New Generation Safe Addiction Control and Recovery Device System

Team 12

10 Dec 2025

Presented by

Adrian Santosh
Bernard Richawn
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Outline

1 Introduction to team

2 Problem, Solution, and MVP Design

3 Block Diagram - Schematics - HLR

4 RVs

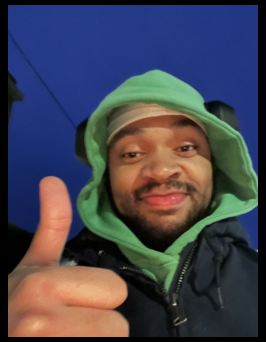
5 Cost Analysis, Schedule, Obstacles

6 Ethics, Safety

Meet the team

Dev Team

Adrian Santosh
Team Leader, Head of Sensor Sub-system design, Director for the whole project, Co-designer for data sub-system, Pitcher communication manager



Bernard Richawn
Head of Control sub-system design, Schedule manager, Co-designer for Storage sub-system, Main Designer for Safety, board Connection manager

Yixuan Li
Head of Power sub-system design, Co-designer for Storage sub-system, Main Documentor(file) Ethics and Safety Supervisor, Co-designer for safety

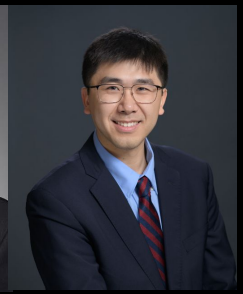
Pitcher Team

(We stole their picture from their slide hopefully they won't complain)

Shrey Patel
MD Candidate

Vedant Jain
MD Candidate

Hewa Artin
MD,
MBA Candidate



Dennison Min
MD Candidate

Big thank you to all of them for helping us when we are facing technical and budget issues! And also thanks for providing us with this amazing idea!

Also, A big thank you to professor. Cunjiang Yu, Dr. Shengyan Liu plus all the course staffs and colleagues who provide helps to us when we were facing difficulties! We really appreciate that a lot!

What's the problem we are aiming?

1, There are people vaping, and there are people smoking.

2, Vaping and Smoking are addictive.

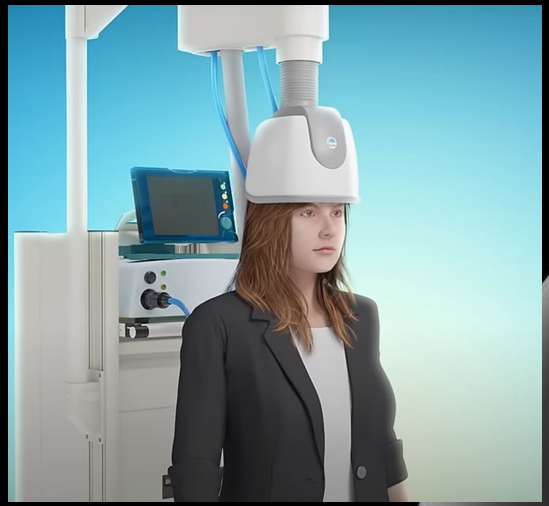
3. There are people who get addicted to smoking and vaping. Here's the problem.

"In Olender's case, his vape caused a coronary artery vasospasm, which he correctly described as "the arteries supplying blood to my heart suddenly clamped down."
That spasm reduced blood flow enough to cause an ST-elevation myocardial infarction (STEMI), better known as a heart attack — not because of a blockage, but because my heart wasn't getting enough oxygen during the spasm," Olender continued."
(Shultz, 2025)

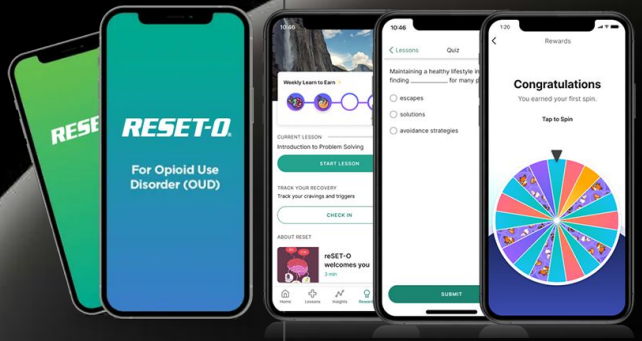
"As of February 18, 2020, a total of 2,807 hospitalized EVALI cases or deaths have been reported to CDC from all 50 states, the District of Columbia, and two U.S. territories (Puerto Rico and U.S. Virgin Islands).
Sixty-eight deaths have been confirmed in 29 states and the District of Columbia (as of February 18, 2020)."
(Outbreak of lung injury associated with the use of e-cigarette, or vaping, products 2021)

In a short term, we are trying to save heavy smoker, opium addict, and modern smoke addict.

Current Devices?



Brainsway: Deep TMS
A helmet-like coil that sends magnetic pulses into specific brain areas involved in craving and self-control.
https://www.brainsway.com/
Problem: Need a training center and is really costly



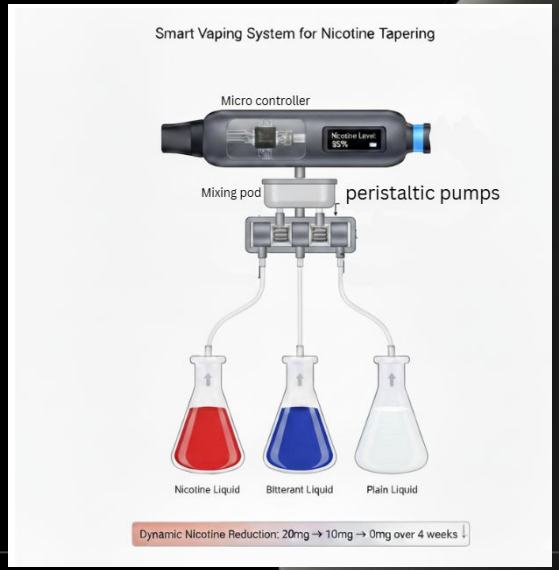
Prescription digital therapeutics (app-based “medical software”)
www.pursuecare.com/digital-therapeutics
Problem: Engagement drop-off
Requires prescription + tech access (smartphone, data/Wi-Fi), which some patients don’t have or can’t use comfortably.
It’s an adjunct therapy: alone, it’s usually not enough for severe addiction.

Monitoring & accountability devices
You blow into the device on a schedule; verified results are sent automatically to clinicians, courts, or family members to document sobriety and catch relapses early. Close to our project
Problems: Can feel intrusive and shame-inducing.
False positives / technical issues (mouthwash, device error, missing a scheduled test) can cause conflict with family, court, or treatment providers.

To better understand the problem, let's watch a short video.
https://www.youtube.com/shorts/-_5vI0OLUfQ

Solution?

Our New Generation Safe Addiction Control and Recovery Device System!



Demo

https://www.youtube.com/watch?v=UP-s7MLZzsg

MVP - Minimum Viable Product Design Strategy

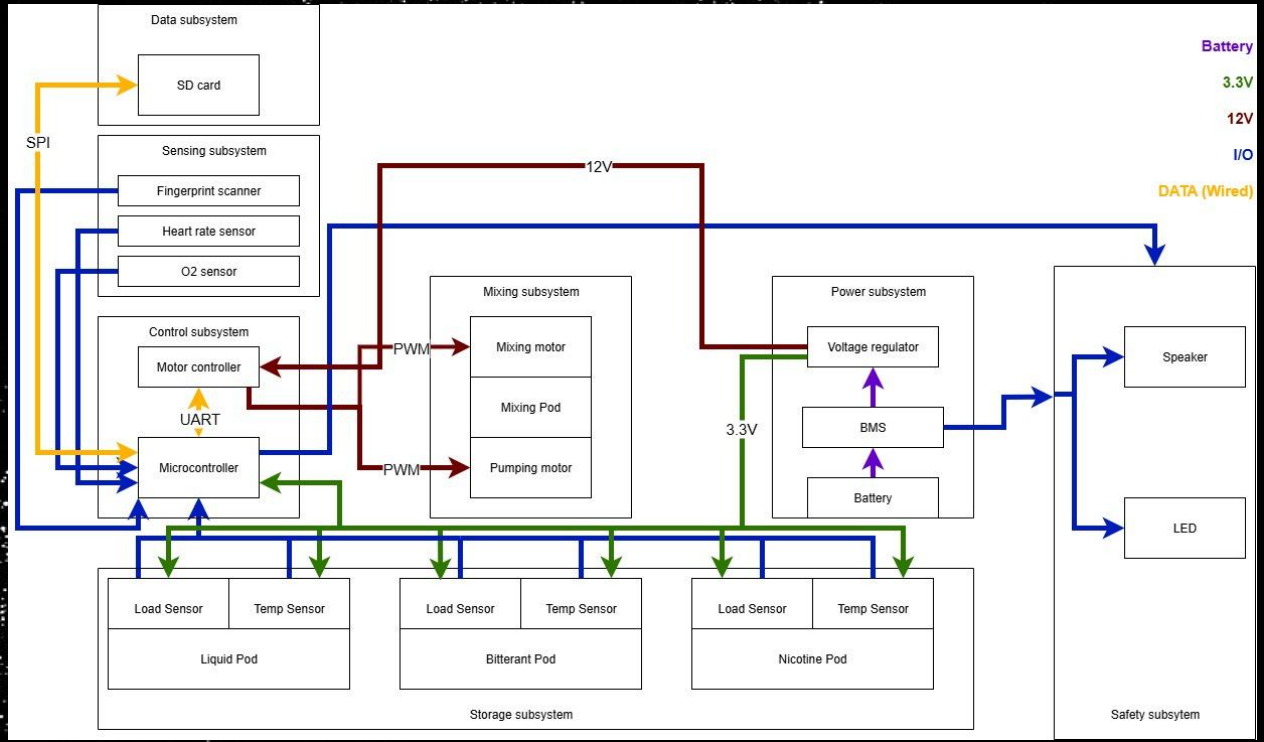
1

Our pitcher has a two semester development time for this project. We don't really have such sufficient time so as we are getting more familiar with the project, we choose to focus on the second step. Rather than leaving an not finished work we chose to develop clearly in a modular way so our pitcher team can easily enhance it or work with another team to enhance it!

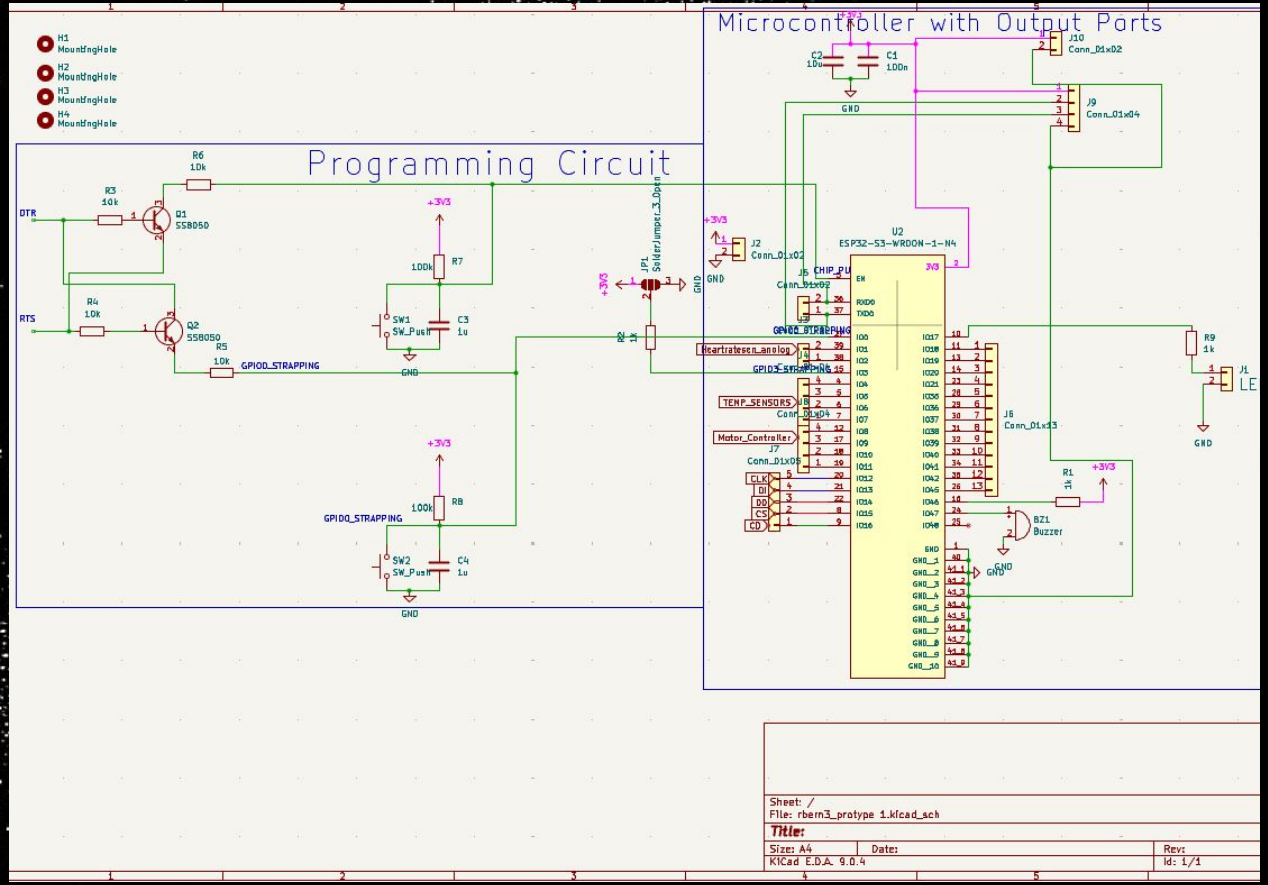
Have an Idea	**Make sure it works**	**Get feedback and do Enhancement**

Block Diagram

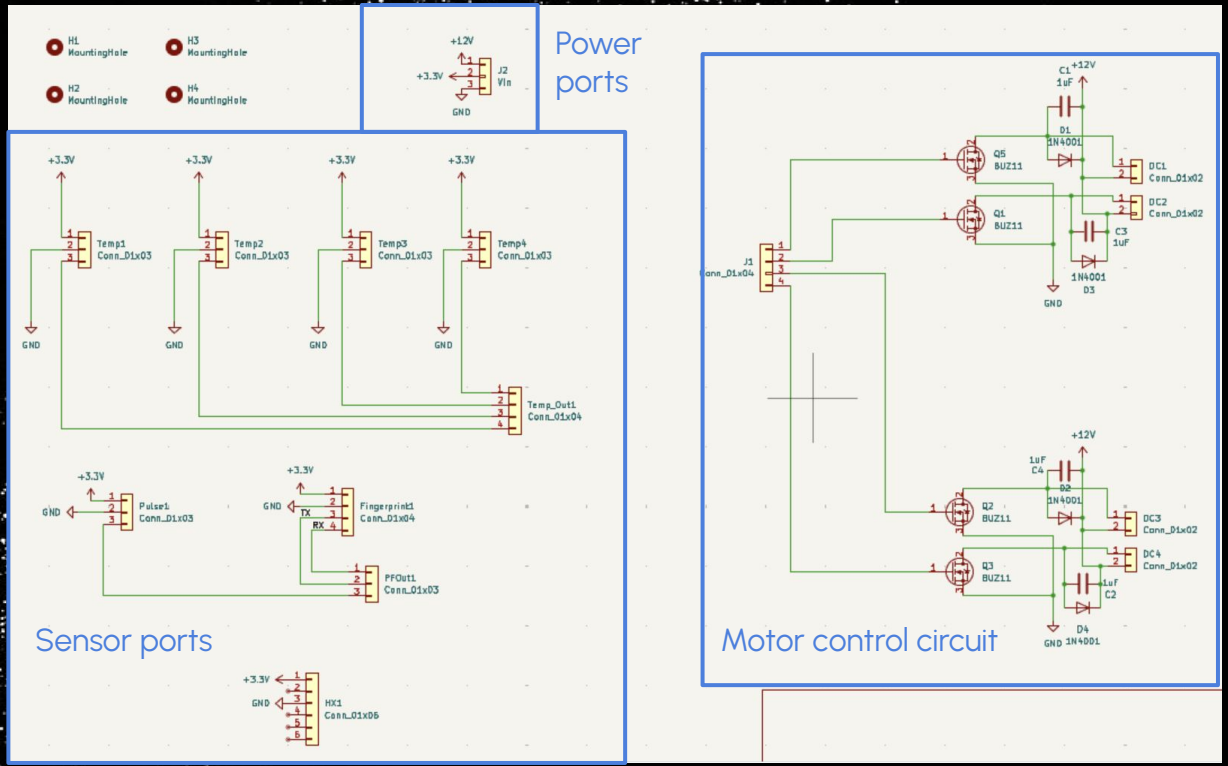
Contains all our design



Control Schematic

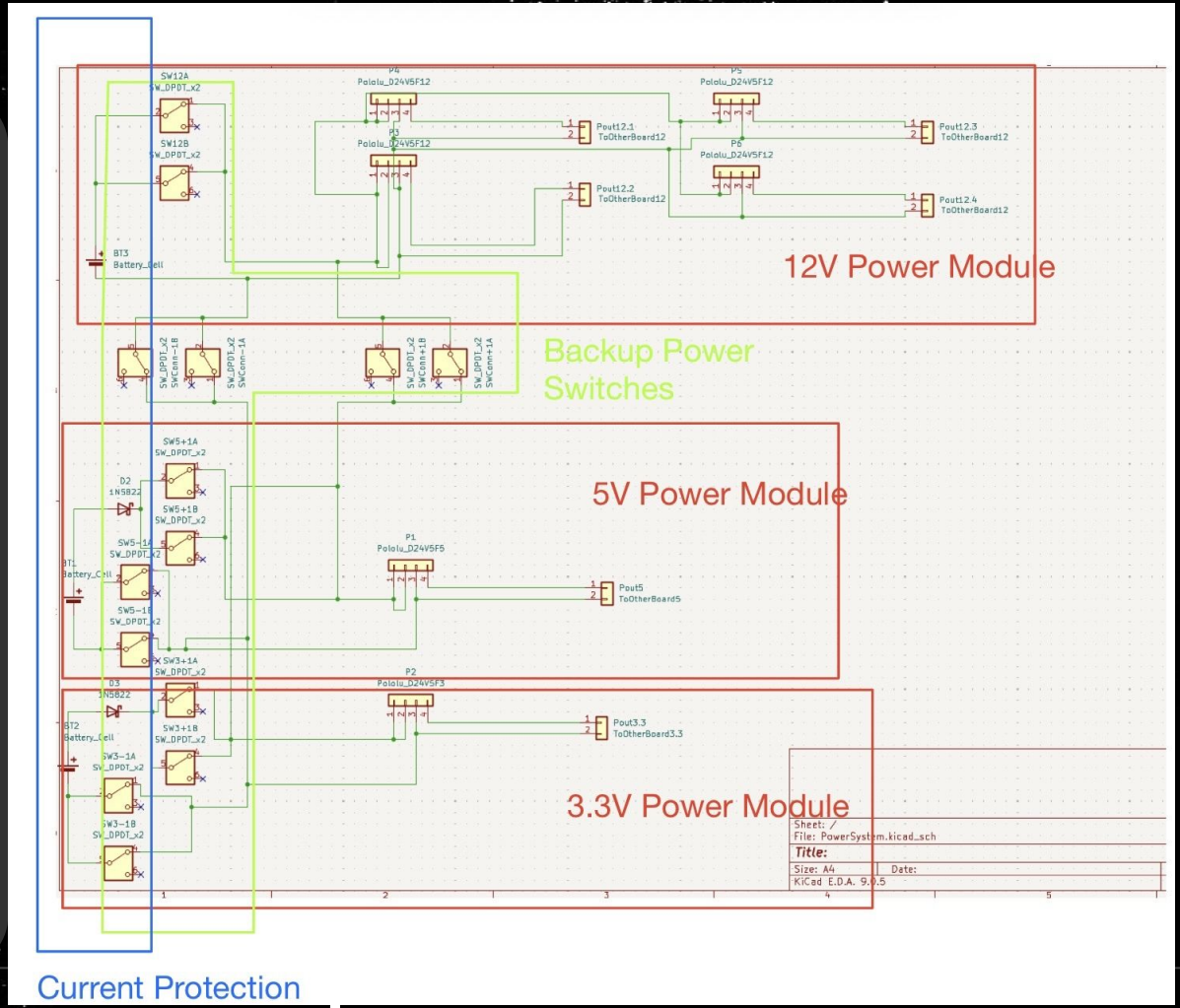


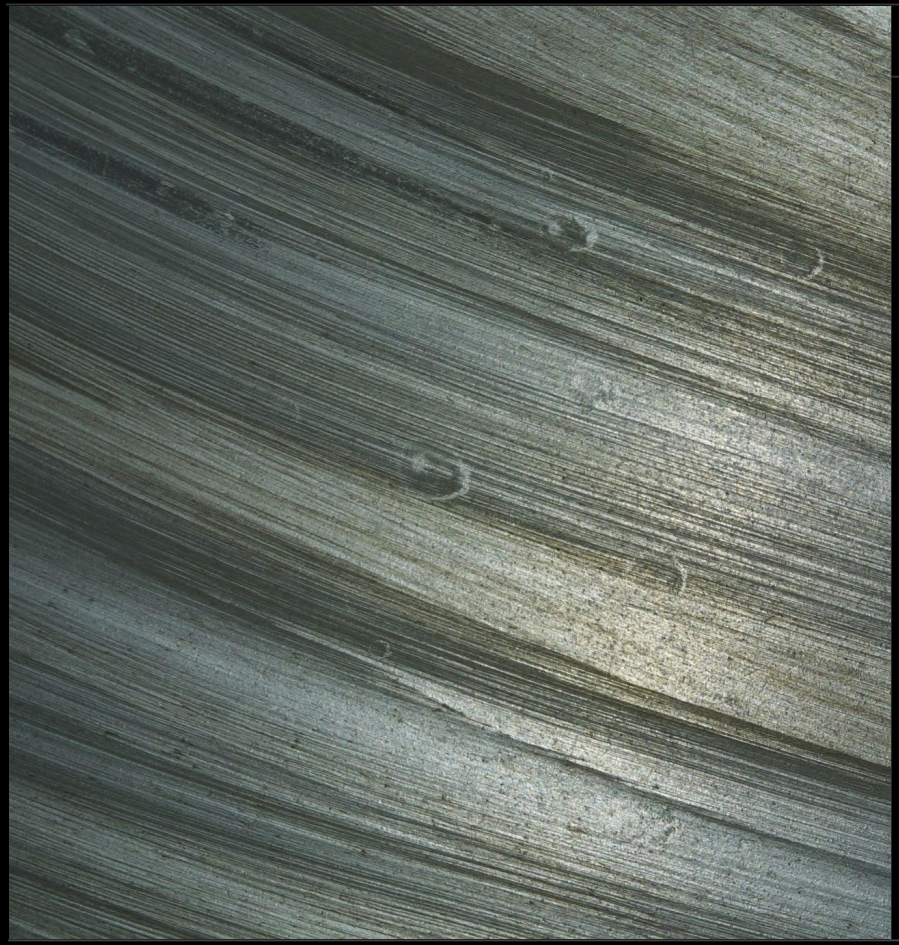
Sensor Schematic



Power Schematic

Note: It includes some designs that are not implemented in the PCB. Solely developed for the convenience of further development.





Let's first talk about the High Level Requirements!

Sensor

The Sensor communicates properly with the Micro Controller and immediate commands.
The Sensor is able to report the result within the range of 5% tolerance when dealing with data.(In the most optimal solution)

Control

The ESP32 Micro Controller is properly working with the certainty of pins and power being adjusted in the correct set up, extreme cases should all be considered and handled.
The safety signal is handled in the Control Module with additional hardware to ensure it is working properly. (FP sensor)
The device calculates the requested concentration with 1s.

Mixing

The Control Signals for the motor are correctly sent to the Mixing System and correctly handled.
The motor device is working correctly in the correct power supply and correct working frequency and power.
The system delivers the commanded dose concentration (using a safe test liquid) within 5% up and down of target as measured on a scale.

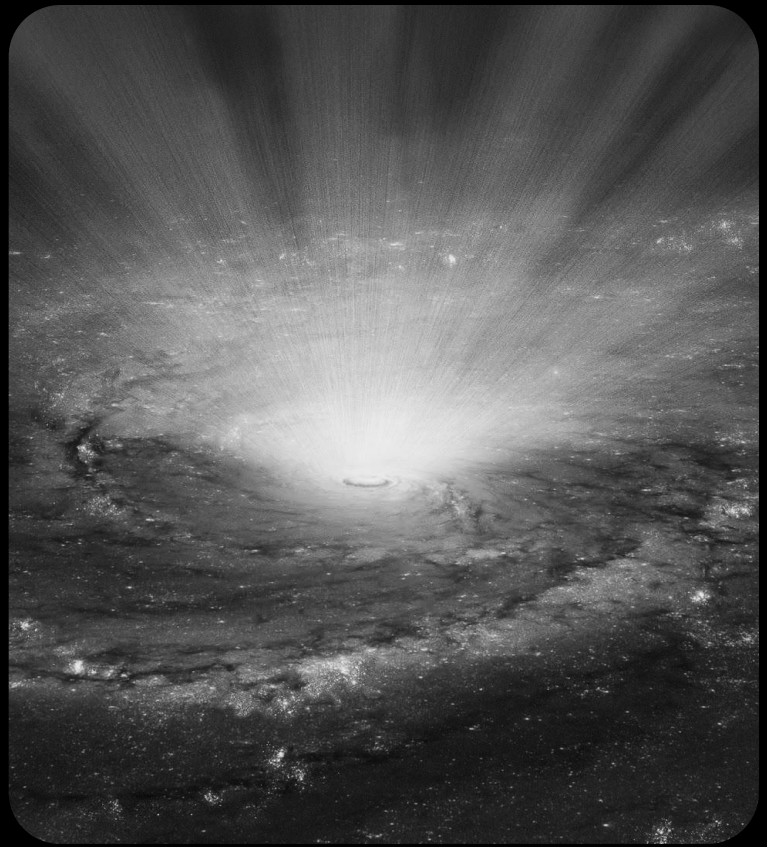
Safety

All the Safety Systems in each module are connected correctly and sending signals to the Safety signal handler in the correct time.
If a red-flag condition appears (wrong fingerprint), a clear alert shows and the system refuses to start.

Privacy

The Device should not perform the operation of presenting detailed information about past usage without the fingerprint.
The device works with no external network. All data is stored on a SD card and the user can erase all local data from the SD card.

RVs

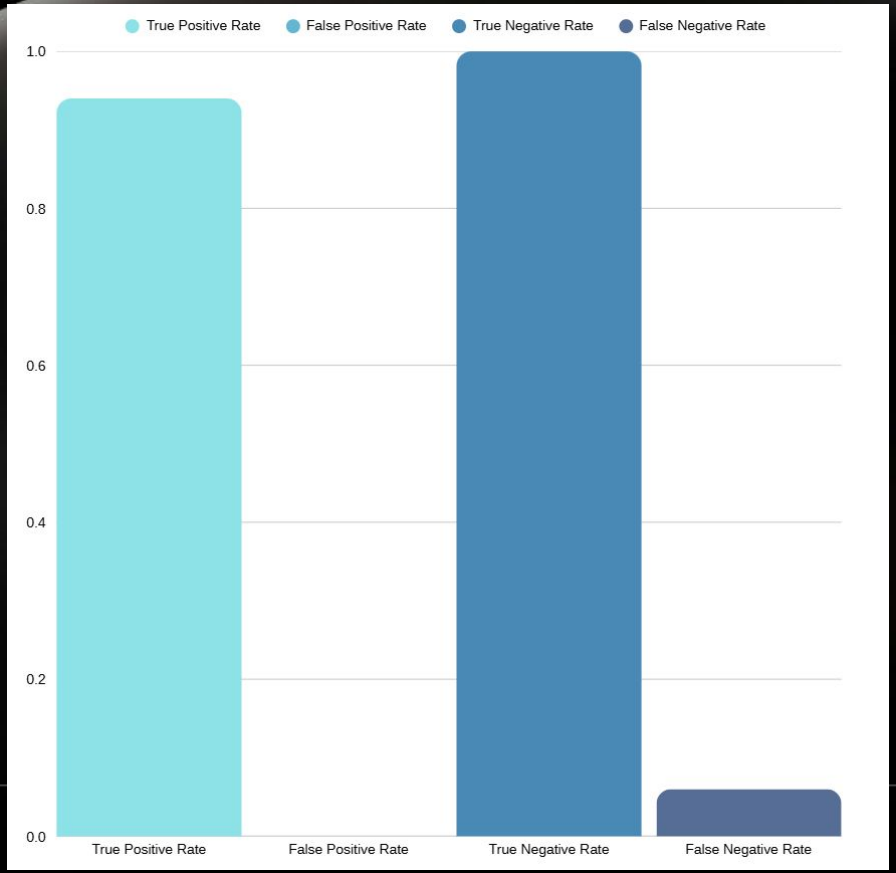


Fingerprint Sensor

We verify the fingerprint sensor by using trials with enrolled and unenrolled users. We enroll a finger and verify that it passes 100 times. We do the same for two unenrolled users.

True positive rate - 0.90
False positive rate - 0.00
True negative rate - 1.00
False negative rate - 0.10

As you can see while the True Positive is not 100% detected, The True Negative is always detected. So the system is definitely safe.



Mixing

We verify the liquid mixing system by conducting multiple tests to achieve a target concentration in the mixing pod.

Target - 4.00
Actual - 4.00 +- 0.10

Target - 6.00
Actual - 6.00 +- 0.05

Target	Amount		Target	Amount
4	4.01		6	6.00
4	4.00		6	6.01
4	4.01		6	6.00
4	3.98		6	6.02
4	4.07		6	6.00
4	3.95		6	6.05
4	4.00		6	5.96
4	4.03		6	6.02
4	4.02		6	6.00
4	4.00		6	6.00
4	4.01		6	6.00
4	4.00		6	6.00
4	4.02		6	6.00
4	4.00		6	6.06
4	4.12		6	6.01
4	4.00		6	6.01
4	4.00		6	6.03
4	3.98		6	6.00
4	4.17		6	6.00
4	4.02		6	5.98


Target and Actual Amount
Target
Actual Amount
4.25
4.00
3.75
3.50
3.25
3.00
5
10
15
20


Target and Actual Amount
Target
Actual Amount
6.2
6.0
5.8
5.6
5.4
5
10
15
20

Power

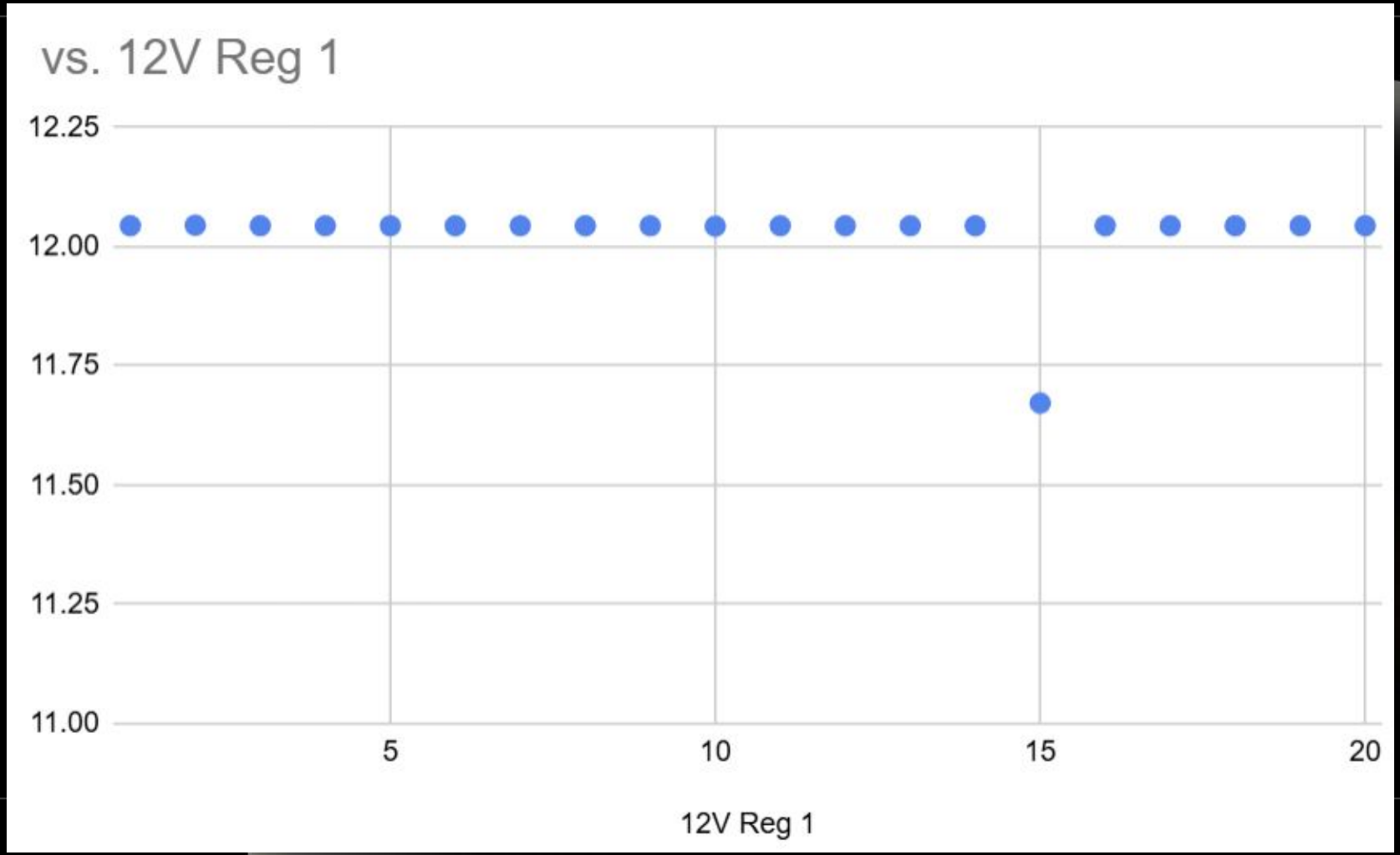
We verify the power system by recording the output against the target value

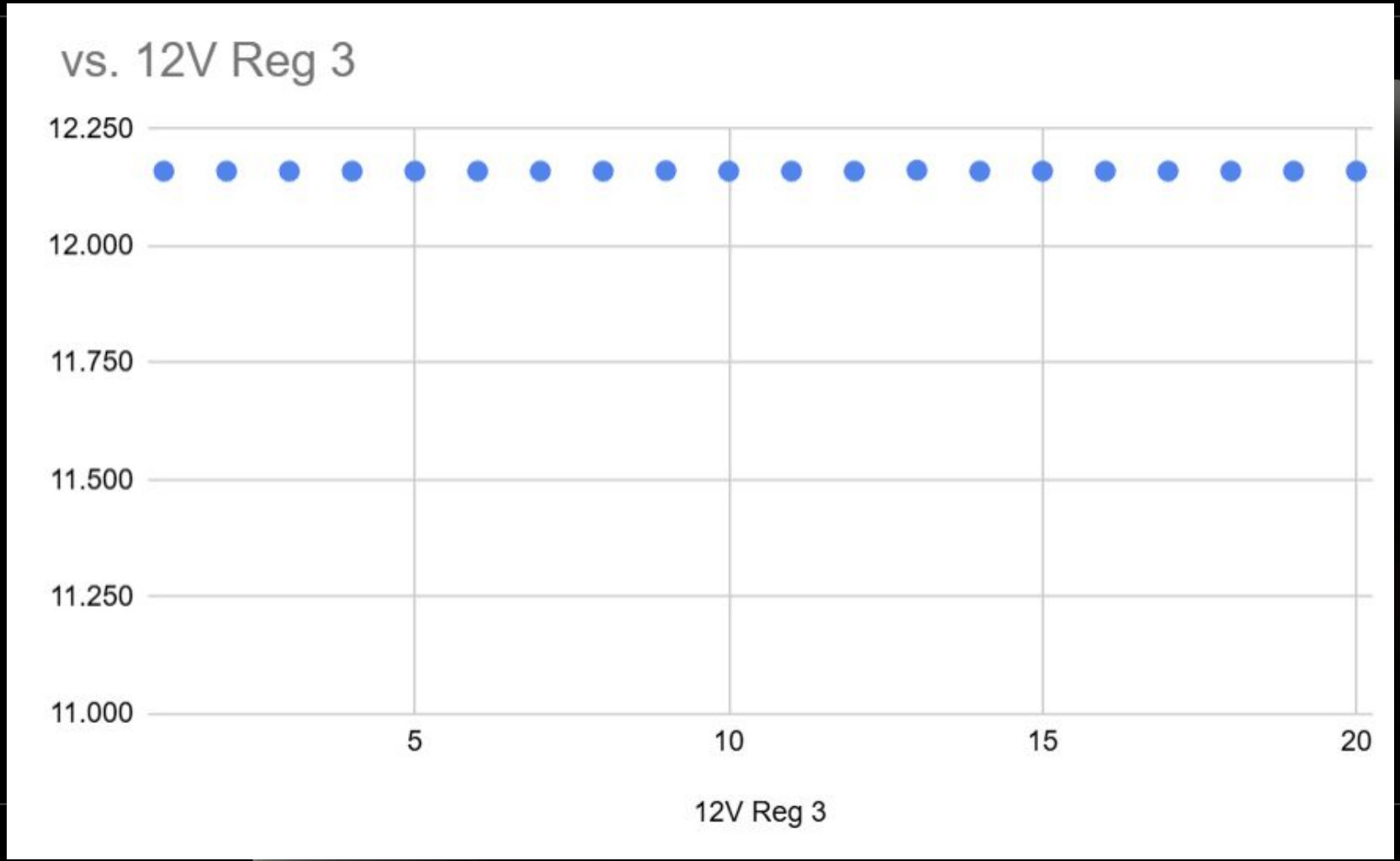
Target - 12.00V
Actual - 12.00 +- 0.50

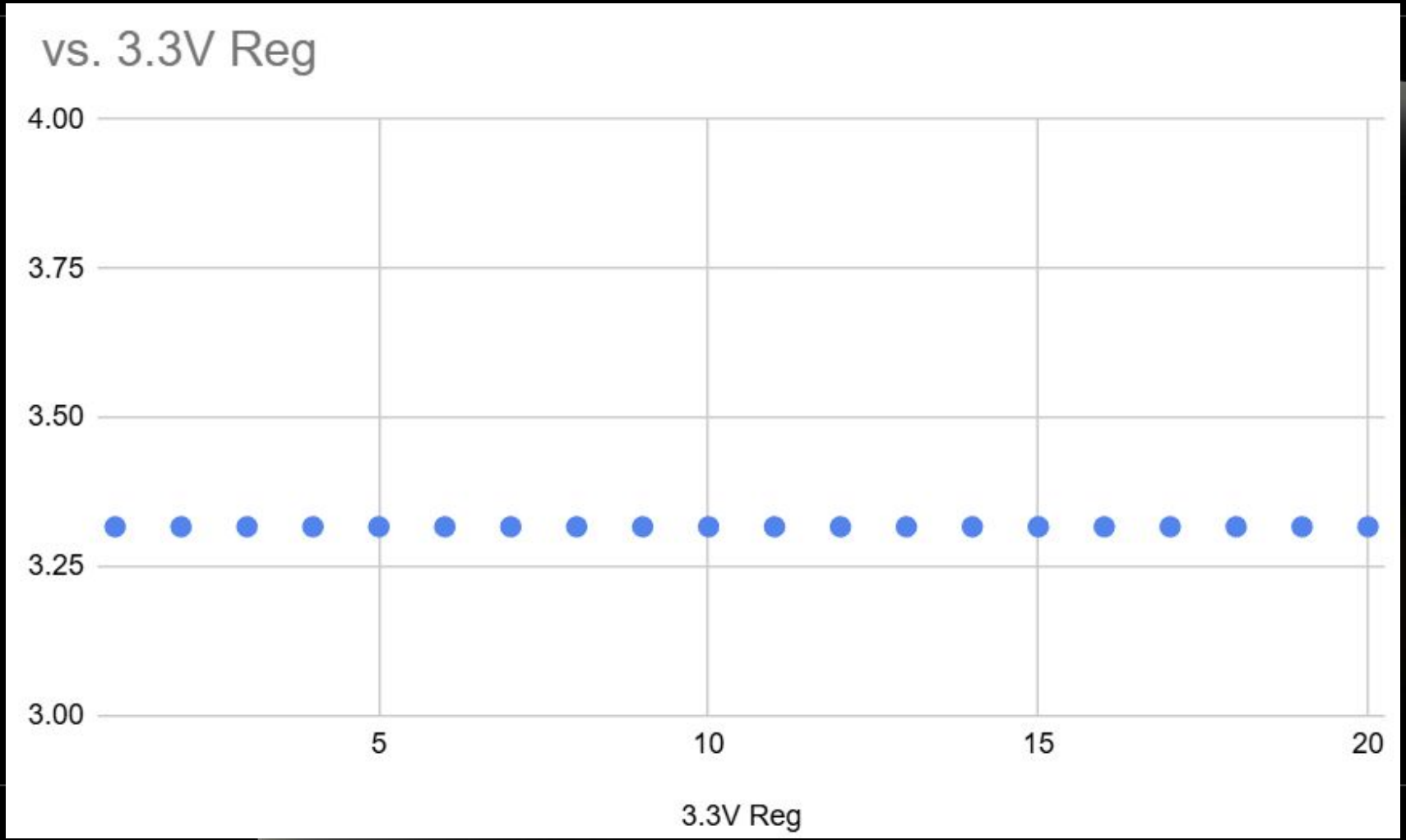
Target - 5.00V
Actual - 5.00 +- 0.05

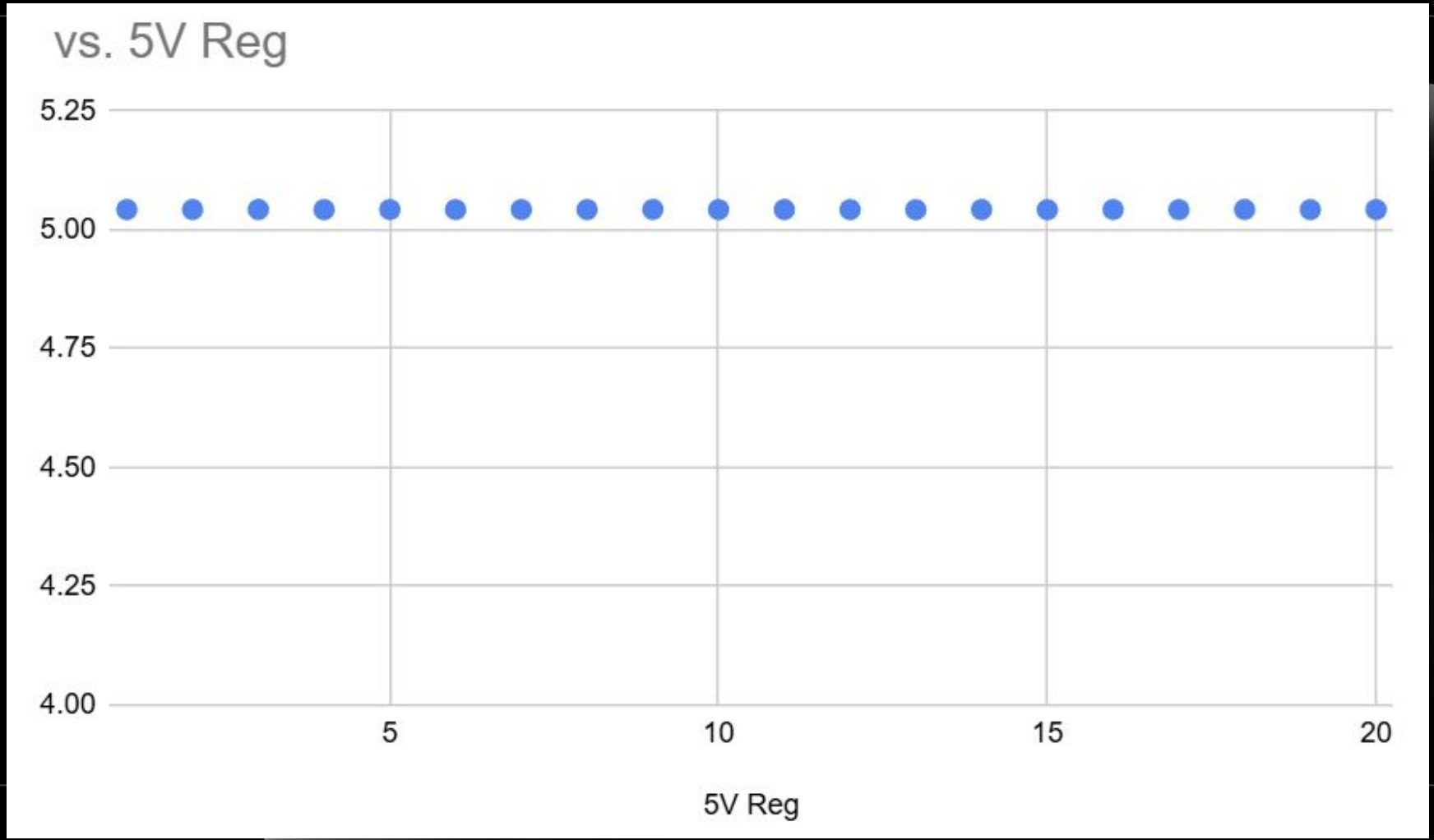
Target - 3.3V
Actual - 3.3 +- 0.02

12V Reg 1	12.044		12V Reg 3	12.160		3.3V Reg	3.317		5V Reg	5.0427
	12.045			12.160			3.317			5.0428
	12.044			12.160			3.317			5.0429
	12.044			12.160			3.317			5.0425
	12.044			12.160			3.317			5.0428
	12.044			12.160			3.317			5.0427
	12.044			12.160			3.317			5.0426
	12.044			12.160			3.317			5.0426
	12.044			12.161			3.317			5.0429
	12.043			12.160			3.317			5.0427
	12.044			12.160			3.317			5.0428
	12.044			12.160			3.317			5.0426
	12.044			12.162			3.317			5.0425
	12.044			12.160			3.317			5.0427
	11.672			12.160			3.317			5.0425
	12.044			12.160			3.317			5.0428
	12.044			12.160			3.317			5.0425
	12.044			12.160			3.317			5.0429
	12.044			12.160			3.317			5.0425
	12.044			12.160			3.317			5.0427


vs. 12V Reg 1
12.25
12.00
11.75
11.50
11.25
11.00
5
10
15
20
12V Reg 1


vs. 12V Reg 3
12.250
12.000
11.750
11.500
11.250
11.000
5
10
15
20
12V Reg 3


vs. 3.3V Reg
4.00
3.75
3.50
3.25
3.00
5
10
15
20
3.3V Reg

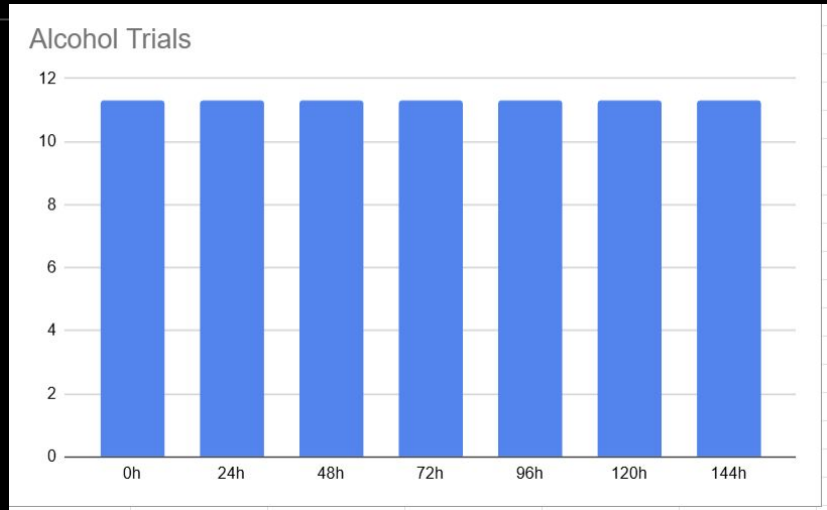

vs. 5V Reg
5.25
5.00
4.75
4.50
4.25
4.00
5
10
15
20
5V Reg

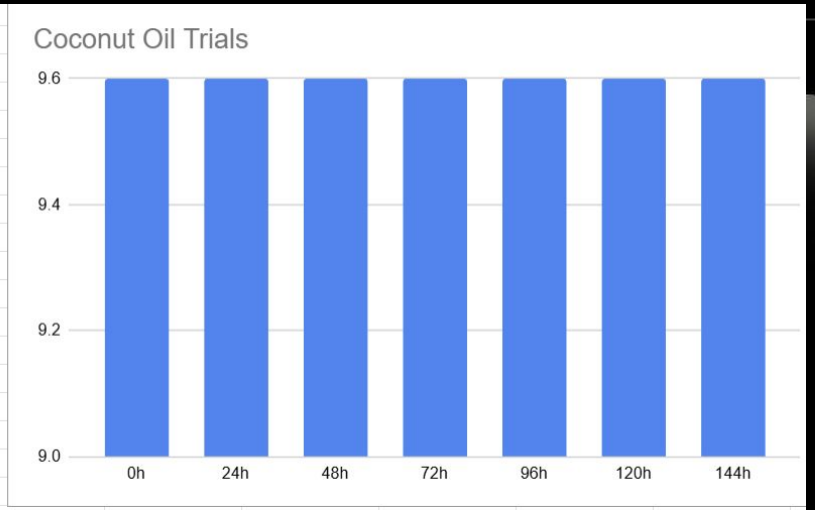
Storage

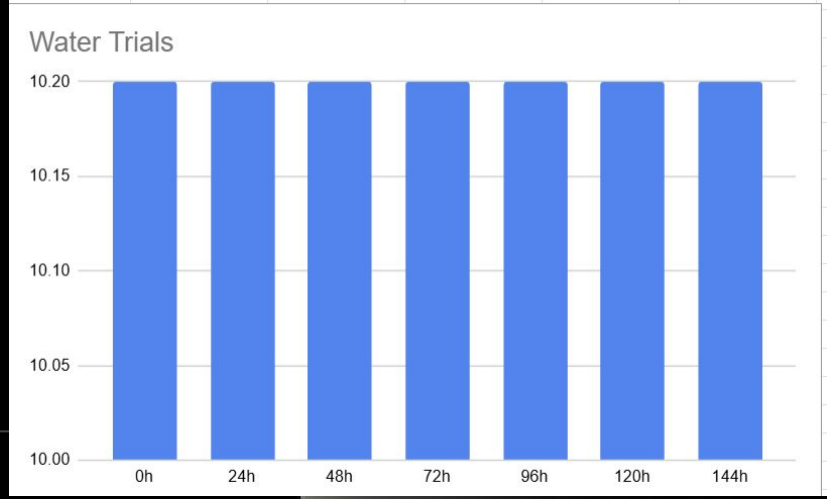
A	B	C	D	E	F	G
Alcohol	0h	11.3g		Coconut Oil	0h	9.6g
with cover on	24h	11.3g		with cover on	24h	9.6g
	48h	11.3g			48h	9.6g
	72h	11.3g			72h	9.6g
	96h	11.3g			96h	9.6g
	120h	11.3g			120h	9.6g
	144h	11.3g			144h	9.6g

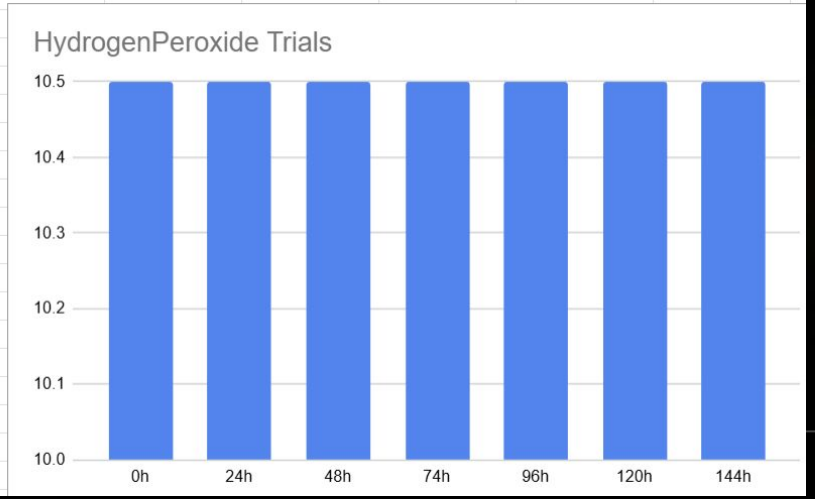
Water	0h	10.2g		HydroPeroxide	0h	10.5g
with cover on	24h	10.2g		with cover on	24h	10.5g
	48h	10.2g			48h	10.5g
	72h	10.2g		Note: all of us	74h	10.5g
	96h	10.2g		were busy	96h	10.5g
	120h	10.2g			120h	10.5g
	144h	10.2g			144h	10.5g

We verify the pod storage by testing with different liquids. There is no loss in liquid mass after 144h when placed in a stationary pod.


Alcohol Trials
12
10
8
6
4
2
0
0h
24h
48h
72h
96h
120h
144h


Coconut Oil Trials
9.6
9.4
9.2
9.0
0h
24h
48h
72h
96h
120h
144h


Water Trials
10.20
10.15
10.10
10.05
10.00
0h
24h
48h
72h
96h
120h
144h


HydrogenPeroxide Trials
10.5
10.4
10.3
10.2
10.1
10.0
0h
24h
48h
74h
96h
120h
144h

A Problem here

The RV results highly depend on lab environment. Disturbance can cause a lot of errors. When were testing the mixing system, just a soldering fan shaking the table is already causing inaccurate results due to vibrations in the pump motor.
The load sensor is the worst, it read whatever noise and can't even get a proper answer.

Cost Analysis, Schedule, Obstacles

Cost Analysis

The labor cost analysis is merely a mock so I will not talk about that too much.
The material cost actually exceeded much more than the original plan. Thanks again to the pitcher who helped us for the extra budget they helped. But even with that Leo had to pay out of my own pocket for the Pololu Buck regulators. It cost more than 200 $.
Expected cost - 150$
Actual cost - 600$

Schedule

We were able to strictly follow the schedule other than the aspects we took out for the design consideration.
We followed every single requirement in the team contract!

Obstacle: Leo

Mistaken design ideas caused waste of time. Spent 4 weeks + in the linear regulator which turns out to be a totally useless idea.
Keep getting trolled by unclear instructions that cannot be physically checked. For example the encapsulation for switches.

Obstacle: Richawn

It is seriously hard to find the correct driver code for some of the devices. Sometimes the code was correct but the device is wrong and sometimes the code was just simply outdated.
Plus programming ESP32 is also much harder than what we thought it would be. Especially on PCB once there was a solder point fall off and all of us were trying to debug it for 3 days until we finally find out what happened.

Obstacle: Adrian

The development of sensor sub-system is horribly impacted by the disturbance. Any minor disturbance even just a current flow inside a wire could distract some of the reading of sensors. Solder connections to the PCB need to be insulated and we can add pin headers to the wire tips to ensure proper connection. The load sensor took time to calibrate and did not work till it was mounted on stand properly.

Ethics, Safety

Ethics

We are happy to announce that we followed strictly on ethics that we declared! We helped each other, cared about humanity and strictly followed the academic integrity guidelines.

Safety

Everyone followed strict safety standards in every single aspect. For example, no single person working in the lab, no working with high voltage without protection, and no continuous working for more than 8 hours for anyone.

Citations

Wikimedia Foundation. (2025, November 10). *Minimum viable product*. Wikipedia. https://en.wikipedia.org/wiki/Minimum_viable_product

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And all the Design Document Citations

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Thank you!