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Landmine Neutralization: Air Excavator

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The Problem

War-torn countries are dealing with improvised explosive devices, landmines, and unexploded ordnance posing a serious danger to the communities living in the conflict areas**.** The team is tasked by HALO to produce a remotely controlled air excavator to operate in these environments.

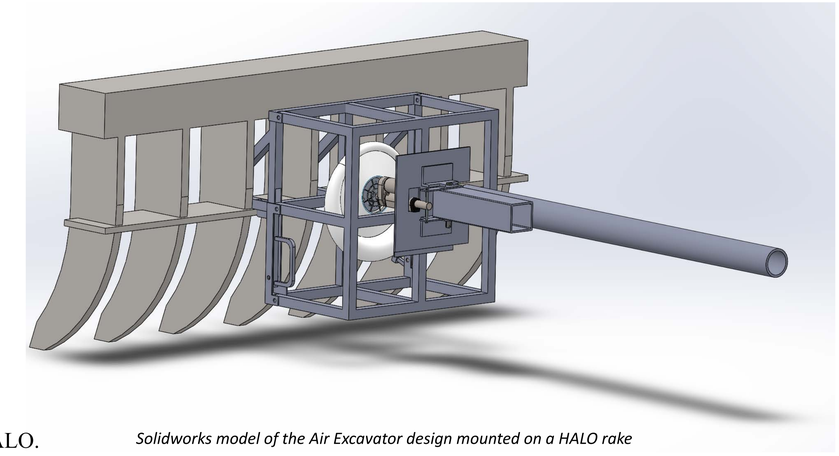
- Dust and debris from destroyed buildings impede demining operations.
- Dangerous environment for operator due to uncertainty of the location of potential explosives.
- Commercial alternatives are too cumbersome or too expensive.

Specifications

- Ability to latch to full-sized backhoe rakes and rakes custom made by HALO.
- Simplicity – the maintenance and usage must be simple through the implementation of parts that can be disassembled in less than an hour and the simplicity of the mechanical and electrical connections so that connectors can be disconnected or connected by one person in less than 30 minutes.
- Rugged design that can survive falls up to 5ft.
- Weather resistant at an IP54 level.
- Design must be self-powered, uses the onboard 12V backhoe power supply system, or the hydraulics system.
- Has at least 750 cubic feet per minute of air (CFM) and 170 miles per hour airspeed (Mph) to remove debris, dust, and dirt.
- The unit must have a quick detach system for the electronic, hydraulic, or mechanical connections to the excavator.
- Controls must be inside the cabin with accompanying cameras with different view angles.
- Blower must be powerful enough to move sand, dust, dirt, and debris with a max size of 3”x3”x3”.
- Design should be simple and easy to maintain in the field.
- Parts should be easily sourced and have no restrictions to facilitate ease of maintenance.

Current Design

- The design consists of a frame which will be mounted to the rake of an excavator.
- The frame will hold all the components of the air blower such as the power source, the connectors, and the extended arm.
- The excavator will be remotely operated from inside the cabin through an interface that controls both the power source, the camera, and the movement of the extended arm.
- The motor will be hydraulically powered using the excavator’s onboard hydraulic system.
- The extended arm and camera systems will be powered using the excavator’s onboard battery 12V source.



Solidworks model of the Air Excavator design mounted on a HALO rake

Our Client

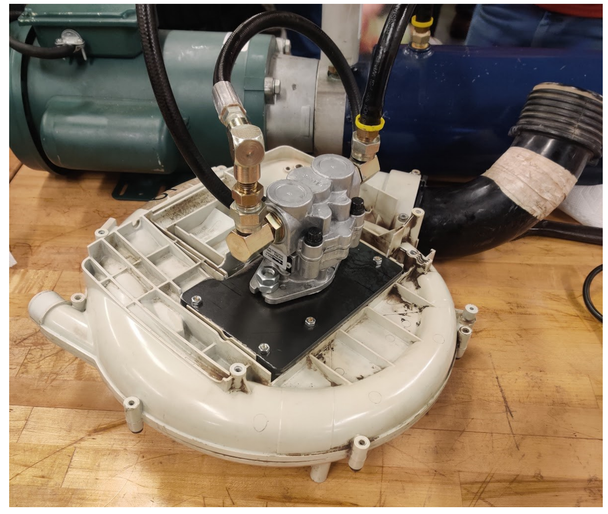
- Mission is to lead the effort to protect lives and restore livelihoods for those affected by war
- Engaged with humanitarian demining in over 20 countries and territories around the world
- In their work to make people and places safe they embed themselves in local communities, build capacity and work 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

Future Work

At this point in this project the only testing that has been done is verifying that the hydraulic motor will power the fan blade. Moving forward will consist of fabrication of frame, cage, and the extension arm. After fabrication many tests will be required to finalize the design and move into a final production phase.

Theses tests include:

- Finalizing blower fan size based on the air volume output required
- Using experiments to determine the optimal size for the frame’s retaining arms
- Vibration and load testing to verify the frame will be secure on the rake
- Determining the best placement of the cameras for the best view from the excavator cabin
- Extension arm testing to finalize linear actuator length and range of motion.
- Determining the arrangement of tubing to allow the air to travel from the blower to the arm with minimal energy losses



Motor with adapter plate to attached to the Stihl 420 blower

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