THE AVIONICS AND GROUND STATION FOR AUTONOMOUS INDOOR FLYER

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ABSTRACT

An avionics and ground station for autonomous indoor flyer have been developed. The ground station is aimed to transmit the position of the flyer from the video navigation system to the flyer. The onboard avionics consists of a radio receiver, a tri-axes accelerometer, an ultrasonic sensor, a microcomputer, servos, and a speed controller. The flight test trial indicated the present avionics and ground station system works correctly.

1. INTRODUCTION

Indoor model planes (the authors call them ‘‘indoor flyers”) can be handled much safer and easier than outdoor model planes. They are considered to be the best way for learning aeronautics comprehensively. Therefore, the first trial of indoor flyer competition was held last year [1]. The main rule of the competition was as following: 1) a small video camera installed on a manually piloted flyer captures letters written on pieces of paper that are placed on the floor, 2) number of letters a flyer pilot recognized correctly determines a winner. However, this rule mostly depends on skill of the pilot, and the acquired learning is limited at the level of so-called "just fun". Then, for deepening aeronautics knowledge and experiences, autonomous indoor flight has been considered to be the appropriate subject matter. Thus, the authors developed a system for autonomous indoor flyers as a reference design for the future competition.

2. DEVELOPED COMPONENTS FOR AUTONOMOUS INDOOR FLYER

2.1 Overview

Figure 1 shows the developed system overview. It can be divided into two components. One is the ground station that controls a flyer roughly based on flyer position information obtained by the video navigation system [2,3]. The other is the avionics that is installed onto the flyer, mixes sensor data into commands from the ground station, and controls the flyer more closely. The information flows from the ground station to the flyer via a model plane radio system.

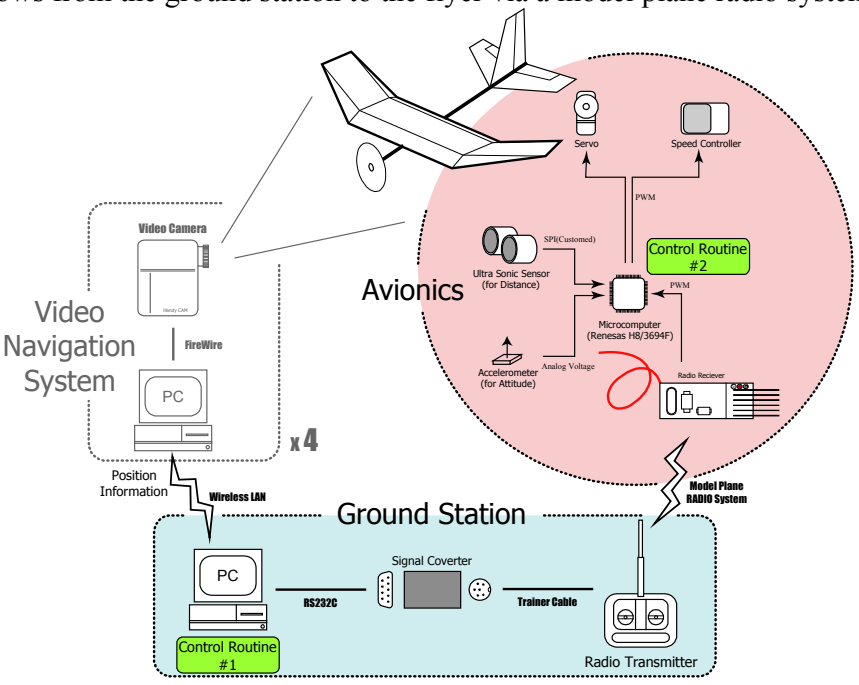

Fig. 1 Developed components overview

2.2 Ground Station

The ground station consists of a PC, a signal converter, and a model plane radio transmitter. The PC calculates commands for an indoor flyer based on position information [4]. Commands are sent to a radio transmitter through the signal converter. The signal converter receives byte format data and sends pulse wide modulation (PWM) format pulse. The signal converter is a self-produced item using a microcomputer (PIC16F648A). This system utilizes the trainer function provided by the transmitter that overwrites the commands of an instructor pilot when a novice pilot fails to control the R-C model plane. In this system, the PC acts as the novice pilot and when the autonomous system fails to control correctly, a human pilot can take over and act as the instructor pilot.

2.3 Avionics

The avionics consists of a radio receiver, a tri-axes accelerometer, an ultrasonic sensor, a microcomputer, servos, and a speed controller. The radio receiver receives commands from the ground station. A tri-axes accelerometer gives rough attitude information by observing gravity vector. The ultrasonic sensor provides distance information between a flyer to the floor. The microcomputer integrates the other parts, and recalculates commands based on information obtained by installed sensors [4]. The microcomputer is a H8/3694F and easy to purchase from the retailer. Servos and a speed controller are the same parts as ones installed on an indoor model plane. The electric circuit that drives them was self-produced.

2.4 Flight Tests

The authors performed flight tests three times, and the developed system worked correctly in all tests.

Fig. 2 The Ground Station

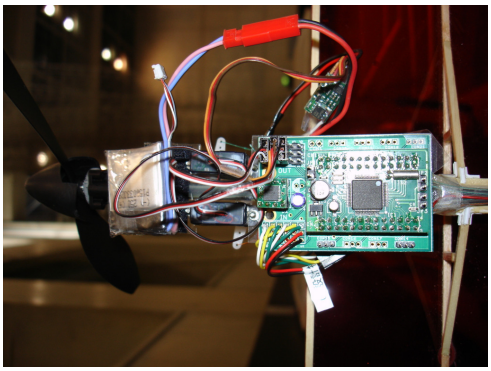

Fig. 3 The Avionics

3. CONCLUSIONS

In this paper, the avionics and the ground station for autonomous indoor flyers were developed. They are easy to manufacture and to use. They worked correctly during flight tests. The developed system is hoped to act as a reference design of the future indoor flyer competition.

References

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