World Academy of Science, Engineering and Technology
International Journal of Cognitive and Language Sciences
Vol:16, No:01, 2022

Multiperson Drone Control with Seamless Pilot Switching Using Onboard Camera and Openpose Real-Time Keypoint Detection

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Abstract : Traditional classification Convolutional Neural Networks (CNN) attempt to classify an image in its entirety. This becomes problematic when trying to perform classification with a drone's camera in real-time due to unpredictable backgrounds. Object detectors with bounding boxes can be used to isolate individuals and other items, but the original backgrounds remain within these boxes. These basic detectors have been regularly used to determine what type of object an item is, such as "person" or "dog." Recent advancement in computer vision, particularly with human imaging, is keypoint detection. Human keypoint detection goes beyond bounding boxes to fully isolate humans and plot points, or Regions of Interest (ROI), on their bodies within an image. ROIs can include shoulders, elbows, knees, heads, etc. These points can then be related to each other and used in deep learning methods such as pose estimation. For drone control based on human motions, poses, or signals using the onboard camera, it is important to have a simple method for pilot identification among multiple individuals while also giving the pilot fine control options for the drone. To achieve this, the OpenPose keypoint detection network was used with body and hand keypoint detection enabled. OpenPose supports the ability to combine multiple keypoint detection methods in real-time with a single network. Body keypoint detection allows simple poses to act as the pilot identifier. The hand keypoint detection with ROIs for each finger can then offer a greater variety of signal options for the pilot once identified. For this work, the individual must raise their non-control arm to be identified as the operator and send commands with the hand on their other arm. The drone ignores all other individuals in the onboard camera feed until the current operator lowers their non-control arm. When another individual wish to operate the drone, they simply raise their arm once the current operator relinquishes control, and then they can begin controlling the drone with their other hand. This is all performed mid-flight with no landing or script editing required. When using a desktop with a discrete NVIDIA GPU, the drone's 2.4 GHz Wi-Fi connection combined with OpenPose restrictions to only body and hand allows this control method to perform as intended while maintaining the responsiveness required for practical use.

Keywords : computer vision, drone control, keypoint detection, openpose
Conference Title : ICHSI 2022 : International Conference on Human System Interaction
Conference Location : New York, United States
Conference Dates : January 28-29, 2022