## I. Abstract

Deforestation is the result of forests decreasing due to people illegally cutting down trees and wild fires. It increases CO2 in the atmosphere, which leads to global warming. It is destroying the habitats of many animals and beautiful forests. According to the World Wildlife Organization, 15% of all greenhouse gas emissions are caused by deforestation. Additionally, the World Wildlife Organization says that 1.25 billion people worldwide rely on forests for shelter, livelihood, water, fuel, and food security. Our future technology solution is artificial trees to power the drones and absorb $CO_2$ as well as drones to protect our forest, put out fires, and replant trees.

## II. Description

### 1. Present Technology

Satellite monitoring is currently used to understand if the forests are changing and what are the causes for those changes. One example of this is Global Forest Watch 2.0. It was developed by "Google, in partnership with the University of Maryland and the UN Environment Programme," according to enviromentalleader.com. This forest watch uses "satellite technology, data sharing and human networks around the world."[1] The purpose of this is to give real-time information regarding deforestation to all countries across the world. The limitation is it's a monitoring system, and cannot actually stop deforestation without something to act on it.

One current technology that exists for replanting trees is drone planting. Drone planting is drones dropping seed pods. Over time, the pods dissolve and the seeds pop out. The benefits of this technology are that this can easily reach hard-to find areas. Some of the challenges with this technology are that many times the seeds don't get planted down far enough or die as saplings for other reasons. Trees also take a long time to grow, and during this time many die. This technology is estimated to restore forest 150 times faster than by hand and be up to ten times cheaper. While drone planting is efficient, it does have some cons. Drones are vulnerable to weather. The main limitation, however, is the time it takes to regrow the forest.

[1] Hardcastle, Jessica Lyons. "Google Technology to Help Prevent Deforestation." *Environment + Energy Leader*, 10 Apr. 2013, www.environmentalleader.com/2013/04/google-technology-to-help-prevent-deforestation/. https://www.environmentalleader.com/2013/04/google-technology-to-help-prevent-deforestation/

Forest Management tries to prevent fires by intentionally burning under the right conditions and removing small trees, branches, and twigs. The limitation is that a controlled burn could remove more trees than planned. Controlled burning is more effective in lower elevations than higher elevations. In higher elevations there is less soil and it is harder for trees to survive, so there are less destructive fires. In Figure 1, the anatomy of a prescribed burn is pictured.

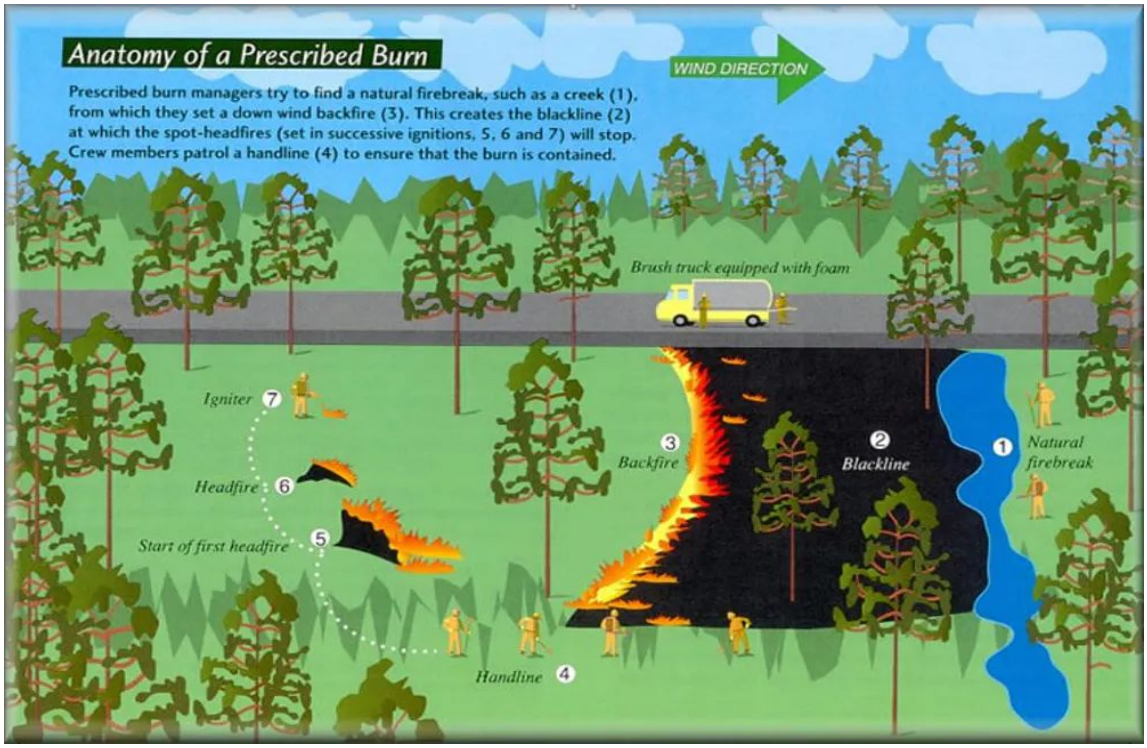



Figure 1: Prescribed Burn

2. **History:**

In the early 1970s, NASA and their astronauts started taking pictures of the earth inspired by environmentalists. In the New England study, Olofsson looked at images from 1985 to 2011, conducting a time series analysis of deforestation.

One of the first historically proven reforestation efforts happened with coniferous seeds. It was developed in 1368 by the Nuremberg councillor/ merchant, Peter Stromer, in the Nuremberg Reichswald. It became known as the first artificial forest in the world.

The first place to help replenish wildfires with drones was performed in Utah, in the United States of America. On July 14, 2016, Utah started letting drones get close to fires and put them out with water.

3. **Future Technology:**

Our vision is to be able to put this duo of artificial trees and drones into a forest to protect the forest. The tree would be able to convert CO2 and power the drones. The drones would be able to monitor the land as well as making controlled burns, planting, and putting out small fires. The purpose of these is to keep the area around safe, better maintain our forest, and prevent global warming.

Figure 2: Artificial Tree and Drone Capabilities

The tree has multiple functions. It would convert CO2, just like a normal tree. Of course, it would do so at a vastly enhanced rate. CO2 causes many negative effects, including extreme weather, increased forest fires, and the melting of the ice caps. The tree would also gain power to keep the drones running.

The tree would take away CO2 using fake leaves that are much more effective than real ones. These leaves would be "coated with a resin that contains sodium carbonate, which pulls CO2 out of the air and stores it as a bicarbonate (baking soda) on the leaf. The CO2 is removed by water vapor in the air."[2] It will dry in the wind, soaking up more CO2 in the process.

[2] https://www.bbc.com/future/article/20121004-fake-trees-to-clean-the-skies "Sucking CO2 from the Skies with Artificial Trees." *BBC Future*, BBC, www.bbc.com/future/article/20121004-fake-trees-to-clean-the-skies.

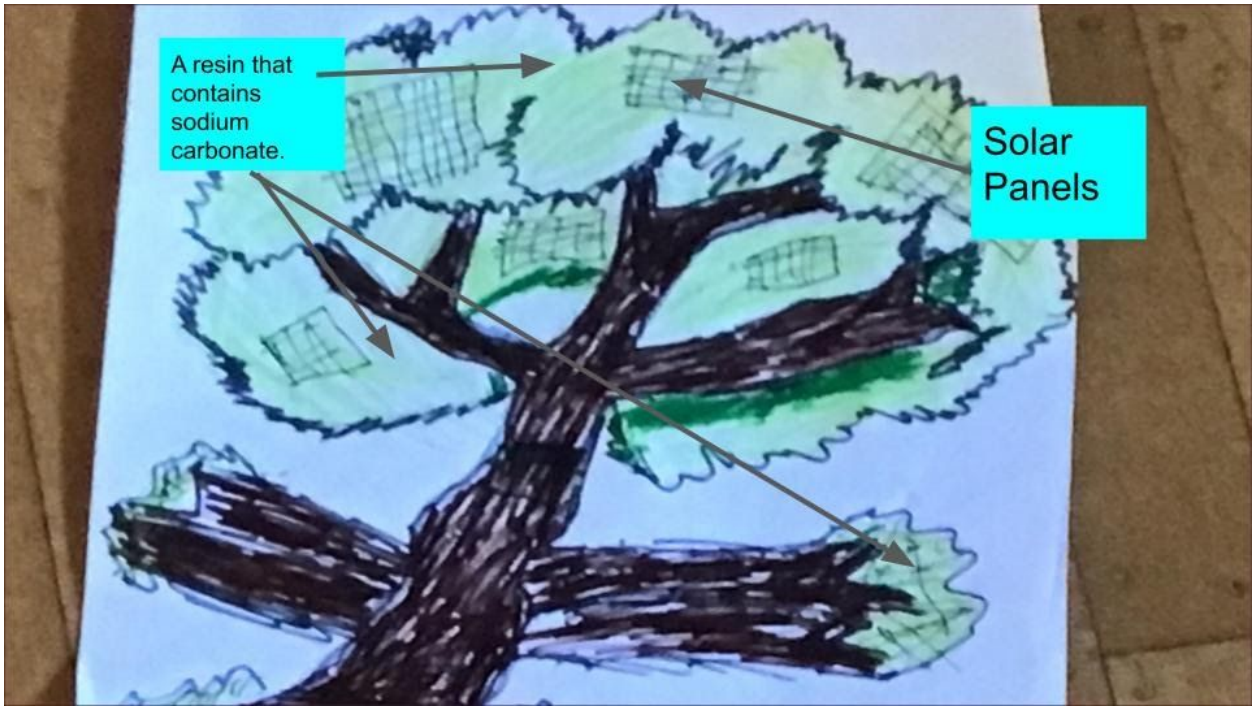



Figure 3 : Artificial tree designed by team

The tree would be powered with solar power. Solar power uses two thin layers of silicon crystal on top of each other. The one on the top has spare electrons it needs to get rid of. The bottom one has the opposite problem; it needs more electrons. When sunlight hits the top layer, it gives the electrons on the top energy to move. The electrons flow from the top layer to the bottom, which creates electricity. If there are two metal contacts on either side of the silicon and there is electricity moving in a circuit, then it would produce power for the trees and recharge the drones.

There would also be a drone in our solution. Like most drones, this drone would be able to fly. It would have multiple small sticks sticking out the drone, each one evenly spaced. There

would be an even number of ‘sticks’. At the end of each ‘stick’ would be small blades which would move rapidly. The movement of the motors on these ‘sticks’ would let the drones fly. Our drone would also have legs on the bottom that allow it to walk on the ground.

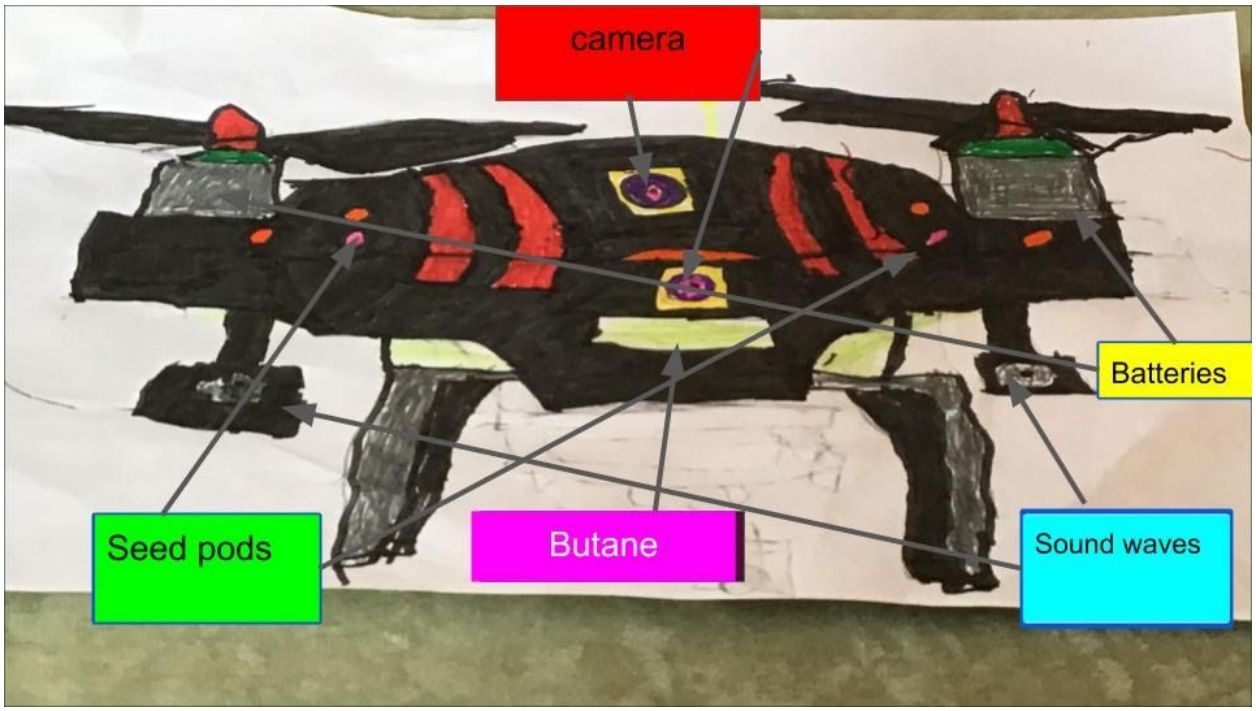



Figure 5: Drone designed by team

The drone would be able to survey and monitor the forest. It will also be able to communicate with the control station. It would have a camera on it that can look around it and take pictures.  It would use radio waves to communicate. Communication capabilities are important to receive satellite imaging, camera images and thermal imaging.

The camera will be able to use thermal imaging to identify lifeforms, and it works as an advanced night vision. Like most thermal cameras, it will use microbolometers to capture

infrared radiation and assign the infrared radiation a color. This will allow it to locate people trying to harm the forest and see at night.

The drones will have a computer with  artificial intelligence, or Ai programs. Artificial intelligence is a ‘smart’ program that can adapt to situations. Artificial intelligence is important because it allows these drones to work without a person actively controlling them, which would be important if many of these are made. Having good artificial intelligence is important because faulty systems could result, burning down forest,  destroying towns, and malfunctioning. Even a small glitch could have large negative repercussions. Having good Ai will assist the drone in other things like preventing forest fires, clearcutting, and more!

The drone would also be able to put out fires. It would use sound to do so. It would use bass music between 30-60 hz to put out fire. The music separates the oxygen and the flame by moving the oxygen away from the flame. Without oxygen, the fire is snuffed out. This method allows us to have a method of snuffing out fires that, unlike water, sound waves can be used anywhere and with near unlimited supply. If the fire gets to big, they can send a message to firefighters,

The drone will also conduct controlled burns when necessary. To do this, it would use butane. Butane is used in the modern lighter, as it is extremely flammable. The butane would be stored in a compartment. If, or when, it runs out of fuel it will be able to contact the HQ and another drone might get sent while it gets sent back to be reloaded. The Ai will help to

understand what areas need a controlled burn, and make sure that the burn is efficient with as little waste as possible.

The drone can plant trees. In order to plant trees, it would have a small compartment with seed pods. These seed pods could be dropped out of the drone into the ground, where a new tree can grow. Hopefully, by the time the seed pods are all used up, the forest is stable. If not, more can be delivered to the drone by another drone.

**4. Breakthroughs**

We will need breakthroughs in many areas especially Artificial Intelligence (Ai) because it's a new technology and will need advancements. Ai would need to be exactly correct, because if the drone needs to know which fires to put out or not to put out. If it didn't detect a fire early enough, it could turn into a large raging fire. If it sensed a fire and put it out but it was only a camp fire, there would be some unhappy campers who might throw rocks at the drone.

Our team would test Ai in our drones by creating different scenarios to see how it would react. One test we might use on the drone would be making a small forest floor. One part would be very overgrown and dry. We would test to see if it did nothing, which would require more testing. If it performed an uncontrolled burn, it would require more work on the Ai. If it performed a controlled burn, then it is fine.

Another test we might use would use a small forest floor. We would shape it like an hourglass. First, we would light a small fire to see if the drone would put it out. Next, we would light a large fire to see if the drone would call for help. Hopefully, the drone would both

call for help and stop fire from crossing from the top part of the forest to the bottom. The second test would make sure it can call for help and see if it is smart enough to use natural barriers and stop the fire there.

## 5. Design Process

The group's first design of our model was replanting trees with drones, but we realized we weren't solving the problem. We wanted to prevent forest fires from happening and if it did occur we would be able to help the process by replanting the trees with drones. Another reason we did this was because trees take a while to grow, so it would be better to stop them from dying in the first place. Instead, we decided to use drones and an artificial tree to both replant trees and protect them.

We needed the drones to be able to protect trees. In many places, fire is a major problem for trees. In order to prevent fire, we needed something to put it out. Our first solution was water. We chose water because in most places that trees can grow, there is water. That would allow the drone to have a near infinite supply. However, there were several downsides, Water is heavy, and carrying any substantial amount of water would weigh down the drone. Water was not infinite, and many places have enough water to grow a specific kind of tree, but not put out a forest fire. Additionally, if there is a forest fire, it is likely that it is the dry season, and the rivers are nearly empty. Then, we found out about the ability to use sound waves to put out fire.

Using sound waves to put out fire was a good idea. All it needed was energy, which our solar panels would give us. It would not require the drone to continuously refill. While it might

not stop larger fires as fast as water, it would allow the drone to destroy smaller fires before they become big ones without having to be heavy. We chose to use sound waves instead of water for the benefits mentioned above.

As we were designing the drones, we decided that they needed to be able to make fire for controlled burns. We started with a magnifying glass, using the glass and the light from the sun to set a fire. The first issue we ran into is the fact that it could not be controlled, so we decided to make it be able to fold inwards. However, there were too many issues. It was heavy, which would hurt the movement speed and flight time of the drone. It also depended on a variety of factors such as the need for no clouds and rain, and the flame it produced was not very strong. Instead, we decided to use butane to make a fire, as it produces a stronger fire.

In order for the drone to have power and to convert C02, we created an artificial tree. The tree started as a genetically modified tree that would convert C02. However, we realized that if it was a non-manufactured tree, it would take too long to grow. Next, we decided to make an artificial tree to convert C02. We then switched to another way to make C02 that was better. Finally, we added solar power to allow the tree to power the drones batteries.

## 6. Consequences

Our future technology of artificial trees and drones will have positive and negative impacts to society. There are many positive benefits. The tree and drone will reduce deforestation, which helps the world to have enough oxygen. The tree and drone will take carbon

dioxide out of the air, stopping global warming. They will reduce forest fires, saving towns and people.

As with most everything, however, there are some downsides. It will stop illegal deforestation, which many rely on to get money. It will also make some people lose their jobs, as why pay someone a lot of money when you could just buy an artificial tree?

**III. Bibliography**

Figure 1 - Controlled Burn Image

https://www.greenbiz.com/article/better-forest-management-wont-end-wildfires-it-can-reduce-risks-heres-how#:~:text=Better%20forest%20management%20won%27t%20end%20wildfires%2C%20but%20it,management.%20...%204%20Prioritizing%20the%20right%20work.%20

Figure 2: Designed by Team

Figure 3: Designed by Team

Figure 4: 250117_SolarCells_explainer.png (835×882) (sashaintl.com)

Figure 5: Designed by Team

**Articles:**

Forest Facts

"Deforestation: 11 Facts You Need to Know." *Deforestation - 11 Facts You Need to Know*, www.conservation.org/stories/11-deforestation-facts-you-need-to-know.

National Geographic Society. "Deforestation." *National Geographic Society*, 15 July 2019, www.nationalgeographic.org/encyclopedia/deforestation/.

"Deforestation and Forest Degradation." *WWF*, World Wildlife Fund, www.worldwildlife.org/threats/deforestation-and-forest-degradation#:~:text=Deforestation%20and%20forest%20degradation%20are,frequency%20of%20extreme%20weather%20events.

"70+ Breathtaking Facts About Deforestation That Will Leave You Spellbound." *Conserve Energy Future*, 12 July 2020, www.conserve-energy-future.com/various-deforestation-facts.php.

Current technology research. -, Marc Prosser, et al. "How Tech Can Help Curb Emissions by Planting 500 Billion New Trees." *Singularity Hub*, 16 Oct. 2019, singularityhub.com/2019/07/16/how-tech-can-help-curb-emissions-by-planting-500-billion-new-trees/.

www.oocities.org/plasmicfurball48/index.html#:~:text=137%20species%20of%20animals%20are,within%20the%20next%2025%20years.

Forest Management

Controlled Burn"California Wildfires: Key Recommendations to Prevent Future Disasters: Lawrence J. McQuillan." *The Independent Institute*, www.independent.org/publications/article.asp?id=12834.

http://www.dronefromchina.com/new/The-Pros-and-Cons-of-drones-and-farming.html

Grischenko, Sharon. “Satellite Maps Monitor Deforestation: The Brink.” *Boston University*, 14 Nov. 2016, www.bu.edu/articles/2016/satellite-maps-deforestation/.

ttps://www.reenbiz.com/article/better-forest-management-won't-end-wildfires-it-can-reduce-risks-here's-how#:~:text=Better%20forest%20management%20won%27t%20end%20wildfires%2C%20but%20it,management.%20...%204%20Prioritizing%20the%20right%20work.%20

“Reforestation Overview.” *Overview*, www.fs.fed.us/restoration/reforestation/overview.shtml.

“Reforestation.” *Wikipedia*, Wikimedia Foundation, 9 Jan. 2021, en.wikipedia.org/wiki/Reforestation#Germany.

Drones:

“10 Limitations Of Drones.” *Grind Drone*, grinddrone.com/features/10-limitations-of-drones.“Up, Up and Away: How Do Drones Work?” *CTIA*,

www.ctia.org/news/up-up-and-away-how-do-drones-work#:~:text=Drones%20use%20their%20rotors%E2%80%94which,descend%2C%20when%20pilots%20perform%20the.

Artificial Trees

Design process. Borgen, Clint. “Artificial Trees Absorb a Thousand Times More CO2 - TBP.” *The Borgen Project*, Clint Borgen Https://Borgenproject.org/Wp-Content/Uploads/The_Borgen_Project_Logo_small.Jpg, 14 July 2020, borgenproject.org/artificial-trees-absorb-thousand-times-co2/.

*Bing*, Microsoft, www.bing.com/videos/search?q=genetic+modfying+trees.

Solar Energy

Team, The Go Greena. “How Solar Panels Work - A Guide For Dummies - Go Greena Blog.” *Go Greena*, 15 May 2018, gogreena.co.uk/how-solar-panels-work-a-guide-for-dummies/#:~:text=The%20inside%20of%20a%20solar,them%20enough%20energy%20to%20move.&text=The%20electricity%20used%20in%20your%20house%20is%20AC%20(alternating%20current).

*Fire From Moonlight*,
what-if.xkcd.com/145/#:~:text=A%20magnifying%20glass%20concentrates%20light,light%20to%20start%20a%20fire.

"How Do Lighters Work?" *Science ABC*, 26 Nov. 2019,
www.scienceabc.com/innovation/how-doe-lighters-work.html#:~:text=Butane%20in%20a%20lighter%20is%20pressurized%20and%20stored%2C,even%20when%20incited%20by%20the%20slightest%20of%20sparks.

Lloyd, Craig. "How Does Thermal Imaging Work?" *How*, How-To Geek, 16 Feb. 2017,
www.howtogeek.com/294076/how-does-thermal-imaging-work/#:~:text=Thermal%20cameras%20detect%20temperature%20by,the%20intensity%20is%20high%20enough.text=From%20there%2C%20the%20microbolometer%20records,pixel%20to%20an%20appropriate%20col.

Authorship, Morphius FilmClose, et al. "Better Forest Management Won't End Wildfires, but It Can Reduce the Risks - Here's How." *Greenbiz*,
www.greenbiz.com/article/better-forest-management-wont-end-wildfires-it-can-reduce-risks-heres-how#:~:text=Better%20forest%20management%20won%27t%20end%20wildfires%2C%20but%20it,management.%20...%204%20Prioritizing%20the%20right%20work.%20.

Hardcastle, Jessica Lyons. “Google Technology to Help Prevent Deforestation.” *Environment + Energy Leader*, 10 Apr. 2013, www.environmentalleader.com/2013/04/google-technology-to-help-prevent-deforestation/.

Fimrite, Peter. “Rebuilding Forests after Massive Fires: Debate over Best Methods Moves to Court.” *SFChronicle.com*, San Francisco Chronicle, 10 Dec. 2019, www.sfchronicle.com/environment/article/Rebuilding-forests-after-massive-fires-Debate-14894315.php.

Gene to make trees grow faster

Quick, Darren. “Gene Manipulation Boosts Tree Growth Rate and Size.” *New Atlas*, 2 May 2015, newatlas.com/gene-manipulation-boost-tree-growth-rate-size/37163/.

*Bing*, Microsoft, www.bing.com/videos/search?q=genetic+modfying+trees.

Fighting Fire with sound:

“Sound Waves to Fight Wildfires: How Does It Work?” *Dell Technologies*, 10 Mar. 2020, www.delltechnologies.com/en-us/perspectives/fighting-fire-with-bass-using-sound-waves-to-drown-flames/.

https://physicsworld.com/a/dousing-flames-with-low-frequency-sound-waves/

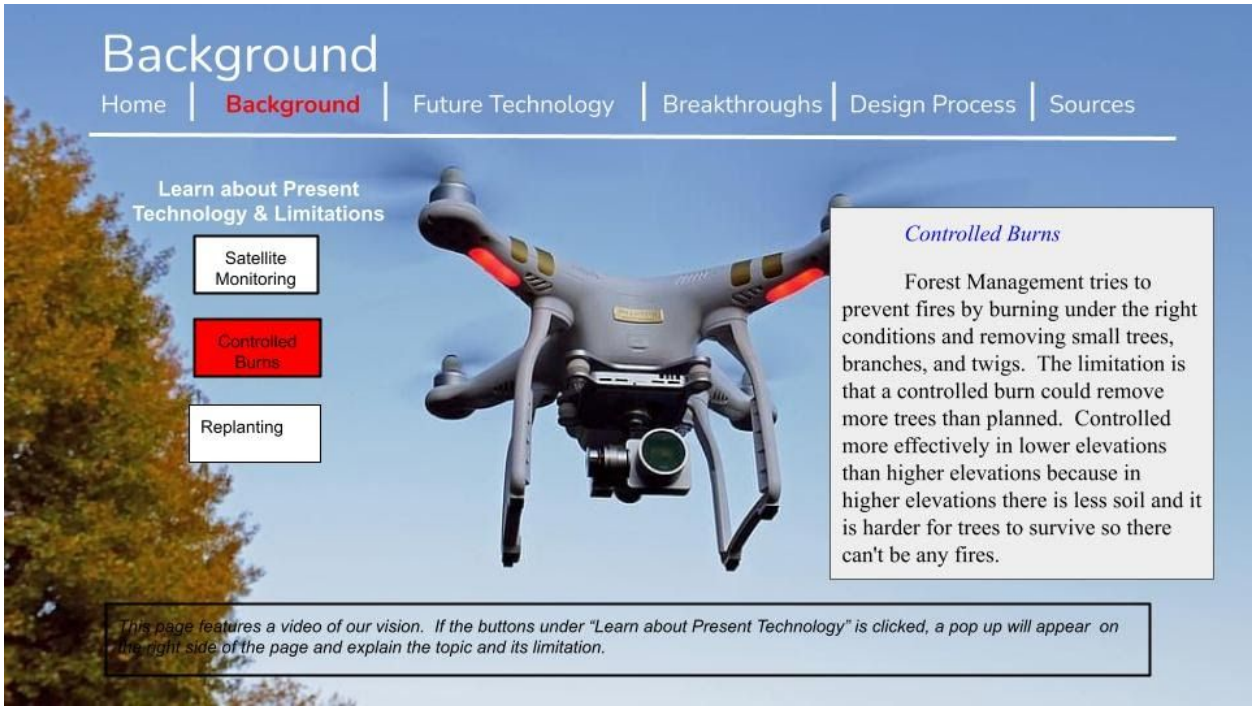
https://www.firerescue1.com/fire-products/suppression-equipment/articles/video-students-invent-sound-wave-device-to-put-out-fire-WRWtfdv8Ob37M3CL/

“Artificial Intelligence – What It Is and Why It Matters.” *SAS*, www.sas.com/en_us/insights/analytics/what-is-artificial-intelligence.html.

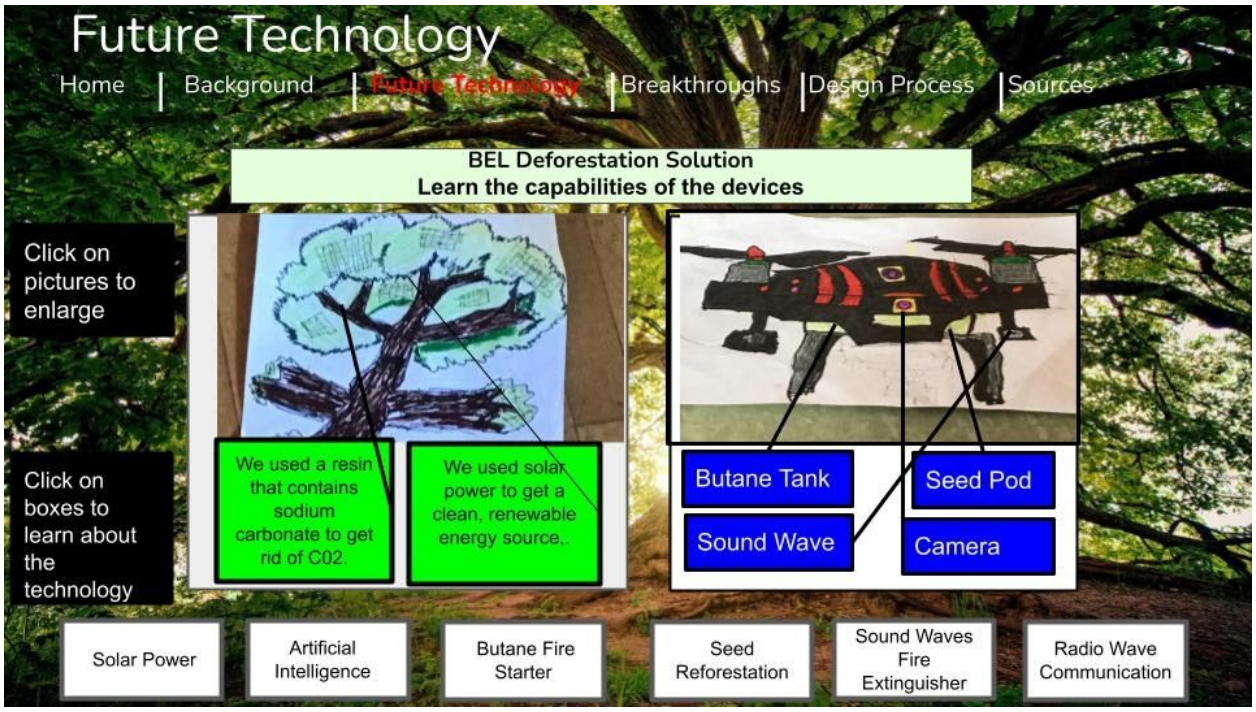
## IV. Sample Web Pages

### Web Page 1

Web Page 2




Web Page 3



Web Page 4


Web Page 5