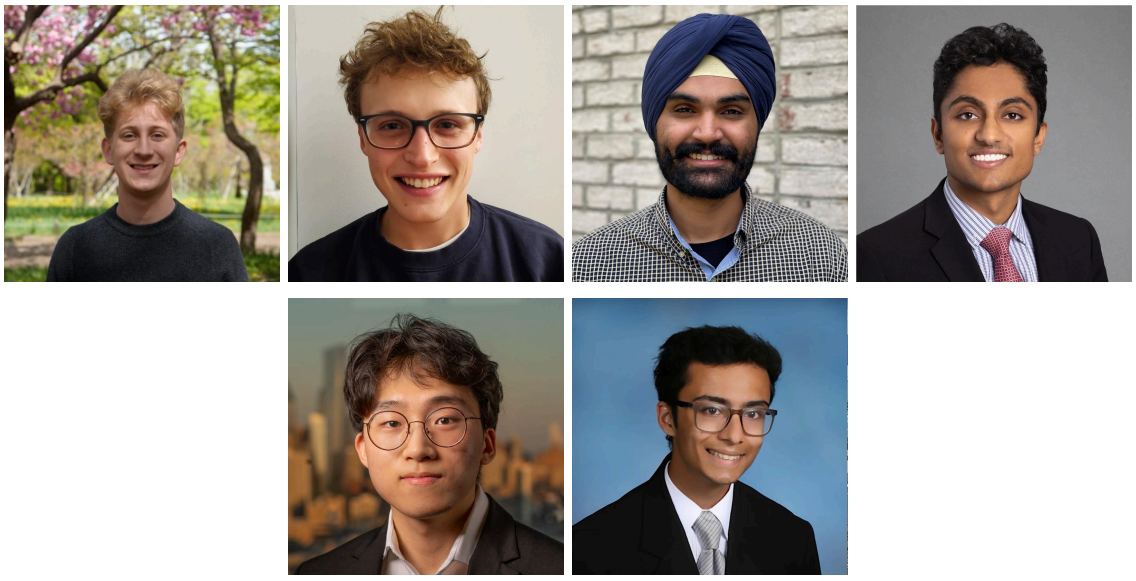
MiniMap Senior Design Business Analysis

The Team



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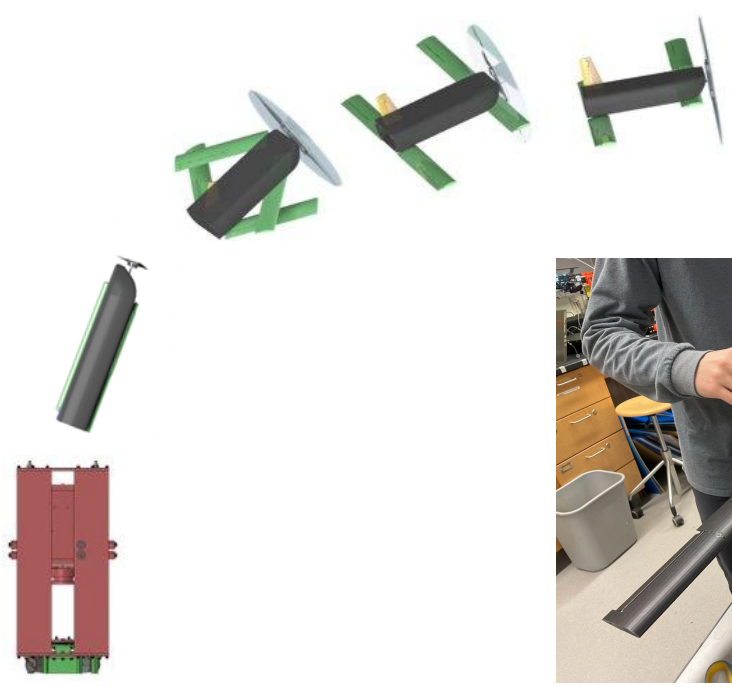
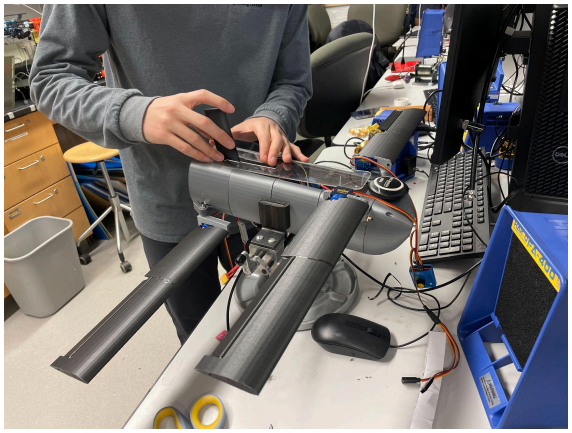
Executive Summary

MiniMap is an autonomous UAV reconnaissance system designed to be placed in the hands of first responders around the world. Housed in a portable canister tube, MiniMap aims to provide a seamless way to survey a fire, crash site, or other emergency safely to gain critical initial information within minutes of notice. First responders simply use a personal device to circle an area on a map, place the MiniMap matrix, and a tube-launched swarm of drones will begin to survey an area of up to a few square miles.

This project is different from existing drone products in several ways: first, the deployment time, second, the swarm-ability, third, the portability. Existing drones require setup time before flight and are not easily nor rapidly deployable. Whether it's unfolding and fastening on propellers for quadcopters, or setting up a catapult launcher for a fixed-wing aircraft, valuable time is wasted in disaster response, and experience is needed to execute the launch. Second, existing drone solutions for first responders are single-operator single-drone. This means that the drone's coverage is limited by its flight time, and is at the whim of an operator who must be focused on controlling the drone. Third, existing swarm solutions are not portable. Current swarms contain dozens of drones that are not packaged for easy transportation and deployment.

MiniMap addresses these issues using canister launching for deployment, an easy-to-use UI for swarm management by a non-expert, and efficient packaging for easy disaster response. It’s tailored for responses to time-sensitive, large-scale disasters, like fires and floods, search and rescue operations for hikers and missing persons, forest monitoring, and more.





Business Plan

Value Proposition

MiniMap aims to make drone use as easy and convenient as a cell phone. By packaging the drone in a ready-to-launch canister, there is less than a minute between operational initiation (inputting a search area) and operational execution. Current drone technology is single-drone, single-operator. This means that drone coverage is limited by battery life, and requires direct operator focus for the duration of the mission.

MiniMap uses a multi-drone, autonomous operation scheme that requires minimal operator oversight and substantially multiplies the impact of the operator. Staggering the launches of many drones means battery life is less of an issue, as one drone is depleted, another drone can launch. MiniMap drones are also fixed-wing, which gives them 2-3x the battery life of traditional quadcopter drones. Lastly, unlike current drone solutions, MiniMap incorporates an easy-to-use UI in the form of an easy-to-use desktop and mobile tablet app, which eliminates the need for extensive operator training. The launcher canister incorporates a storage unit, battery charger, command and control station, and staging point for operations. Besides manual re-folding of the MiniMap drone, there is very little mechanical expertise required for operation.

As MiniMap drones fly, they analyze their flight path for a chosen target. If conducting a search-and-rescue operation, for example, the drones look for heat signatures indicative of a person and classify them using an image recognition algorithm. Locations of potential targets are flagged, and secondary coverage flight paths are arranged by the command and control point. The secondary coverage boosts the confidence in an identified target to the operator; allowing them to deploy field resources in a deliberate manner. The search algorithm will show the most relevant images to the operator, giving them very little data to process before calling secondary flight paths.

Whether users include firefighters trying to locate the source of a fire, national park rangers trying to find missing persons across vast swaths of land, or even police forces searching for criminals, MiniMap represents a differentiated solution that can survey large areas and identify key objects of interest in a cost-effective and user-friendly manner.

Market Opportunity

While first responders have many ways of gathering information about a developing scene, they can either use (1) Satellite Imagery, (2) a Chartered Plane, or (3) a survey drone. For example, when alerted about a growing forest fire, the CalFire department has the option to (1) wait for satellite imagery to update, which can be very slow and low resolution; (2) send out a manually operated quadcopter drone to get data over a relatively small region, which requires a trained operator to execute and is slow to setup, or (3) to send out a chartered plane from a nearby airport, which can cover a large region and take pictures, but is very expensive and very

slow. Other first responder departments like law enforcement and even naval protection like the Coast Guard have similar problems with slow situational awareness products, a lack of usability, and low-resolution imagery.

There is a clear market opportunity for a quick, medium-high resolution solution that can help first responders get “eyes on the problem” as quickly as possible without much training. MiniMap offers all of those solutions in an easy-to-use, portable box. MiniMap’s rapid launch system lets drones launch every 6 seconds, and can autonomously search 5 square miles in just 15 minutes, while also performing multi-passes to very data and pursuing complex, dynamic paths. Users will simply need to drag out an area on the map that they want to survey, which drastically reduces the complexity of flying a drone especially compared to current solutions that require a trained operator to set up and fly a drone.

Competitors

The main competition that MiniMap will face is the current manned aerial vehicles and drones that are currently used in first-response scenarios. MiniMap will be a replacement for these solutions that often require special training and take a while to get up in the air to a point where useful data can be transmitted to the team. For example, the California Fire Department currently uses a manned spotter plane to map out a fire and decide how to deploy resources. These planes must be stored at one of a few CalFire airports and may be far away from a response site, not to mention the time required to get the pilot on board, perform pre-flight safety checks, and take off to the desired location. Our product will be an easy-to-use, prepackaged system that can be housed at a local fire station and deployed by a single person, at a moment’s notice. This will save the CalFire personnel precious time and help them make more informed decisions to allocate their resources and manpower to areas that need the most attention.

Skydio is a competitor that uses a copter to autonomously map an area in three dimensions with high resolution. Wingtra is another competitor that uses a plane to autonomously cover and image approximately 1.2 square miles at maximum with centimeter resolution. We believe that these companies only indirectly compete with MiniMap’s product because MiniMap is intended to fill a different service niche. Both of these companies make an attempt to acquire very high-resolution data in a very long timeframe to beat easily accessible satellite imaging. Additionally, neither of these companies offers autonomous drone swarm solutions, which are key to covering larger areas and performing multi-passes for increased accuracy. MiniMap provides medium-resolution data of a very large area (a few square miles) at very short time scales. The use case and targeted customers are thus different from existing drone companies. Another competitor is Anduril, whose Roadrunner is an autonomous plane intended to collect intelligence and intercept other drones. However, this plane is very big, not portable, and expensive, so it would likely not be a usable option for a team of first responders.

Other potential competition that we may face would come from satellite imaging. While we see our solution as being competitive with satellite imagery, we believe that MiniMap can be used alongside satellite imagery in order to supplement coverage at the immediate timeframe.

Customer Segments and Market Size

MiniMap targets two first responder segments: law enforcement and fire protection. The product will be primarily marketed to municipal fire departments and state police departments. There is a huge market for MiniMap to break into with the wide range of use cases of this product. We estimate a Total Addressable Market (TAM) of $7.3B, which includes the total spending on Aerial Products in Public Safety, Disaster Response, and Precision Forestry. The Serviceable Addressable Market (SAM) is estimated to be $4.5B, which includes total spending on Aerial Products in Disaster Response and Public Safety. Finally, we expect our Serviceable Obtainable Market (SOM) to be $3.2B, which includes total spending on aerial products in disaster response. The projected CAGR in the public safety drone market is 18.5%, and with an increasing number of natural disasters as a result of climate change, we expect this number to increase in the coming years.

Our initial target customers are fire departments around the country that need minute-by-minute updates on the area that they survey. After talking with the CalFire and LA Fire departments, we saw there was significant interest in a product like MiniMap that could offer instantaneous situational awareness across a large area without much user training. Based on this and the compatibility of our product with such use cases, we set our initial target customers on fire departments that could use MiniMap. There are about 850 fire departments in California alone, each of which can greatly benefit from having their own set of MiniMaps to quickly react to the prevalent fires.

We also plan to target other first-responder customer bases. For example, we also spoke with policemen from the Pennsylvania State Police Department, who used a manually operated drone borrowed from the DEA to catch an escaped prisoner in Chester County, PA, a full two weeks after the prisoner escaped. There is a need for situational awareness in police departments, and we believe that MiniMpa can best address this need.

Stakeholders

Stakeholders include the general public, who are often interested in potential surveillance, particularly by drones and particularly from law enforcement. The general public is also particularly attuned to natural disasters and natural disaster prevention in the status quo. Our targeted customers, law enforcement and firefighters are also stakeholders interested in how their situational awareness can be increased at short time scales. Moreover, the government is a stakeholder that regulates the functionality and use of drones; politicians and regulators might be interested in how drones are deployed by law enforcement. Suppliers of parts for the drone (e.g., electronics, materials for the airframe) are another natural stakeholder.

Revenue Model

When selling our product, we will be employing a “razor-and-blades” model. Customers will be offered a relatively low-priced canister launch system that fits our particular drone design. The drone swarm, however, will be more expensive and could be purchased in varying quantities/configurations depending on the use case. We plan to sell a standard full system with 6 drones and a launcher at a price of $16,000. Each drone can be replaced for a price of $2,000, and purchasing the launcher alone will cost $5,000. In addition, we plan to ultimately use a proprietary command and control software and user interface. The basic user interface will cost $150 / 6 drones / year, while the add-on data processing features like image processing will cost an additional $900 / 6 drones / year.

Revenue will also be generated on drone maintenance and replacements, which will be priced according to the level of service provided.

Cost

The main cost driver for the product will be manufacturing inputs, since inexpensive machinery was used to manufacture the system and can be employed at scale. Currently, each drone costs $484 to build, which includes electronics, raw materials, motors, and more, and the launcher costs $859 to build. However, with additional scale, we expect these costs to drastically decrease. By using injection molding, custom flight computers, better actuators, custom telemetry devices, and advanced composites, we expected the unit material cost per drone to be less than $309, which results in a 82.1% contribution margin ratio (gross margin before labor and fixed costs). We also expect the launcher cost to decrease to less than $648, by sourcing materials, using a better battery, manufacturing with a scalable CNC, and simplifying the system. This puts the launcher contribution margin at 82.4%.

While we have a concrete idea of the variable costs, we lack information about fixed costs, since this would eventually require setting up a manufacturing facility, hiring trained labor, and buying advanced assembly and manufacturing equipment to produce these drones at scale. Regardless, because of the high gross margin before fixed costs (contribution margin, explained above), we expect MiniMap to be highly profitable, even after high fixed costs from setting up a factory.

IP

We have designed the mechanical and electrical systems ourselves and will be pursuing a patent on the launcher mechanical design, airframe mechanical design, and the novel and non-obvious system for our portable, fast-launched fixed-wing drone swarm. We also plan to patent the communication network technology.

Link to Demo