Team 4 - Rescue Drone

Needs Assessment

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Abstract

Unmanned aerial vehicles (UAVs) used by the Emergency Management and Homeland Security Program (EMHS) at Florida State University (FSU) lack efficient data processing. The focus of this UAV project is to develop an UAV with features improved to enhance the search and rescue (SAR) missions. This needs assessment report shall discuss the major focus areas for development which can be categorized as connection, location, detection, and improved flight duration.

1. Introduction

UAVs were heavily criticized in their early years for being unreliable; however, about a century later they have become central to a global market that is worth almost $127 billion [1]. Over the years, in addition to military purposes, UAVs have been employed in a wide range of applications, from weather monitoring and bridge inspection to border patrol and 3D mapping [2].

One of these applications is SAR operations. Due to their small size and high maneuverability, UAVs provide a safer and faster way to incorporate aerial assistance in SAR operations for a fraction of the cost and resources [3]. Unlike manned aircrafts, which are traditional tools of aerial assistance in SAR operations, small UAVs have a lower noise footprint that causes less interference to the rescue operations [3].

FSU's EMHS has successfully used drones on risk reduction projects in the Caribbean [4], and is currently working on integrating them into emergency management and public safety. While prescribed autonomous flight operations allow UAVs to collect huge amounts of data quickly with minimum human interaction, transmission of those data to analysts is cumbersome and processing of the data rely heavily on humans. This greatly reduces the efficiency and accuracy of the data acquisition process when it comes to detecting target objects. With this concern, Senior Design Team 4 has been tasked with designing an UAV that can reduce human involvement in such operations.

2. Project Definition

a. Background

The UAVs were first developed during World War I in an effort to reduce air losses. When the US entered the war, the government developed the world's first "self-flying aerial torpedo," known as Kettering Bug, Fig 1[5]. Although it had more in common with a guided missile than a drone, its conception as a pilotless plane represented an important step in the historical development of UAVs.

Figure 1: Kettering Bug

Aerial data gathering has been an important job of aircraft for most of aviation history. Rapidly dropping prices and ease of operation have moved small, multi-rotor type UAVs to the forefront of use for recreational flight and professional data collection. Limited flight time is a penalty of this type of vehicle. Prescribed autonomous flight operations allow modern UAVs to collect huge amounts of data quickly, and with minimum human interaction. Returning those data to analysts, and processing them are time consuming, detail oriented

tasks. Increased flight times, improvement of data processing, and improvement of data transmission are areas for continued improvement of the small multi-rotor UAV.

b. Needs Statement

The objective is to create an autonomous, multirotor aircraft that can scan a designated area for objects. The identified objects shall then be reported to a ground station with information that also pertains to the object's location. This project is specifically requested and sponsored by the FSU EMHS Program. The request is to provide an aircraft that can be reproducible, easily repairable, and user friendly. FSU EMHS seeks to deploy such a vehicle in contexts ranging from local to state needs.

c. Goal Statement and Objectives

The desired specifications of the autonomous drone has been divided into needs and wants. The listed "needs" shall be the main objective for the design of the product, while the "wants" shall be our goals for further development.

Needs:

- Multirotor Aircraft
- Autonomous flight based on user designated path
- Fits in a hard-case (24"x20"x14")
- Flight time of minimum 18 minutes

- Identify particular object
- Carry photometrics; sensors
- Able to communicate with a ground station
- Output location data using USNG coordinates
- Reproducible vehicle design based on construction documentation
- Includes concise user manual
- Two axis gimbal for camera

Wants:

- Flight time closer to 30 minutes
- Use of IP network for the communication of data
- Autonomous collection of stand-out data
- Autonomous location logging of stand-out-data
- Fits in the sponsor's backpack

d. Constraints

This project shall proceed with consideration of and compliance to local, state, and federal regulations; codes of safety, conduct, and ethic as prescribed by FAMU-FSU College of Engineering, and FSU department of EMHS; as well as the code of conduct agreed upon, signed, and submitted by this project team.

e. Methodology

Team 4 shall operate in tandem with the sponsor with regard to the final path taken to fulfill the sponsor's needs, and meet the sponsor's budget. The path

set here shall be open to discussion and modification as the project and its needs require.

[i] Design

The first step in creating this UAV is to determine reasonable size and mass for the sensors, processors and supporting electronics for accomplishing the novel tasks requested by the sponsor. An airframe suitable to payload shall then be determined.

[ii] Prototyping

During prototyping novel electronics and software shall be in lateral development with the airframe. Both portions of the project shall be well optimized before they are joined and flown as whole vehicle.

[iii] Verification

The verification of the design shall ensure that while the UAV is running and in the air, the sensors are accurately scanning and processing the data of the designated area. Ensuring that the basic needs stated by FSU EMHS, for this UAV have been adequately met is the task of this phase.

[iv] Modification

If defined needs are not adequately met, modifications to the design shall be made to correct any errors. This stage shall be used as an opportunity to optimize the vehicle and its novel electronics. The opportunity to add extra functionality may be possible here.

3. Conclusion

FSU's EMHS program needs a multirotor autonomous drone that can recognize objects and send back geographical locations of these objects. The needs of the project were collected and listed by the team after a discussion with Mr. David Merrick. In further conversation, some wanted capabilities of the drone were discussed and are noted. The drone will be constructed based on parts that Mr. Merrick has within his lab. Thus, the construction needs to be well documented so that the drone can be replicated in the future.

4. References

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