INDIVIDUAL LAB REPORT

KARTHIK RAMACHANDRAN

TEAM F

Autonomous System for Aerial Search and Rescue

Karthik Ramachandran, Sumit Saxena, Juncheng Zhang, Xiaoyang Liu

10/20/2016

Overview

Team Goals

- Explore options for sound, thermal and rgb sensors.
- Rampup on DJI operability.
- Inital strategy for localized navigation pattern.

Individual Deliverables

The individual deliverable was to explore use-cases and feasibility of sound based sensing for Aerial Search and Rescue.

Usecases

1. The drone flies to each of the waypoint and records the sound at that waypoint. This data is processed through some filtering and VAD software to detect timestamps where there was a human sound and increases the probability of that location being a rescue location.
2. The drone is fitted with multiple microphones and this can be used to localize the sound coming from a source accurately, while dropping a rescue package. This option is desirable but not mandatory as of now.

Challenges and Possible Mitigations

The biggest challenge with using sound based sensors in a drone is to, be able to filter out the noise generated by the propeller and to isolate the sounds that are desired. This problem can be addressed in the following ways. Note that these are not mutually exclusive. Some or all of them may have to be used.

1. Use of unidirectional microphones (Cardioid/Hypercardioid) which are sensitive to sound from a particular direction and block noise from other directions
2. Another option to reduce the noise from the propeller is, to lower the microphone through a suspension mechanism to roughly 10-15 feet below the drone. This has shown to reduce the impact of propeller noise considerably.
3. Use of Filtering and Voice Activity Detection Software to remove unwanted frequencies and figure out timestamps in a sound sample where there was a high likelihood of human voice. There are tools like Adobe Audition and Webrtcvad[1] that can be used for filtering and voice activity detection.
4. There is some research data that point a very direct correlation between the rpm

of the rotor and the frequency of noise that is generated. By tracking the temporal rotor rpm graph, specific frequencies corresponding to the rotor noise can be filtered out from the sound sample.

5. The last option was to explore the use of safety whistle as a sound source. Safety whistles are commonly carried by hikers and they emit sound in the range 3-5K hertz which is easier to detect and isolate.

Team Work

Xiaoyan worked on exploring the capabilities of the DJI Matrice 600 and also studying different modes it provides. The DJI matrice provides a simulator that can be used to test the code but unfortunately, the simulator cannot be used unless the drone is connected to the laptop. Since we do not have a drone yet, no further progress could be made on this. Juncheng and Sumit worked on exploring RGB and Thermal Imaging options. Since the payload provided by NEA has both of these sensors, the task was more along the lines of validating if the sensors provide the necessary functionality. The team also worked together on initial design for a local navigation strategy. The initial motivation for a narrow local navigation strategy was based on the assumption that the drone might not be able get good coverage and resolution unless it took a path of concentric upward circles. But based on the quality of RGB and thermal sensors, it looks like a simple pattern should be sufficient for capturing good sensor data.

Future Work

Task from CODR for week of October 20th - October 27th 2016

- Localized Pattern Navigation
    - Software for planning localized navigation pattern with acceptable sensor coverage (as per FVR)

Goal is to implement a prototype that will accept

- GPS coordinates for potential search locations
- GPS coordinates for boundary limits for an area
- Parameters for local navigation pattern at each waypoint

The program will output a path comprising a list of intermediate waypoints.