Autonomous Piloting System for a Drone using Computer Vision Algorithms

Saulo Fernando Guedes da Silva Junior, Prof. Jeongkyu Lee
Computer Science and Engineering Department
University of Bridgeport, Bridgeport, CT

Abstract

We develop an autonomous piloting system for a quad-copter drone to make it fly by following a lane on a road. The system consists of two main components, Image Acquisition and Processing, and Auto Navigation. Our approach consists in capture the image frames from the bottom camera and employ computer vision techniques. The results show that the autonomous piloting system can make a drone follow the lane automatically without manual control.

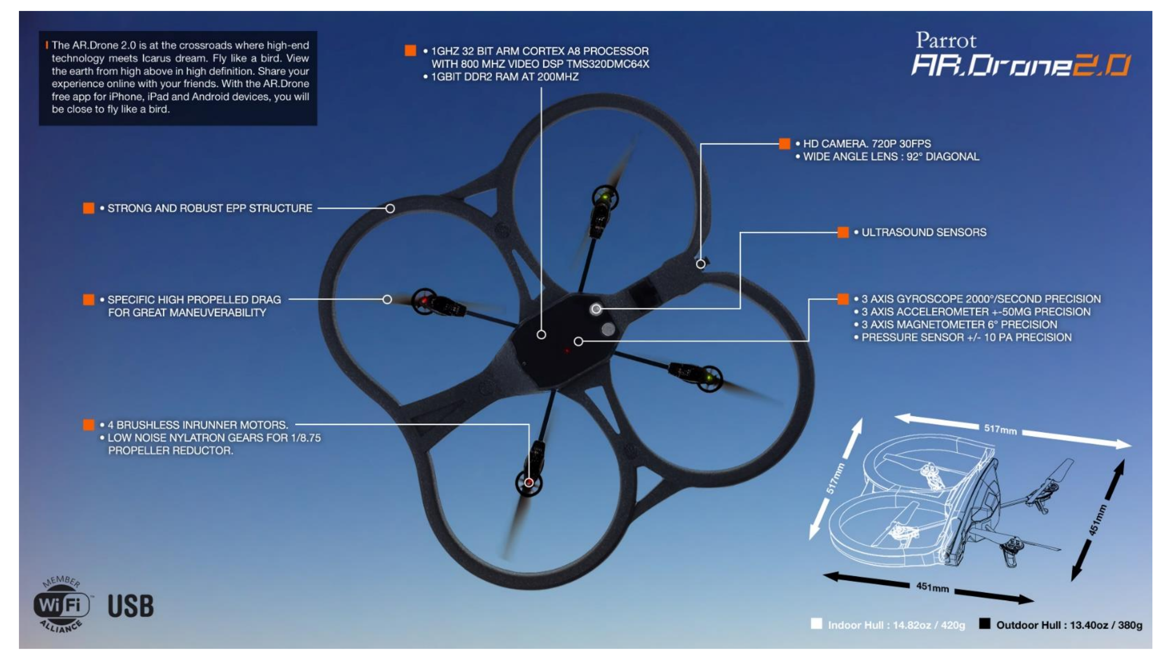

Fig.2 - Drone's architecture

Introduction

The development of information technology is particularly in the methods and technique of data acquisition and now data can be stored in many forms of digital media. The use of image as main characteristic for autonomous navigation of robots is a recurring approach. However, the image processing never reached its maximum level due to the existing complexity to do it. Our goal in this project is to make the Drone be able to identify the correct path by a specified lane and create an autonomous flight for the Drone using image processing assisted by computational vision algorithms.

Image processing

The images provided by the drone's bottom camera are taken 60 frames per second. These images are converted to HSV color space and them filtered by the desired color. Once this is done, a gray image is generated. Now that we have our image filtered by color, we need to identifier the shape and found the contour of our lane.

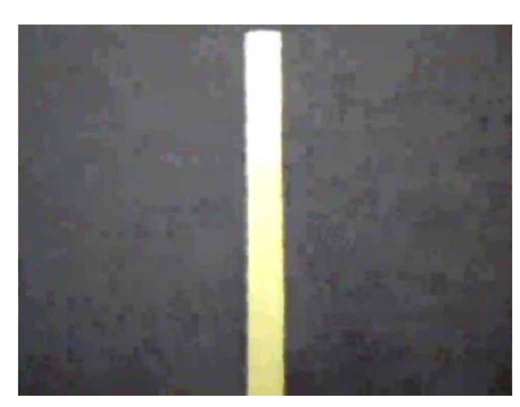
Fig.3.A - Original image

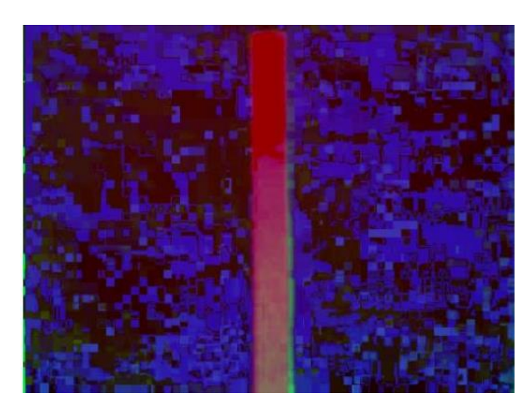
Fig.3.A - HSV image


Fig.3.A - Gray image with contour

System Overview

Our goal in this project is to make the Drone be able to identify the correct path by a specified lane and create an autonomous flight for the Drone. To do so, our project was divided in two main parts. First, the image acquisition and processing, which is responsible for the capture of the image by the Drone, processing it and getting the parameters to fly. Second, the autonomous navigation module, which is a Java base application responsible for setting the parameters and commanding the drone.

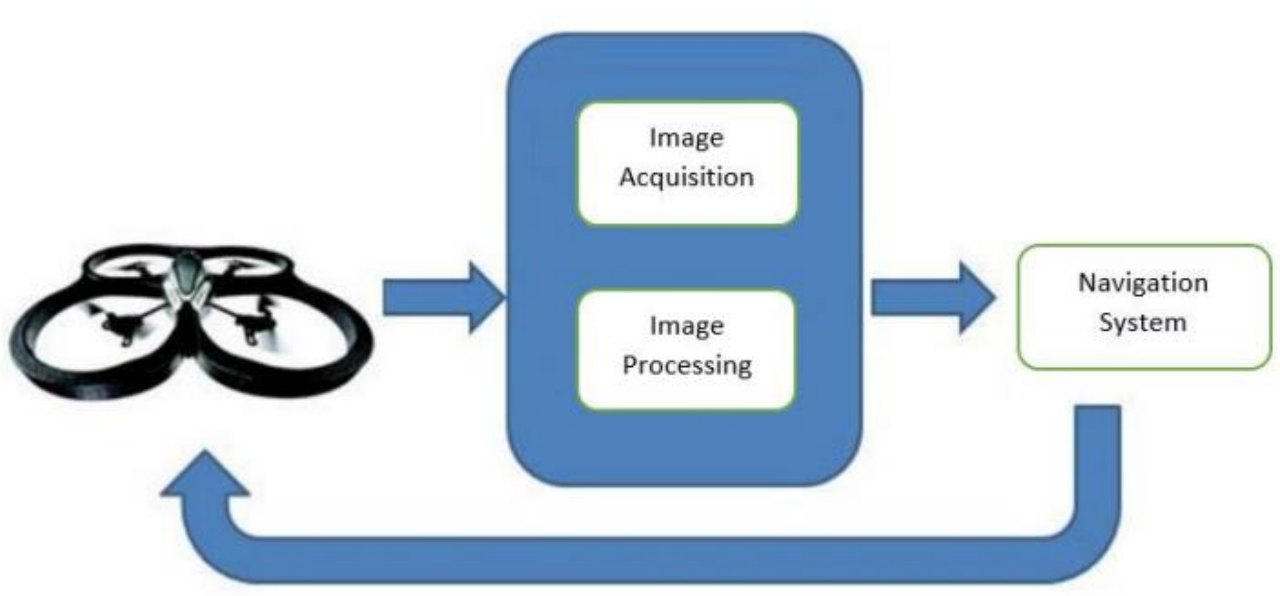

Fig.1 - System diagram

Auto Piloting System

Our system is a Java base application that uses YADrone API for controlling the drone. The job of the navigation system consists of interpreting the submitted values of image processing and generating the commands and send it via Wi-Fi.

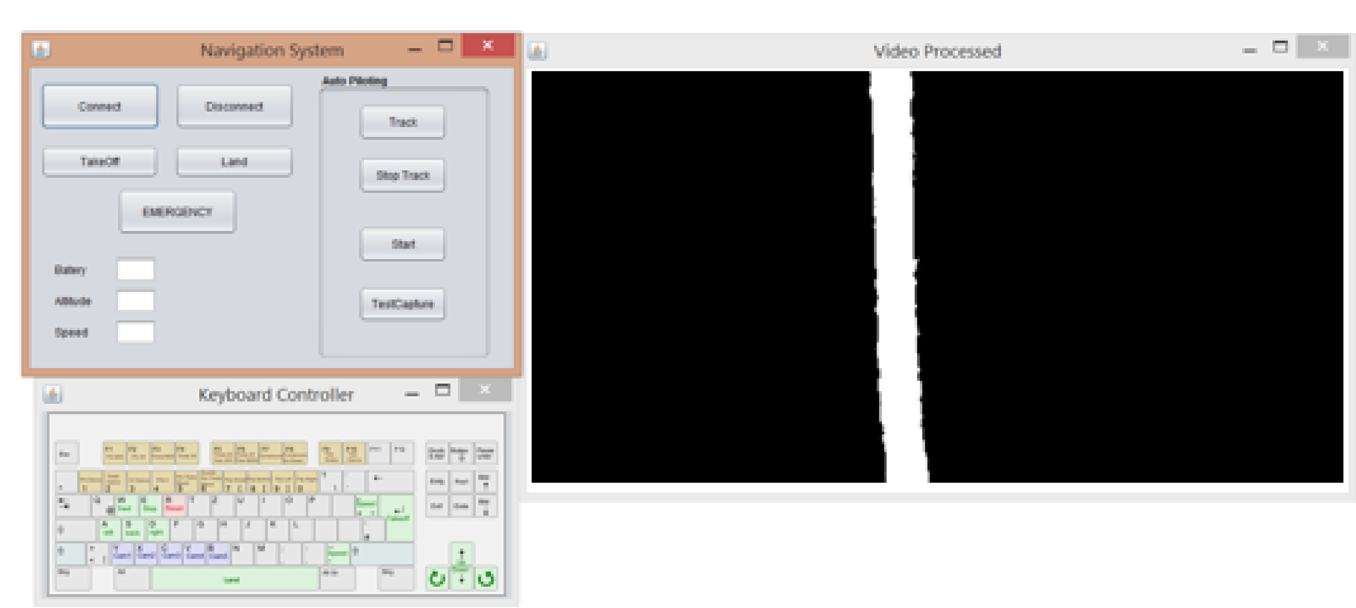

Fig.4 - Auto Piloting system

Hardware

The AR Drone 2.0 (fig. 2) is a quadcoper constructed by nylon and carbon fiber, with an onboard computer that runs Linux operating system and communicates with the computer by a self-generated Wi-Fi hotspot. The Drone has two cameras. The Front camera has 720p resolution and a sensor with 93° lens, recording up to 30fps. The Vertical camera has QVGA resolution and a sensor with 64° lens, recording up to 60fps.

Conclusion

In order to evaluate the developed system, we conducted 3 different tasks: (1) straight lane, (2) 45 degree turn lane, and (3) 90 degree turn lane. The lanes are marked with at least 10 feet long, 2 inches width and yellow color. With 90% of accuracy, the results showed that the autonomous piloting system can make a drone follow the lane automatically without manual control.

References

http://opencv.org/
http://ardrone2.parrot.com/

Multimedia Information Group