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Automatic Road Detection System for an Air-Land Amphibious Car Drone

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Abstract: In recent years, unmanned aerial vehicle (UAV) technologies have rapidly developed. Drones, which are one type of UAV, are used in many industrial fields, such as photography, delivery and agriculture. However, a commercial drone can fly for only approximately 20 minutes on one charge. Furthermore, drones are prohibited from flying in some areas, and cannot be operated in bad weather. Due to the development of drone technologies, we must reduce energy consumption and achieve long-range movement. To overcome these limitations, we develop a new air-land amphibious car drone that can fly and requires less power consumption in land mode; this extends the range of mobility of the drone. Moreover, land mode can be used to pass through restricted areas or bad weather conditions by sliding. Furthermore, we develop a Convolutional Neural Network (CNN)-based algorithm for detecting the road in a captured scene. To more accurately segment the road region based on images from the equipped camera of the drone, we propose atrous spatial pyramid pooling (ASPP) ResNet blocks, instead of Resblocks, which were proposed by DeepLab. The experimental results demonstrate that the proposed method improves the pixel accuracy (PA) to 85.6% and achieves a mean Intersection over Union (mIoU) of 55.8%.

Keywords: Unmanned aerial vehicle, Air-land amphibious car drone, Road detection

1. Introduction

Due to faster control signals, smaller motors and lighter computers, drone technology has rapidly developed. Drones have the potential to be used in the fields of photography, delivery and agriculture, and around the world, countries and companies have other potential applications. The BI intelligence expects that the value of the worldwide drone market is going to reach $12 billion in 2024 [1].

However, Japan does not have much large-scale land compared with the other countries. It is possible that we can benefit from expanding the use of airspace. At the public-private Association for Environmental Improvement of Small Unmanned Aerial Vehicles, we are aiming to realize delivery service by drone by 2019. In addition, we are aiming to realize a society in which autonomous