VITALS

Team TETHER

Medical Diagnostic System with Machine Learning and Artificial Intelligence (from a non-medical person's perspective)

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Visit the website

Problem statement

When the doctor is 20 minutes away, the crew still needs an answer now.

4 to 40 minutes

each way, with blackouts of up to two weeks

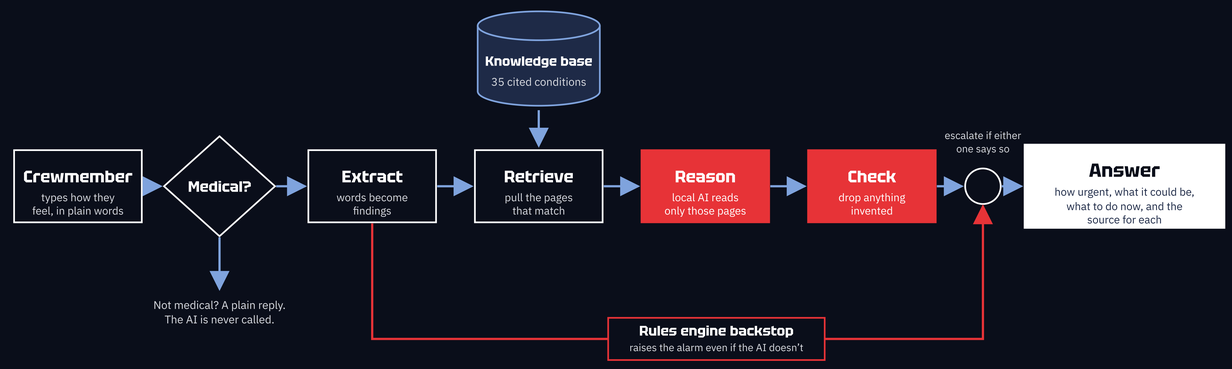
Earth — Mars

Long missions will usually fly with **no physician on board**. When someone gets sick or hurt, a non-medical crewmember has to answer three questions, offline and fast.

What could this be? **How serious is it?** **What do we do now?**

Functional diagram

How VITALS answers



Mission log: every step writes a line with the time, subsystem, element and status.

We drew three options. **Rules only** explains itself but can't hold a conversation. **AI only** talks well but invents conditions and citations. **Grounded AI with a rules backstop**, above, does both, so we chose it.

Research 1

There is no flight data to train on

NASA's own risk models call in-flight medical data severely limited. For some serious conditions the count is zero. So VITALS grounds a local AI in **cited NASA research** instead of training one.

Condition	What changes in space
Fluid shift	Stuffy nose on day 1 is not a cold
Motion sickness	Only early in flight; day 60 means something else
Decompression	Joint pain after a spacewalk outranks a strain
Kidney stone	Bone loss and dehydration raise the risk
Neck vein clot	Found on the ISS in crew with no symptoms

35 conditions and 145 findings, every rule cited.

Constraints and requirements

- **C1** Works with **no internet** at all
- **C2** Used by a **non-medical** crewmember under stress
- **C3** Runs on a **Jetson Orin Nano**, 8 GB
- **C4** Almost no in-flight medical data exists
- **C5** Health data stays private
- **C6** Small screen, gloves, bad lighting

Met: plain-word input, no invented conditions, a source for every answer, a **Wrong?** button, PIN login, emergency button. **Close:** escalates 18 of 19 must-escalate cases. **Weakest:** saying "nothing fits."

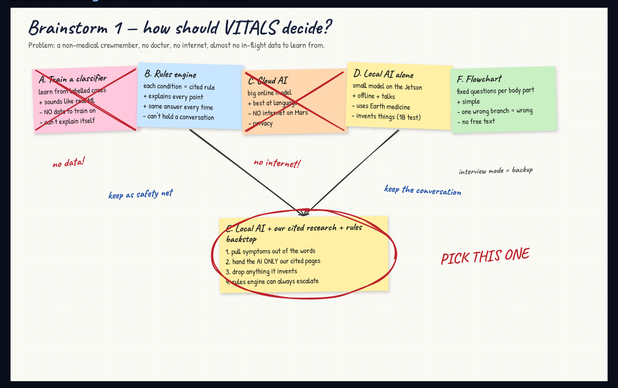
Research 2

We measured the models

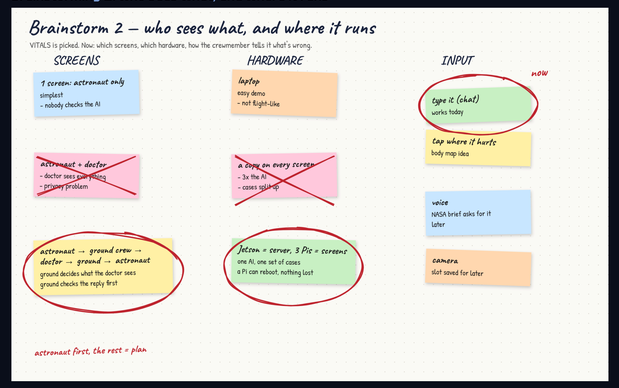
Model	Right condition	Missed alarms	Time
Llama 3.2, 3B	**73%**	**0**	**4 s**
Llama 3.1, 8B	85%	0	8 s
Llama 3.2, 1B	Invented a symptom	Backstop only	80 s

Tested on 33 prompts in September. The rules backstop cut missed alarms from 3 to 0.

Brainstorming 1: how should it decide?



Brainstorming 2: who sees what, and where it runs

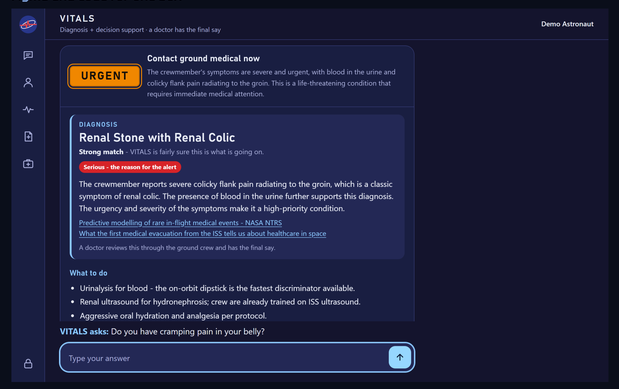


Decision matrix

What matters	Weight	Classifier	Rules	AI only	Grounded
Works offline	5	5	5	5	5
Never misses an alarm	5	2	4	2	5
Shows its sources	4	1	5	2	5
Understands real speech	4	3	2	5	4
Works with the data that exists	4	1	4	4	4
Runs on the Jetson	3	5	5	3	3
Testable and repeatable	3	3	5	2	5
Buildable this year	2	2	4	5	3
Total out of 150		**83**	**127**	**104**	**132**

Same method picked the model (Llama 3.2 3B) and the hardware (one Jetson server, three Raspberry Pi screens).

Figma and code for one box



server.py, run_pipeline() runs the boxes in order:
classify(), then KeywordExtractor().extract(), then retrieve(), then ask(), which reasons, checks the reply and runs the rules backstop.

Cruz's Figma is the plan; the working astronaut screen follows it. The command line runs the same function, so what we test is what the screen does.

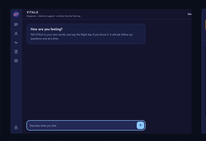
Storyboard

It comes in waves

Commander Rivera, day 63 of a Mars transit. The ground is 18 minutes away.



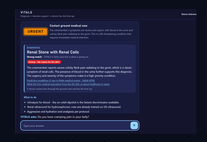
1 Enters her PIN



2 "Pain in my side, comes in waves, blood when I pee"



3 Urgent: kidney stone, with the NASA source



4 Taps Wrong? on a misread; the answer updates



5 Planned: ground crew hides her name, sends it on



6 Planned: the doctor agrees and adds a note

Missions and logs

6 of 6 basic missions pass

18 of 19 must-escalate cases caught by the real AI

262 automated tests pass

Time (UTC)	Subsystem	Element	Status
22:33:50	Knowledge base	kb/	Pass
22:33:50	Sensors	sensors.py	Not connected
22:33:50	Scope	"hi"	Pass
22:33:50	Engine	29 cases	Pass
22:33:50	Cases	owner check	Pass

The one miss: elbow pain after a spacewalk, which should be decompression sickness. Fix in progress.

Preliminary test plan

Test	Passes when	Now
Missed alarms	zero, always	1
Unit tests	all pass	262
60 real-speech prompts	80% right	73–85%
Network unplugged	still answers	Yes
5 people try it	urgency read in 3 s	Nov
On the Jetson	15 s an answer	Nov

Next steps and schedule

About 62% built — the bar marks 60%

November	Run it on the Jetson; teach it to say "nothing fits"
Dec to Feb	Ground crew and doctor screens, first sensor, user testing
March	CDR at 90%, with voice input
May 4–6	FDR at Johnson Space Center

VITALS is a student prototype for decision support. A doctor has the final say. Not a medical device.