

I. **Abstract**

Our vision for the future is that firefighters can put out fires without risking their lives. The technology included in our solution are drones, swarm intelligence, and cutting edge impermeable nonflammable graphene nano-fabric to smother fires. The fires in California this year burnt over 4 million acres, the most ever burnt in recorded history, and on the west coast 4.1 million acres were burnt with nearly 21,000 fires.

## **II. Description**

### **1. Present Technology**

Present Technology exists for preventing, monitoring, and putting out fires. We will describe each of the present technologies in the area along with the current limitations.

Satellites.

Satellites are used to fight wildfires because the new generation of satellites is equipped with the ability to see in infrared (A heat sensor that can detect heat signatures). This helps fight forest fires because fire experts and meteorologists can see temperatures and because of that better understand the flames, smoke, and hot spots (a hot spot is a place where a fire could easily start or is burning higher than normal) below the satellite.

Drawback: Some drawbacks with satellites are that they are very expensive to buy, and maintain. That they are also prone to interference.

Robots.

Firefighters use robots because sometimes wildfires get so hot that firefighters can't get close enough to put them out. But engineers have figured out a way to put them out anyway. Some engineers from Howe and Howe in Maine created a robot named Thermite. Thermite can withstand the temperatures of the fires so it can put them out.

Drawbacks: The key drawbacks to robots are that they can put humans out of their jobs. That they are restricted to their programming and perform only relatively easy tasks. And that they require experts to set them up.

Drones.

Drones are a very useful way to fight fires. They can be equipped with thermal imaging cameras, and they can fit into spaces way manned aircraft cannot. Drones used to fight fires are primarily used for mapping the terrain and hot spot detection. Drones can make maps overnight which are very helpful for rescue teams.

Drawbacks: A couple drawbacks to drones are that you usually need some training to fly them. That there are many wireless issues that can occur. Also, they are vulnerable to hackers.

The Internet Of Things.

Internet Of Things sensors are also being used to gather information from hard to get to areas that are possible hot spots. The sensors can also be used to detect high amounts of CO<sub>2</sub> in the air as well as check for abnormally high temperatures which could mean fires are in the vicinity. These sensors also use very little power.

Drawbacks: Drawbacks to the internet of things are that it can cause an over reliance on technology. If it is a complex system there are several opportunities for failure, and the system is vulnerable to hackers.

Virtual Reality.

Virtual Reality is being used to combat wildfires by training smokejumpers (firefighters who parachute into remote areas to fight and put out fires) in a safe place. This is being used by the

Red Cross to the United Nations to combat wildfires. The trainers can also change the wind speed and direction in the VR in order to simulate real conditions.

Drawback: Some drawbacks to VR are that the headsets are quite expensive. VR can also cause many health effects such as loss of spatial awareness, nausea, disorientation, and dizziness.

## **2. History of the Technology**

The History of fighting fires dates all the way back to Ancient Egypt and Rome. The first firefighters were essentially slaves with buckets of water. To get the buckets of water to the fire they would have “bucket lines”.

The first fire truck was invented in 1907 and was called the “Combustion Fire Engine”. It used pumps, hoses and chemical extinguishers to put out fires.

The earliest way firefighters communicated when putting out fires was using a trumpet to keep the people pumping water in time. The first two way radio to fight fires was invented in 1940 and it was 131 pounds. Eventually, smaller radios were made in 1948.

Today firefighters use SCBA’s (Self Contained Breathing Apparatus) to be able to breathe clean air in dangerous environments. When they were introduced they were optional and not a necessity like they are today. They have three parts, the high pressure bottle, the regulator, and the mask.

Another technology firefighters use today is a PASS (Personal Alert Safety System) device. What the PASS does is when the firefighter has not been moving for thirty seconds it makes a loud noise so other firefighters can hear. The PASS device can also be activated manually if the firefighter cannot wait thirty seconds.

### 3. Future Technology

Our vision for the future is that firefighters can put out fires without risking their lives. The technology included in our solution are drones, swarm intelligence, and cutting edge impermeable nonflammable graphene nano-fabric to smother fires. Our drones will work together to monitor and put out the fires by covering vast distances. The drones will be using swarm intelligence to coordinate with each other. Swarm intelligence is the collective behavior of decentralized, self-organized systems, natural or artificial.

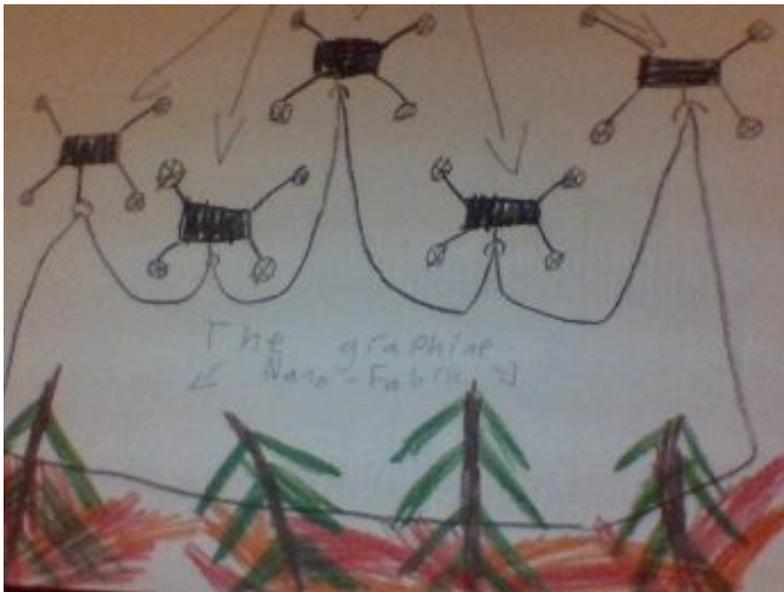


Figure 1.

The drones will be carrying the impermeable nonflammable graphene nano-fabric and we will have them all act as one. This works because there are drones carrying a large amount of this fabric together to drop onto and smother the fire. Fire needs oxygen, heat and fuel to burn. The non flammable graphene nano-fabric puts out fire by smothering it and eliminating the oxygen which is required in order for a fire to burn. Impermeable non flammable graphene nano-fabric is paper-like material. This was discovered by researchers working for the University of Arkansas. It is non flammable because the researchers bonded graphene oxide flakes into a membrane like material. This then made the material incredibly strong and also fireproof. Plus, it is very lightweight because graphene is only one atom thick. This all transforms what was a highly flammable material into a super strong, lightweight, and fireproof membrane.

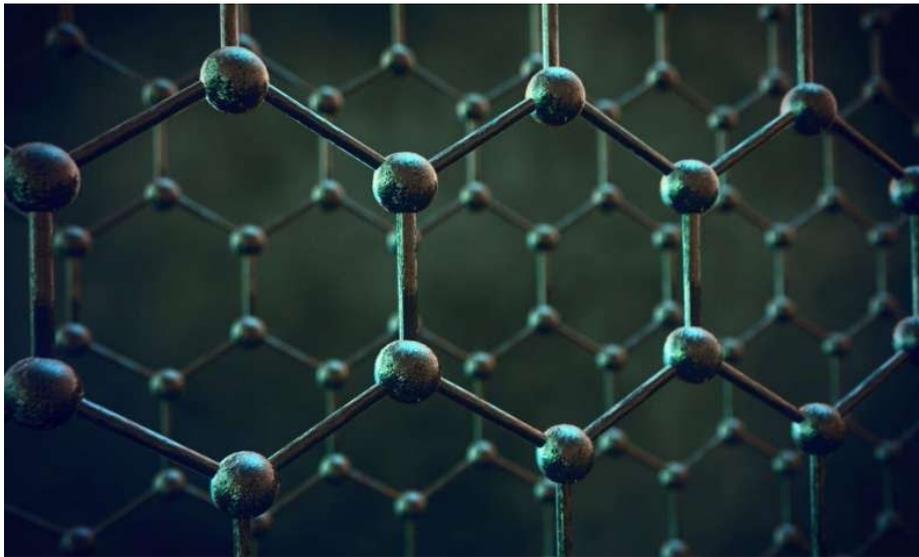


Figure 1=2: A picture of the Graphene Nano-Fabric

Our drones have rotors hooked up to motors. Then those motors are hooked up to a battery which propel the drone into the air. The drones will also have hooks to be able to attach the fabric and work together. Drones will technology to determine if action needs to be taken.

Thermal cameras to see where there are fires and if there are people near the fires. In addition, the drones will be using satellite images along with images coming from the camera to survey the land and to determine what to do. The drones will have computers running artificial intelligence to understand how and where the drones will work together to smother fire or prevent the fire from spreading.



Figure 3

#### 4. Breakthroughs -

We will need our fabric to be impermeable to keep oxygen from passing through to the fire. The fabric should be non flammable at any heat so it won't burn up and stop working. Also, lightweight nano-cloth which won't blow away in the wind and so the drones can handle it over larger spaces. We need breakthroughs to design our nano graphene fabric with those traits impermeable, nonflammable, and lightweight.

We will be testing the nano cloth's fire resistance, its wear and tear limit and how well the drones can carry it in the bad weather. We will heat up the room to as hot as 1,472 degree fahrenheit which is the highest forest fire temperature. We will also stretch the fabric to test it's

light enough for the drones to carry to smother the fire. We also need to test how well it will handle getting snagged on trees and branches. Another test would be how well the drones and the fabric can handle in the wind by testing this in a wind tunnel.

## 5. Design Process

Some design changes we made were switching from a fiberglass blanket to a graphene one so it would be more lightweight and easier to engineer so not to burn in the fires. The second thing we did was introduce swarm intelligence into our project because we realized the solution would work better with multiple drones. And thirdly, we decided to use AI to find the best ways to either contain a fire or smother it.

## 6. Consequences

Positive impacts to society are that firefighters would not have to risk their lives when fighting fires, and that the fires could be put out quicker if they are in remote locations. Another positive impact is that more people could become firefighters so that most fires would be put much quicker.

Negative impacts on society that our solution would cause AI and drones to take over the jobs of firefighters and would cause a rise in unemployment. Another bad consequence would be that the drones may disconnect and shut down while the

firefighters were fighting the fire, letting the fire grow bigger. And finally, the drones might melt while over the fire wasting technology and money when the drone is destroyed.

III. Bibliography -- List all sources you used to gain knowledge about the topic.

Present Technology.

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## IV. Web design

# IGNIS Drone

[Home](#) | [Background](#) | [Future Technology](#) | [Breakthroughs](#) | [Design Process](#) | [Sources](#)

Our vision for the future is that firefighters can put out fires without risking their lives. The technology included in our solution are drones, swarm intelligence, and cutting edge impermeable nonflammable graphene nano-fabric to smother fires.

The fires in California this year burnt over 4 million acres, the most ever burnt in recorded history, and on the west coast 4.1 million acres were burnt with nearly 21,000 fires.

Team Video

*The home page provides a summary of our project with visual and interactive details. When the Sources button on the top bar is clicked, a additional page will appear referencing the sources.*

# IGNIS Drone

[Home](#) | [Background](#) | [Future Technology](#) | [Breakthroughs](#) | [Design Process](#) | [Sources](#)

Description of Present Technology & Limitations

Satellites.  
Satellites are used to fight wildfires because the new generation of satellites is equipped with the ability to see in infrared (A heat sensor that can detect heat signatures limitations: Some drawbacks with satellites are that they are very expensive to buy, and maintain. That they are also prone to interference.

Present Technology

- Satellites
- Internet of Things
- Drones
- Virtual Reality
- Robots
- History of Technology

*If the buttons under "Present Technology" is clicked, a pop up will appear and explain the present technology topic and its limitation.*

# IGNIS Drone

Home | Background | **Future Technology** | Breakthroughs | Design Process | Sources

Learn How it Works



Learn the Technology behind the ....

Graphene Nano-Fabric is a membrane like material that is super strong and super light. It is fireproof so when thrown onto fires it will smother them. This was created by researchers at the University of Arkansas by bonding graphene-oxide flakes into the material we are using.

When you click on Graphene Nano Fabric this window will pop up.

AI / Swarm Intelligence

Drones

Graphene Nano-Fabric

*Fill in any type of effects or information you want the judges to know how this slide will perform*

