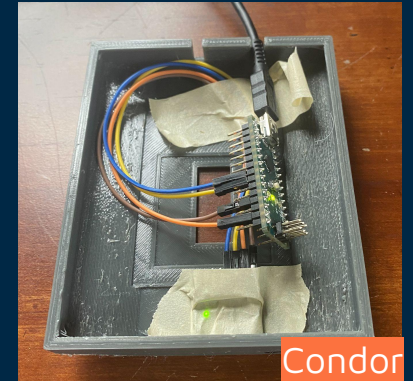
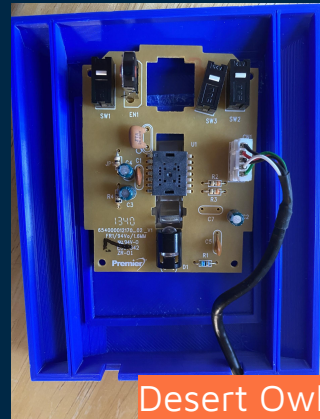
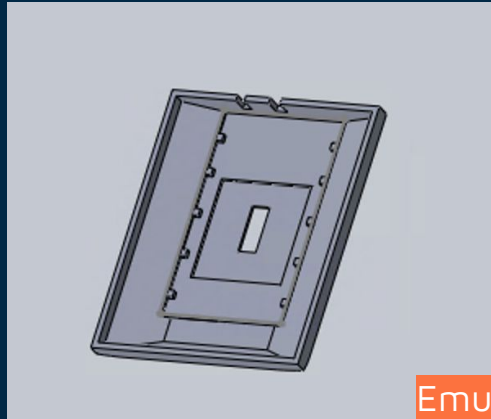
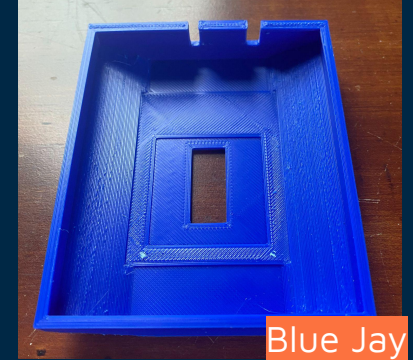
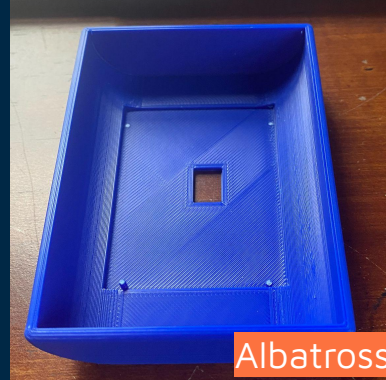
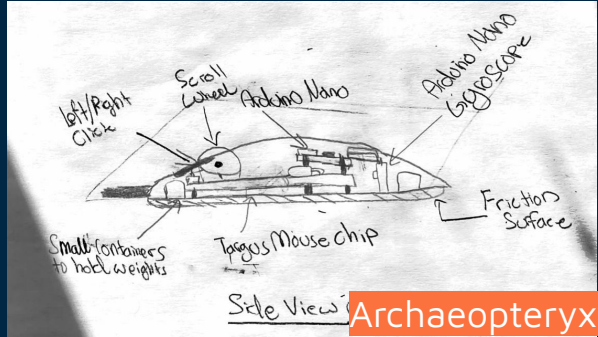


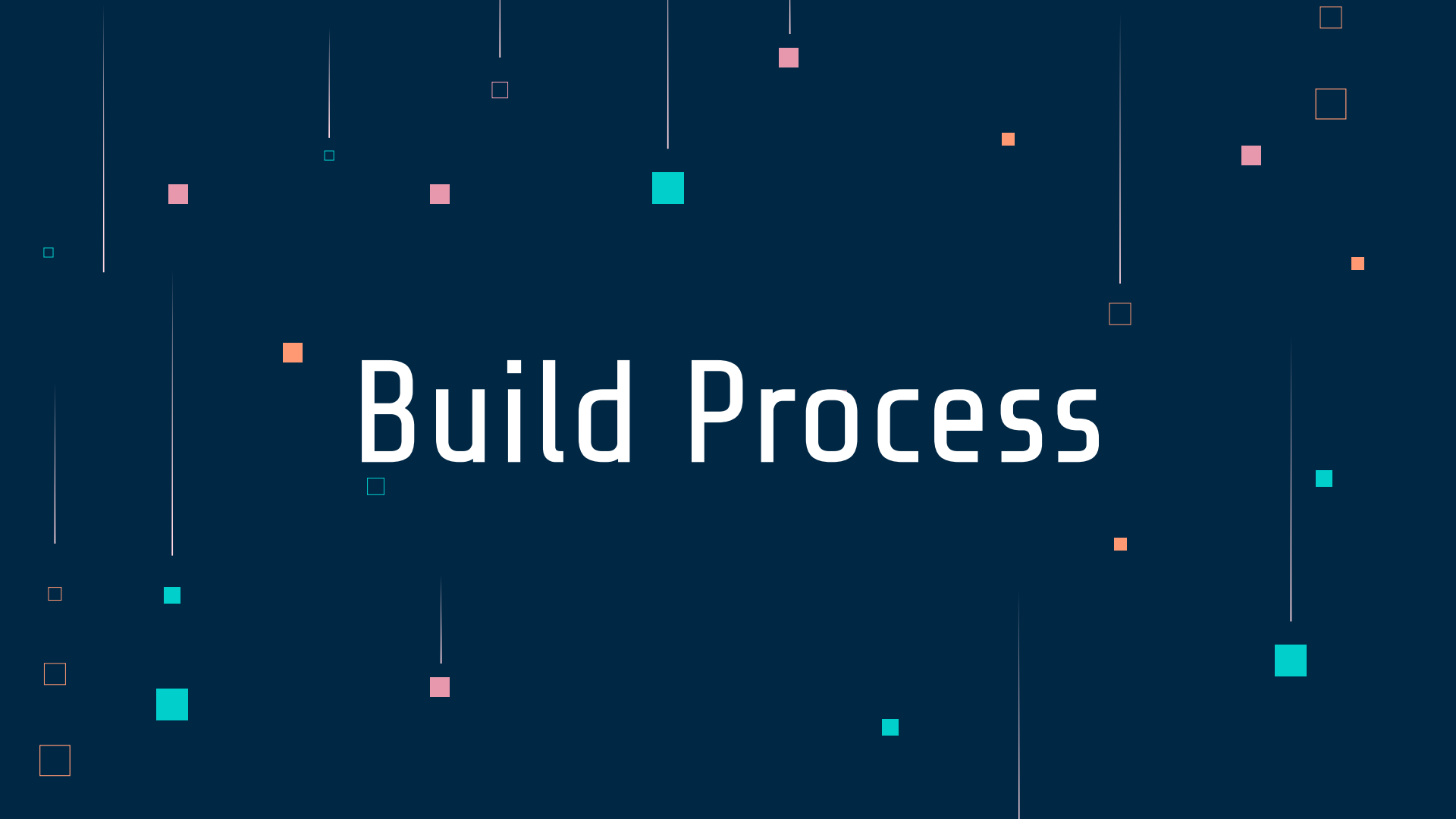
- Stylus design
- Natural movements
- Unrealistic for PWP's

CDR Designs

The background is a dark navy blue. It is decorated with various geometric elements: small squares in teal, orange, and pink, some of which are solid and others are hollow outlines. Thin white vertical lines of varying lengths are scattered across the composition, creating a modern, minimalist aesthetic.

Designs at CDR (March 2021 - Early May 2021)



The background is a dark blue field decorated with a pattern of small squares and thin vertical lines. The squares are in three colors: pink, teal, and orange. Some are solid, while others are outlined. The lines are thin and white, extending vertically across the frame. The overall aesthetic is modern and minimalist.

Build Process

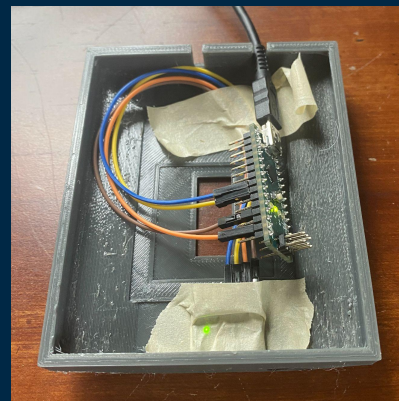
Version Condor (Pre-CDR)

➤ Electronics:

- Arduino Micro and Gyroscope
- Angled Base

➤ Functions:

- Right Click: Right Rotation 25°
- Left Click: Left Rotation -25°
- Double Click: Hold Right Click Rotation at 25



```
//function to convert accelerometer values into pitch and roll  
void getAngle(int Ax,int Ay,int Az)
```

```
double x = Ax;  
double y = Ay;  
double z = Az;
```

```
pitch = atan(x/sqrt((y*y) + (z*z))); //pitch calculation  
roll = atan(y/sqrt((x*x) + (z*z))); //roll calculation
```

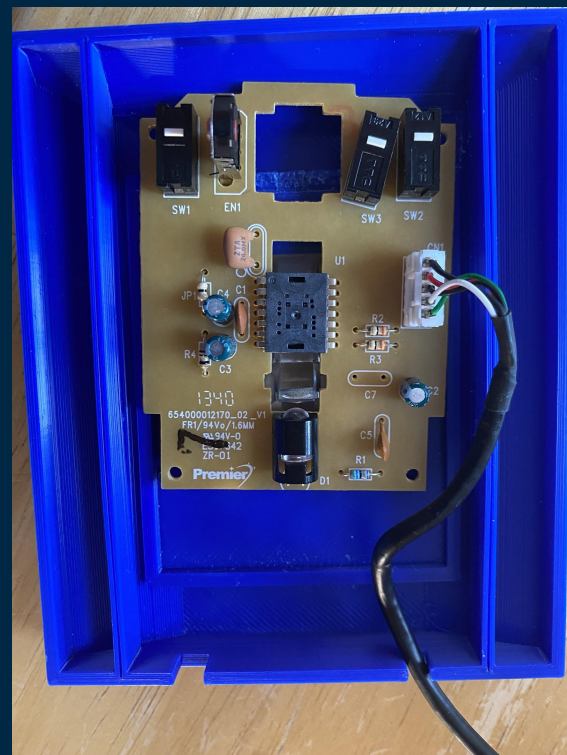
```
//converting radians into degrees
```

```
pitch = pitch * (180.0/3.14);  
roll = roll * (180.0/3.14) ;
```



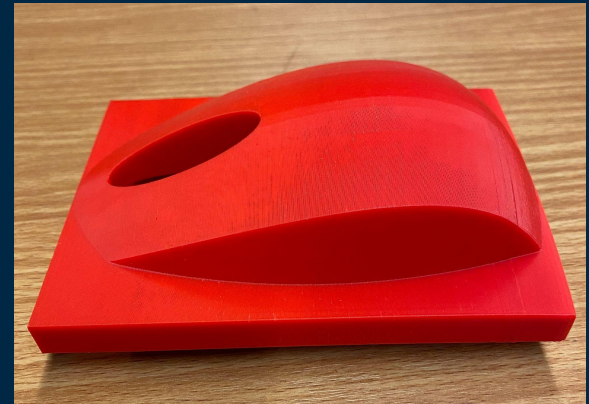
Version Desert Owl (Pre-CDR)

- Mouse Chip and LED Lens
 - Adapted from Lenovo MO28UOA mouse
- Base
 - Houses chip and lens
- Function
 - Cursor Motion



Steps Taken After CDR:

- Integrated mouse chip with Arduino/Gyro
- Implemented additional movements:
 - Scrolling
 - Dragging
- Improved ergonomic grip
- Widened base for easier rotation
- Added weights to the base



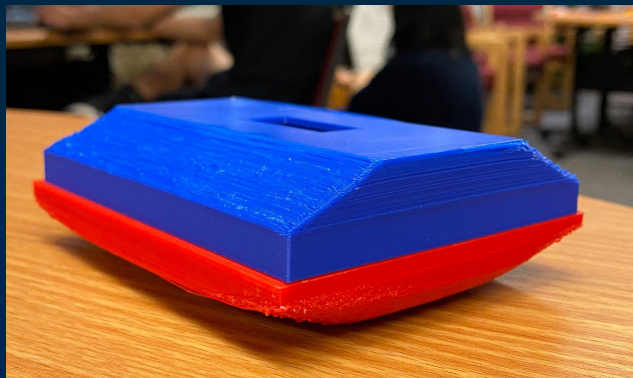
Version Emu (Post-CDR)

Features:

- First fully functional prototype
- Integrates Mouse Chip + Arduino
- Rounded base towards corners
- Uses adhesive strips for temporary fixture
- Added weight slots to the base's edges

Drawbacks:

- Top is not ergonomic
- No access to scroll wheel
- Accidental clicks



Version Falconet (Post-CDR)

Features:

- Prototype with an ergonomic mouse top
- Retains base (with electronics) from Version Emu
- Implemented scrolling and dragging
- Fixed accidental clicks

Drawbacks:

- Displayed space issues with the location of the Arduino



```
//If mouse is tilted to the back-left, perform left down press
if(roll > 16 && pitch < -13){
  //Dragging Feature
  Serial.println("Diagonal Click");
  if (!Mouse.isPressed(MOUSE_LEFT)) {
    Mouse.press(MOUSE_LEFT);
    Serial.println("Diagonal Press");
    delay(750);
  }else{
    Mouse.release(MOUSE_LEFT);
    Serial.println("Diagonal Release");
    delay(750);
  }
}

//If the mouse rotates 20 degrees up, scrole up
else if(pitch + 6 > 20) {
  Mouse.move(0, 0, 1);
  Serial.println("Scrolling Up");
  delay(100);
}

//If the mouse rotates 30 degrees down, scrole down
else if(pitch + 6 < -30) {
  Mouse.move(0, 0, -1);
  Serial.println("Scrolling Down");
  delay(100);
}
```

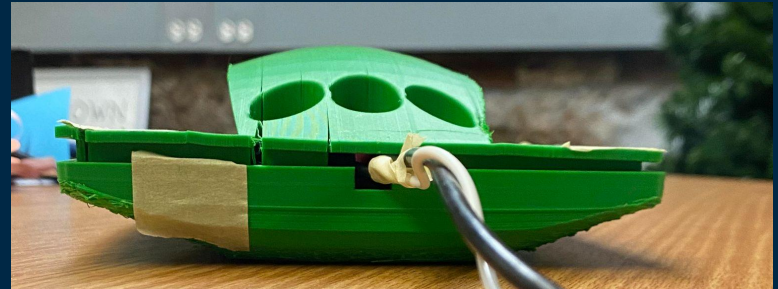
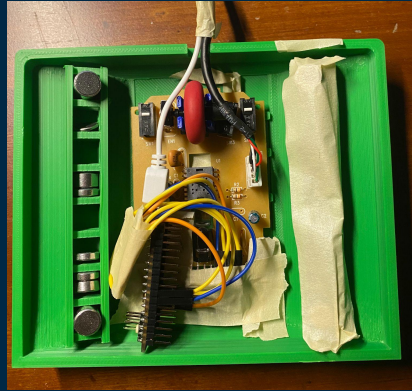
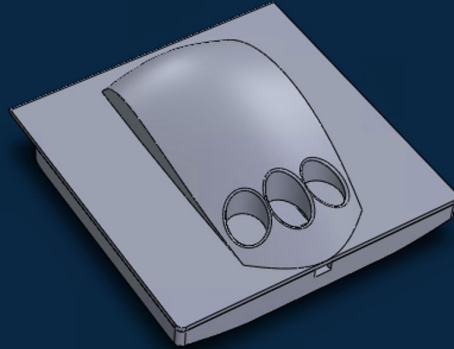
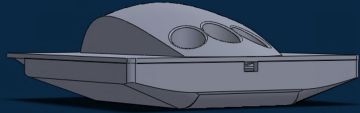




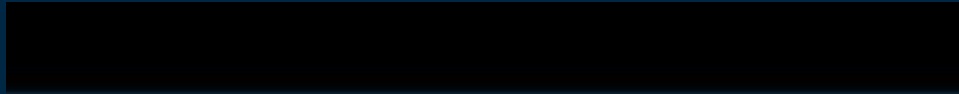
Final Prototype

Version Greenfinch

CAD Models + 3D Printed Prototype



Video Demonstration

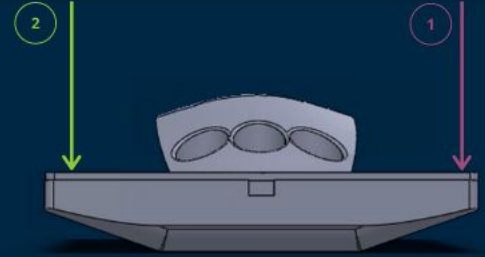
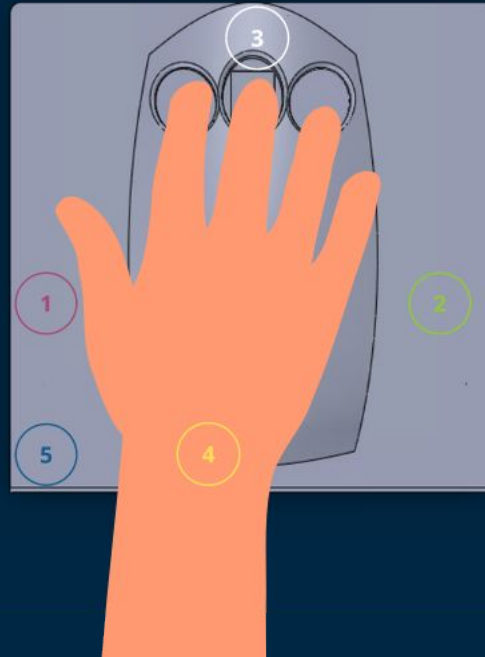


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Recap + User Guide

1. **Left click** - CCW rotation
 - a. **Double click** - Hold a rotation on left side
2. **Right click** - CW rotation
3. **Scroll Forward** - Forward tilt
4. **Scroll Backwards** - Backwards Tilt
5. **Drag** - Bottom Left click



Level 3 Requirements Reviewed

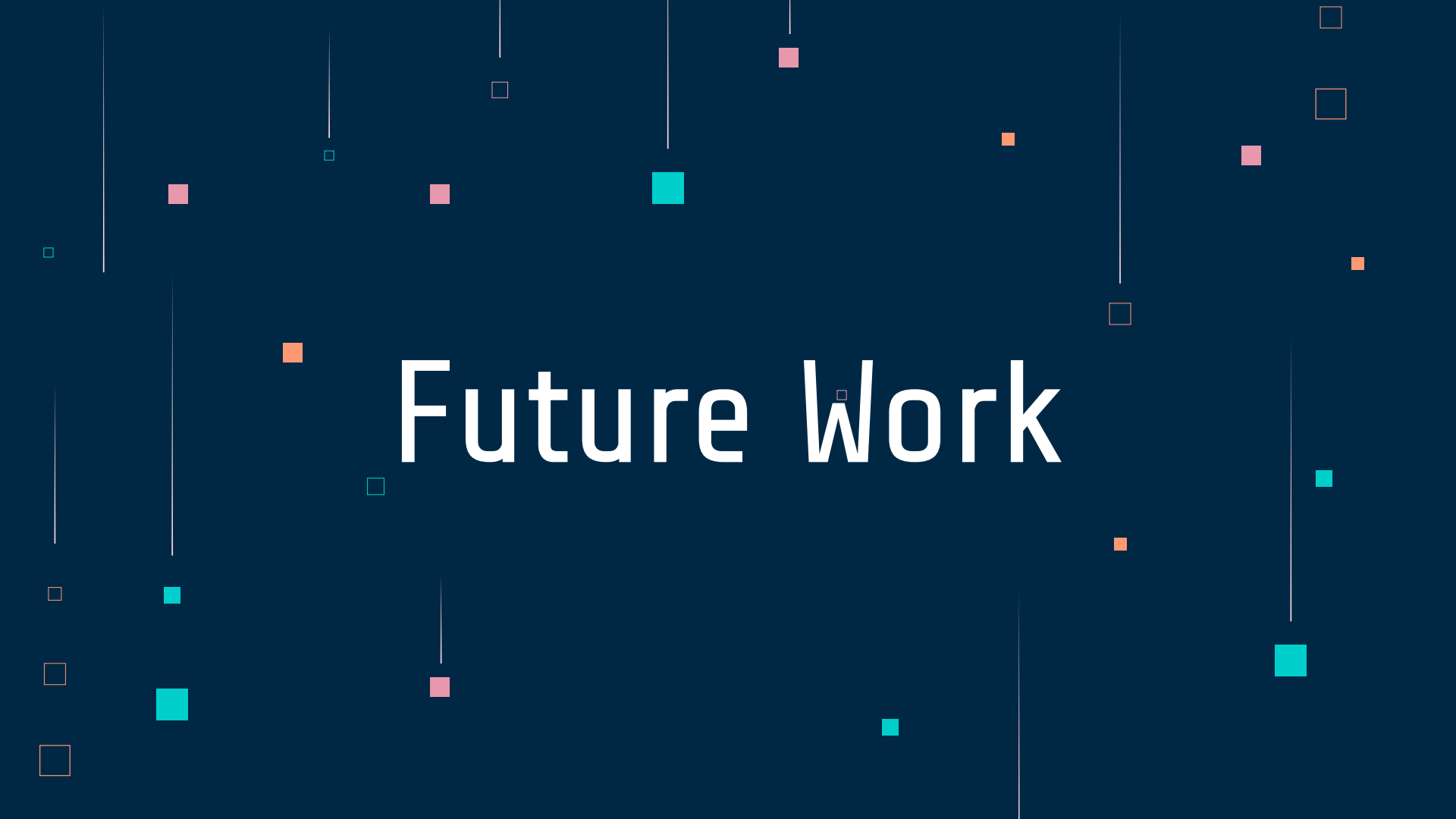
#	Criteria:	Priority:	Type:	Emu:	Greenfinch:
1	The total cost for materials used in the device shall be less than \$75.	Level 3	Cost	YES	YES
2	The device shall be aesthetically pleasing.	Level 3	Physical	NO	NO
3	The device shall be able to be implemented with minimal external software.	Level 3	Functional	YES	YES
4	The device shall be universal for all systems and operating systems.	Level 3	Functional	YES	YES
5	The device shall have a system of visual or auditory indication for mouse actions.	Level 3	Functional	NO	NO

Level 2 Requirements Reviewed

#	Criteria:	Priority:	Type:	Emu:	Greenfinch:
1	The device shall be ergonomic for a wide range of hand sizes, being optimized for medium hand sizes of height 17-20 cm and width 8.5-10 cm.	Level 2	User-Oriented	NO	YES
2	The device shall be portable and if applicable, weigh at least 0.2 kg and no more than 1 kg.	Level 2	Physical	YES	YES
3	The device shall be durable and be able to withstand prolonged 30 N vertical forces applied in the conventional direction of usage.	Level 2	Physical	YES	YES
4	The device shall have a sufficient level of friction along the bottom surface such that it does not slip uncontrollably during usage.	Level 2	Physical	TBD	TBD
5	The device shall be intuitive for the user to install and use (has a user's manual).	Level 2	Functional	YES	YES
6	The device shall be resistant to accidental mouse clicks caused by the symptoms of Parkinson's Disease.	Level 2	Functional	NO	YES
7	The device shall be sensitive to all intentional user movements, including rotational and translational motion.	Level 2	Functional	NO	YES

Level 1 Requirements Reviewed

#	Criteria:	Priority:	Type:	Emu:	Greenfinch:
1	The device shall be safe to use and not worsen the symptoms of Parkinson's Disease.	Level 1	Physical	TBD	TBD
2	The device shall be novel.	Level 1	Functional	YES	YES
3	The device shall be specific to people with Parkinson's.	Level 1	Functional	TBD	TBD
4	The device shall be able to accommodate basic motions such as precise clicking, scrolling, and dragging.	Level 1	Functional	NO	YES

The background is a dark navy blue. It is decorated with various geometric elements: thin white vertical lines of varying lengths, small squares in solid colors (pink, orange, teal), and squares with thin white outlines. These elements are scattered across the frame, creating a modern, minimalist aesthetic.

Future Work

Future Work and Extensions

Client Testing

- direct feedback from PWPs regarding the mouse's functionality and physical convenience



Structural Improvements

- automated activation of Arduino Micro
- pro-ergonomic adaptations
- improve comfort of use



Functional Expansions

- addition of visual or auditory indicators
- more simple, intuitive gestures based on client testing



References

- “Demographics.” *Parkinson’s Foundation*,
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- Nes Begnum, M. E. (2010). Challenges for Norwegian PC-Users with Parkinson’s Disease – A Survey. *Lecture Notes in Computer Science*, 292–299.
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- “Statistics.” *Parkinson’s Foundation*,
<https://www.parkinson.org/Understanding-Parkinsons/Statistics>. Accessed 25 May 2021

Questions?



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[https://github.com](https://github.com/MiceUp)
[/MiceUp](#)

