Development of the Drone with the Function of Flight and Vehicle to Save Power Consumption

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Abstract

In recent years, the drone technology is developing rapidly. Drone is going to be used in many places, e.g., photography, delivery and agriculture. Due to the development of drone technology, we must reduce energy consumption, and realize high range movement. However, the drone can fly only about 20 minutes at once. In order to solve this limitation, we develop a new type of drone. The drone with the function of flight and vehicle can move less power consumption, and it lead high range of mobility to drone.

Keywords: Battery, Drone, Energy.

1. Introduction

Because of faster control signal, smaller motor and lighter computer, the drone technology has come rapid development. Mainly, the drones has potential to work in the field of photography, delivery and agriculture, and around the world countries and companies have high hopes for its potential. The BI intelligence expects that drone market is going to be reached at the \$ 12 billion until 2024 in the worldwide ⁽¹⁾.

Japan doesn't have much large scale land compared with the other countries. It is possible that we can get benefit expanding the use of airspace. At the public-private Association for environment improvement of small unmanned air vehicle, we are aiming to realize delivering service by drone till 2019. In addition, aiming to realize a society of that autonomous drones are active in areas including cities from the 2020s ⁽²⁾. An experiment was held on 11/2016 at the Chiba city which is the national strategic zone drone flied 700 meters over the sea and the book were

reached at goal ⁽³⁾.

It is necessary that investment for technology by companies due to expand drone use, but there are some restrictions. For example, drone flies only 20~30min and cannot go far away, it be required circumvent around the no-fly zone, and it isn't safe in the strong wind. So, we need to develop drone that flying more distant and more efficiently ⁽⁴⁾.

There are many previous studies. First one is that car has only wheels and does not have motor but it move with wind power by propellers. However, this system has a drawback. This drone cannot move minutely. One of the benefit function of flight and vehicle is that change position in detail, but it is so difficult to do that by wind power. The second one is that has caterpillar instead of wheels. However, caterpillar system cost high energy ⁽⁵⁾.

Fig. 1. Wind power

Fig. 1. Caterpillar

So, we intended to develop the drone with motor car, and reduce power consumption. Furthermore, we compensate the shortcoming of flying by driving system.

2. System Configuration

2.1 Multicopter

There are various drones like airplane type or helicopter type. Multicopter is one type of the Unmanned Aerial Vehicles (UAVs). Its power source is a battery. Generally, it has four or more DC motors.

Table 1. Types of multicopter

name	Number of rotors	Stability	Weight	Maintenance
Quadcopter	4	Low	Light	Few
Hexacopter	6			
Octocopter	8	High	Heavy	Much

We use quadcopter, “Parrot AR.Drone 2.0 ⁽⁶⁾” which is propelled by four rotors.

Fig. 3. Parrot AR.Drone 2.0

2.2 Constitution of Drone with Motor Car

In this research, we develop the drone with motor car. And, switching between flying and driving, measuring of each power consumption. We use the drone which communicated with Wi-Fi. And we control it from iOS application.

Fig. 4. AR.Drone application

In addition, attached “Raspberry Pi 2 model B” for control the motor car. Raspberry Pi ⁽⁷⁾ has forty GPIO pins.

Fig. 5. Raspberry Pi 2 model B

We make a circuit with a motor driver to control motor car by Raspberry Pi. Raspberry Pi with a Wi-Fi dongle connect to the drone Wi-Fi. Plus, the laptop for control GPIO pins connect to the drone too. This means that Raspberry Pi and laptop exist on the same network. In that state, we used an application called WebIOPi ⁽⁸⁾ to link both GPIO pin and laptop. WebIOPi is an application for accessing Raspberry Pi GPIO pins through a browser. It makes us to control motor car.

Fig. 6. System Configuration

Fig. 7. Drone Car

3. Experimental Results

Operation of the drone is carried by the laptop and the smartphone. In particular, motor car is operated

from the laptop, and drone is operated from the smartphone.

The payload of “Parrot AR.Drone 2.0” is 142g, and the weight of the whole system is 139g. So, the drone can fly without problem. Furthermore, switching of running and flying could be smoothly and that can be used for experiments.

First, we research the power consumption of flying. And it compared with the drone without car system.

Table 2. Flight experiment

System	Flight Time(s)	Consumption(W)
Before	630	105
After	625	106

As shown in this table, it is found that the power consumption increased 1W by installation of the system.

Next, we research the power consumption of running. We checked current value from the battery during it runs.

Table 3. Running experiment

Times	Current (mA)
1	442
2	447
3	443
4	447
5	446
6	442
7	442
8	441
9	442
10	445
Average	443.5

The average current value is 443.5mA. Since the output voltage of the battery is 12.3V, the average power consumption is 5.5W.

The above results are summarized as follows.
 Drone before system installation (flying): 105 W
 Drone after installing the system (flying): 106 W
 Drone after installing the system (running): 5.5 W

4. Conclusion

From the results of the experiment, we find that the power consumption is very low when running the drone car

compared with the case of flying.

As a future task, we are planning to equip with AI^(9, 10). It realize that a system switches autonomously between running and flight according to the environment. Also we are planning to update its hardware sturdier and improve position control accurately.

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