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Invited Paper

Proposal of a Power Saving Drone with the Function of Flight and Vehicle

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Abstract. In recent years, drone has been used in many applications, e.g., photography, delivery and agriculture. However, recent usually used drone can fly only about 20 minutes. In order to solve the battery limitation, we proposed an energy consumption reduction, and robust for bad weather drone. The proposed new drone can work in heavy rain or strong rain day, without any further protection equipment. Meanwhile, it also can be used in wireless prohibition area in urban. The experimental results demonstrate that the new designed drone with the function of flight and vehicle can move less power consumption, and it lead high range of mobility to drone.

1. Introduction

Because of faster control signal, smaller motor and lighter computer, the drone technology has coming development rapidly. The drones have some potentials to work in the field of photography, delivery and agriculture. The world countries and companies have high hopes for its potential applications in future. The BI intelligence expects that drone market is going to be reached at the $ 12 billion until 2024 in the worldwide [1].

At the public-private Association for environment improvement of small unmanned air vehicle in Japan, we are aiming to realize delivering service by drone in 2019. In addition, the government is aiming to realize a society of that autonomous drones are actively 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 the investment of the technologies by companies due to expand drone useage, but there are some restrictions. Traditional drones fly only 20~30 min and cannot go far away. So, we need to develop drone that flying more distant and more efficiently [4].

2. Experiment

In the previous research, we have developed the drone with a motor car. And, switching between flying and driving, measuring of each power consumption. We choose the drone which communicated with Wi-Fi. And we control it from iOS application. We use quadcopter, "Parrot AR.Drone 2.0 [5]" which is propelled by four rotors. In addition, the attached "Raspberry Pi 2 model B" for control the motor car. Raspberry Pi [6] has forty GPIO pins. We make a circuit with a motor driver to control motor car by Raspberry Pi (see Fig. 1). 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 [7] 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, like Fig. 2.

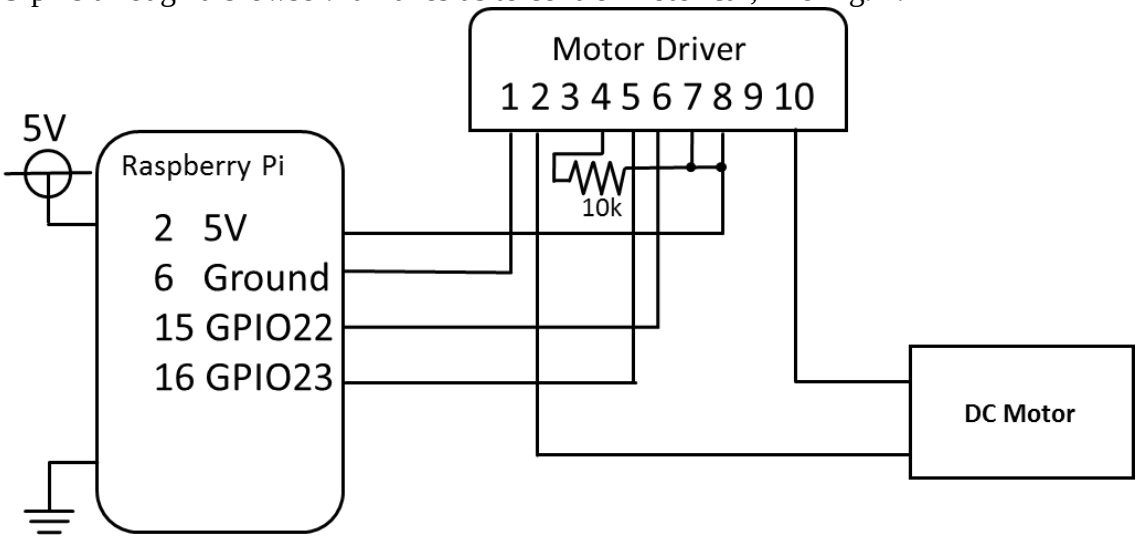

Fig. 1. System circuit.

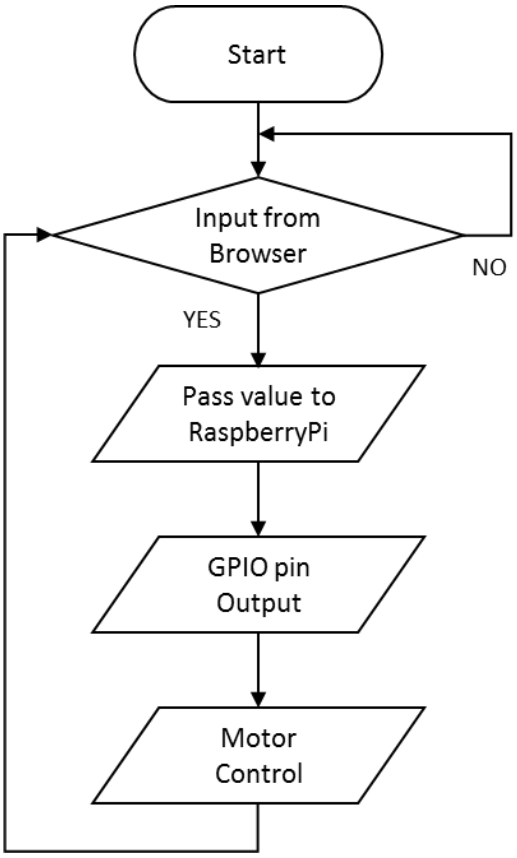

Fig. 2. Motor car system flowchart.

Using this system, we investigated the power consumption. First, we studied the power consumption of flying. And it compared with the drone without car system. Next, we studied the power consumption of running. We checked current value from the battery during it runs.

The results are shown as the following:

Drone before system installation (flying): 105 W
Drone after installing the system (flying): 106 W
Drone after installing the system (running): 5.5 W

3. 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. Fig. 3 is the comparison of drones' power consumption. We can find that using the function of vehicle lead lower power consumption.

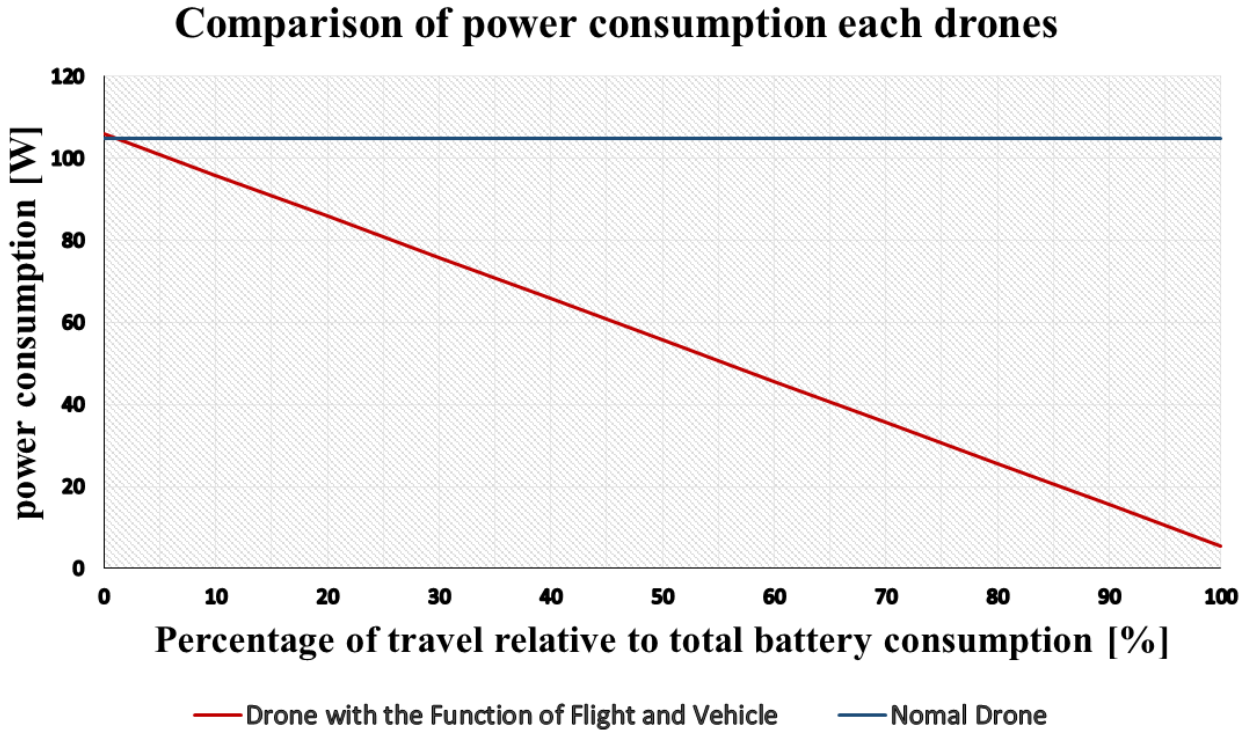

Fig. 3. Comparison of power consumption.

We couldn't find out how long does it move from the power consumption. So, we will propose a measurement of battery economy in the future work. This lead from divide mileage by battery capacity.

$$E = R[m] \div C[Wh] \quad (1)$$

Battery economy makes us easily intuitively.

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