V.I.A.

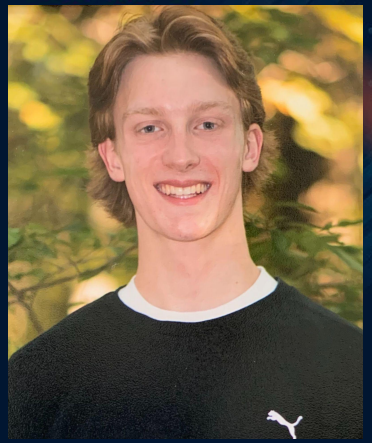
Visually Integrated Assistant

Meet the team

Antonio Romanoski Neto
Electrical Engineering

Lucas Georg Guertin
Electrical Engineering

Kevin Alfred Bardhi
Electrical Engineering



Jared Louis Simmons
Electrical Engineering

Problem Statement

Individuals with severe physical disabilities may have a hard time controlling many devices in their own home without the need of assistance. Modern smart homes propose a solution, but still face issues. How can we improve and design a new smart home system that can greatly improve the quality of life specifically for disabled residents?

Project Goal

To design and create a cyber physical system that utilizes human eye movement as an input, and allows the user to control different connected devices wirelessly within a given closed environment.

Background Information

- Common control methods of smart homes utilize either closed local bluetooth connectivity or internet infrastructure to send and receive requests from different devices
- Common inputs are through laptop/phone applications, voice control, or touch input
- Systems often require both an initial investment of human movement and persistent physical human interaction
- Systems are also known for being costly in order to fully integrate.

Target Audience Example: Travis Roy

- Former American ice hockey player, Boston University
- Broke fourth and fifth vertebrae in first career shift, paralyzing him from the neck down (1995)
- Started “The Travis Roy Foundation” to fund spinal cord injury related research
- Passed away October 29, 2020

Existing Competing Solutions: Google Nest

- Line of smart home products
  - Smart speakers, thermostats, security systems, etc
- Keeps track of electrical usage, set timers on products for when they turn on and off
- Security cameras
- System optimized only for devices within the product line
- Estimated price for full system: $720+

Existing Competing Solutions: Amazon Alexa

- Voice Controlled and app controlled
- Can schedule a routine
  - Locking doors at a set time
  - Turning off and on lights
- Controls a variety of different smart devices
  - Speakers (~$100)
  - Amazon Echo (~$100)
  - Ring Security System (~$100)
  - Smart Display (~$130)
- Estimated cost for entire system: up to $700+

Existing Competing Solutions: Apple Homekit

- Only works with packages stamped with “works with apple homekit”
    - Light Bulbs (~$20)
    - Smart doorbell and door lock (~$200)
    - Security cameras (~$160)
    - Thermostat (~$170)
    - Apple TV (~$100)
- Connects to all apple devices and separates them into separate rooms/areas
- Not as openly used as Google Nest or Amazon Alexa
- Estimated price for system: $1000+

Comparing Existing Solutions to Our Design

	Devices with human input	Ocular input	Internet-free design	Bluetooth connectivity	Useful for people with disabilities	Visual interface	Can access devices of multiple brands	Low-cost
Google Nest	✓	X	X	X	✓	X	X	X
Amazon Echo	✓	X	X	X	✓	X	✓	X
Apple Homekit	✓	X	X	X	✓	✓	X	X
Our Design	✓	✓	✓	✓	✓	✓	✓	✓

Our Design: Project Specifications

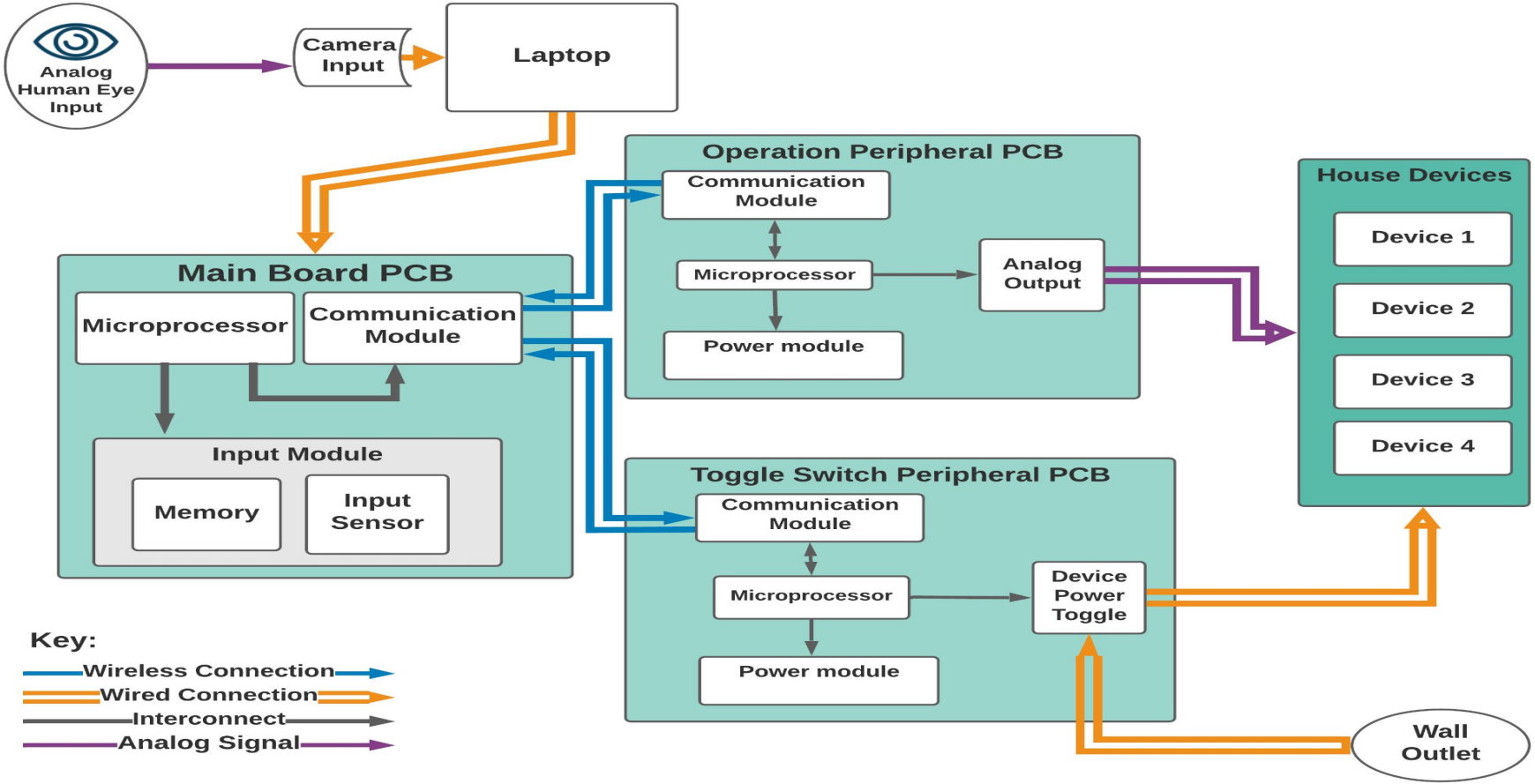
1. Compatible with existing common use Laptops
2. Toggles and controls at least 3 devices, but capable of more
3. Avoids accidental command execution when user is not looking at input screen
4. Peripheral boards are able to communicate with any IR device
5. Works in any range up to 30 feet
6. Controls experience detail parameters beyond power, including:
    - TV: Volume, Channel, Pause/Resume
    - Fan: Speed, Rotation
7. Establish bluetooth communication between main and peripheral boards, though master-slave connection.
8. Be able to add/store new devices to main system
9. Delay 3 seconds for command execution
10. Battery Life (4 AA alkaline batteries) ~ 28 days

    Avg current use for BLE ~ 15ma

    Avg Capacity of 4 duracell AA batteries ~ 10000mah

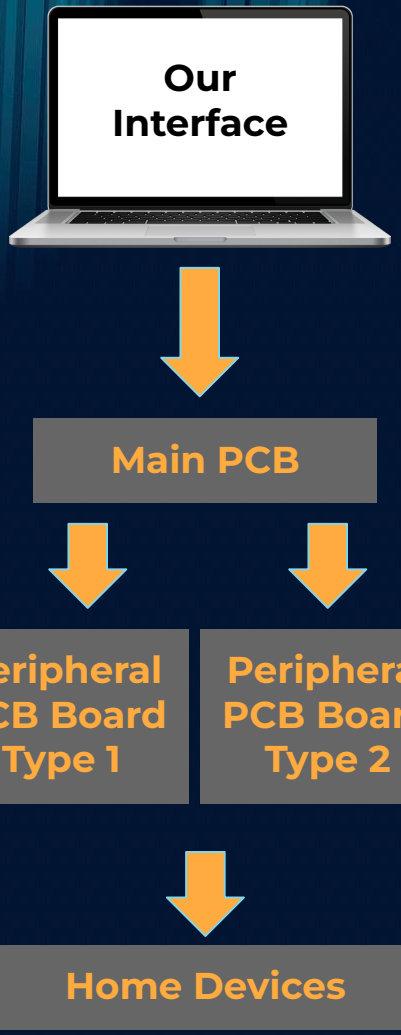
    10000mah/15ma = 667 hrs ~ 28 days

Hardware Block Diagram



Hardware Components

- Laptop
  - Nexico Webcam
- Main Board PCB
  - ATmega328P microcontroller
  - Memory Unit
  - IR Receiver
  - Usb Connection
- Peripheral Board PCBs
  - IOT Power Relay (Toggle switch peripheral)
  - ATmega328P microcontroller
  - AdaFruit BT Module
  - LS-00031 Battery Holders
  - IR LED (Operative Peripheral)
  - 4x1.5V alkaline batteries each peripheral



Eye tracking software

Most Favorable:

Ogama

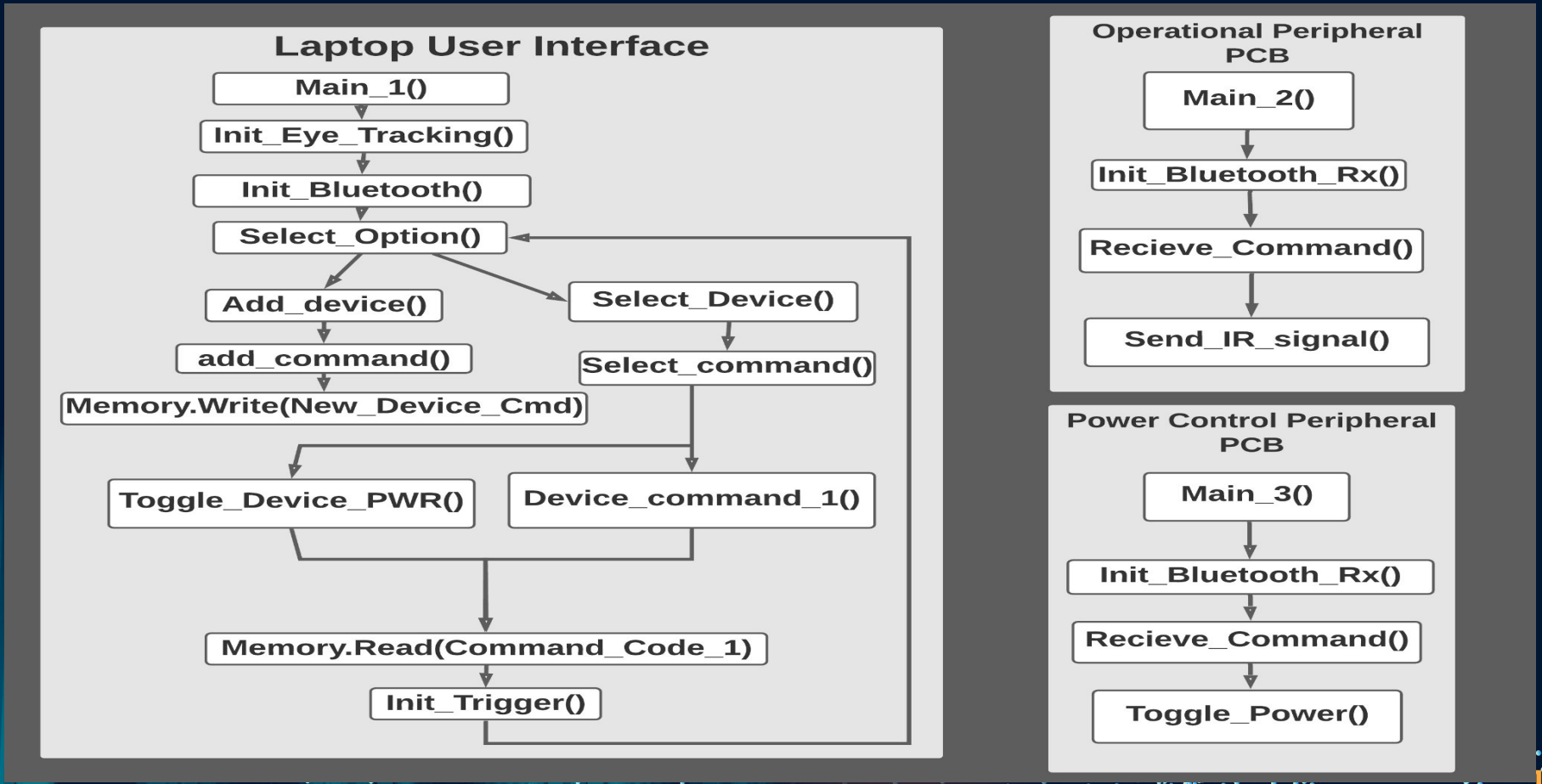
- Records eye and mouse movement
- Uses C#
- Database preprocessing
- Filter gaze and mouse data

GazePointer

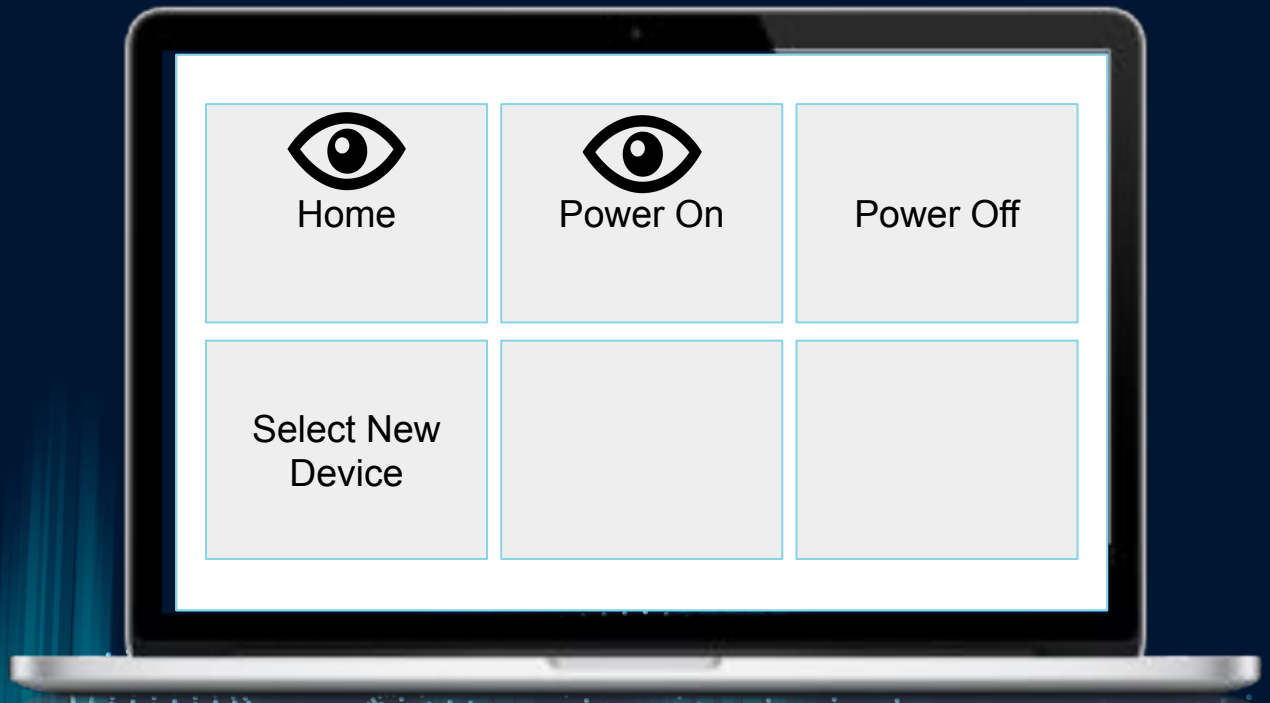
- Webcam Eye Tracker
- Cursor tracker

Eye Tracking Demonstration

Software Block Diagram



Example Demonstration

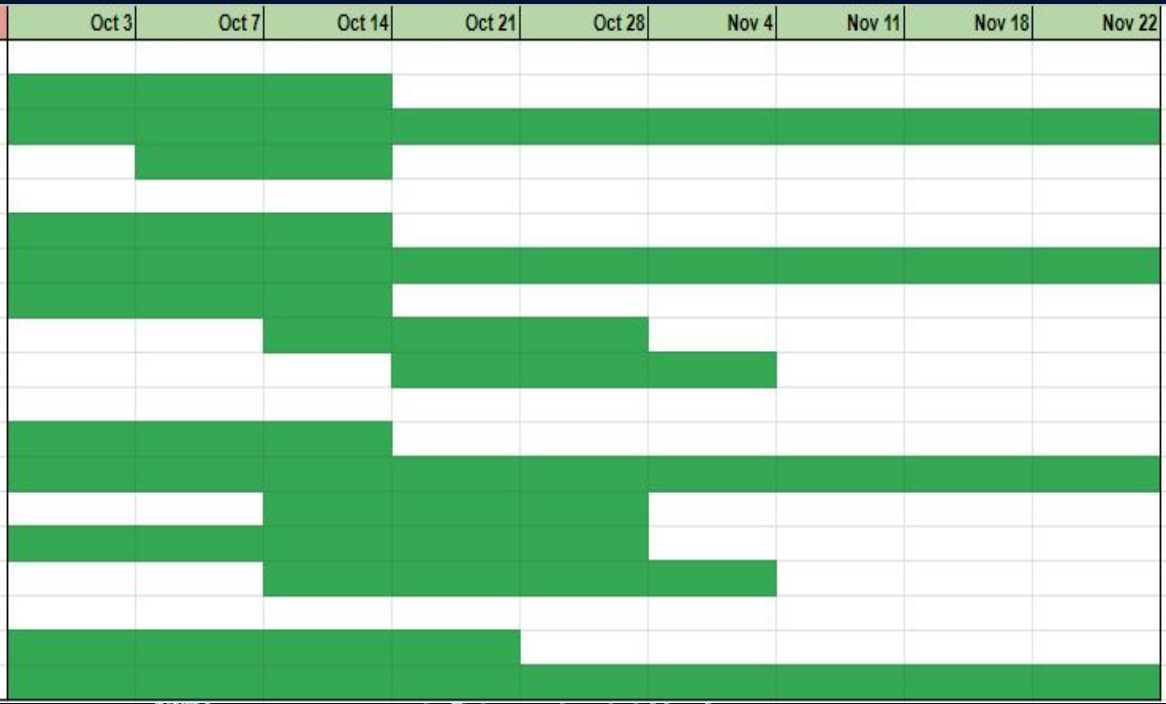


Cost Estimate

Item	Predicted Cost	Quantity	Total Price	Location
Nexico Webcam	$40.00	1	40	Amazon
Roku TV	$129.99	1	169.99	Target
IOT Power Relay	$29.95	1	199.94	Sparkfun/Amazon
Main Board PCB	$13.00	1	212.94	pcbgo
Peripheral Power PCB	$13.00	2	238.94	pcbgo
Peripheral Control PCB	$13.00	2	264.94	pcbgo
IR LED	$0.75	5	268.69	Adafruit
Batteries 1.5V (4 pack)	$4.39	1	273.08	Target
BT Receiver	$10.57	3	304.79	Amazon
LED Light Strip	$18.98	1	323.77	Amazon
Voltage Regulator	$1.50	3	328.27	Digikey
Battery Holder	$4.95	2	338.17	Digikey

Gantt Chart

Task	Start Date	End Date	Assigned to
Main Board			
Microcontroller Hardware integration	10/3/2021	10/14/2021	JS+LG
Bluetooth Communication Hardware integration	10/3/2021	11/22/2021	KB
Memory Integration	10/7/2021	10/14/2021	AR+JS
Peripheral Boards			
Microcontroller Hardware Integration	10/3/2021	10/14/2021	JS+LG
Bluetooth Communication Hardware Integration	10/3/2021	11/22/2021	KB
Power Source Design	10/3/2021	10/14/2021	AR
Power Relay Integration	10/14/2021	10/28/2021	AR
Infrared Hardware	10/21/2021	11/4/2021	AR+JS
Software			
Microprocessor Programming	10/3/2021	10/14/2021	JS
Bluetooth Communication Programming	10/3/2021	11/22/2021	KB
Memory Programming	10/14/2021	10/28/2021	JS
PCB - Altium Designer	10/3/2021	10/25/2021	AR
Peripheral Output Programming	10/14/2021	10/28/2021	KB+JS
Laptop Computer			
User Interface Prototype	10/3/2021	10/21/2021	LG
Eye Tracking Software Integration	10/3/2021	11/22/2021	AR+LG



MDR Deliverables

Showcase prototype UI with eye-tracking software:

- Show cursor response to user eye movement
- Show command selection with timed cursor placement

Peripheral Capabilities:

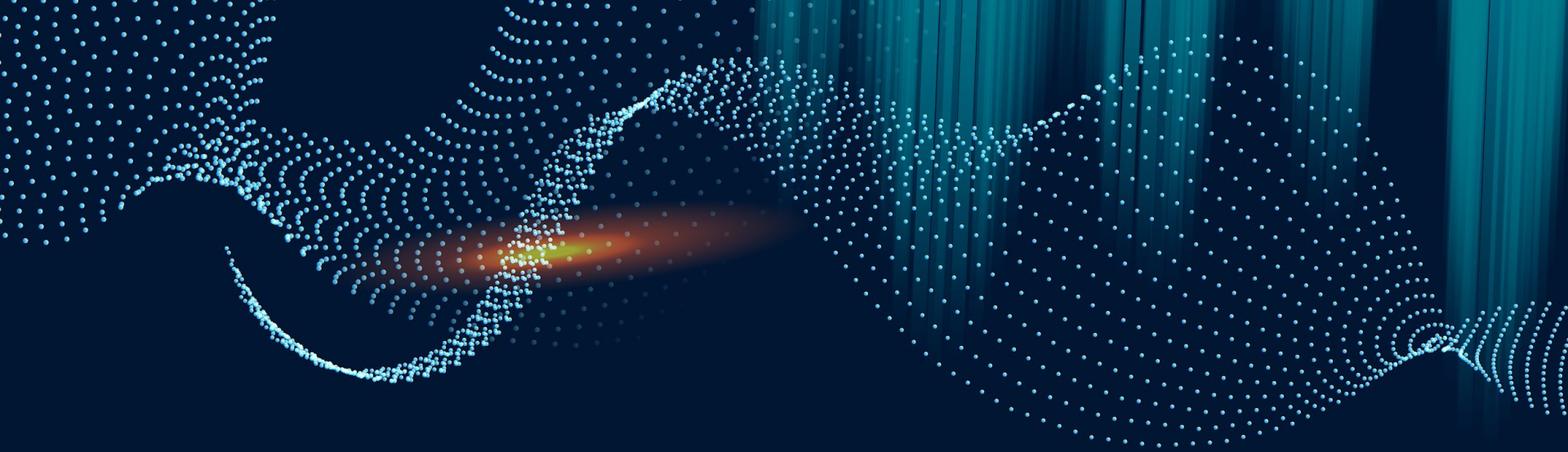
- Showcase power toggle on fan
- Show Speed Control on fan
- Show rotation control on fan

Main board Capabilities:

- Take a command from UI and communicate with a peripheral board

Teammate Obligations

- Antonio
  - Team Coordinator
  - PCB designer
  - Power supply development/management
- Jared
  - Operative Peripheral board development
  - Schedule management
  - IR Input module
- Kevin
  - Bluetooth module Programmer
  - Power Peripheral board development
- Lucas
  - Financial Tracker: Keeps track of whatever expenses the project needs
  - User Interface software Designer
  - Research and development



Questions?