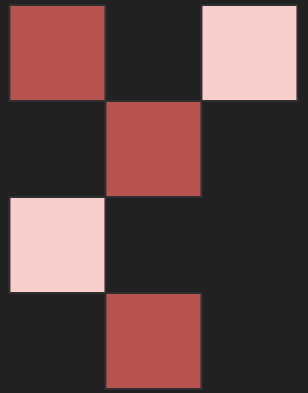
FIREPATCH



ECE 598-07: Fire Detection Project

Colin R., Thomas D., Shriya S., & Velu M.

FIREPATCH / problem overview

Fires are growing, more **frequent** and more **dangerous**. Communication is limited, visible is zero, and hazards are everywhere

- In 2024, 61,000 wildfires burned across the US [1]
- Destroying 8.8 million acres (+26% the 20 year avg) [1]

Current firefighting jackets provide **thermal** and **liquid** protection can be improved to provide **critical location**, **surface temperature**, and **SOS** capabilities.

FirePatch addresses these **issues** and more



Malibu Beach Fire LA Jan 9th 2025

1. Assessing the U.S. Climate in 2024, NOAA

FIREPATCH / solution

A Temperature Aware Continuity Safety Patches

FEATURES:

> Quick Snap Away SOS signaling
> Temperature monitoring
> Remote Monitoring
> GPS Tracking



FIREPATCH / system overview

Network of Patches Maximize Safety

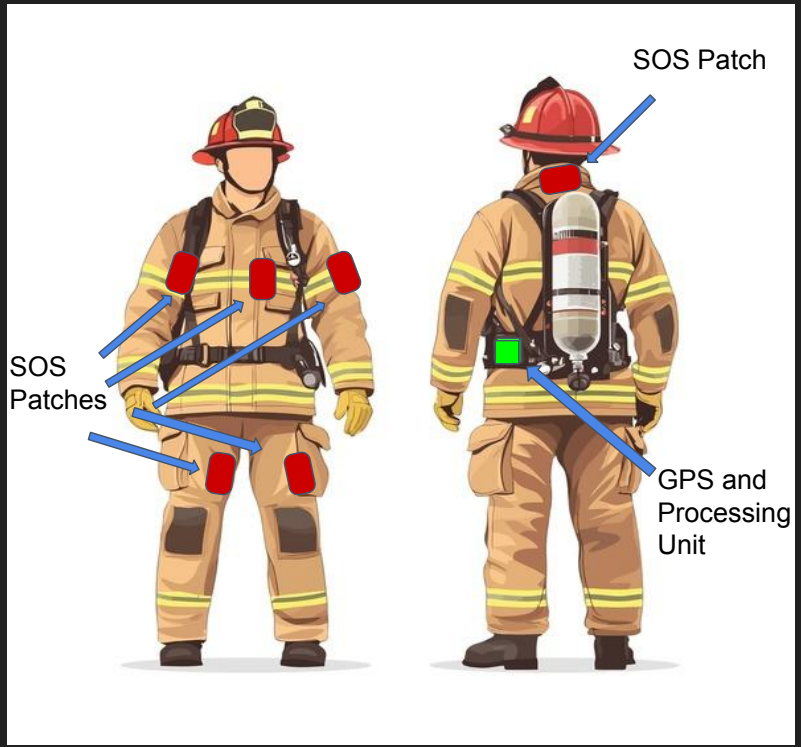
FEATURES:

> Six patches across body

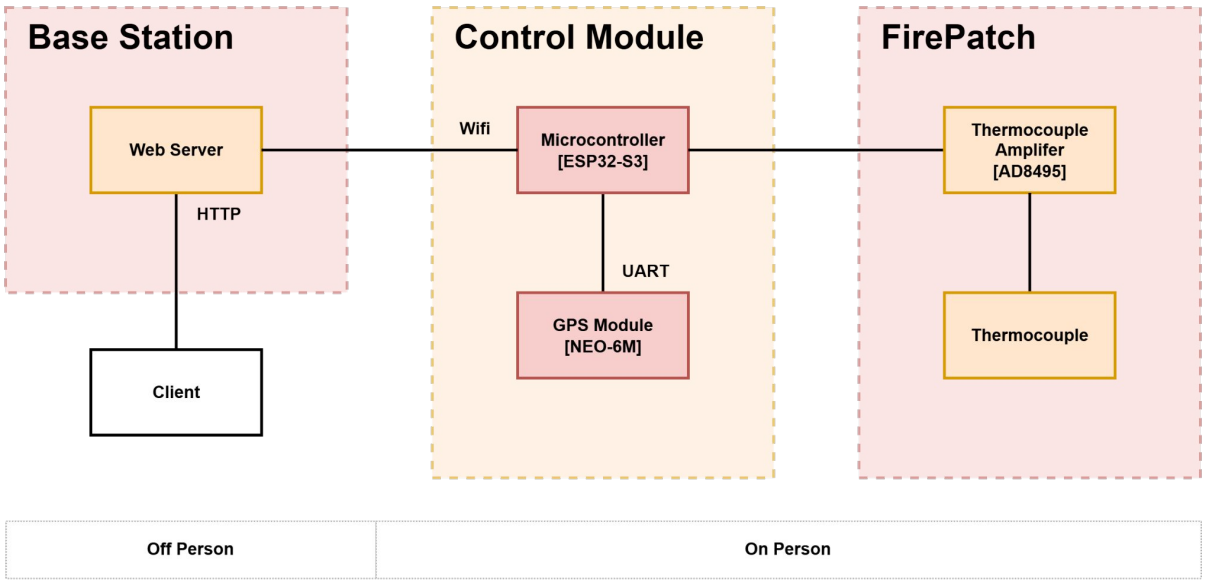
> Patches share common processing and power source

> Cheap unit cost - easily replaceable

> Can be activated by individual or third party



FIREPATCH / technical overview



FIREPATCH / assembly



Thermocouple Circuitry

> K-Type Thermocouple through small external hole

> AD8495 Analog Output K-Type Thermocouple Amplifier in patch boosts voltage for better signal processing

FIREPATCH / assembly



Patch Internal Circuitry

> 28 gauge PVC insulated copper wire

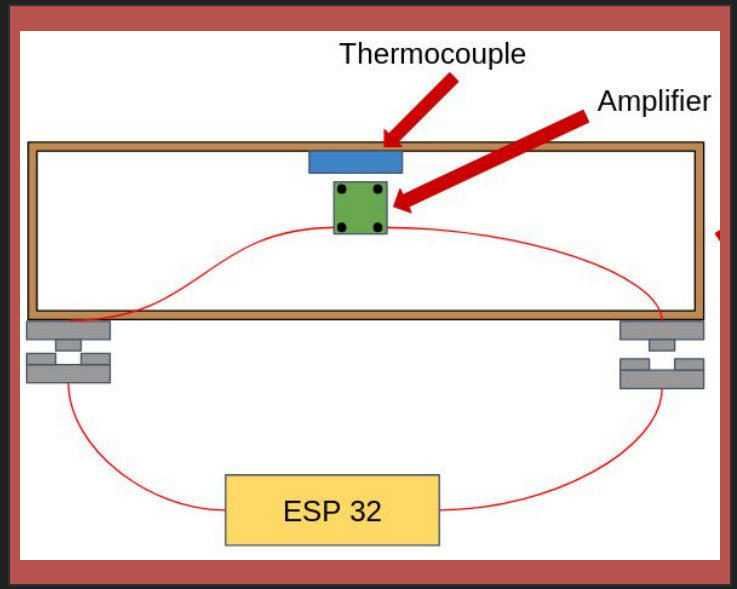
> Wire soldered to stainless steel snaps

> Snap is connection between patch and jacket

> Both continuity and thermocouple signal

> Using snaps in retains signal fidelity

FIREPATCH / SOS Functionality



> Metal snaps function as continuity loop breakpoints

> Four wires out of amplifier

> Two Ground

> 1 Vout

> 1 Vsupply

> One wire to each snap, any button disconnected immediately triggers SOS

> Each Vout corresponds to a different body part

FIREPATCH / assembly









Assembling

> Soldered Snaps

> > Riveted stainless steel connection

> Insulated pouch from welding blanket sewn

> > Rated to 900°C

> Internal Jacket Wiring

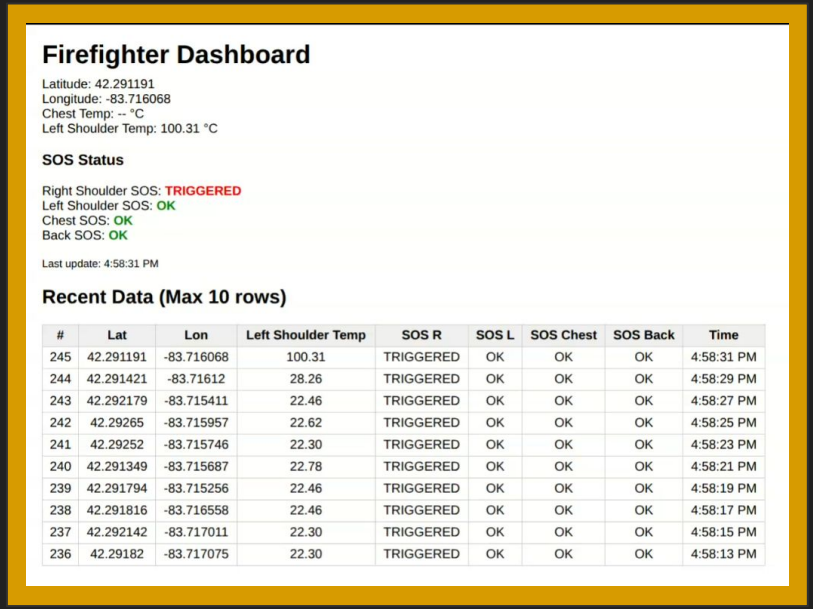
> > Internal soldering combined with stitching

FIREPATCH / operation

> Once the firepatch system is turned on it automatically connects to its local ad hoc wifi network, were temperature, sos, and positional data of the system is sent.

> When an SOS patch is removed it's marked triggered in the Dashboard

> Tempreture information and gps data is continuously updated during operation



Firefighter Dashboard

Latitude: 42.291191
Longitude: -83.716068
Chest Temp: -- °C
Left Shoulder Temp: 100.31 °C

SOS Status

Right Shoulder SOS: TRIGGERED
Left Shoulder SOS: OK
Chest SOS: OK
Back SOS: OK

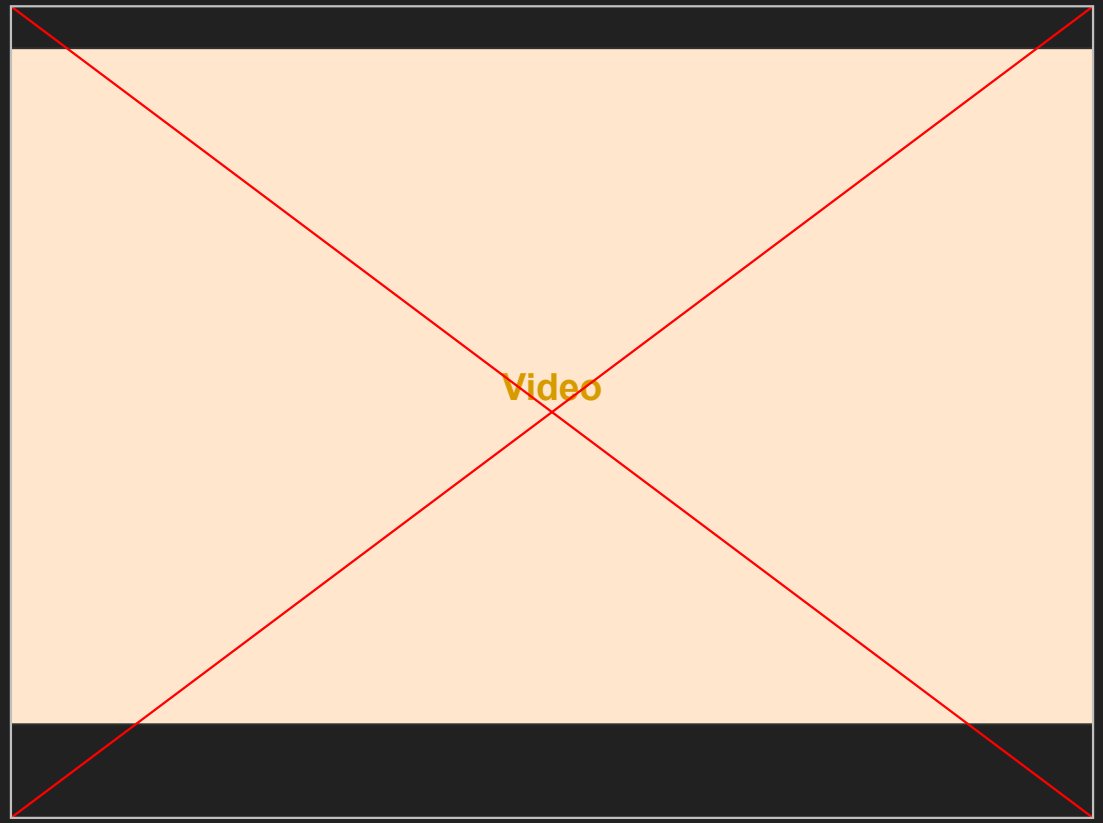
Last update: 4:58:31 PM

Recent Data (Max 10 rows)

#	Lat	Lon	Left Shoulder Temp	SOS R	SOS L	SOS Chest	SOS Back	Time
245	42.291191	-83.716068	100.31	TRIGGERED	OK	OK	OK	4:58:31 PM
244	42.291421	-83.71612	28.26	TRIGGERED	OK	OK	OK	4:58:29 PM
243	42.292179	-83.715411	22.46	TRIGGERED	OK	OK	OK	4:58:27 PM
242	42.29265	-83.715957	22.62	TRIGGERED	OK	OK	OK	4:58:25 PM
241	42.29252	-83.715746	22.30	TRIGGERED	OK	OK	OK	4:58:23 PM
240	42.291349	-83.715687	22.78	TRIGGERED	OK	OK	OK	4:58:21 PM
239	42.291794	-83.715256	22.46	TRIGGERED	OK	OK	OK	4:58:19 PM
238	42.291816	-83.716558	22.46	TRIGGERED	OK	OK	OK	4:58:17 PM
237	42.292142	-83.717011	22.30	TRIGGERED	OK	OK	OK	4:58:15 PM
236	42.29182	-83.717075	22.30	TRIGGERED	OK	OK	OK	4:58:13 PM

Prototype Dashboard

FIREPATCH / demo video

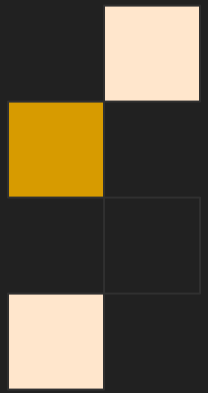


FIREPATCH / goals & results

Goals, Improving firefighter Safety through
> Separated temp sensing and SOS capability

> GPS communication if SOS activated

> Temp sensing up to 500°C



Achieved Results
> Continuity looped patches have redundant loops

> Patches integrate both temperature and SOS, increasing functionality

>Constant GPS communication

> Temp sensing up to 650°C

> Base station and GUI created

> Signal connection thru snaps

FIREPATCH / prototype limitations

Limitations and Areas of Improvement

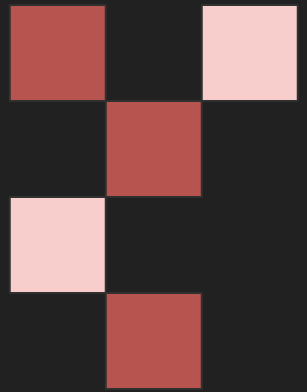
> Cheap GPS module

> Jacket lacks fire and moisture resistance

> Thermocouple Amp is not rated for high temperature

> High Resistance of Snaps

> ESP32 provides a low reference voltage reducing maximum readable temperature



FIREPATCH / future ideas & improvements

Simple Improvements

> Brass Snaps

> Custom PCB

> Stitched wiring

> Conformal Coating for water infiltration

> Improved Dashboard

Complex Improvements

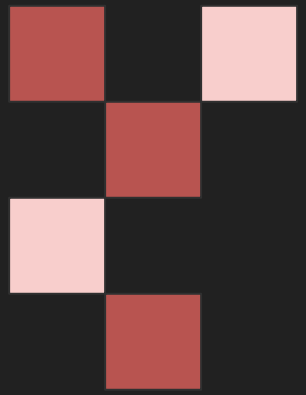
> Wideband localization, to allow better indoor tracking

> Visual feedback system for firefighters

> Further redundancy (duplicate ICs etc.)

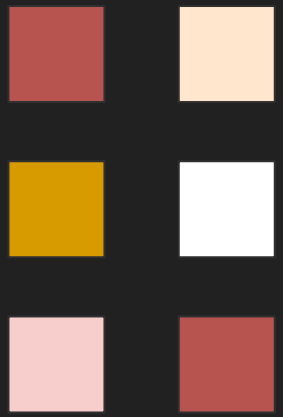
FIREPATCH / questions?

Thank you for listening!



THEME COLORS

WHITE / white
DARK RED / dark red
LIGHT RED / light red
DARK YELLOW / dark yellow
LIGHT YELLOW / light yellow



OUTLINE

Prob Overview
Solution
Sys Overview
Assembly [2-3?]
Operation [2-3?]
    Sub Systems
Demo Video
Questions