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Object Tracking Capabilities of Security Drones

Introduction

The drone, with the addition of the camera, has gradually become one of the most useful forms of technology, being adopted by companies, schools, and even governments as delivery apparatuses, photography tools, and surveillance devices. Great progress has been made, specifically in the object recognition capabilities of drones, which have further increased their appeal. Unfortunately, the development of algorithms to recognize and evaluate images and moving objects has slowed down, limiting the potential and proficiency of these drones. As a result, the most efficient and practical use of the drone can ultimately only be described in four ways: object detection through images, object detection through videos, tracking of single objects, and tracking of multiple objects. This technical review, as a result, aims to summarize the methods by which these techniques may be implemented and the applications of this technology in the scope of surveillance.

Object Detection Techniques

In regards to multi-object detection, the main focus of the algorithm used to identify objects is to distinguish objects of interest from the rest of the environment which the drone is surveilling. Under the assumption that the drone is flying at an altitude that allows the drone to fully comprehend its surroundings, a major priority of ensuring the drone appropriately detects the object or objects of interest is through ground object localization. This concept describes the drone's ability to distinguish its relative position to the ground and to the object of interest [1]. In order to ensure that the drone frequently localizes itself and recognizes its relation to the ground and the object of interest, one can program feature points which the drone would constantly pinpoint and refresh. These feature points can include but are not limited to the shape and movements of a human and the stability and the flatness of the ground. Programs and technology are also already available to allow a drone to essentially map itself with respect to the ground and the object of interest such as simultaneous localization and mapping technology or SLAM technology [2].

Another method for multi-object detection by drones is implementing previously gathered datasets. Datasets include various images of objects of interest in different scenarios such as under different forms of light, on differently leveled platforms, etc. For example, a datasheet for cars may contain around 1000 images of cars during the night or day, under the rain or sunlight, on a hill or on a flat surface, and many other environments. Additionally, datasheets exist for many of the most popular objects of interest such as cars, bikes, and pedestrians [4]. For difficult objects such as pedestrians or any specific type of human such as a victim or delinquent, datasets exist for specific actions. For example, a dataset may include 40 minutes worth of human movement and activity that is ultimately used to distinguish around 10 specific action sequences that can then be analyzed and detected in the future. By downloading datasets that are specific to the object or objects of interest that relate to the intended purpose of the drone, one can easily develop algorithms to properly distinguish the object or objects of interest and to direct the drone to act according to the desired operation.

Surveillance Applications

Using predetermined datasheets or programs that implement the use of feature points to allow for easy identification of objects of interest, drones have many applications in the field of surveillance. In regards to agriculture, drones are often used to survey fields and farms to detect plant disease and decay through heat sensors and light filters. Both of which can be programmed into the drone either as objects of interest with the use of feature points, or through algorithms based on previously gathered datasheets of plant decay and disease. A common use for drones near areas surrounded by large bodies of water is to detect nearby sharks or other potentially dangerous sea life that may inadvertently interact with humans such as at a coast or a beach. Similar to the technique used for drones to detect plant decay and disease detection, datasheet based algorithms or feature point based algorithms can be used to program the drones to determine if any dangerous sea life are around in a particular area that may lead to them potentially running into contact with humans. These drones would then ultimately alert authorities to prevent humans from approaching those dangerous areas [3]. As of recently, drones have also been used as guiding assistance systems. For example, a drone can detect a cargo vehicle, either on land or water, and guide this vehicle past or around obstacles to reach a certain checkpoint [5]. Finally, drones are also used for infrastructure detection. These drones are capable of detecting the stability of certain buildings or structures through these structures' foundation integrity [6].

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