EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

ABSTRACT

For many nations around the world, forest and urban fires have been and continue to be a severe hazard. Forest fires can currently be put out using a variety of methods. These solutions primarily aim to reduce the harm brought on by fires by employing techniques for their early detection. In this study, we discuss a novel fire detection and suppression method that makes use of contemporary technology. We specifically suggest a platform that makes use of unmanned aerial vehicles (UAVs), which continuously patrol over areas that could be at danger from fire. The UAVs have on-board computing capabilities and make use of the advantages of artificial intelligence (AI). They can now recognise and detect smoke or fire using computer vision techniques based on the still images or the video data gathered by the drone cameras. The paper presents and analyses a number of distinct use cases for unmanned aerial vehicles (UAVs) for detecting forest fires, including one that involves combining fixed- and rotary-wing drones.

INTRODUCTION

The most up to date information on the current fire season in Europe and in the Mediterranean area is provided by the European Forest Fire Information System EFFIS . Each year this institution provides annual report on the forest fires in Europe, the Middle East and North Africa. According to the latest report, which they provided for 2017, the dramatic effects of wildfires have caused damages of over 1.2 million hectares burnt natural lands in the EU and killed 127 people, including fire fighters and civilians. Over 25% of the total burnt area was in the Natura 2000 network, which destroyed much on the efforts of the EU countries to preserve key natural habitats and to save the biodiversity of Europe for the future generations. The same report says that these fires caused estimated losses of around 10 billion euros. Despite these large numbers, EFFIS informs also that the report is showing a decrease in the number of fires, compared to the number of fires, which occurred annually during the last decade. This decrease can be explained with the more severe actions and sanctions to the people that caused the wildfires and with the introduction of more advanced technical solutions for early detection of fires. Obviously, the fight against fires can mitigate the damages, but the numbers, which represent the burnt area and the human lives, are still huge. This reason presents the necessity to constantly develop, implement and upgrade the solutions and systems for fire detection. The most important factors in the fight against forest fires include the earliest possible detection of the fire event, the proper categorization of the fire and fast response from the firefighting departments. The aim of the proposed platform is not only to use modern technologies, but also to improve the above mentioned factors by reducing the fire detection time, by minimizing the false alarms and by issuing of timely responses and notifications to the fire services in case of real forest fires. In the paper, we discuss the proposed platform for early forest fire detection, which involves two types of UAVs – a fixed-wing drone and a rotary-wing drone. Both UAVs will be equipped with cameras, which will be optical, thermal or both. The fixed-wing drone will constantly patrol the monitored area and will observe the territory below. Since this drone will fly at medium altitude (350 m to 5500 m), it might report false alarms because of the altitude or the lack of clear visibility. If the fixed-wing UAV detects a fire, it will trigger an alarm, which will activate the rotary-wing drone. The rotarywing drone will then closely inspect the area, where the fire is suspected to have occurred, by using the GPS coordinates provided by the patrol drone. The role of the second drone is to either confirm or reject the alarm bases on its close observation of the area and will then go back to its base station. It will not permanently monitor the targeted area. The reason to use a second drone is to reduce the number of false-positive alarms as the rotary wing drone will fly at much lower altitude (10 m to 350m) compared to fixed-wing UAV and will have better and more detailed visibility of the area. If the fire is confirmed, another alarm will be triggered by the rotary-wing drone and the ground level teams and the fire protection departments will be informed. The platform is completely automated since both drones have on-board computers and processing capabilities. They can detect fires based on the data captured by their thermal cameras and they can process this data without the need for centralized computing engine. In addition and to further improve the platform, we have planned to implement artificial intelligence by allowing the drones to make fire predictions based on computer vision techniques. In order to implement this artificial intelligence solution we will rely on and use neural networks. The neural networks are currently a very hot topic in the computing systems, because of their ability to “learn” how to perform tasks by considering examples, without being programmed or instructed to follow specific rules. The neural networks are inspired by the biological neural networks that constitute human brains.

CONCLUSION

The system for early forest fire detection is still in its development stage. We are still waiting for some equipment to be purchased, but we have planned and discussed the actual implementation. We have performed a thorough research and some simulation experiments and we believe that we follow the right way to achieve the goal. We also believe that we apply adequate approach that is also up-to-date. We think that the system could enhance the available platforms for fire detection and we hope that such improvement could significantly reduce the damages caused by untimely or late fire detection.

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