



VSENS

Centralized Cryogenic Vacuum Monitoring

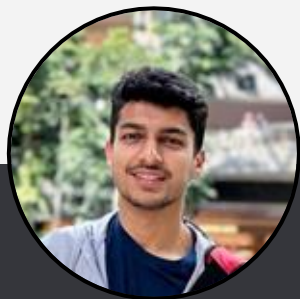
VSENS Dashboard Live

Module	Last Update ▼	Vacuum (torr)	Temp (K)	Controls	Battery
Sensor 18	14h 18m	748.00	302.87	(300.00) [icon]	[icon] [battery]
Rachit's Macbook Air	3d 14h	0.00	3.82	(930.00) [icon]	[icon] [battery]
WhiteRaspi	3d 15h	0.00	500.00	[icon]	[icon] [battery]
Sensor 18	4d 16h	0.00	500.00	[icon]	[icon] [battery]
Sensor 14	7d 17h	0.00	293.95	[icon]	[icon] [battery]
Sensor 1	7d 18h	0.00	300.49	[icon]	[icon] [battery]
Sensor 3	9d 8h	0.00	295.68	[icon]	[icon] [battery]
White Raspi	23d 18h	0.00	0.00	(900.00) [icon]	[icon] [battery]
Rachit's Laptop	2mo 10d	0.00	0.00	(100.00) [icon]	[icon] [battery]

Show Past Data

MACBOOK PRO

The Team



Rachit Gupta

UI/UX

Design & Power



Abdullah Ahmed

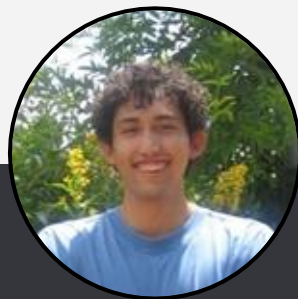
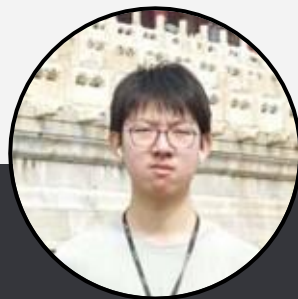
Hardware & Design



Kauri Mai

Andrew Yanez

Software & Enclosure



Forrest Zhou

Low-power mode FSM

PCB

The Problem: Testing Infrastructure for IR Sensors

Advanced IR Sensors → Cryogenic Dewar Testing → Precise Vacuum & Temperature Control

⚠️⚠️ Current Testing Systems Are:

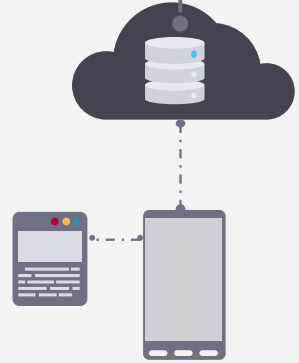
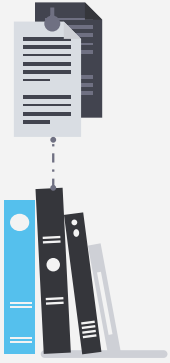
- 📦 Bulky and non-modular
- ⚙️ Manually configured
- 🔄 Difficult to scale across multiple test setups
- 👤💻 Not intuitive for operators



VSENS is our attempt to engineer a finished, deployable system that solves these constraints simultaneously.

What is VSENS?

A compact, low-power, automated **Vacuum & Temperature sensing and control** system
with integrated hardware-software architecture



Core Objectives



Ultra Low Power
Consumption



Automated setup
(plug-and-play architecture)



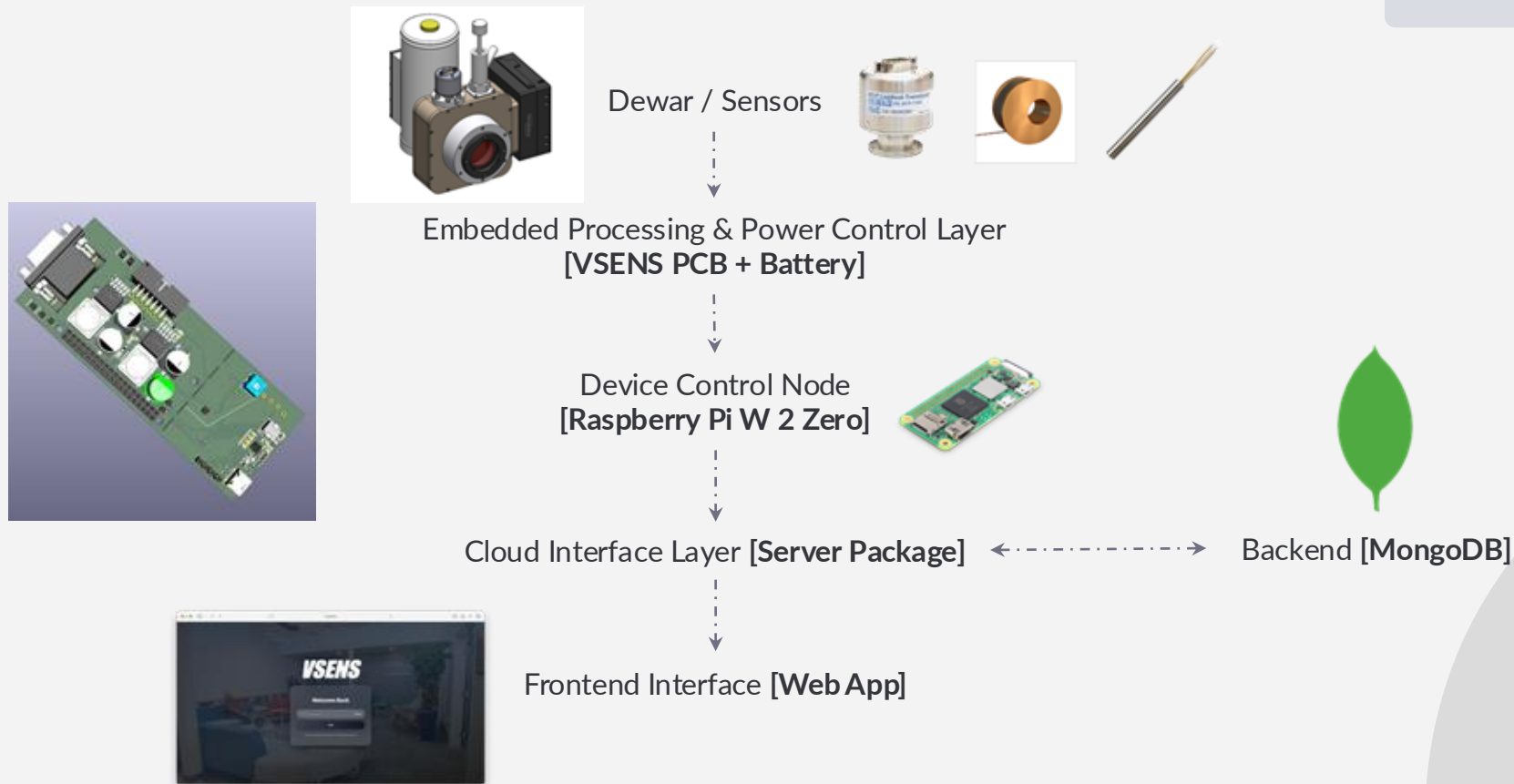
Small form factor



Intuitive UI for
control & monitoring

Every design decision — electrical, mechanical, and software — was constrained by these four objectives

Architecture Overview



VSENS Module



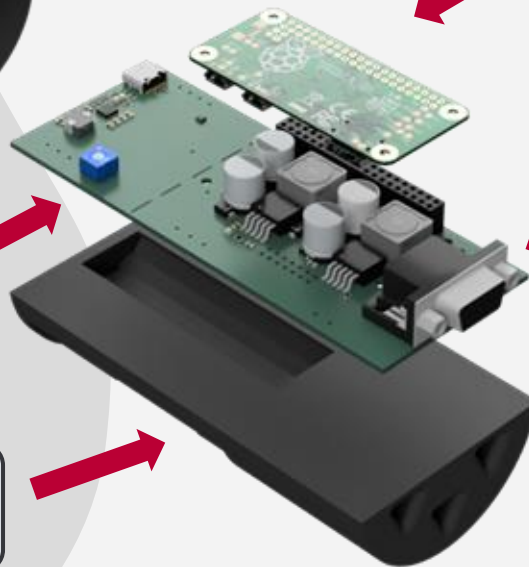
Raspi Zero
2W

DSUB
Connector

Vsens PCB

Battery
Compartment

Small Form Factor
2.7" x 2.7" x 5"



Currently Presenting
- Kauri

Module Enclosure



- Securely Stores the Raspberry Pi, PCB and battery
- Has output ports for both USB-C Power and the 14 pin connector for the heater & temperature sensor
- There is a separate compartment for the battery underneath the PCB & Raspi



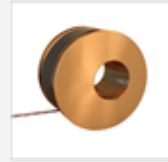
Main Components



901P Vacuum Sensor



Sensor Processing



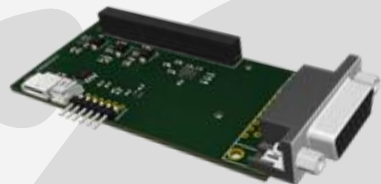
Temperature Sensor



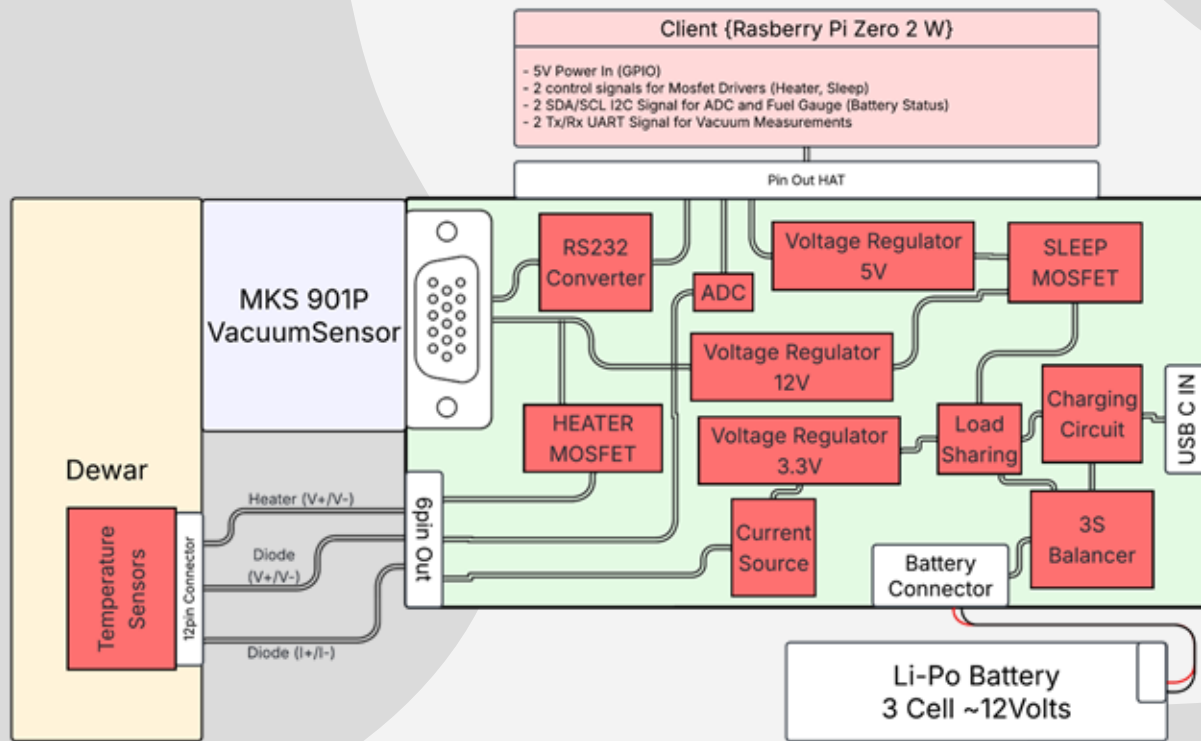
LIPO Batteries



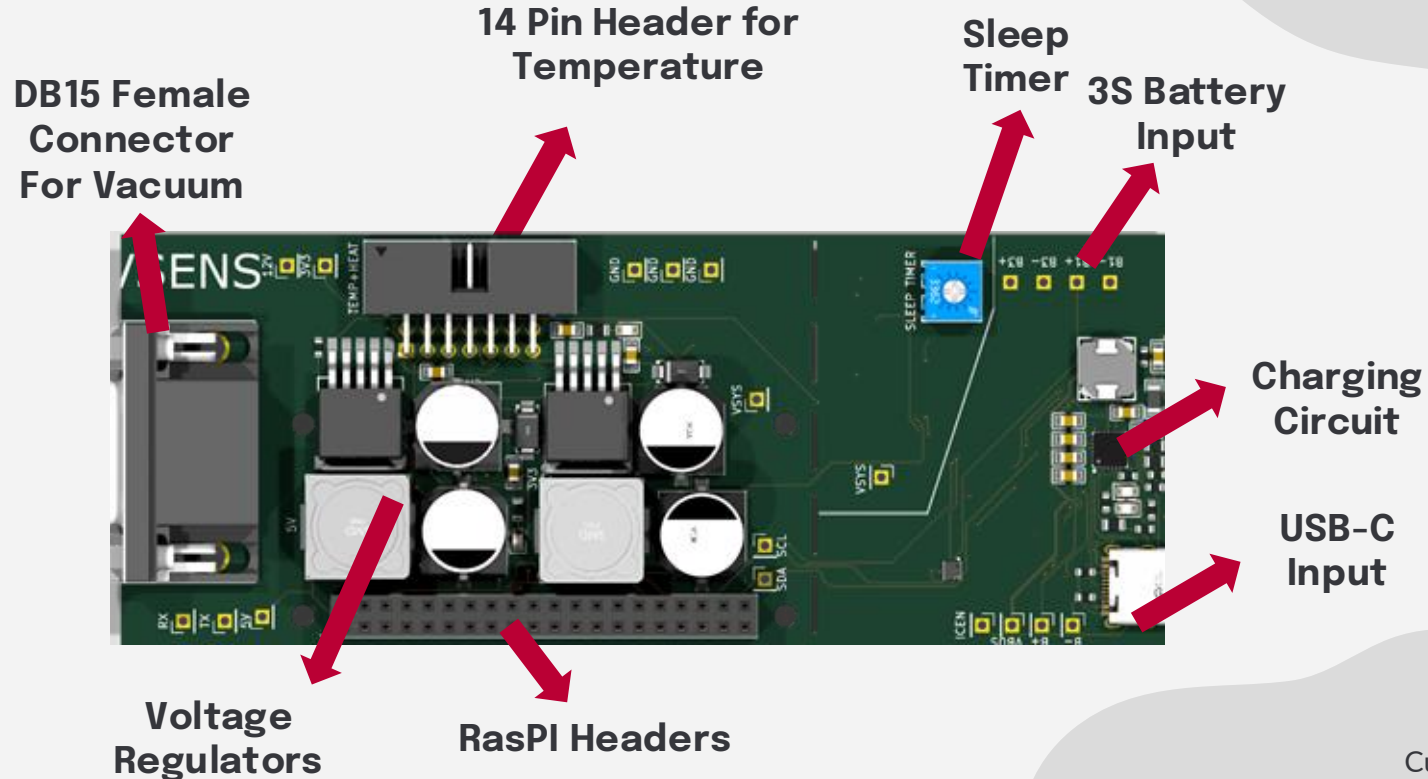
Heater



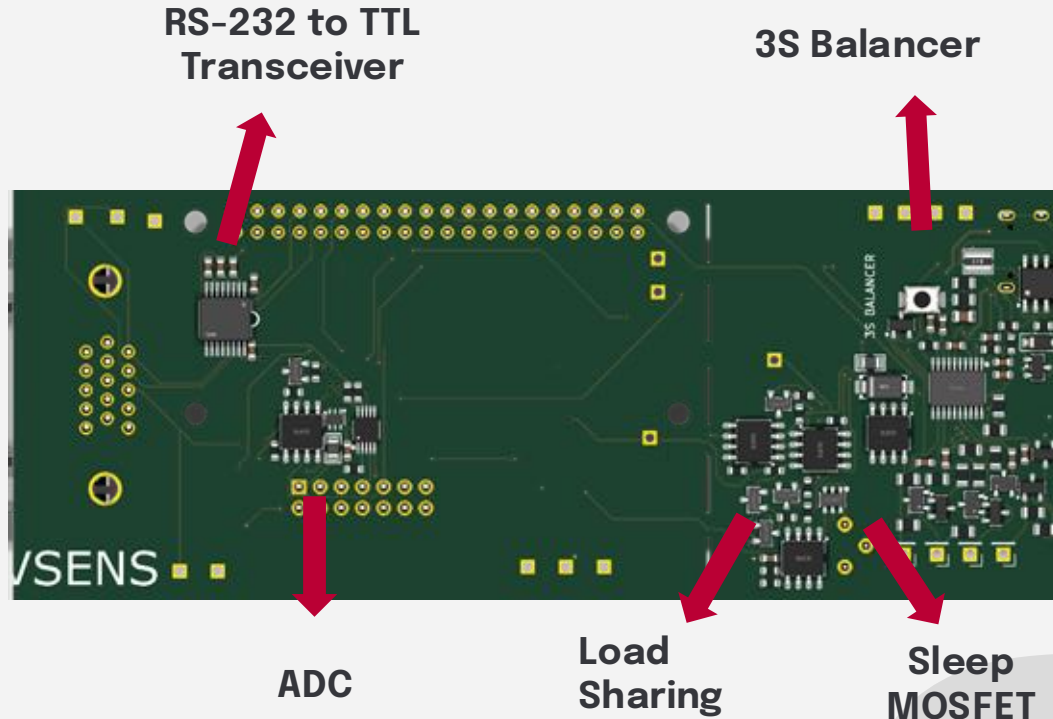
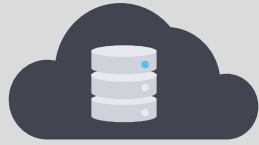
What's on the PCB?



What's on the PCB?



What's on the PCB?

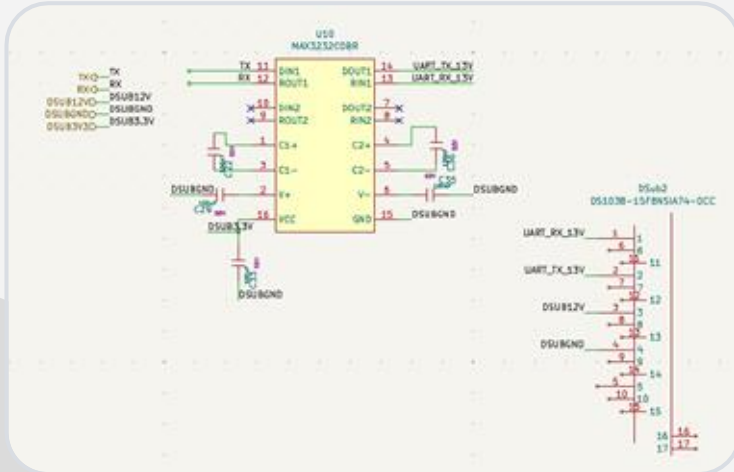


Vacuum Sensing Module



Hardware Interface

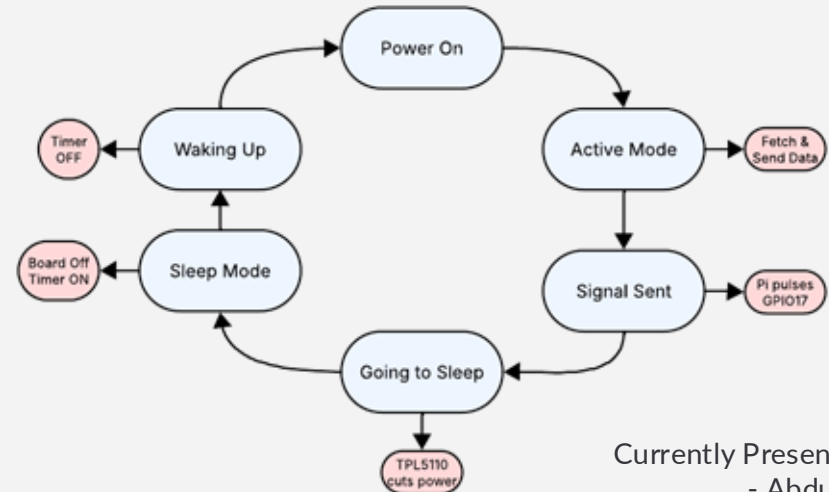
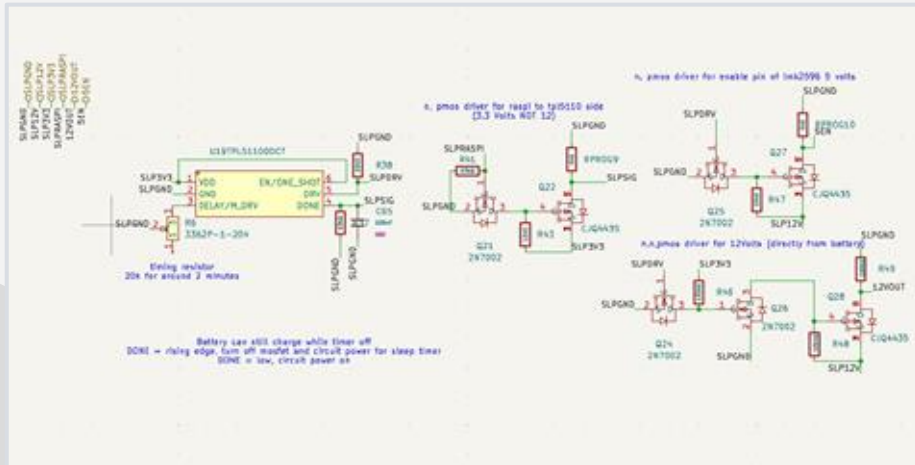
- **Communication Protocol:** Our vacuum sensor communicates via RS-232. We integrated a **Max3232** onto our PCB to translate TTL to RS232 for effective sensor-client communication.
- **Communication interface update:** We successfully migrated from a Micro-USB connector to a direct GPIO connection, freeing up board space and making full use of the existing header pins already present on the PCB.



Low-power Mode

Sleep MOSFET

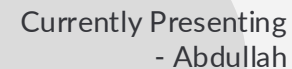
- TPL5110 (Hardware timer) : Hardware timer IC that holds the power switch open on boot, and drives a pin HIGH for a set amount of time
- MOSFET DRIVERS: It sits in series on the supply rail. When the gate is driven, the entire board loses power.
- Raspberry Pi sends signal to timer.
- Timing can be adjusted using resistor value.



- The screenshot shows the iSens Dashboard with the following data:

Module	Last Update	Vacuum (torr)	Temp (K)	Controls	Battery
Sensor 24	5/25/2026, 5:51:26 AM	0.00	298.09	0000 DOI	100%
Test Sensor 0	5/21/2026, 4:43:14 PM	1.058e-5	—		100%
Test Sensor 1	5/21/2026, 4:43:16 PM	93.15	—	0000 DOI	100%
White Respi	5/21/2026, 5:05:57 PM	3.69	294.03		100%

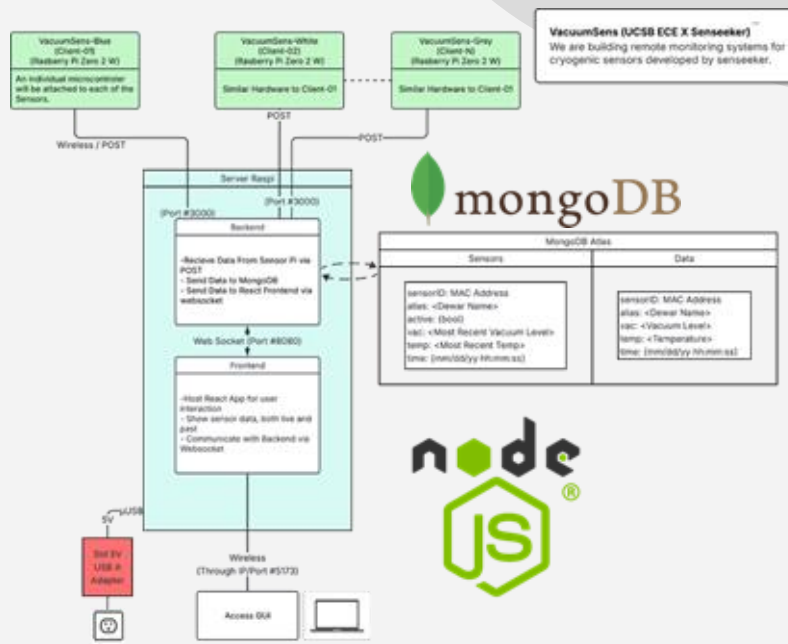
At the bottom, it says "Show Past Data" and "WS only • Auto updating • 11:02:37 AM".

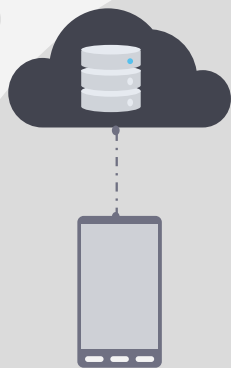


Backend Architecture

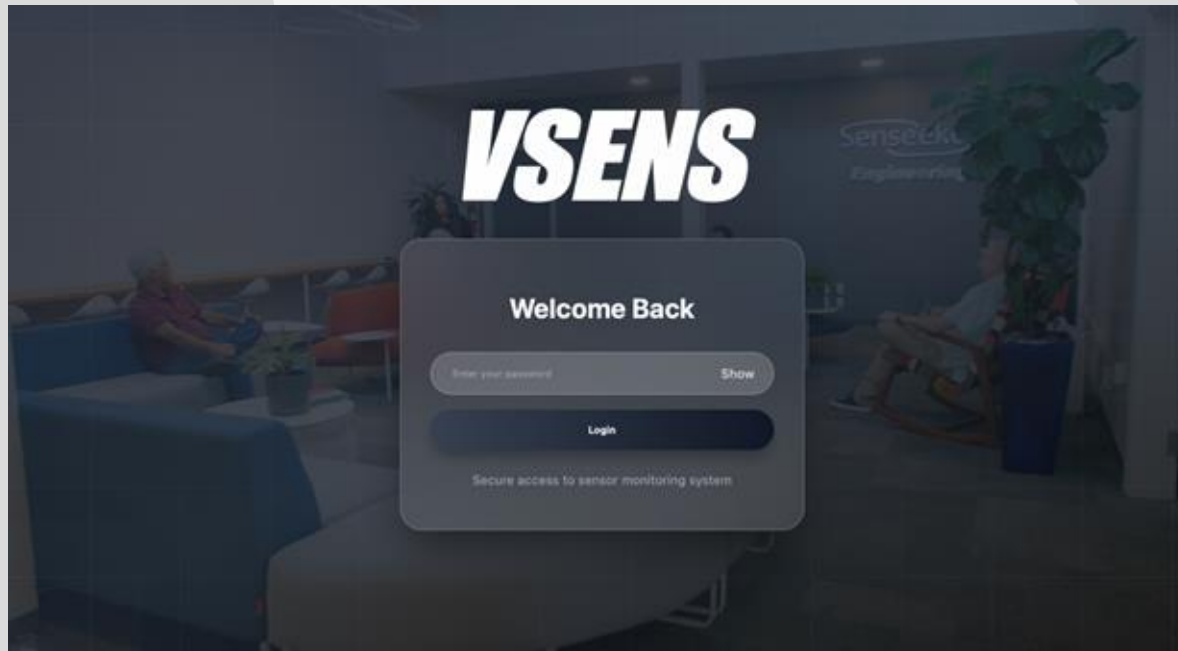


- Dedicated server Raspi to host Node.js backend
- Uses HTTPS POST endpoint for client side
- Uses websocket for frontend communication
- Data is stored on mongoDB for persistence, but also has a small cache for fast lookups
- When it receives a new data entry from a sensor it automatically pushes the new information to all frontend users and updates the database at the same time
- Properly handles renaming and deactivation of any sensor
- Sends out email alerts when temp/vac value is off thresholds





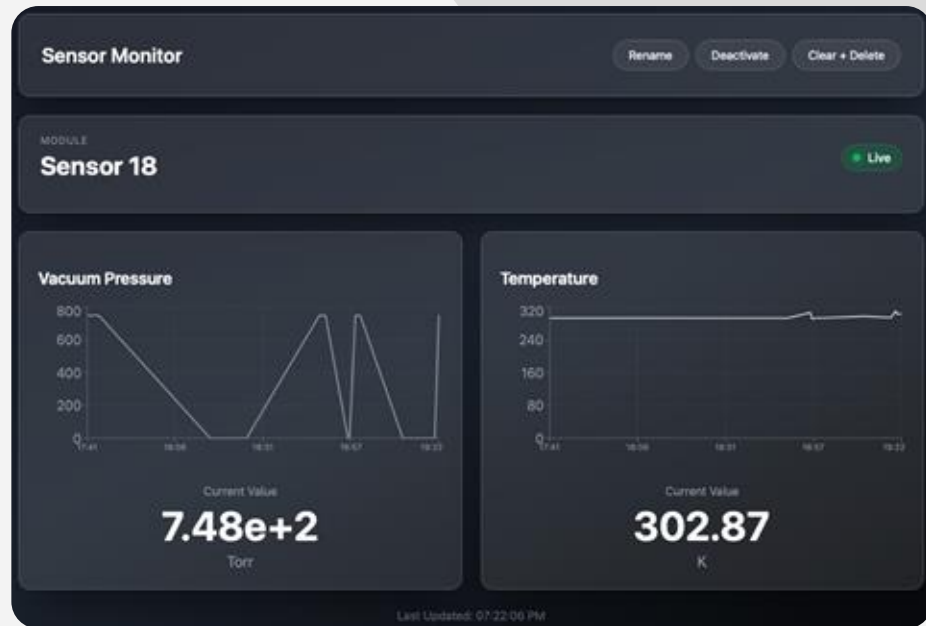
UI & Controls



Password-gated access to prevent unauthorized monitoring/control.



UI & Controls



- Real-time vacuum and temperature charts.
- Current value display for precision monitoring.
- Rename module, Deactivate node, Clear data safely



Email Alerts



[ALERT] Vacuum Pressure exceeded on Sensor 18: 748.0Torr (threshold 0.0Torr)

vsensinfo2026@gmail.com
to me ▾

⚠ VacuumSens Monitoring Alert

Device Sensor 18

Metric Vacuum Pressure

Current Value **748.00 Torr**

Threshold 0.00 Torr

Time (UTC) 2026-05-18T22:32:21.382Z

This email was sent automatically by VacuumSens. Please do not reply.

Settings

- Alerts
- General
- Security

Alerts

Alert Recipients

No emails configured.

Add new email address...

Add

Save Recipients to Server

Alert Thresholds

Hit Enter in a box to save that specific threshold.

Low Battery (%)

Value 7

Vacuum (Torr)

Min 3e-5

Max 7e-5

Temperature (K)

Min 90

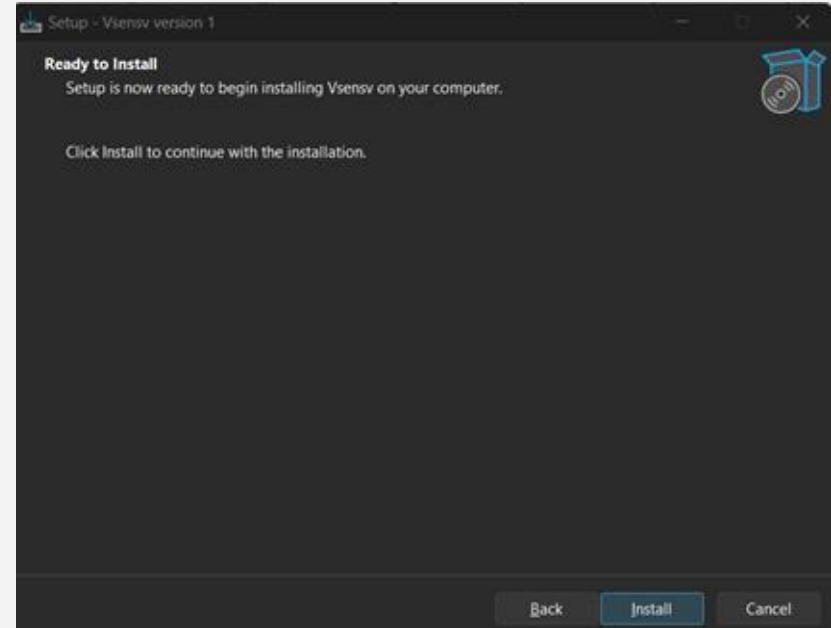
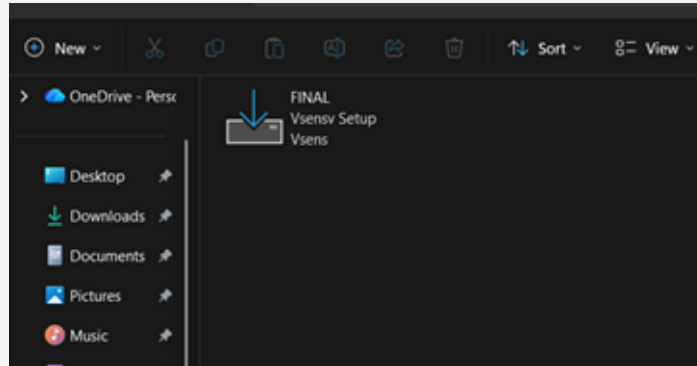
Max 170

Enable Email Alerts

Server Packaging



- Download the package
- Run it
Installer or npm startServer
- UI is live
Local URL: localhost:PORT
Network URL: 192.168.x.x:PORT
- Done — server ready



Client Initial Setup



Step 1: Install server using windows installer on a local computer on the network.

(or use Raspberry Pi with npm)

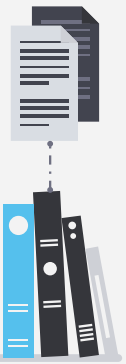
Step 2: Flash SD card of client Raspberry Pi following standard process to install our custom image

Step 3: Connect to Raspi wifi and setup local wifi information

Step 4: Assemble Client Module and install batteries

Step 5: Plug into D-SUB connector and ribbon cable for temperature controller to

the dewar.



Client Automatic Startup



Power on

Connect via USB-C
Client boots up

Auto-discover

Scans local network
Finds active VSENS server

Connected

Appears as Sensor [XX]
Rename anytime in the UI

No configuration needed - the client finds and connects to the server automatically every time



Thank you so much for your time!

Questions?

Acknowledgements



Dr. Yogananda Isukapalli
Lucas Liang



Kenton Veeder
Nishant Dhawan
Alex Russell
Greg Pierce
Ritesh Bhatt



Demo Video



Currently Presenting
- Abdullah