Title: Panoptic segmentation based approach for visual dynamic obstacle detection and trajectory prediction for Autonomous aerial/ Ground systems.

Name: Suryaprakash Rajkumar

Email: suryaprakash.2018@vitstudent.ac.in

University: Vellore institute of technology, Chennai

Introduction:

In recent times autonomous cars, drones and robots have been a topic of development and research. Thousands of Researchers around the globe are working tirelessly to achieve greater level of autonomy. Since the introduction of machine learning and artificial intelligence, these technologies have progressively improved every day. Dynamic obstacle detection has always been a prime topic of research as it is a prime feature of a completely autonomous system. Present systems are performing the tasks by using Optical flow algorithms, Feature tracking algorithms and using hardware like event cameras, this proposal of research is to use Panoptic segmentation to predict and assign every member/pixel in the image to a particular class of objects then use those information to track the optical/ feature flow to effectively predict the trajectory of the object with respect to the system. This novel solution is expected to be more efficient than the current techniques.

Objective:

The main goal of this research is to optimize the detection of dynamic obstacle and its trajectory. The main issues with the current algorithms are that it can have a significant amount of error in the measurement. By using panoptic segmentation a novel CV algorithm which every instance of a class is semantically segmented to get the image data of a particular object of a particular class at a point of time and use this data to track the movement of that object in the frame and predict the trajectory of the obstacle with respect to the system.

Preliminary Literature Review:

The existing literature for obstacle avoidance and detection uses standard cameras (Mono, Stereo Cameras)[1][2] considering a static working reference frame or the system to be static or Quasi-Static in nature which uses SLAM based approach using optical flow algorithms or feature tracking algorithms. Dynamic obstacle avoidance for quad rotors with event cameras[3](D.Falange et al) suggested using a event camera to detect the dynamic obstacle in quad copters using the changes in subsequent frames to percept the trajectory and detect the obstacles in real-time and compared to those of the results produced by traditional optical flow based algorithms, as a result the Event camera based algorithm identified to be more effective in detection. Panoptic Segmentation[4] (A.Kirillov et al) proposed the concept of merging instance and semantic segmentation to identify every pixel in a frame to a instance and assign it to a particular class of objects. By this method we can easily identify the objects in the environment and assign a unique tag to every object in the frame. By using the panoptic segmentation we can identify the pixels which are transeversing in a more effective way.

Methodologies:

A extensive literature review has to be done to understand the concepts in the transformations associated with the perception from just the vision data. Then the transformation algorithms must be tested and simulated to make it work properly. A dataset for training and testing must be prepared with high level of confidence in accuracy of the data. Once the data is collected we can use it to test the algorithms under different physical condition. Once this is done next is optimizing the results and benchmarking it with other standard methods. Once all the benchmarking data is ready then we can choose the best effective method for the dynamic obstacle detection.

Expected Results:

To develop a novel algorithm to detect and percept the trajectory of a dynamic obstacle in 3D space is tested and compared with traditional methods with various applications in the robotic and automation industry. The algorithm has to be computationally effective to make it easily usable in the systems of less availability of computation. Integration of panoptic segmentation should effectively reduce the noise and errors associated to the measurement.

References:

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[3] Falanga, Davide, Kevin Kleber, and Davide Scaramuzza. "Dynamic obstacle avoidance for quadrotors with event cameras." Science Robotics 5, no. 40 (2020).

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