

iOS Application for Quadrotor UAV Remote Control

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1. Introduction

This research is focused on the proposal of an original quadrotor UAV controller design based on widely spread personal smartphones. In recent years, if a UAV is operated with wireless communication, a PC or specialized controller is generally used for controlling it. Smartphones have rapidly gained popularity and become very important due to the simple operability and mobility, so that the flexibility and ease of use to control a UAV will be provided with the portable technologies such as iPhone. It is also expected that the smartphone will enable us to get real-time information from various kinds of sensors built in a quadrotor, however, it seems that actual applications using smartphones are not many. In this research, to cope with the need, a quadrotor UAV equipped with multiple monochrome binocular cameras, ultrasonic distance sensors and a RGB camera is first considered as a controlled object. Then, a basic control system is developed to monitor the surrounding environment while remotely controlling the quadrotor using iOS devices such as iPhone and iPad.



Fig. 1 Quadrotor used for development.

2. Basic Handlers and Automatic Return Function

Figure 1 shows the hardware of the quadrotor used for development. Basic handlers for obtaining compass information, controlling a gimbal, automatic return function were firstly developed and implemented [1,2,3]. Secondly, following a moving object function and circling around function while gazing it were developed [4]. Generally, beginners are not familiar with the operation of a quadrotor, so that they are prone to have misoperations or accidents. To cope with this problem, functions to automatically conduct takeoff, landing, and hovering were implemented. These functions provide simpler and easier operations for beginners. In addition, an automatic return function was considered and implemented in order to ensure that the quadrotor is under control and it does not get lost due to an unpredictable trouble, e.g., flying beyond the plan. For example, when some undesirable signal interference or signal loss occurs, the quadrotor cannot be directly controlled and consequently goes out of view. To deal with the problem, the implemented automatic return function reduces such a serious risk that the quadrotor is out of control and consequently is lost. **Figure 2** shows an example of detailed flight record, in which the quadrotor successfully flew from the point ① to the initial point ④ via points ② and ③ over Mt. Ryuo. It was verified that the quadrotor could linearly return to the initial point where the operator set in advance using an iOS device. The functionalities of the programs were evaluated through the software development and actual experiments using the quadrotor and iOS devices.

3. Mission Planning Function

In order to enable the quadrotor to achieve more complex tasks, based on the above developed basic functions, a mission planning function was further considered and developed [5]. In this function, the Apple map available on iOS is used for operators to input desired task points. The desired task points are set in the map in accordance with the operator's planning, so that the quadrotor can automatically fly along the task points. In the developed interface, the operator can move the map in the screen as he wants to set, and enlarge or reduce the size. When a target point on the map is clicked once, it is set to a task point. Clicking again will add the next task point. The numbers of task points are automatically given in the order. After recording the task points, the operator can edit them while deleting and adding, and set flight altitude, flight angle and repeat times between two points. The corresponding latitude and longitude information at each point obtained by GPS (Global Positioning System) can be monitored in the task points editing menu. In addition to editing the

task points, the task plan can be further refined. For example, the operator can add an action such as hovering, landing at a task point, returning to the starting point or the first task point. Finally, an actual self-flight experiment using GPS information was conducted using a mission plan, so that the effectiveness and validity of the proposed system were confirmed.

4. Conclusions

In this research, a remote control and monitoring system has been focused on and designed for a quadrotor to remotely control it using an iOS device and to monitor the surrounding environment. First of all, three basic handlers for obtaining compass information, controlling a gimbal and automatic return function were developed for remote control. Secondly, photo and video preview, photo shoot and movie video recording functions were implemented. Thirdly, following, rounding and gazing functions for a moving object were further developed. And finally, an iOS application was successfully designed and implemented to allow the quadrotor to execute a self-flight function using GPS information called mission planning function. The functionality and effectiveness were evaluated and confirmed through actual experiments carried out outdoors.



Fig. 2 Flight record of the quadrotor over Mt. Ryuo viewed using Google Earth.

5. References (Research results)

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Abstract

With the progress of electronics and information technologies, the development of civilian UAV (unmanned aerial vehicle) applications becomes possible. In addition, smartphones have rapidly gained popularity and become very important device due to the simple operability and mobility. Hence, there is a need to have an easy and flexible way to control a UAV only using such a smartphone. To cope with the need, a remote control application was developed for a quadrotor to enable an operator to remotely control it and monitor its surroundings using an iOS device. Basic handlers for obtaining compass information, controlling a gimbal, automatic return function, photo and video preview, photo shoot and movie video recording were firstly implemented. Then, a following and circling a moving object function while gazing it were developed. Finally, another function called the mission planning was additionally designed and implemented to allow the quadrotor to execute a self-flight function using GPS information. As a result, the iOS application enabled the quadrotor to achieve complex tasks. The functionality of the developed software was evaluated through experiments using a quadrotor and an iOS device.