**Intelligent Techniques Based Early Wildfire Detection by Unmanned Aerial Vehicles**

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Every year, millions of acres of forest destroyed by wildfire, this leads to billions of dollars of financial loss and may even threaten the life safety of wild animals and wildfire fighters. Wildfire is becoming more and more powerful or harmful because of global warming and climate-changing. Building a wildfire detection system to detect fires in the shortest time is becoming an urgent task.

In general, it can be easier and faster to detect wildfires with the help of unmanned aerial vehicles (UAVs), especially the quadrotor or drone. Quadrotor can hover in exact altitude to measure and estimate the situation and environment and detect fires with sensors [1]. The fire detection sensors consist of convolutional point sensors [2]. Detecting the smoke of early wildfire can be an efficient method to help wildfire fighting, and it is often based on various intelligent techniques. For example, convolutional neural networks [3], color models [4] and fuzzy logic [5].

Paper [3] proposed a deep smoke segmentation network to infer high-quality segmentation masks from blurry smoke images. This means that the impacts of disturbance, wind or high-speed flight of UAVs on sensor data can be decreased. The method to generate synthetic smoke images in paper [3] also skipped from a complex problem, labeling fuzzy smoke boundaries.

Fuzzy logic algorithm and extended Kalman filter (EKF) are combined in paper [5] to finish the detection and segmentation task of smoke in images. This paper clearly states the wildfire environment, which is helpful in building the concepts of UAVs’ application in anti-wildfire.

Paper [6] proposed a fully connected two-stream fusion network for image segmentation. Generally, the two-stream convolutional network is designed for action detection, this kind of novel two-stream fusion network can be applied for UAVs’ interactive image segmentation, especially for UAV swarm if it is possible in the future’s work. Two-stream convolutional network can also be applied in flame detection, this is proposed by the works of Dr. Yu, et al [7].

To apply UAVs better in the bad environment (area with tall trees, bad weather conditions) for fire-fighting, visual sensors can also provide position information to assist the global-positioning system (GPS). The proposed navigation scheme in paper [8] assumed that UAV can hover high enough to overlook a paddy field with computer vision system to get image position markers. Paper [9] uses the multi-UAV system for accuracy cultivating in forest fire detection and points out that a network-based confinement system is progressively reasonable for flame restriction so that relates to a near flame or more distant more enormous flame could be avoided. These concepts may be helpful in the next step study and research, and go deeper into the convolutional network-based fire detection will be the coming work recently.

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