How did this project start?

Me: Find some way to help people.

(later)

The teacher: Ok everyone I have posted all the assignments on schoology, please plan your time accordingly
Me: Why no lessons?
Me: This is literally like doing research for a science fair project
Me: Wait.

Schedule

Timetable

Task	Date
Start disaster recovery project	09/03/25
Robotics meeting (FTC/FRC/VEX)	09/17/25
VEX meeting (new recruits)	09/23/25
Science fair meeting	10/06/25
Test and research arduino sensors	10/13/25
Start building	10/20/25
Sensors detecting sensors?	10/25/25
Science fair meeting/ set up project on CYSF	11/03/25
Finish ethics	11/09/25
Finish deciding on components	11/12/25
Find someone to supervise testing of robot + significant risk form	11/16/25
Order components	11/23/25
VEX competition(?) + Lock in for finals	01/09/26

English Part A	01/16/26
Math	01/20/26
English Part B	01/21/26
Have online project done	02/02/26
Online project due	03/04/26
Project setup	04/09/26
Judging	04/10/26
Awards	04/11/26

Contact Information

Science fair coordinator: k.okeefe@stemia.ca
Mechatronics: s.padhya@stemia.ca

Background Research

09/03/25

What causes fires?

- Fuel
- Oxygen
- Heat

Taking away one of these will extinguish the fire

Forests have large amounts of oxygen (that one's obvious…?) and fuel (grass, trees, dead leaves, roots, moss, fallen branches, etc).

Sensing + new technology for sensing

- Lookout towers
- Aerial surveillance
- Ground patrols
- IR to help detect wildfires that can't be seen (smouldering areas)

- Satellites
- Remote sensing and machine learning
- Gas sensors and IoT
- Pano AI

- Sensors in forests that measure temp, humidity, smoke, etc
- Recognizing which areas are more prone to wildfires
- Recognizing pyrocumulonimbus clouds

Thoughts: Should I get rid of this??? Ms. O'keefe was thinking I was doing a research project instead of an experiment until halfway through the presentation :')

Other issues

- Zombie fires: fires that burn underground in winter and return in spring- caused by fires that burn for long periods of time

Problem

11/01/25

Forest fires are easy to detect when very large, but by that time, they are very difficult to put out. So, how can they be detected early on in order for firefighters to extinguish them?

Current technology and limitations

- Easier to extinguish when small
- Difficult to detect until they have significantly spread
- Crown fire = bad

Lookout towers

- Unfortunately humans do not have night vision
- Fire will be very large before spotted
- Limited vision range

Aerial surveillance

- Fires must be very large to be detected
- Can scan large areas though

AI in cameras

- Night vision!!
- Still, fires must be large (they have thermal sensors though)
- Potential false alarms

Sensors

What sensors could be useful to detect fire?

10/13/25

Fires make environments hot, dry, and polluted.

Temperature and humidity sensor- Can be used to detect heat and humidity changes
Gas sensor- can be used to detect smoke, carbon dioxide, etc
Ultrasonic sensor- detects distance from an object
Flame sensor- can be used to detect a flame
Traffic light (not really a sensor, but…ok)- can be used to display if fire is within range with 3 lights (red, yellow, green)

My teacher says that we are not allowed to use buzzers, because the class (that consists mostly of questionably well behaved teenage boys) will turn the classroom into a construction zone. :(

That said, would sound or light be better?

Sensor testing

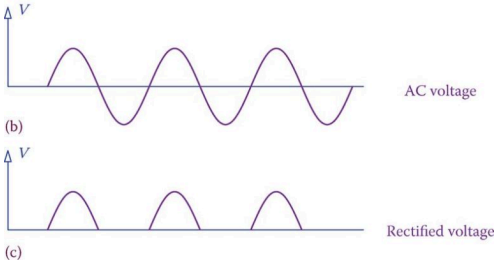
10/20/25

I have no idea how, but the temperature and humidity sensors have no power going to them. Not only that, but they're MELTED???

The ultrasonic sensor seems to be broken…

```
Distance: 0 cm
Distance: 23471 cm
Distance: 0 cm
Distance: 1059 cm
Distance: 0 cm
Distance: 1066 cm
Distance: 0 cm
Distance: 23472 cm
Distance: 0 cm
Distance: 4777 cm
Distance: 0 cm
```

(I am not outside. I am in the classroom where the ceiling probably isn't even 3 meters high.) Why's it alternating between very high numbers and zero?? Is it only reading half the voltage???



??????????

10/23/25

My group has decided to use a temperature sensor and a gas sensor with a 3 watt LED, but I don't know how to make the light turn on when the gas or temperature is too high.

10/27/25
"The classroom is going up in flames/freezing!!!"

These pictures were taken three seconds apart from each other

My teacher told me to reset the code by pressing the button on the arduino but it's still not fixing the problem.

10/28/25
So values are read from the voltage and adding a 3W LED appears to throw the entire system off. I swapped it to the other side of the breadboard but I don't think it's fixing the problem.

10/31/25
The print finally worked and we almost got everything set up. The code however stopped working. I did not change it from last time.

Search: arduino showing random characters please help
It's called a garbled lcd and apparently it's a bad pinout…I didn't change the pins!!!!!

Update as of 10 minutes later: it works again

???

Arduino sensors are terrible so I am staying as far away from them as possible

11/05/25

C++ takes way too long to learn and I will not be proficient in it by the science fair so I have decided to build a sensing station instead

Materials

Item	Cost (CAD)
Arduino MEGA	$27.60
USB Cable	$5.90
DHT 11 Module	$6.65
LCD 16x2	$13.29
RGB LED	$10.99/100pcs

Wires	$10.89/120pcs
Total	$75.32

Update: The sensors from class are the only sensors I can find. I think the best option is to try them first and then find new sensors just in case its a melted sensor problem and not a manufacturing problem

11/15/25

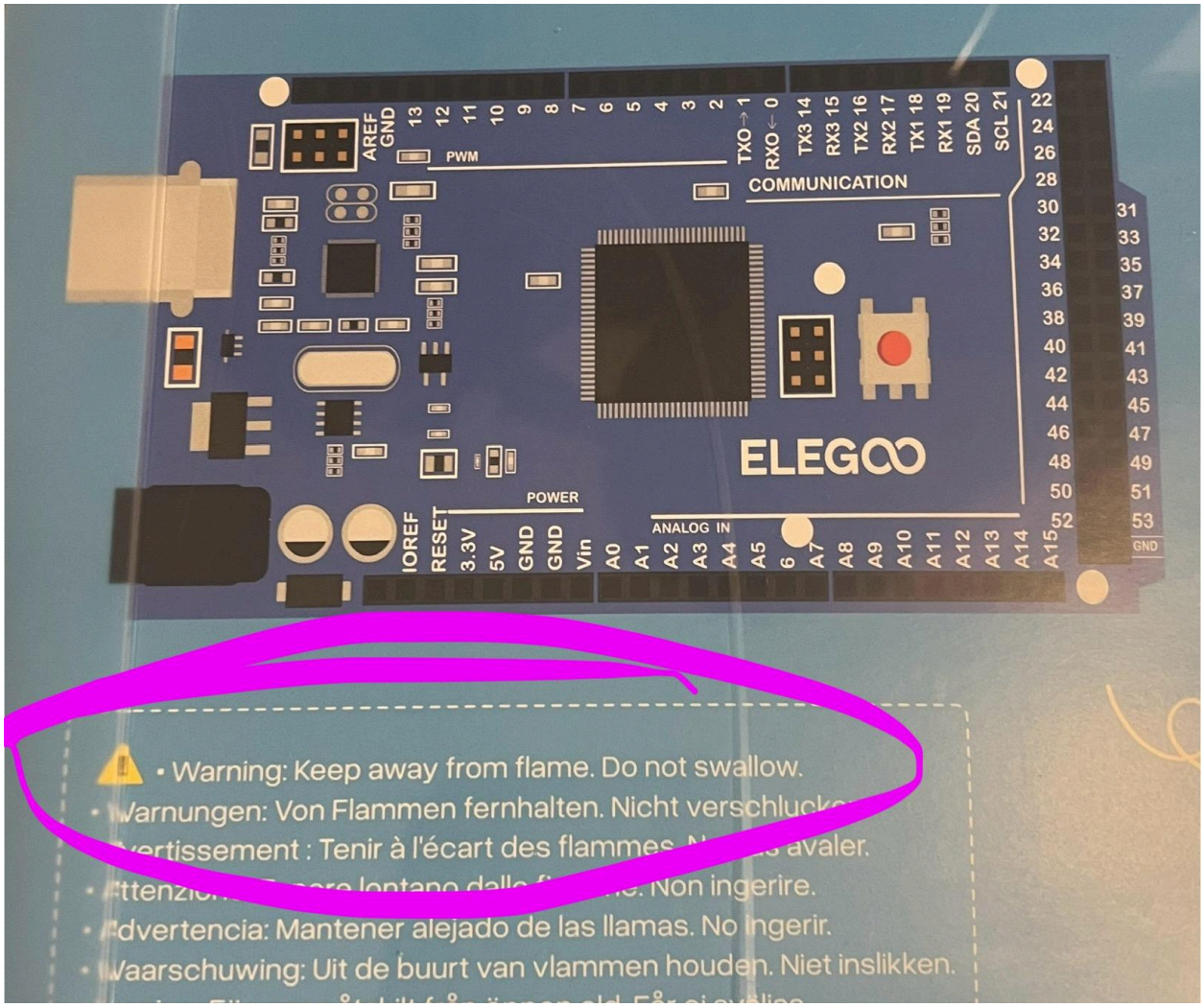
Update 2: The Arduino MEGA kit has just arrived

ELEGOO Arduino MEGA Starter Kit	$88.99

Sensing Station

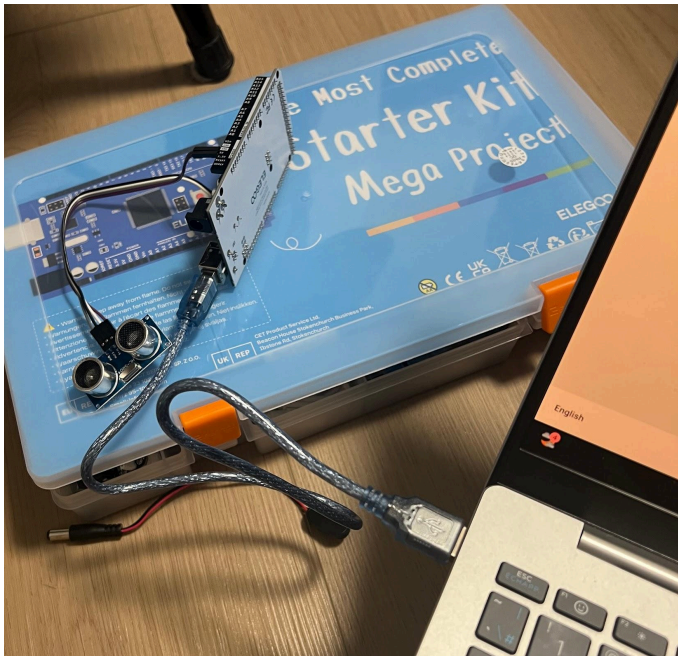
11/15/25

Well, that explains a few things:



We've been holding them near flames this entire time. So, maybe the problem this whole time wasn't the sensors

11/24/25



Since the kit does not come with the temperature or gas sensors that we have used in class, I am testing another one of the sensors that has not been working very well. This is the ultrasonic sensor that can detect distance.

The one in class:

```
Distance: 0 cm
Distance: 23471 cm
Distance: 0 cm
Distance: 1059 cm
Distance: 0 cm
Distance: 1066 cm
Distance: 0 cm
Distance: 23472 cm
Distance: 0 cm
Distance: 4777 cm
Distance: 0 cm
```

The problem with this is that

1. Its not supposed to be near fire
2. It only knows how far away SOMETHING is, not what specifically it is

What to do now?

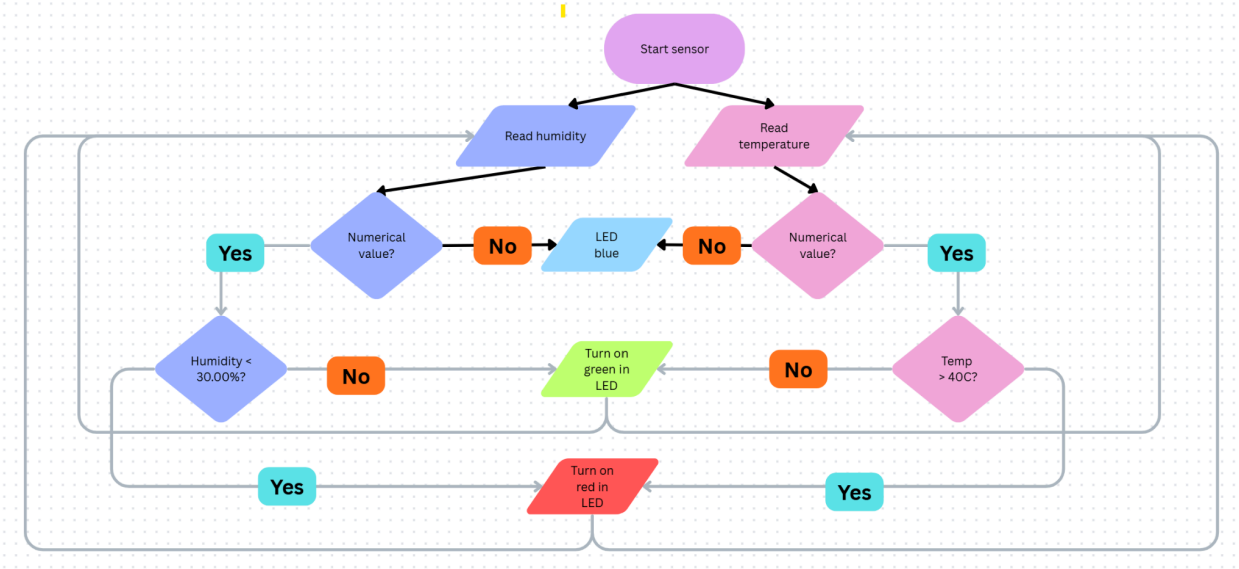
The bad news: These sensors will get completely fried not even in but near flames
The good news: I can use that to my advantage!!!

From my experience testing them during class, the melted sensors do not read anything. But the arduino can output a signal that indicates a need for either maintenance or firefighters

Code

```
#include <DHT.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(22, 2, 4, 5, 6, 7); // Parameters: (rs, enable, d4, d5, d6, d7)


#define DHTPIN 20     // DHT sensor reads from pin 20
#define DHTTYPE DHT11 // Using a DHT11 sensor


DHT dht(DHTPIN, DHTTYPE); // Initialize DHT sensor

void setup() {
  Serial.begin(9600); // Start serial communication
  lcd.begin(16,2); //Start LCD
  dht.begin();        // Start DHT sensor

}

void loop() {
  delay(100); // Wait 0.1 seconds


  float h = dht.readHumidity();// Read humidity
  float t = dht.readTemperature();// Read temperature as Celsius

  // Check if any reads failed
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    analogWrite(13,10); //Make the light blue
    analogWrite(10, 0);
```

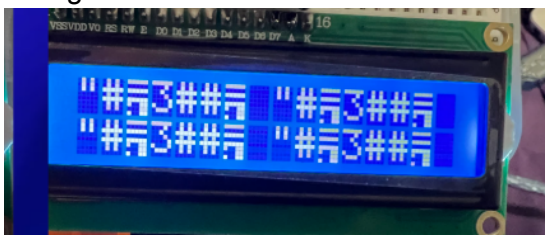
```
    analogWrite(12,0);
  }
   if (!isnan(h) && !isnan(t))/*if both are numbers */{
    analogWrite(13,0);//Turn the blue LED off
  }
 // LED pinout: Red- 10, Green- 12, Blue- 13
  Serial.print("Humidity: ");
  Serial.print(h); // Print humidity on serial monitor
  Serial.print(" %\t"); // \t adds a tab
  Serial.print("Temperature: ");
  Serial.print(t);
  Serial.println("*C");  // Print temperature on serial monitor

  lcd.setCursor(0, 0);
  lcd.print("Temp:");
  lcd.print(t);
  lcd.print(" C "); //Print temperature on the LCD
  lcd.setCursor(0, 1);
  lcd.print("Humid:");
  lcd.print(h);
  lcd.print("%"); // Print humidity on the LCD

  if (t > 40 && h < 30) { //if temperature is greater than 40C and
humidity is less than 30%
    analogWrite(10,10);
    analogWrite(12,0); //Make the light red
    }
    else if (t<40 && h<30 || t>40 && h > 30) { //if temperature is less
than 40C but humidity is less than 30% or temperature over 40C and
humidity greater than 30%
    analogWrite(10,10);
    analogWrite(12,10);//Make the light yellow
    }
    else if (t<40&&h>30) { //if temperature is less than 40C and humidity
is greater than 30%
      analogWrite(12,10);
      analogWrite(10,0);//Make the light green
    }
  }
```



1

Testing + Solving problems

Testing procedure

Test No.	What went wrong	Why and how I fixed it
1	“Failed to read from DHT sensor!”	Wrong pin in code (10 instead of 20), changed to correct pin
2	LCD garble 	I thought it was a data overload and set it to sense slower (once every 2 seconds), but it was actually because pin 1 was malfunctioning so I swapped it to pin 22
3	Nothing went wrong, just added an LED as an indicator for temperature and humidity levels	
4	Colors would stay on and interfere with each other (ex. cyan instead of blue)	Added code to turn all other colors off
5	LED will not turn red	The red got fried somehow (not sure

		how, the green and blue worked fine in the same setup) but I found a replacement
6	Data updating too slowly	Forgot to change the data to upload faster, changed it back to 10x per second
7	LED wouldn't turn red or blue	It got partially unplugged by accident
8	Flashing light makes my eyes hurt	Cover it up

Improvements

1. Only one sensor, many are needed to have a complete system
2. No gas sensor (but like, do I really want to inhale smoke?)
3. Very short detection range
4. Thermal camera
5. Use AI to help
6. Temperatures CAN reach 40C
7. No GPS…where are they supposed to find the fire???
8. No wireless communication either (these wires are *not* surviving the flames)
9. Theoretically not an issue since it would be placed on a tree, but that flashing light on the arduino is giving me a REALLY bad headache

So, simply put: I've got a long way to go before this can be used

Acknowledgements

Ms. O'Keefe- organizing science fair
Mech25 teachers- being the reason this idea started + providing starting materials

What I've learned (even when it feels like I haven't)

Reviewing my project and the guidelines one last time before it can no longer be edited

My previous science fair ideas be like:

- Most effective solution to procrastination
- How to become immune to mosquito bites
- How to make sure students follow lab safety procedures

- ACTUAL project from last year: effectiveness of Alberta's phone policy (unfortunately I do know what I was thinking: that I would find out it's not effective and would convince people to change it. I think what I actually did was just make all my teachers strongly dislike me due to the surveys)

My goal back then was to help people. My interests have changed, but I haven't. I wanted to help people then, and I want to help people now.

It doesn't feel like it, but I have learned a lot. Just last September I had no idea how an Arduino worked, how any of the sensors worked, how to code, or most of the information about forest fire detection.

I still distinctly remember figuring out that the sensors didn't need to detect each other (I think it's still written in the schedule??) and that they could rely on the data and managed to use "if" and "else if." It worked (surprisingly) and I have never felt better. A certain individual said it wasn't an accomplishment, but rule #1 is that the full time programmer will always think you are not cool, so their opinion is always not important :)

For improvement, I see a long journey ahead. One day, a project like this will be easy and I won't need to spend most of it trying to figure out why something isn't working. (Although I hear code is like 5% working and 95% fixing errors…I can definitely attest to that :( )

"I still have no idea how to code." - my teammate.

Now, time for the hardest part: to believe in myself :')

Citations

Works Cited

CDC. (2024). NIOSH Science Bulletin. In *NIOSH Science Bulletin*.

https://blogs.cdc.gov/niosh-science-blog/2024/04/29/wildland-ff-webinar

How Are Wildfires Detected: Understanding the Techniques and Technologies. (n.d.). In

Battlbox.com.

https://www.battlbox.com/blogs/outdoors/how-are-wildfires-detected-understanding-the-techniques-and-technologies

How tiny sensors in the forest are shaping the future of firefighting - National. (n.d.). In *Globalnews.ca*. https://globalnews.ca/news/9812366/forest-fire-sensors-ai

Igini, M. (2023). What Causes Wildfires? In *Earth.Org*. https://earth.org/what-causes-wildfires

Natural Resources Canada. (2011). Fire behaviour. In *natural-resources.canada.ca*. https://natural-resources.canada.ca/forest-forestry/wildland-fires/fire-behaviour

Why do my temperature sensor values become inconsistent when additional hardware is added to the board? (n.d.). In *Arduino Stack Exchange*. https://arduino.stackexchange.com/questions/28574/why-do-my-temperature-sensor-values-become-inconsistent-when-additional-hardware

Wildfires 101: How NASA Studies Fires in a Changing World - NASA Science. (2023). https://science.nasa.gov/earth/wildfires-101-how-nasa-studies-fires-in-a-changing-world

Works Cited

Dejan. (2022). Arduino 16x2 LCD Tutorial - Everything You Need to Know. In *How To Mechatronics*. https://howtomechatronics.com/tutorials/arduino/lcd-tutorial

DHT11–Temperature and Humidity Sensor. (n.d.). In *Components101*. https://components101.com/sensors/dht11-temperature-sensor

DRYAD Networks. (2023). Uses of Wireless Sensors for Wildlife Monitoring. In *Dryad*. https://www.dryad.net/post/different-uses-of-wireless-sensors-for-wildfire-monitoring

Electronic Noses Sniff Out Diseases, WildFires, and Pestered Plants - News. (n.d.). In *www.allaboutcircuits.com*. https://www.allaboutcircuits.com/news/electronic-noses-sniff-out-diseases-wildfires-and-pestered-plants

Fire weather index legend - Open Government. (n.d.). In *open.alberta.ca*. https://open.alberta.ca/publications/fire-weather-index-legend

Forest Fire Sensors: How They Work, Types, and Their Importance in Early Detection - SenseNet Inc. (2025). https://sensenet.ai/forest-fire-sensors

Gupta, V. (2023). Forest Fire Detection using Sensor Network and IoT. In *PsiBorg Technologies Pvt. Ltd.* https://psiborg.in/forest-fire-detection-using-sensor-network-and-iot/#elementor-toc__heading-anchor-3

Natural Resources Canada. (n.d.). Canadian Wildland Fire Information System. In *Canadian National Fire Database (CNFDB)*. From https://cwfis.cfs.nrcan.gc.ca/ha/nfdb

Project. (2025). In *TinkerBlock ESP32*. https://tinkerblock.io/04-project-dht-temperature-humidity-sensor-with-lcd-display

Samborska, V., & Ritchie, H. (2024). Wildfires. In *Our World in Data*. https://ourworldindata.org/wildfires

Silvanet Wildfire Sensor. (n.d.). In *Dryad Networks*. https://www.dryad.net/wildfiresensor

Understanding forest fuels. (2022). In *BC Wildfire Service*.

https://blog.gov.bc.ca/bcwildfire/understanding-forest-fuels

Understanding isnan() in Arduino. (2025). In *TinkerBlock ESP32*.

https://tinkerblock.io/isnan

Wildfire Recovery for Communities: How to Rebuild and Cope. (2023). In *WFCA*.

https://wfca.com/wildfire-articles/wildfire-recovery-for-communities

(N.d.-a). In anglican.ca.

https://www.anglican.ca/wp-content/uploads/Wildfire-aftermath-FB.jpg

Notes to self + cysf links

GIVING UP IS NOT AN OPTION!!!

https://www.cysf.org/wp-content/uploads/logbooks.pdf
https://www.cysf.org/wp-content/uploads/Division-Topic-Descriptions.pdf
https://www.cysf.org/frequently-asked-questions-project/
https://www.cysf.org/wp-content/uploads/CYSF-Secondary-Rubrick.pdf
https://www.cysf.org/wp-content/uploads/tally_s.pdf
Judge questions
https://www.youtube.com/@ScienceFairInfo/videos