MiceUp: A Novel Mouse for People with Parkinson's

Acceptance and Delivery Review

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Overview

01 **Motivation**
Problem Description
Target Audience

02 **Requirements**
Function and
Physical Needs

03 **PDR & CDR Designs**
Design concepts and
prototypes at PDR and CDR

04 **Build Process**
Engineering process
for prototypes and
key versions

05 **Prototype & Demonstration**
Final MiceUp
prototype in
action!

06 **Future Extensions**
Improvements and
Next Steps

Motivation

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

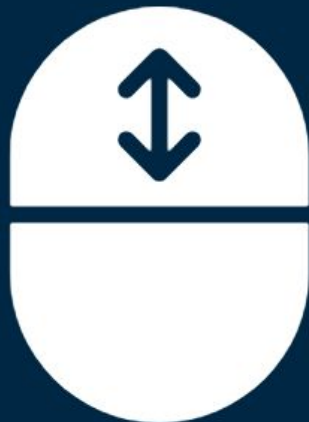- many individuals with PD have difficulties operating a computer

MICEUP
2021

("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

(Nes Begnum, 2010)

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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

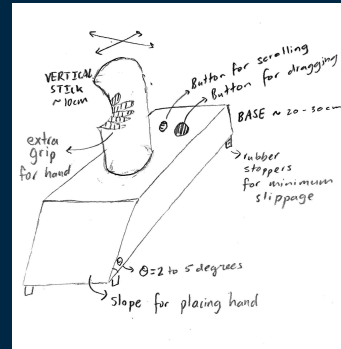PDR Designs

Designs at PDR

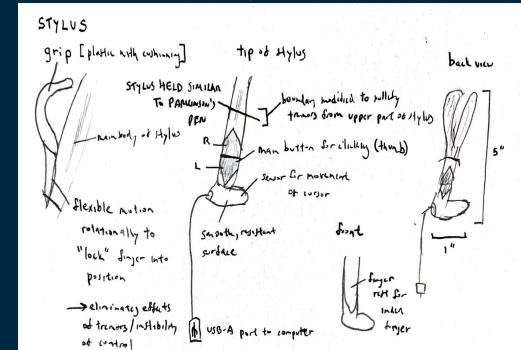## Design #1:
Adaptive Mouse
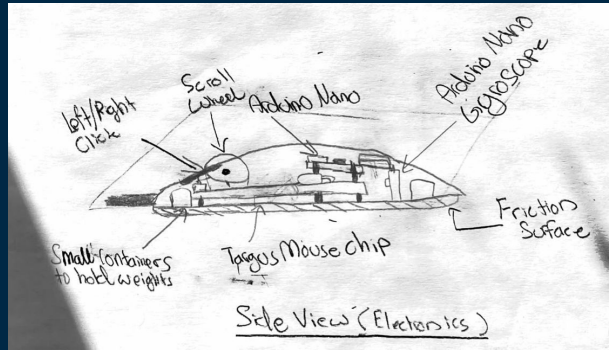
- ➤ Mouse design
- ➤ Novel movements using the gyroscopic sensor

Design #2:
Joystick

- ➤ Joystick design
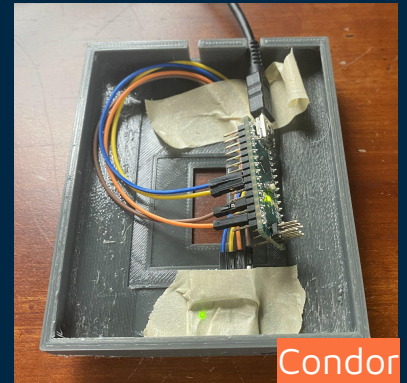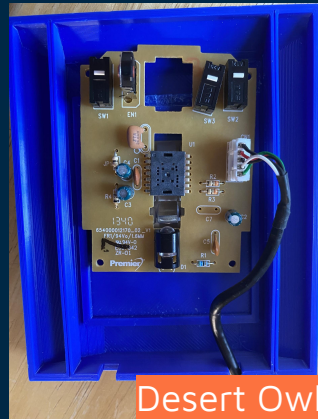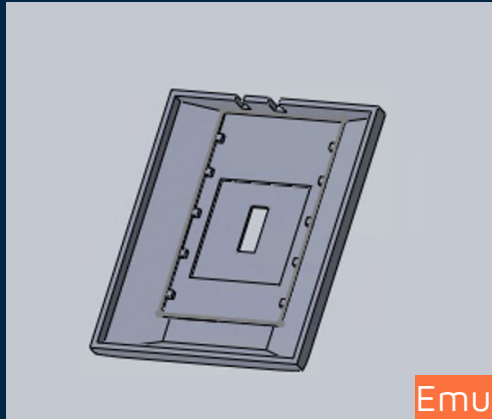- ➤ Ergonomically better
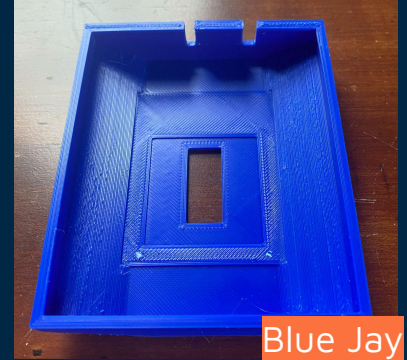- ➤ Higher learning curve

Design #3:
Stylus

- ➤ Stylus design
- ➤ Natural movements
- ➤ Unrealistic for PWPs

CDR Designs

Designs at CDR (March 2021 – Early May 2021)

Archaeopteryx

Albatross

Blue Jay

Emu
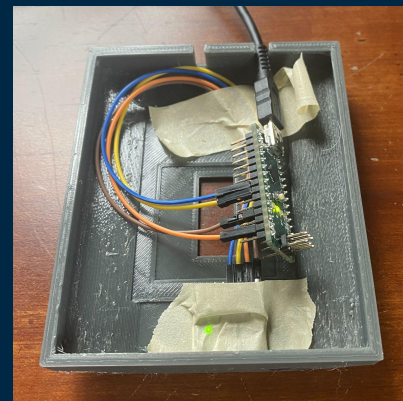

Desert Owl
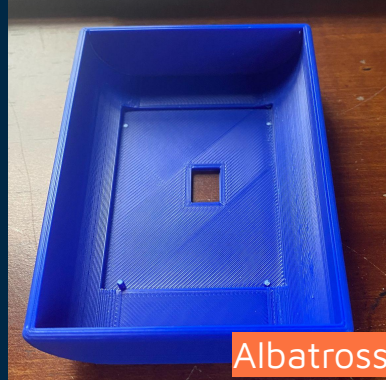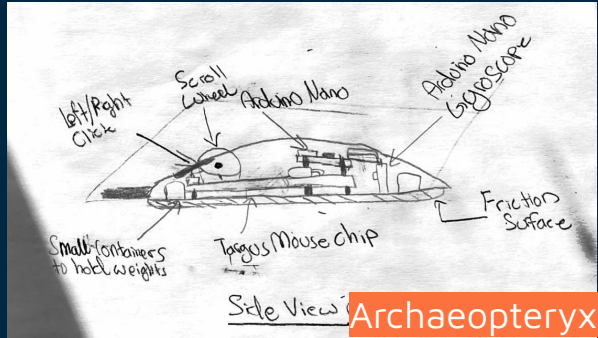
Condor

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) ;

}
```
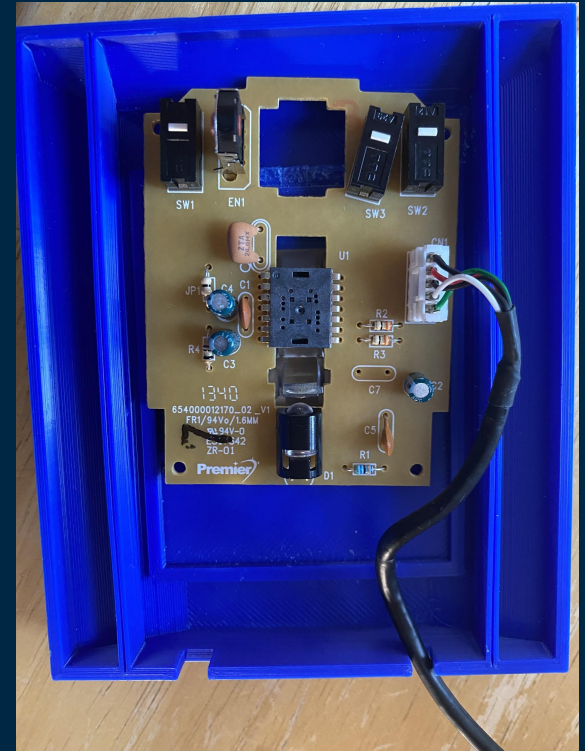
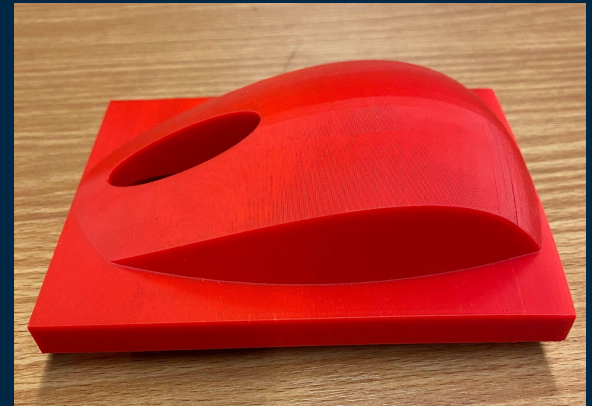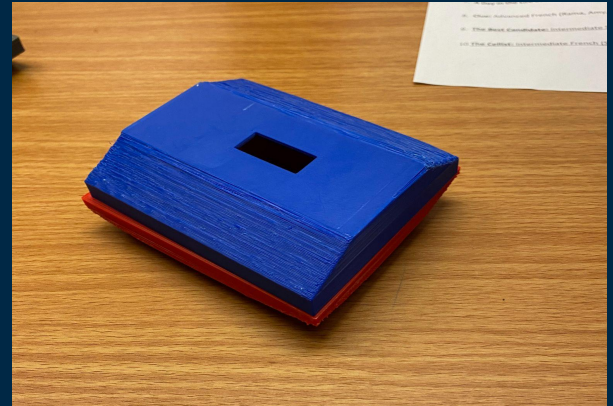# Version Desert Owl (Pre-CDR)

➢ 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
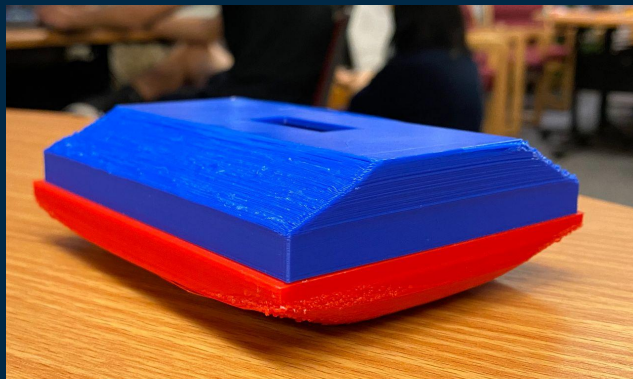
➢ Added weights to the base

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);
}
```
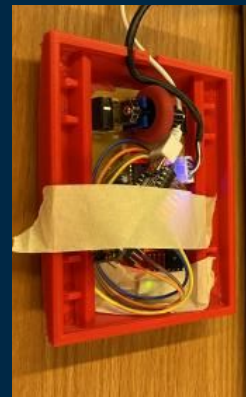
Final Prototype

Version Greenfinch

CAD Models + 3D Printed Prototype

136 mm
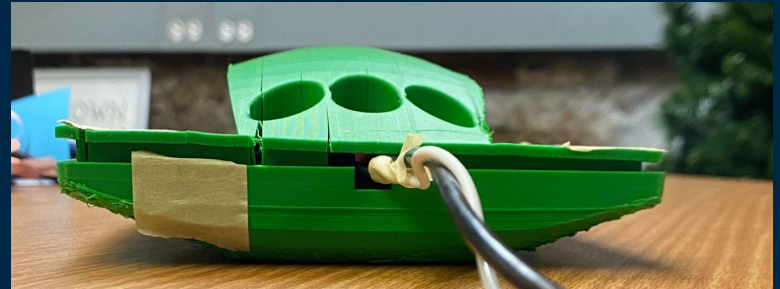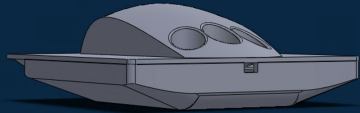
Video Demonstration
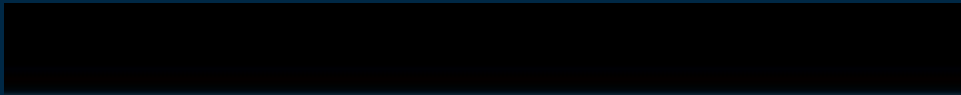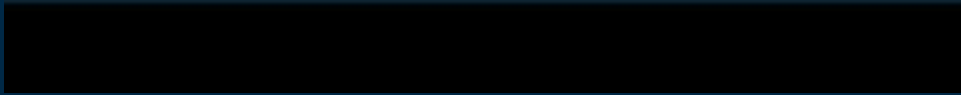
Recap + User Guide

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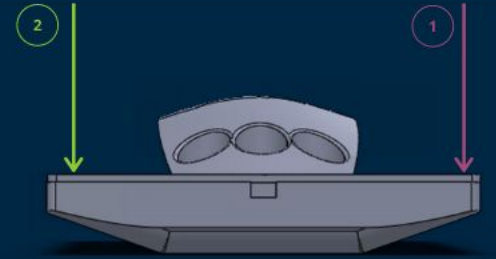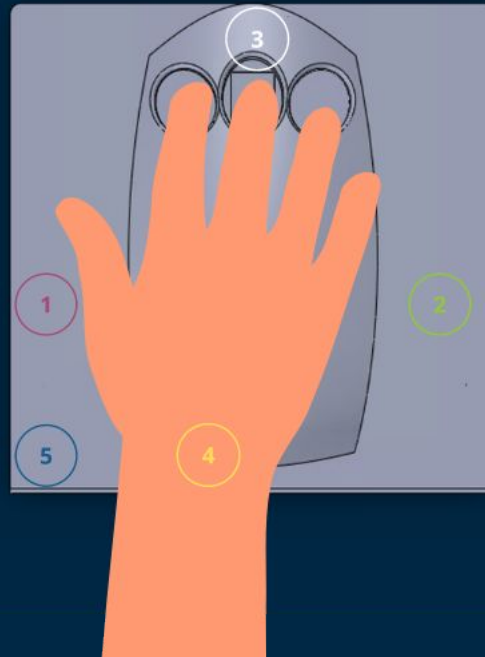
Level 3 Requirements Reviewed

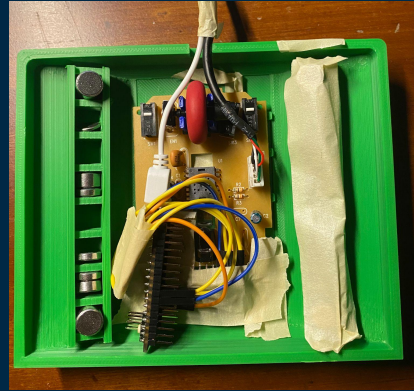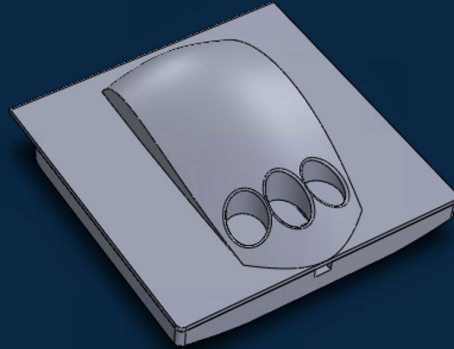| #	Criteria:	Priority:	Type:	Emu:	Greenfinch:
1	The total cost for materials used in the device shall be less than $75.	Level 3	Cost	YES	YES
2	The device shall be aesthetically pleasing.	Level 3	Physical	NO	NO
3	The device shall be able to be implemented with minimal external software.	Level 3	Functional	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

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*,
    https://www.parkinson.org/research/Parkinsons-Outcomes-Project/Demographics.
    Accessed 25 May 2021.

Nes Begnum, M. E. (2010). Challenges for Norwegian PC-Users with Parkinson's Disease –
    A Survey. *Lecture Notes in Computer Science*, 292–299.
    https://doi.org/10.1007/978-3-642-14097-6_47

Editorial Team. September 19, 2019. "How Common Is Parkinson's Disease?"
    ParkinsonsDisease.Net. /basics/statistics. Accessed 25 May 2021.

"Statistics." *Parkinson's Foundation*,
    https://www.parkinson.org/Understanding-Parkinsons/Statistics. Accessed 25 May
    2021

Questions?

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https://github.com/MiceUp

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20 21