Fowado Technology Group - White Paper Submission: sUAS Detection and/or Tracking Prize Challenge

Company Name: Fowado Technology Group (FTG)

Capability Tile: Modernized Passive Acoustic Detection (MPAD)

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Problem Statement Tile: As outlined in the Challenge Use Case the proliferation of Small Unmanned Aerial Systems (sUAS) presents a challenging problem for the SOF mission, particularly in light of the inherent SOF constraints that render conventional solutions impractical. Our approach, Modernized Passive Acoustic Detection (MPAD), takes a fresh look at a tried and true technology for this problem space.

EXECUTIVE SUMMARY

Fowado Technology Group (FTG) proposes Modernized Passive Acoustic Detection (MPAD) as a possible solution for the detection and tracking of Small Unmanned Aerial Systems (sUAS) in a passive manner. We are taking a novel approach built atop a tried and true concept that dates back to World War I. MPAD uses Machine Learning (ML) paired with sound localization to provide an Artificial Intelligence (AI) powered solution to detect and track sUAS in all-weather conditions.

TECHNOLOGY CONCEPT

Our technology concept is rooted in sound localization, a technique used as a military air defense tool during World War I and early stages of World War II before radar render it largely obsolete. During that period of time the implementation entailed large acoustic locators which functioned in both active and passive modes. In modern times acoustic location is the underpinning of sonar as either a passive or active underwater detection mechanism. Due to its proven track record the sound localization component of the system has a very mature technology and manufacturing readiness level (TRL/MRL 9).

The second major technology component of MPAD is the use of Machine Learning (ML) to power the detection and tracking capability. Rather than building detection based on human defined characteristics, ML empowers a system to perform data analysis automatically, learning from data on its own. This branch of Artificial Intelligence (AI) has blossomed over the last few decades and now it's a central component of many civilian and military system. Much like sound localization, ML as a technology component also has very mature technology and manufacturing levels (TRL/MRL 9).

MPAD takes a novel approach to sound localization by combining it with machine learning. For the initial 30-day prototype demonstration we propose a detection only capability (tracking being part of the end state system) that can detect the presence of sUAS inside a protection zone under the constraints dictated by the challenge: passive and all-weather. Additionally, it will be able to function beyond line of sight (BLOS) due to the diffraction properties of sound waves.

Initially an ML model will be built to detect sUAS by learning to recognize the unique characteristics associated with the sound a sUAS produces. We propose using a supervised learning approach to produce the ML model. One of the most important consideration when building a supervised ML model is the labeled training data that is utilized to train the model. MPAD will make use of the extensive corpus of open source self-labeled sUAS data in the form of user generated videos in general sites such as

YouTube and Facebook and others which are more sUAS focused such as Dronestagram and SkyPixel. We will leverage videos that have been tagged as sUAS platforms and that contain the sound produce by the sUAS. These videos will then be used as the labeled training data to create the ML model. Over time as the model is continuously trained with new data it could serve as a library of different sUAS that will grow to improve the overall performance metrics (accuracy, recall, precision, etc…) of the system including the ability to classify the specific sUAS platform.

Once the model has been developed it will be coupled with the sound localization hardware (high performance microphone array) to provide detection of sUAS in the protection zone. The protection zone will be largely dictated by the range characteristics of the microphone array. The initial form factor will target a FOB installation to reduce the complexities associated with vehicle-mounted and man-portable implementations. The desired end state system would add the sUAS classification as well as the tracking capability by introducing additional microphone probes and using the time difference of arrival (TDOA) or triangulation methods to determine the source direction.

The detection and tracking capabilities could scale down from FOB with additional time and funding. For the detection capability the miniaturization would involve reducing the acoustic hardware as well as additional considerations in the detection model for sound interference in a vehicle or mounted scenario. The tracking capability would require further considerations as the microphone array could also be moving while tracking the target. The scaling of tracking to vehicle-mounted or man-portable will likely be the most challenging and has the biggest risk of not being within the art of the possible.

For the initial 30-day system the major risks involve the development of the ML model, particularly the ability to process the large amount of training data required to achieve acceptable results. In order to mitigate this challenge, we envision using the cloud ML offerings on Amazon AWS. The breadth and depth of AWS ML cloud services will help us meet the aggressive timeline of the challenge.

COMPANY VIABILITY

Fowado Technology Group (FTG) is a small, minority, veteran owned business based out of Tampa, Florida. While selling some of the most sophisticated drone equipment available to civilians FTG also offers custom UAS solutions that include engineering and manufacturing of both hardware and software components and systems. Additionally, we also pilot drones for a variety customer needs; this gives us the unique perspective of the entire UAS lifecycle: sale, service, modification, and operation.

In terms of recent applicable past performance FTG participated at SOFWERX "Airspew" competition. Using a DJI Phantom 4 quadcopter as the platform, the requirements of this competition were to:

- Develop a leaflet/payload drop system capable of holding 1 pound of leaflets
- Develop a speaker system that can broadcast a message to crowds of people
- Develop a software defined radio broadcasting device

FTG was able to meet all requirements which resulted in a top three finish and further evaluation by SOCOM for potential future production.

ROM COST/SCHEDULE

Proof of Concept Prototype (30 days)
Assumptions: Detection only; FOB scale; one prototype covering one protection zone;

- Cost ($25,000)
  - Acoustic Hardware - $1,000
  - Field Compute Hardware - $2,000
  - Cloud Services - $5,500
  - Testing Facilities and Hardware Access - $2,500
  - Engineering - $14,000

Fully Matured Desired End State
Assumptions: Detection and Tracking with sUAS platform identification; FOB scale; one system covering four individual protection zones; can re-use hardware from 30-day prototype;
Variables: Availability of training data to support drone platform identification;

- Cost ($70,000)
  - Acoustic Hardware - $3,500
  - Field Computer Hardware - $2,000
  - Cloud Services - $10,000
  - Testing Facilities and Hardware Access - $8,500
  - Engineering - $46,000
- Schedule: 90 days after completion of prototype

If not selected as an immediate cash prize winner for this prize challenge we would most likely not complete this project using our own money. This is not a final decision and could be swayed by firm demonstration opportunities, reduced scope for initial prototype, and clear path to eventual funding.