Software Engineering

Group 8

Search And Rescue Assistant (S.A.R.A.)

https://abhiek187.github.io/emergency-response-drone/

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Individual Contributions Breakdown

Project Deliverable	Sahana	Won	Avnish	Abhishek	Shantanu	Krishna M.	Krishna T.	Vishal
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Customer Statement of Requirements

Search and rescue operations can often involve first responders and volunteers trying to cover a vast area in as little time as possible to save the most lives. These operations can be categorized by the environment take place in. They can further be categorized by the specific type of operation that needs to take place, such as in urban areas or in remote mountainous regions. The circumstances that could merit such operations could involve natural disasters such as earthquakes and hurricanes. Regardless of the type of operation, technology is being increasingly used to streamline the efforts of first responders and volunteers in their efforts to try to save as many people as possible. There have been many search and rescue missions in the past. Many of these missions involved the use of large amounts of people and resources. Even with all the effort put by the people involved many lives were lost in the process. One such organization that is involved in search and rescue operations is the Coast Guard. The table below illustrates the statistics of these operations conducted by the Coast Guard from 2011 through 2015.

Fiscal Year	Cases	Responses	Sorties	Lives Saved	Lives Lost	Unaccounted Lives
2011	20,512	43,954	21,566	3,793	735	392
2012	19,787	43,940	21,609	4,037	713	440
2013	17,803	38,272	19,420	3,753	651	252
2014	17,508	38,282	19,032	3,443	595	308
2015	16,456	37,215	18,781	3,536	603	330

The sheer number of cases and responses conducted by the Coast Guard shows how big of an issue search and rescue missions are in the United States. The table also emphasizes that concept that these operations are not always successful or efficient. This is based on the number of lives lost and the number of people not accounted for along with a high number of responses for the cases. Our method looks into a possible alternative approach to these search and rescue missions.

The Search and Rescue Assistant, or S.A.R.A. will modernize the techniques employed by first responders on search and rescue operations. A drone can cover more distance than a single person is able to. Currently, the most frequently used techniques to cover a lot of areas very quickly is to either use a helicopter or to use a lot of people. The problem with helicopters is that they usually have to fly in from somewhere else and that can take time. Another problem with the use of helicopters is its lack of ability to search in narrow or tight areas. The issue with using a lot of volunteers is that people end up risking their own lives to find survivors. Often times these search parties tend to be time-consuming and depending on the circumstances, unorganized.

Ready-to-launch drones can be set up in minutes, which will save time. By attaching a camera to the drone the user will able to see the video feed that the drone is transmitting. Doing so will reduce the risk of potentially sending people in harm's way to get the most accurate information about where people might be trapped. Additionally, this would also be cost-efficient. This would reduce actual labor since we would mainly be investing in developing an efficient algorithm, and the device. This algorithm would take one initial investment and would be developed for improvement. Due to the cost effectiveness of the device and the reusability of the

algorithms involved, if the resources were to be available, it should be rather simple to manufacture multiple devices.

Naturally, an important aspect of an aerial vehicle of this nature is whether or not it can survive the challenges/harsh conditions it can face while in the field. To bolster S.A.R.A's ability to withstand these conditions, it will be able to avoid obstructions in its' path, in part due to the implementation of ultrasonic sensors. Using these sensors, and the usage of the primary camera, the user can easily maneuver through different obstacles that he/she may encounter during a search and rescue mission. To assist the end-user in knowing the immediate environment, a thermal imaging attachment will be mounted to the mobile phone that serves as the drone's primary camera. Image processing will not occur on the drone itself, but instead on a centralized hub located back on an emergency vehicle, which receives relayed images/video real-time so that emergency responders can quickly determine the best course of action. The sensors/equipment necessary to accomplish this will be either be purchased or obtained by the team members from existing laboratories/organizations.

Regarding the working environment, S.A.R.A. will have to be able to maneuver in potentially tight/enclosed spaces. In such an environment, being able to receive data on how close an object is to the drone is a specialized function ultrasonic sensors can provide. The drone can then properly take a course of action based on the proximity data it receives, such as change the amount of thrust in a particular direction or instead start pushing in an entirely different direction. With regards to processing visual data, the S.U.R.F. identification algorithm can be used to accurately determine an image's correlation/accuracy to a specific desired target object. In this case, the target would be the human faces/heat signatures.

Even with many solutions to search and rescue operations, S.A.R.A. offers a new take on optimizing the field. One of the key priorities of search and rescue missions includes safety, not just for the missing people, but for the people involved in the rescue operation. This approach makes it easy for even a single person to actively investigate the search and rescue operation in a safe manner. There would be more focus on the actual goal of the mission instead of also worrying about the safety of the people working the rescue/search missions.

GLOSSARY OF TERMS

Database - Server that will keep data of the drone and pictures from the drone camera.

UI - A physical program that allows the user to see the environment from the camera, information of the drone speed and health, and distance away from the objects.

Controller - A device that will allow the user to control the drone movements and avoid any obstacles.

Proximity Alert - Internal mechanism that will use proximity sensors to see if the drone is getting dangerously close to any obstacles in the flight path.

Wireless Connection - The connection between the drone, controller, and database that allows the user to stay in control of the drone.

Drone Sensors - Devices that allow the drones to detect its speed, distance from user, stability, to detect obstacles, the drone's health, etc. Examples include an IR/Thermal sensor, Accelerometer, and Gyroscope.

S.U.R.F.(Speeded Up Robust Features) - an algorithm that finds key points of an image using Hessian Matrices and scaled space, making it simpler to compare different images and see if they correlate appropriately.

FUNCTIONAL REQUIREMENTS

REQ1 - Database/Server
REQ2 - UI Screen
REQ3 - Controller
REQ4 - viewDroneCondition
REQ5 - Proximity Alert
REQ6 - Wireless Connection
REQ7 - GPS tracking
REQ8 - Infrared Sensor

Requirement	Priority	Description
REQ1	5	Data server that will store the information from the drone and allow the user to access it
REQ2	2	The user interface will allow the user to see the drones footage and any other relevant information
REQ3	1	The user should be able to control the drone's movements
REQ4	4	The drone will send a signal to the controller to notify of its operating status
REQ5	1	The drone should be able to correctly identify any close obstacles and be able to able to avoid them.
REQ6	2	A connection between drone and controller
REQ7	2	The user will be able to know exactly where the drone is.
REQ8	3	This sensor will allow the user to detect heat signatures through any material walls

<u>NONFUNCTIONAL REQUIREMENTS</u>

<u>Usability</u> - User will figure out that it is easy to learn the functions of the drone using the inputs and outputs involved in the system

<u>Security</u> - User will be able to use the interface without having to jeopardize his/her safety by using the drone from a reasonable distance.

<u>Accessibility</u> - The user will be able to run the software to operate the drone, on any smartphone regardless of the OS on the device.

<u>Efficiency</u> - User will be able to use the software with any accompanying hardware through a wireless connection.

<u>Recovery</u> - User will be able to recover the drone if the signal is lost. If the drone software is program to auto course to controller and land back safely.

USER INTERFACE REQUIREMENTS

Requirement	Priority	Description
REQ1	1	The controller for the drone will have a live feed of what the camera is seeing
REQ2	3	It will also display various properties of the drone. Some properties include speed of motors, drone battery level, wireless connection etc...
REQ3	2	Proximity alerts will be sent to the controller so the user know which direction to avoid
REQ4	4	The operating status of the drone will be sent to the controller so the user will know if they have to pull the drone back if case of low battery level.

Image 1

Project Management

Shantanu came up with the project idea and was able to explain how we could contribute to the project during weekly meetings.

Krishna Mahadas created and shared the Google Drive for our project so we could easily collaborate on creating the reports.

Abhishek manages the GitHub repository to maintain the project code and divide the work among the team.

A website is going to be made and developed with relevant updates to the project. This will be managed by Abhishek. Other team members will help.

We divided the project into four categories:
- Visual Data Processing (Abhishek, Shantanu, Krishna Mahadas)
- Location Data (Avnish)
- Physical Data (Sahana, Won Seok, Sri Sai Krishna Tottempudi)
- Obstacles (Vishal)

All other contributions to the project can be found in the individual contributions breakdown matrix on page 2.

References

https://www.dronesense.com/?gclid=EAIaIQobChMIqo-45_Gx4AIVwoCfCh2CbA0QEAAYAS
AAEgKMu_D_BwE

Image 1:
https://s.yimg.com/ny/api/res/1.2/2P8Y6UqlB8dKOiVIg9Rscg--~A/YXBwaWQ9aGlnaGxhbmR
lcjtzbT0xO3c9ODAw/http://media.zenfs.com/en-US/homerun/digital_trends_973/8122e594705a
009db372bf32720d9fe9

https://www.aopa.org/news-and-media/all-news/2018/october/01/drone-study-reveals-potential-a
nd-limits

Coast Guard Table:
https://www.dco.uscg.mil/Portals/9/CG-5R/SARfactsInfo/SAR%20Sum%20Stats%2064-16.pdf