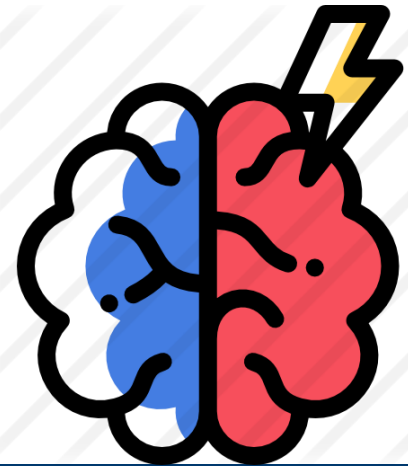


# Design and Development of a Brain Computer Interface

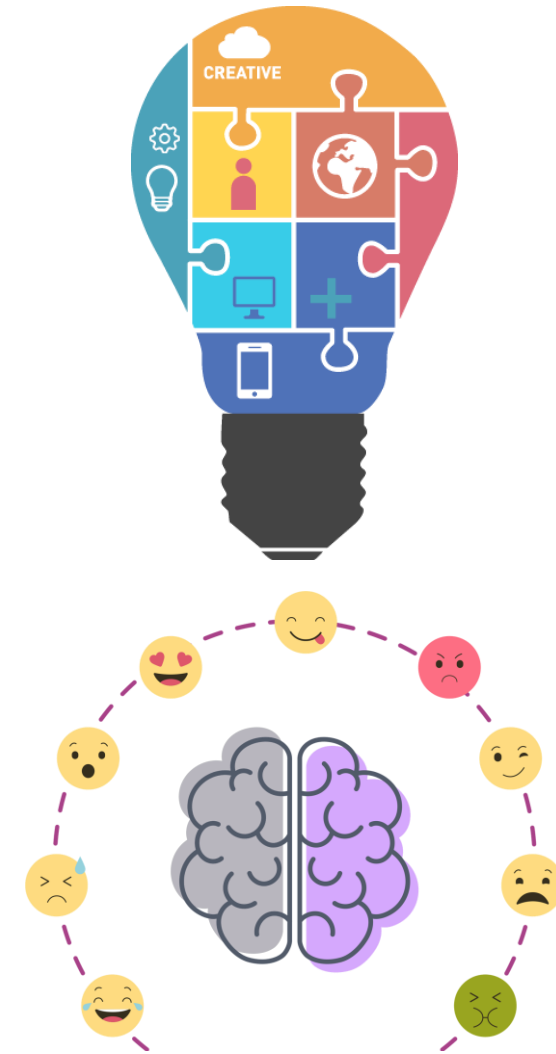
# Product Brainstorming

- Trying to find a real world marketable use for an EEG headset
- Searching for scenarios that affected us personally
- Targeting a sizable demographic that can benefit greatly from an EEG headset system



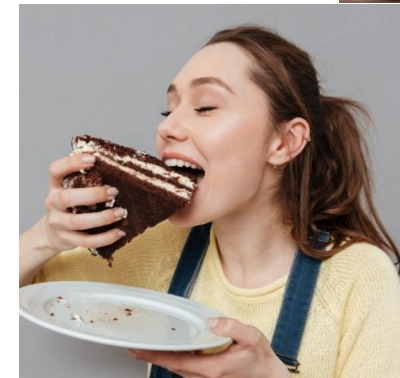
# Further Development of the Idea

- How to make this system a usable application
- Word conceptualization?
  - Issue with interpretation of concepts
- Emotion and feeling detection
- Creating a system that any individual can use



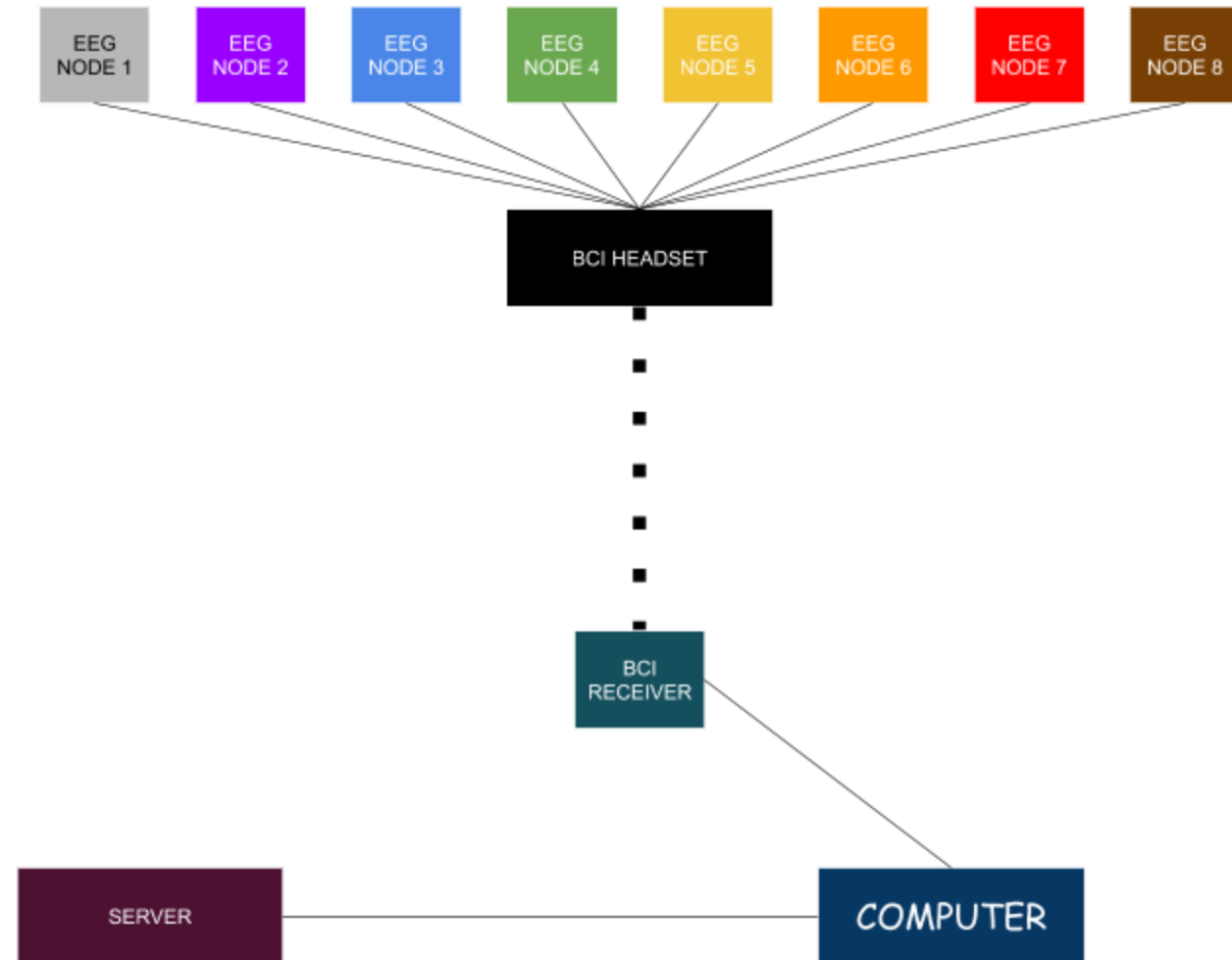
# Project Objective

- Classify brain-waves into thoughts / emotions
  - Focused vs. Relaxed
  - Urinary urgency vs. Normal state
  - Hot vs. Cold
  - Hunger vs. Full
  - Stressed vs. Normal state



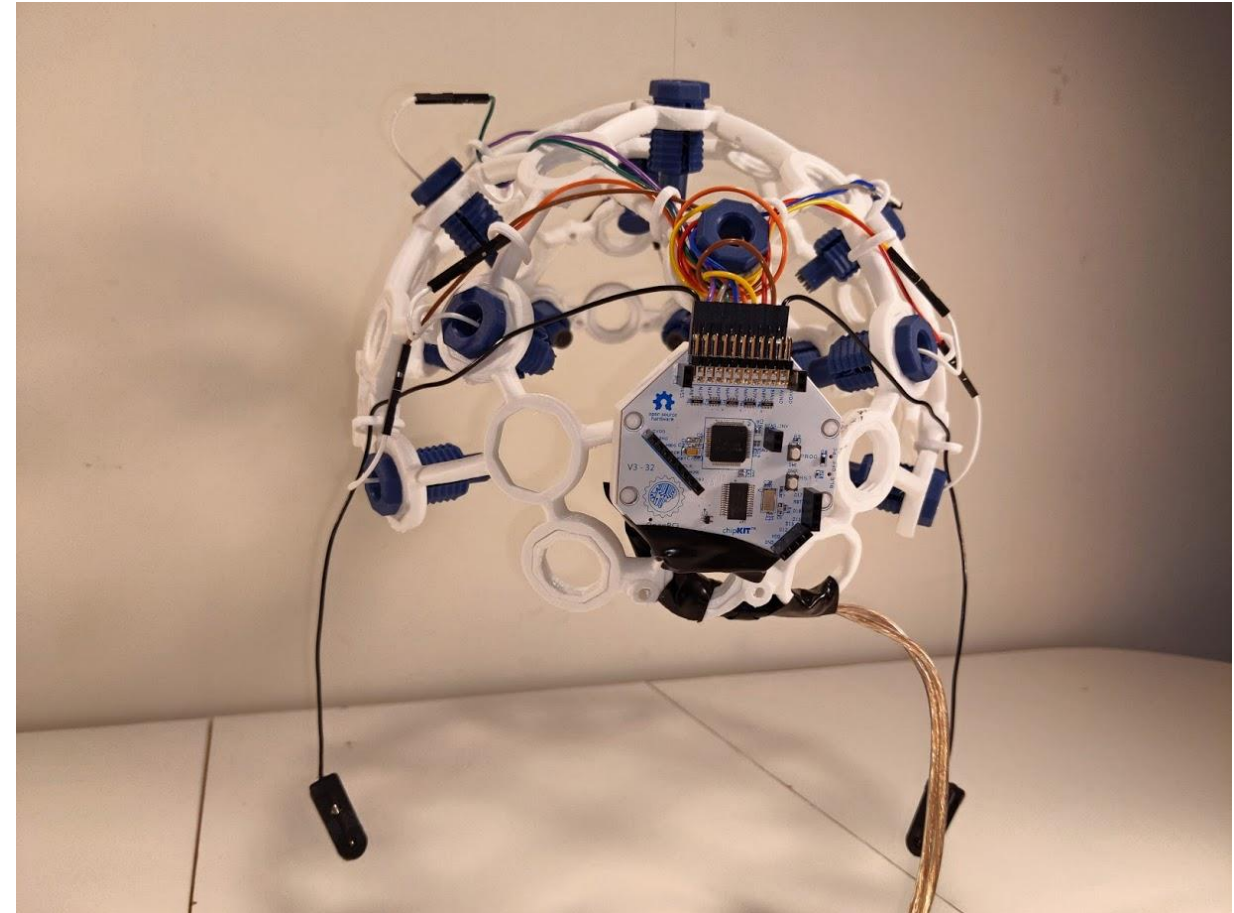
# System Architecture

- Layered Architecture
- Decoupled Components
- Distributed Processing



# The Headset

- OpenBCI Mark IV
- OpenBCI Cyton board
- 8 EEG sensors
- Battery Operated
- Wireless connection to the server through dongle

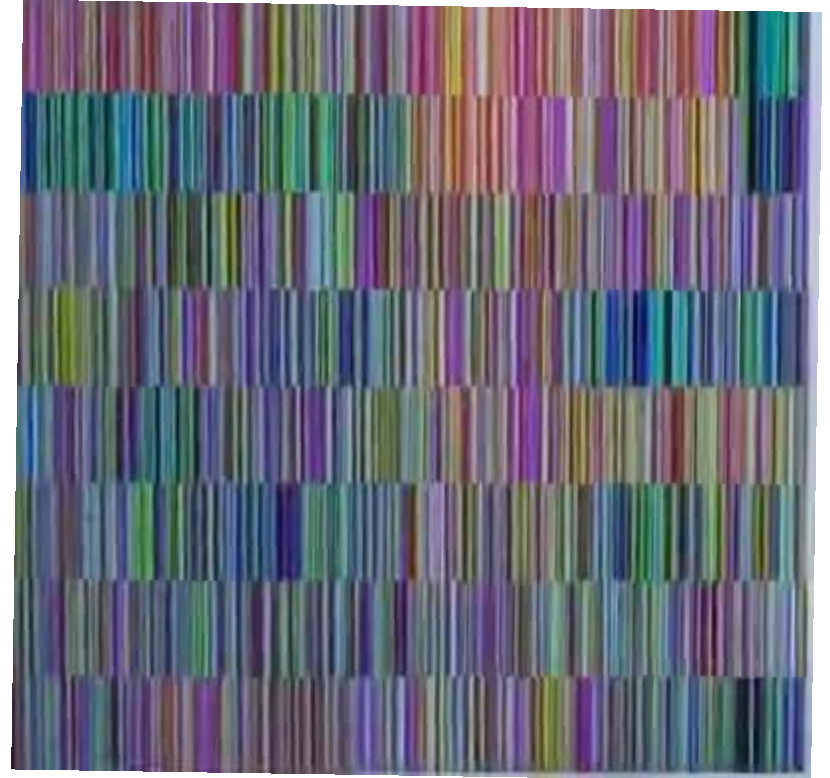


# Data Processing System

- Dedicated system for input and processing of data.
- Custom library for filtering and cleaning
- Combination of components
- Computers connected via socket for data exchange
- Over WiFi or Wired
- Main server built on Node.js

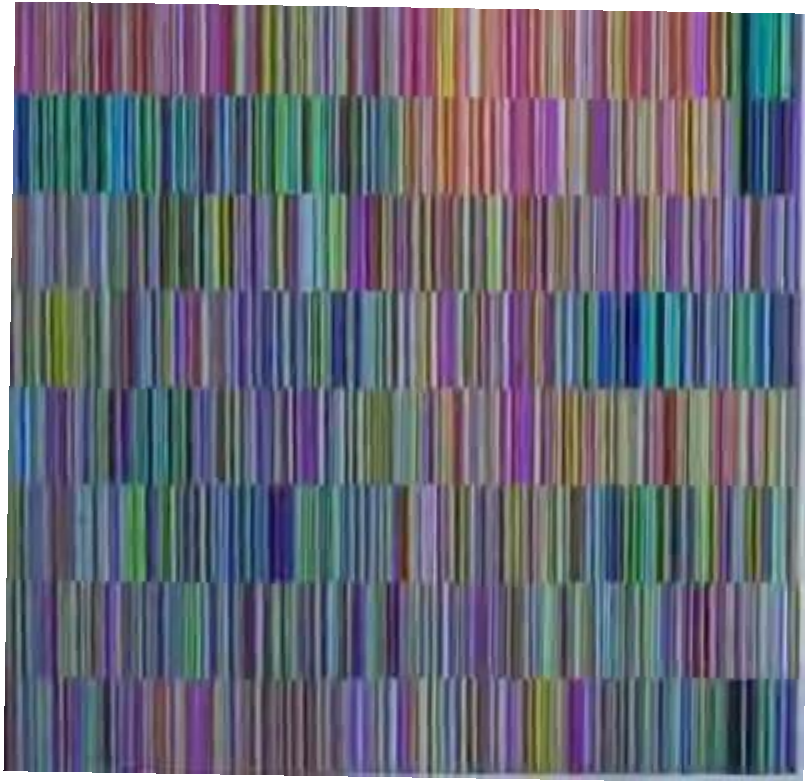
# The Interface

- Electron Application
- Uses chart.js for plotting
- Uses P5.js for generating the image
- Controls and mutates the system state





# Convolutional Neural Network



Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 320, 320, 16)	448
max_pooling2d (MaxPooling2D)	(None, 160, 160, 16)	0
conv2d_1 (Conv2D)	(None, 160, 160, 32)	4640
max_pooling2d_1 (MaxPooling2D)	(None, 80, 80, 32)	0
conv2d_2 (Conv2D)	(None, 80, 80, 64)	18496
max_pooling2d_2 (MaxPooling2D)	(None, 40, 40, 64)	0
flatten (Flatten)	(None, 102400)	0
dense (Dense)	(None, 32)	3276832
dense_1 (Dense)	(None, 1)	33

=====  
Total params: 3,300,449  
Trainable params: 3,300,449  
Non-trainable params: 0  
=====

# Training Process

1. Evoke an emotion or feeling
2. Gather data at random intervals
3. Train model
4. Test predictions with 20% of gathered data from session
5. Tweak the network
6. Test predictions on trained users
7. Test predictions on untrained users

# Project Testing

- Hardware Evaluation
- Datastream Evaluation
- Neural Network Classification

Environmental or Physical Stimuli	Targeted Response Type
Heat Lamp	Temperature - Hot
Air Conditioning Unit	Temperature - Cold
Not Eating for 10 Hours	Hunger
Waited for Need to Urinate	Need to Urinate
Math Questions Website	Focus
Focus on Breathing	Relaxation
Induced stressful situation for user	Stress

Table 4. Stimuli and Corresponding Targeted Response

## Test Results

Tester #	Hunger	Stress	Urination	Hot	Cold	Focussed	Relaxed
00	93%						
01		46%	78%				
02		64%		90%	99%		
03	60%		76%	93%	46%		
04			19%				
05						57%	86%

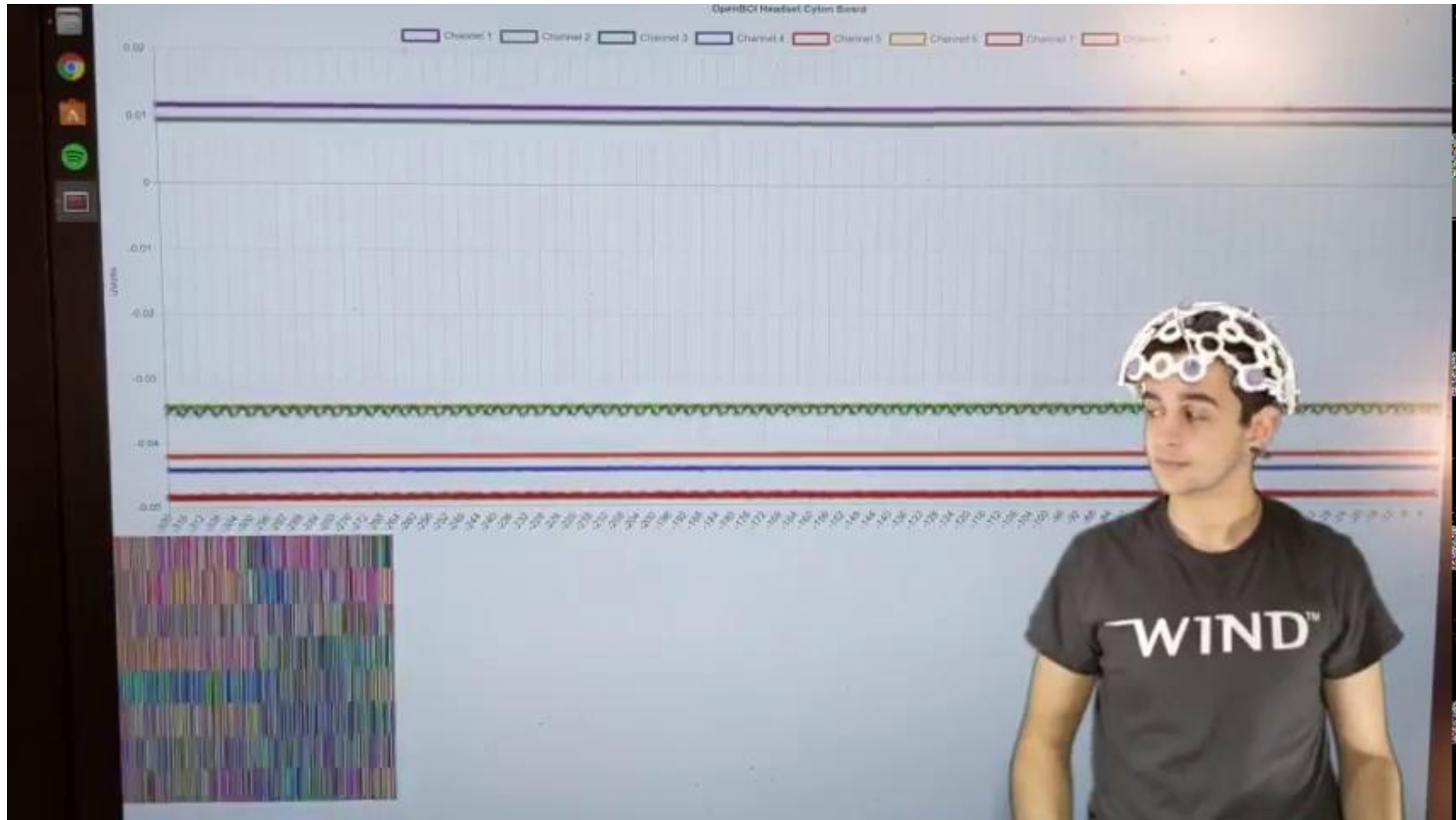
Table 5. Prediction Test Results

# Product Feasibility

- Safety Concerns
- Ethical Considerations
- Data Security
- Underlying Technology Cost



# Demo



# COVID-19



# Closing Remarks

# Q&A