Control of a Mini-helicopter (SL2-13)

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Overview

Introduction

A Quadrotor helicopter is a kind of unmanned aerial vehicle with four rotors. The complexity of controlling a Quadrotor is caused by the under-actuated system. In terms of its potential, it is the unmanned flying ability that enables a wide range of applications, such as aerial photography and aerial delivery services. The result of this project has the potential for practical application in operations involving target following, for example, in law enforcement and movie production, where helicopters and human resources are used at great expense.

Objective

The objective is to develop a Quadrotor to automatically fly following a ground object without the need of human control which makes target following process automatic, thereby saving human resources and the use of large expensive equipment.

System Block Diagram

Methodology

The Corner Identification Method is the algorithm in Robot Recognition and Tracking Module which is used to identify the ground robot and it consists of four parts.

1. Corner Detection: It is to detect all the possible corners in the image after blurring the image.
2. Edge Identification: All the edges will be found out in this part.
3. Contour Detection: Contours bounded by the edges are detected.
4. Corner Tracking: Eight corners with correct order are found out.

Results and Conclusion

There were in total four algorithms implemented and the one shown here, Corner Identification Method has the best performance. It can identify the ground robot on each image frame in 10 milliseconds while some other algorithms will take around 100 milliseconds. In addition, with pre-known target object, it can locate the exact eight corners in the correct order.

With the help of Kalman Filter, a stable and reliable position of ground robot will be sent to the Flight Control Board to achieve real time tracking. The result of this project has the potential to improve the operations involving target following. For example, in law enforcement, it is hard for police to catch thieves if there are some obstacles around, while with the technique in this project, police can possibly identify the thieves with a Quadrotor in real time. Another possible application would be in the movie production. In Hollywood, helicopters are often used to take movies, and UAV's controlled by human are adapted in recent years for some cases. With the method in this project, directors could simply pre-set the initial location of the actors, and then the Quadrotor could fly following the actors automatically and take videos. This can save human resources and equipment at great expense.

Further work could be done on the testing and integration to make sure that this algorithm has good performance in different environment with various kinds of noise, or improve the efficiency of it.