OSURC Aerial team

IARC 2012 Paper

1 abstract

The Oregon State University Aerial Robotics Team has the goal to develop an indoor autonomous flight platform to compete in the International Aerial Robotics Competition. Our team is comprised of undergraduate students in the Mechanical, Industrial, and Manufacturing Engineering and Electrical Engineering and Computer Science departments. Over the past year we have developed a quad rotor flight platform along with a Robot Operating System (ROS) base station interface in order to navigate indoor environments. A robotic hand is also being developed in order to handle manipulating the environment (picking up the flash drive).

2 Introduction

The Oregon State University strategy for indoor automous flight involves specific functional goals for each part of the system. Flight stability is handled by the flight platform, however, all navigational data gathered from distance sensors and cameras mounted on the flight platform is transmitted to the base station for processing. The base station then transmits navigational commands to the flight platform. Stabilization sensory is handled using a three axis gyroscope, accellerometer and magnetometer. Navigational data comes from a number of distance sensors mounted on servos. This solution was chosen because of the low electrical and computing power required to process distance sensor data. A seperate wireless camera is also implemented to provide object recognition through the OpenCV libraries.

3 Electrical

The electrical setup for our quad rotor runs primarily off of a 3 cell lithium polymer battery. The 12V from they battery is used to power the motors and motor controllers on the flight platform. This supply is also regulated down to 5V to power an Atmel Xmega microcontroller used as the central intelligence on the flight platform, an xbee radio for wireless communication, and addionally to power the various distance and inertial sensors. A wireless camera is powered by a seperate 9V source.

4 Flight Control

The on board flight control system was developed to provide basic stability for the flight platform. It does not have contingencies to prevent drift. Integration of gyroscope samples is used to create an estimate of the orientation of the flight platform. This combined with the raw data from the gyroscopes is as input to a position differential (PD) controller. To prevent the gyroscope positional estimates from drifting they are averaged with magnetometer and accelerometer samples.

5 Flash Drive Pickup

The IARC competition requires the use of a grasping mechanism for one of the primary objectives. The chosen design for the grasping mechanism will make use of an under-actuated, passively compliant four-fingered hand. Each of the four fingers will contain two flexure joints, rather than rotational bearing joints. A fully actuated hand would require eight actuators; this under-actuated design will require only one. A single actuator will control all joints through the use of a pulley system, allowing each finger link to actuate until it comes into contact with an object. All tendon cables will see the same force from the actuator. Not only does this design greatly reduce cost, but it saves weight–an essential benefit for an aerial vehicle. In addition, the design all ows the hand to automatically adapt to the shape of any object, without the need for special positioning and calculated movements.

6 Chasis

The new chassis design will make use of lighter weight carbon fiber tubing. The current design consists of 4 motors mounted on arms that mount to a central chassis. The new design will consist of only two solid arms that mount to one another, each connecting a pair of motors. This will remove bending moments resulting from motor forces from the central chassis, allowing for material reduction and weight savings. The current chassis also has a tendency to snag the ground when the aerial vehicle lands with significant lateral speed. This causes the vehicle to tip over, sending its propellers into the ground and causing damage. The new chassis will have less skid resistance, while allowing for vertical impact absorption. Blade guards will also be added around the perimeter of the propellers, to reduce the risk of propeller damage from incidental contact with the environment.