Abstract Section

Ecosystems around the world struggle with invasive species for which they have no defenses. The Invasive Species Eradicator (ISE) is a drone designed to detect invasive species and inject pesticides or herbicides into their nervous systems or roots while limiting negative impact on the surrounding ecosystems. ISE can work 24/7, requiring only a landing bay where it autonomously performs simple repairs, refills pesticides or herbicides, and changes its battery. ISE will mark treated plants and bugs to identify them as not requiring further treatment.

The ISE can be programmed to target specific invasive species. With a built-in search engine, ISE is able to identify specific bugs and plants at all stages of growth and in all seasons. The search engine will also direct ISE to locate the proper injection site. ISE does not require manual controls. It is fully programmable to function independently in a designated area.

Present Technology

Drones have been used successfully in agriculture for years. They deliver pesticides and herbicides efficiently to plants. These drones use an advanced system of sensors and cameras to identify routes and to ensure complete coverage. In addition to being employed in agriculture, other fields, like the military, use drones with smart technology to identify and eliminate targets autonomously. The ISE will bring the search engine technology employed by the military to the field of agricultural.

While drones are great for agriculture and delivering pesticides, they face limitations. Most drone batteries are rechargeable, but the battery can take considerable time to recharge. We address this with a drone landing bay that enables the drone to independently change out its battery. Another significant limitation of agricultural drones is that they break and need repairs. We address this with a fully equipped landing bay and a drone that is programmed to perform autonomous repairs. When our drone is broken, it simply repairs itself. Finally, agricultural drones are designed with sprayers that cover a wide area. The targeted approach we follow is aimed to have limited impact. Therefore, we will have a telescoping needle to deliver pesticides and herbicides, making the process as safe as possible.

History

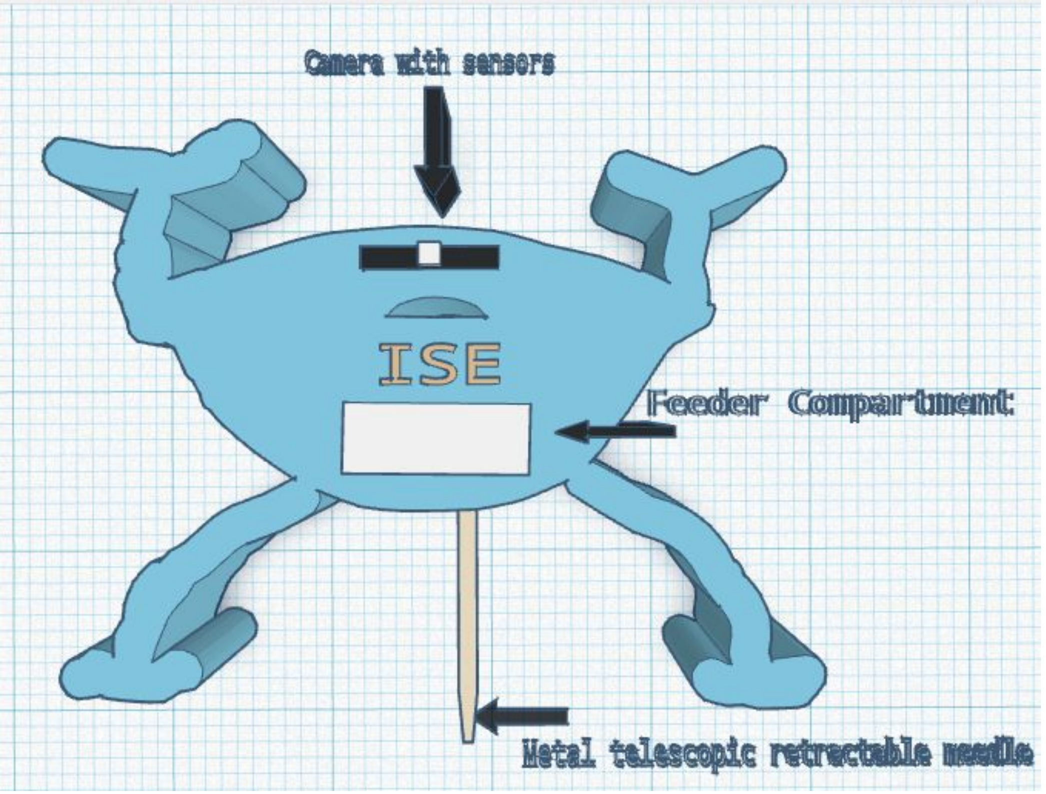
About 4,500 years ago ancient Sumerians invented pesticides out of sulfur compounds to control insects and mites. Around 3,200 years ago ancient Greece and Rome used chemicals to keep weeds, diseases, and bugs off their plants. One of the earliest pesticides used was tar. Pyrethrum, made from daisies, was one of the more common insecticides used for over 2,000 years.

Inorganic compounds began to be used in agriculture in the 1940s. Nitrophenols, chlorophenols, creosote, naphthalene, and petroleum oils were all used to ward off fungus and insects. A study in the 1940s proved DDT (dichloro-diphenyl-trichloroethane) an effective and inexpensive solution to plant pests, while also having a low toxicity rate to mammals. This finding was premature, as within ten years DDT was identified as dangerous to humans and animals. In the 1970s a new pesticide, glyphosate, was produced with a lower toxicity level to replace DDT. By the 1990s, safety for the environment became a goal in chemical research, leading to pesticides and fungicides that are targeted and have less residual impact. Triazolopyrimidine, triketone, isoxazole, strobilurin, azolone, chloronicotinyl, spinosyn, fiprole, and diacylhydrazine were all produced at this time with the goal of limited environmental impact.

Drones, as a delivery system, appear in the late 1800s as balloons fit with explosives for battle. The first remote-controlled aircraft were experimented with in 1916 during World War I. During World War II, unmanned drones were produced for the American and British Royal Navies. By the 1960s the next advance in drone technology included remote control planes in smaller form. Twenty years ago, the first drones were produced for civilian use for entertainment and recreation.

Ten years ago, pesticide technology and drone technology were combined in agricultural drones, enabling farmers and agricultural businesses to target crops with specific chemicals, using less manpower. While this technology has transformed commercial agriculture, it has yet to be used for environmental preservation against invasive species.

Future Technology – Slide 1



In the Future, Invasives Meet Their Match

The Invasive Species Eradicator fuses the technology already in use in military, agricultural, and civilian drones with the science of targeted environmentally-friendly pesticides. Our solution provides a way to protect our environment, while destroying what doesn't belong.

There are changes constantly happening in our ecosystem due to climate change. Invasive species have proliferated throughout the world because of these changes, causing significant damage to habitats and ecosystems.

How it Works:

Invasive Species Eradicator (ISE) will be the solution to our problem. It is a battery operated drone with computer vision, sensors, and a search engine, along with other features. It will eradicate invasive species, and by strengthening native trees, enable them to generate more oxygen. Climate change will slow, as will ozone layer depletion.

Future Technology – Slide 2 (optional)

Sensors will be programmed to detect invasive species. Once a particular invasive species is identified, pesticides will be injected into the invasive. Following the injection, ISE will mark the invasive to identify it as having already been treated.

Telescopic Needle: Once the sensor detects an invasive species, it will inject pesticides into the invasive using a telescopic needle that enables the drone to remain more than three feet away from the invasive. The needle will be strong enough to go through the invasive and insert the pesticides.

Feeder Compartment: This compartment, connected to the needle, is filled with the required pesticide. The pesticide compartment is fully refillable when needed.

Landing Bay: The landing bay will have a change of battery, extra pesticides, a navigation system, built in search engine, and a mini-repair center. From the landing bay, the ISE is programmed to attack a specific invasive. When the ISE is in the air, it marks where the landing bay is and how far it can go before returning for a battery change. The landing bay will also perform a series of checks on the drone before take off, and can initiate autonomous repairs as needed.

Future Technology – Slide 3 (optional)

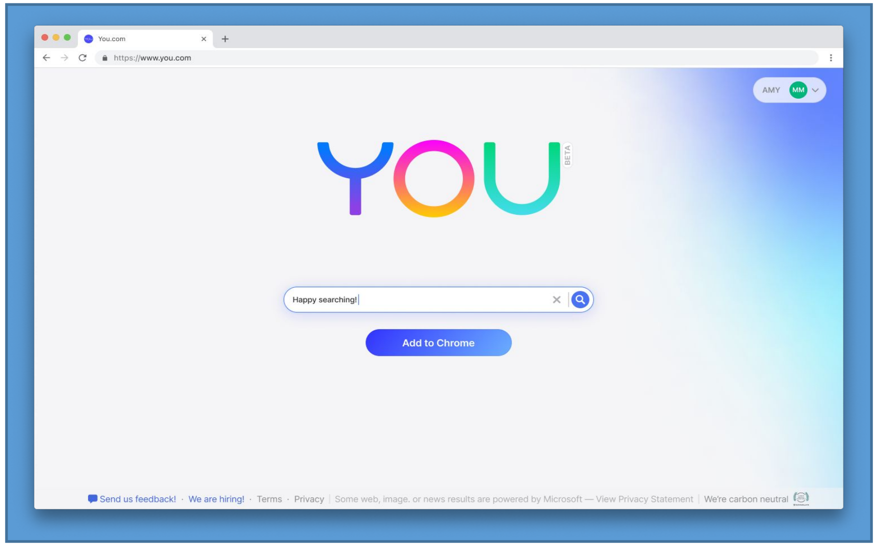
Our vision for ISE is to make it affordable so that government organizations involved in conservation and non-profits will be able to invest in this technology. Manually removing invasives is extremely difficult. We envision our product replacing the need for manual work. It will reduce man hours dedicated to removing invasives and our refillable pesticide containers will reduce reliance on plastic pesticide containers.

Breakthroughs– Slide 1

Three technological breakthroughs are needed to create ISE:

1. Landing bay
2. Telescopic Needle
3. Built-in search engine

Breakthroughs– Slide 2 (optional)



Telescopic Needle

The telescopic needle is meant to provide a safe way to deliver pesticides. The needle is microscopic and precise to the nanometer. The telescopic needle head creates a safer environment in crowded areas. By being telescopic the needle can reach far beyond the body of the drone, enabling the drone to hover safely at a distance from its target.

Built-in Search Engine

The built-in search engine will provide the drone's sensors with a range of images of the invasive. This enables the drone to match the bug or plant in front of it, with the image it was sent to treat. The search engine, because it relies on photos and not on complex coding, allows the drone to be programmed by those who aren't especially tech savvy.

Breakthroughs– Slide 3 (optional)

Landing Bay

The landing bay is the drone’s home base. It is waterproof, allowing for the drone to be stored there when not in flight, in most weather conditions.

The landing bay contains most of the tools that the ISE needs. The landing bay holds the refillable pesticide containers and extra drone batteries. Some tools for easy repairs are also maintained in the landing bay and can be used autonomously.

The landing bay is home to the search engine. It is where the user will input the invasives they wish to control, and where the drone will receive its orders.

Design Process – Slide 1

Alternative Idea (Glucose Monitor)

Originally we thought of doing a medical invention specifically for type one diabetes that involved a tracker that will keep track of the glucose or sugar in the body, and if it is high then it would alert you immediately with flashing lights and buzzing. We decided not to do it because, after doing some research, we saw that it was already invented. Our new idea is better than all of our other one's because it will help reduce climate change and global warming, and make our earth a better place. Invasive species are a significant problem in many ecosystems, and the ISE will put a stop to it. Lastly, ISE has not yet been invented.

Design Process – Slide 2: Original Features of ISE

Originally we had thought to use a spray nozzle instead of a telescopic needle. We decided not to use this technology because we didn't want to spray harmful pesticides onto native species. We also vetoed this idea because our pesticide would have to change from a stronger pesticide to one that would be less potent and less effective.

We had also thought about using a technology that would autonomously destroy all invasives. We decided that the margin of error would have been too great because it would destroy plants and animals that were potentially valued. We decided a programmable search engine would be more precise and tailor the placement of pesticides specifically to where they were wanted.

Design Process – Slide 3 (optional)

For our original battery we had thought of only using one single rechargeable battery. When we realized this would create a lot of time when the drone was unusable, we realized it would not be efficient. So instead we are using multiple batteries, each of those are rechargeable, leaving a shorter amount of time between the depletion of the battery to the takeoff of the drone.

Consequences

Eradicating invasive species with drones has its pros and cons. Powering drones by battery allows them sufficient energy to function over hours, and be lightweight enough to fly. However, batteries die and the drone will not be able to function without a fully charged battery. Needing to change out batteries requires a landing bay with extra charged batteries.

The ISE will constantly use its supply of pesticides. Therefore, the landing bay must contain quantities of refillable pesticides. Like all technology, the drone may malfunction. The landing bay will have tools to provide some repairs that the ISE can perform autonomously. The landing bay will have solar panels to take in light, charge the batteries, and power the search engine. We recognize that a drone going to each and every plant to administer pesticides won't be fast. It could take significant time, but it will be very precise and get the job done.

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TOSHIBA | nsta ExploraVision 30 YEARS OF INSPIRING SCIENCE AND IMAGINATION

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