**Development of UAV for fire detection and for Object Detection and Tracking of Flying Object**

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Extended Abstract:

Computer visions is an interdisciplinary field which automates tasks that human visual system can do from the engineering perspective. With technology advancements, computer vision technology is now able to achieve better video tracking, object detection, 3D pose estimation, event detection, scene reconstruction, motion estimation, image restoration and indexing. With the increase of drone applications, the first part of this work is to bridge the engineering capability gap by allowing drone to detect fire, eventually to put out the fire autonomously without the human interaction. This will greatly reduce the risk faced by the front-line firemen in relatively small spaces and improve the efficiency of the firemen team. The second part of this work is about object detection and implementing it with the ability to detect and track flying object using computer visions.

This system requires the integration of several programs which includes OpenCV with Python and Robotics Operating System. Firstly, coding is developed with OpenCV which provides vast open source library which mainly aims at real-time computer vision. Also, the coding must allow the program to first learn to detect colours, mainly orange, yellow and red which would aid in detecting once the integration with the thermal camera happens. The thermal camera is calibrated accordingly to the required sensitivity as to when the red spots should occur to detect fire. The work progress demonstrates good stability control of the drone when shooting water to put out the existing fire. This is carried out by 1 of the 3 means, by robotic leg, by micro spines or rubber. As the drone approaching the ceiling, low pressure is created due to the high velocity created at the top of the drone, this will create a differential in pressure relative to the bottom of the drone, causing the drone to stick to the ceiling. Also, when the drone is shooting water, correction is done for the stability control by also adding sensors to the system to measure force incurred upon contact with the ceiling.

This integrated work shows the development of object detection and tracking codes using OpenCV and Python on Ubuntu 16.04 which is the computer operating system. OpenCV is an open source computer vision library that focuses on real-time applications and has Python interface that is compatible with Linux Operating System. The code for object detection will have to be able to detect flying object such as drone and track the object that is being detected. The centroid coordinates of the detected object will then be computed based on real time and is sent to another drone. The code is integrated with a graphic processing unit, Nvidia Jetson Tx2 along with a stereo 360 camera that is mounted on the drone. Flight testing is done on the drone to ensure that the objectives that are stated above are achieved. Refinements to the drone is made after flight testing to further improve the system. The integrated drone has deep learning incorporated into the system. The accuracy of the system is one of the key factors in the efficiency of the system. Finally, we demonstrate that the drone is able to detect and put off fire, as well as track flying object accurately and efficiently.





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