Vision Based Autonomous Micro Areal Vehicle with Graphic Processing Unit Acceleration

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Autonomous Micro Aerial Vehicles (MAV) are available today to process and navigate within indoor environments. However, lack of processing power of the drone generates unreliable, inaccurate and inefficient navigation results. This paper presents a model for a vision based autonomous hexa-copter for navigating within an indoor environment with the use of GPU acceleration. The MAV is embedded with Jetson TK1 board with GPU computing power, MS Kinect, Arduino Flight controller. Jetson TK1 on development kit gets the outside data using Kinect sensor and build the map itself by Jetson TK1 board with the help of GPU computing. Then drone can navigate without a remote access and it uses the flight controller to control MAV. In addition to that, Real Time Appearance Based Mapping (RTAB) was used to build the 3D map of an indoor environment. RTAB-map is used for the SLAM (Simulation Localization and Mapping) approach. GPU parallel computing power of the Jetson board was used for optimizing SLAM algorithm. MAV estimates position over time using visual odometry. Adaptive Monte Carlo Localization algorithm used for estimate robot position. A Robot Operating System (ROS) uses the Rviz (ROS visualization) framework to visualize all the data. Rviz visualizes the 3D module of MAV and 3D map. ROS uses Rviz framework as a virtual environment and it passes the command to flight controller through serial communication while navigating through this virtual environment. MAV uses the navigation stack for the autonomous navigation. The main feature of this research is MAV process the data itself. The process includes the 3D mapping, real time state estimation, obstacle detection and navigation planning. RTAB-map builds the environment 3D map and navigation stack use for MAV navigation. Although the drone navigates real time itself, embedding all the component within the drone make its weight greater which make the power consumption, issues.

Keywords: SLAM, Jetson Tk 1, Rtab map, Rviz, ROS, navigation stack, MS Kinect, MAV