Path planning for an Autonomous Search and rescue drone

Search and rescue

Search and rescue missions are crucial in safeguarding human lives during emergencies and natural disasters. These missions often require a substantial investment of resources, including financial funding, fuel, and the dedicated involvement of human rescuers. The complexities in these operations, along with the need for rapid response, have placed immense strain on organizations involved in search and rescue efforts (Waharte & Trigoni, 2010).

The financial costs associated with search and rescue missions are significant, with maintenance of equipment, compensation for rescue teams, and the logistics required for mission coordination. Moreover, the heavy reliance on fuel for conventional search and rescue vehicles, such as helicopters and boats, contributes to a considerable environmental footprint. Human resources are also a main component of search and rescue operations, with skilled personnel risking their safety to aid those in need. In addition, human rescuers' safety is always a safety concern, particularly in disaster-stricken areas. Using Unmanned Aerial Vehicles is often seen as a solution to search and rescue missions.

Unmanned Aerial Vehicles (UAVs)

Unmanned Aerial Vehicles (UAVs) are pilotless aerial vehicles. They are small, reliable, and do not require any kind of advanced equipment and measures to take off and land. In addition to that, they can perform more intelligent tasks. Over the past few years, there have been many advances in tasks performed by UAVs. UAVs have been used to perform various tasks, such as environmental monitoring, wildlife population tracking, wildfire monitoring, and border patrol (Erdos et al., 2013).

Using Autonomous UAVs for Search and Rescue

Since UAVs are versatile, they could be deployed in a wide range of SAR scenarios. Unlike conventional search and rescue teams, which may require significant time and resources, UAVs can be launched swiftly. This swiftness is especially useful in time-sensitive situations, where every minute counts in potentially saving lives (Półka et al., 2017).

Traditional SAR operations often necessitate substantial financial investments in equipment, fuel, and personnel. However, UAVs drastically reduce these costs. Furthermore, they minimize the risk to human lives by performing tasks in hard-to-reach areas, ultimately reducing the reliance on human resources (Naidoo et al., 2011).

Drones also excel in navigating challenging terrains, such as areas affected by natural disasters, rough landscapes, or remote regions. They can fly at various altitudes making them ideal for conducting aerial surveys over large, inaccessible areas.

Moreover, the autonomous technology integrated into UAVs enables them to autonomously scan vast areas and identify survivors. Advanced image recognition software can detect human figures and share their exact locations with SAR teams. This capability expedites the rescue process, as it eliminates the time-consuming and labor-intensive task of manually searching for survivors.

However, to perform the search and rescue tasks, the drone must be capable of planning its own path and detecting humans using image recognition.

Path planning

One of the key aspects of path planning for drones involves the implementation of search patterns. Search patterns are predefined routes that drones follow to systematically cover an area and search for specific objects or information. These patterns are particularly essential in applications like search and rescue missions, where time is of the essence, and thorough coverage of an area is crucial.

Problem Statement

Currently used search and rescue drones are limited due to their battery power and lack of efficient path planning because of their limited knowledge of the environment around them. To address this, multiple drones can be used to map the environment, properly divide the area and conduct a search by traveling on a path that would consume the least energy while covering the entire search area. This project will simulate the

Objectives

Obj. 1- Obstacle Avoidance: The first objective was to create an obstacle avoidance algorithm for a drone based on ultrasonic sensor input.

Obj. 2- Mapping: The second objective was to collectively map the obstacles in given environment using lidar sensors equipped on multiple drones.

Obj. 3- Optimal Area Division: The third objective was to assign a given environment to 2 different drones considering each drone's current location.

Obj. 4- Energy-aware Coverage path generation: The final objective was to create an efficient path for each drone within the assigned area while minimizing energy cost but maximizing coverage.