

Landmine Neutralization

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The Problem

We are trying to create a safer way to destroy landmines, IEDs, and other unexploded ordnance (UXO).

We are working with the Halo Trust, the world's largest demining NGO. The most common method of destroying UXO is to use a small explosive charge to detonate the mines in place. However, this method is dangerous and explosives are expensive and highly regulated in many areas where Halo is working. Also the use of explosives spreads debris around the surrounding area.

Specifications

- Destroy UXO without the use of explosives
- Penetrate and deflagrate UXO without detonation
- Low cost per use — less than \$1 for a typical landmine
- Variable burn times for various types of UXO
- Practical device capable of being transported easily
- Uses unregulated parts that can be shipped without difficulty and able to pass through airport security and customs
- One-time use per tube
- Capability of being initiated remotely
- Portable oxygen tank system for ease of use

Past Work

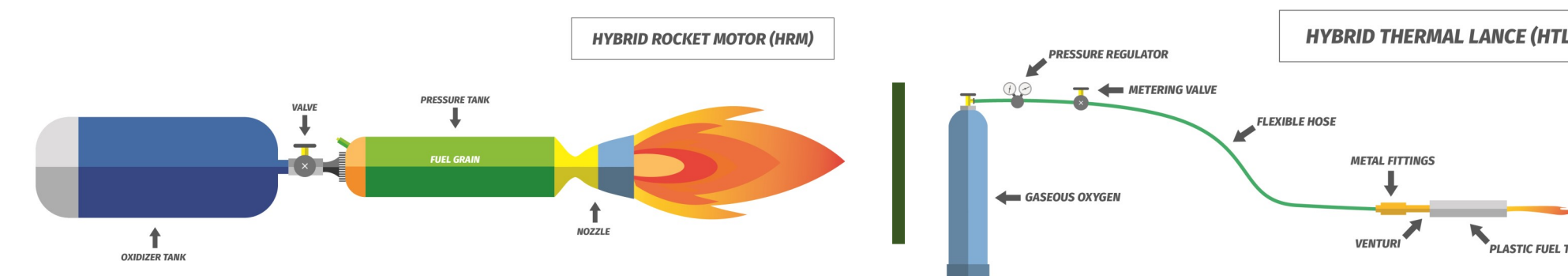
We are expanding on the work started by the Messiah College Landmine Action Project (MCLAP) in 1997. Their work revolved around three core ideas:

- 1.) Raising awareness and educating Messiah College and the general public through events such as Mine Awareness Week and minefield simulation.
- 2.) Basic research and development projects pertaining to the detection and removal of landmines and the remediation of minefields.
- 3.) Prosthetic design for landmine victims.

Today, we are building on the foundation of their work with a new project involving the destruction of landmines and UXO.

Methodology

Hybrid rocket motors provided the inspiration for this project. Hybrids burn solid fuel with a liquid oxidizer to create thrust. Our device, which we call the hybrid-thermal lance (HTL) uses acrylic plastic as the fuel and gaseous oxygen as the oxidizer, producing a concentrated torch type flame without creating thrust. The following diagrams show the basic concept.



The HTL replaces the oxidizer tank with a standard oxygen tank and a hose is run in between the fuel grain and tank. A high voltage module producing an electric arch is used to ignite the fuel in the presence of gaseous oxygen. Since we are not trying to create thrust, a nozzle is not required.

To test this project on campus, the team has built a flame retardant box out of concrete board that can protect team members from fire.



Our Partner

Their mission is to lead the effort to protect lives and restore livelihoods for those affected by war.

They continue to play a major part in getting mines out of the ground, but they are also increasing their role dealing with the broader debris of war – small arms, IEDs, and UXO.

They are engaged with humanitarian demining in fifteen countries and four territories and they have a growing portfolio of programs delivering weapons and ammunition management, including weapons disposal, ammunition disposal and physical security and stockpile management.

In their work to make people and places safe they embed themselves in local communities, build capacity and work closely with local and national governments as well as aid and development partners.

They create safe and secure environments, offer opportunities to rebuild lives and livelihoods, and prepare the way for development and long term stability.



Field Trials, Results, and Future Work

The project team has developed a prototype that has been tested on campus on wooden, mine-sized pucks. With these promising results, in April 2018, Dr. Pratt traveled to Halo's test facility in Afghanistan to test the HTL on real UXO. Initially, the HTL was intended only for landmines with plastic casings, but the tests in Afghanistan proved to be useful in destroying both anti-tank and RPG metal casings, as shown below. These tests and field trials have demonstrated proof of concept and the team is now working on fine tuning and simplifying the design mechanism for ease of use. Initially, the team made a multi-burn device, meaning that the same tube could be used for multiple burns. However, Halo wants to simplify this and make them single use. This means that the team must explore burn tube sizes both in length and diameter. Furthermore, the team hopes to automate the burn cycle by using a timed valve for the oxygen flow with a delay start and burn time. Finally, the team had used a tripod to mount the lance and aim it and a high voltage module to ignite it, but Halo wants to use sandbags to hold the lance in place and use electric matches for ignition. All in all, the project is going exceptionally well and the team looks forward to continuing to work with Halo.



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Collaboratory Sector

