Vision Navigation System to Manoeuvre Unmanned Aerial vehicle (UAV)

The Research (The Problem)

Can an UAV robot be an explorer?

The aim of this research is to investigate the development of an on-board multidirectional stereo vision system enabled to autonomously navigate a miniature UAV – Quadrotor, to explore **unknown, unmapped and cluttered environments.**

The on-board Multidirectional stereo vision system will enable the UAV-Quadrotor to fly:

- Fully Autonomously.
- Beyond the line of sight.
- Without GPS signal – no GPS localization.
- In environments with high electrical and magnetic interference. No IMU (inertial measurement unit) - too much interference.
- In environments with low lighting conditions.
- Randomly detect and avoid obstacles and explore an unknown environment.

Methodology

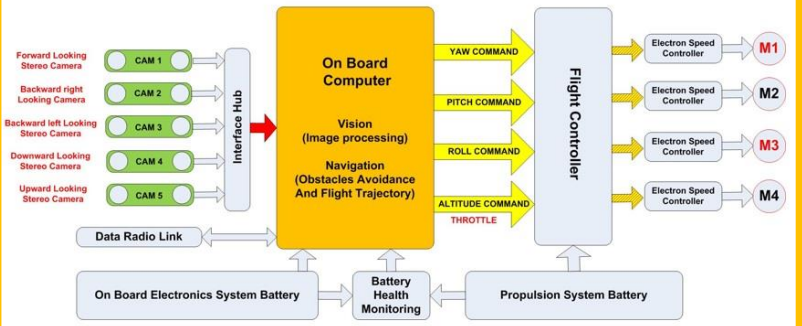
The Vision System (Software Algorithm)

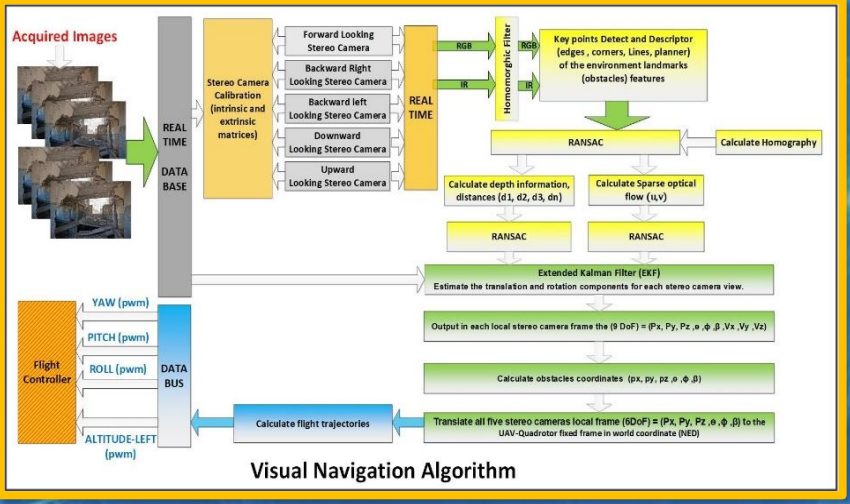
At every instant (at 20 Image/second) acquiring the images from the five stereo cameras the algorithm performed under the assumption that:

- The stereo vision system has 360 degree stereo vision coverage. During flying it is able to detect edges , corner , curved surfaces and flat surfaces features of the surrounding environment landmarks.
- Depth information and optical flow will be calculated on the sub-pixel level.
- The UAV-Quadrotor at the hovering position is stable and at a safe altitude stabilized by the onboard flight controller.
- The UAV-Quadrotor receives its flight commands from the onboard vision system computer and not from remote pilot.
- The vision system will navigate the UAV-Quadrotor goalless. Navigation is based on visually detect and visually avoid obstacles (landmarks), then proceed to explore the surrounding environment.

Vision System overview

Multidirectional Multiple Stereo Cameras Vision System

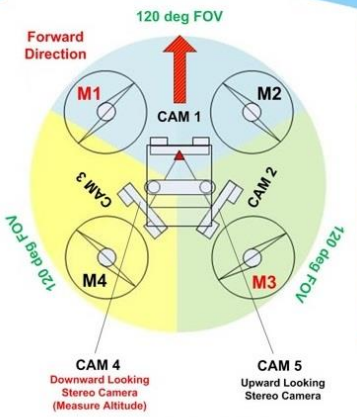




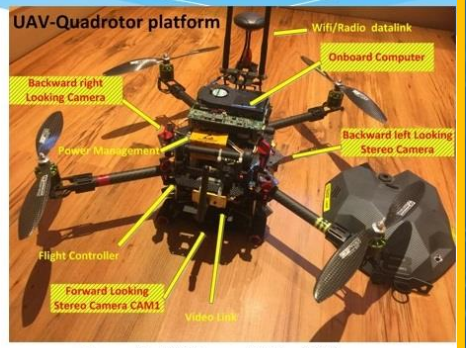
Visual Navigation Algorithm

The Multidirectional Vision System

Stereo Cameras orientation:

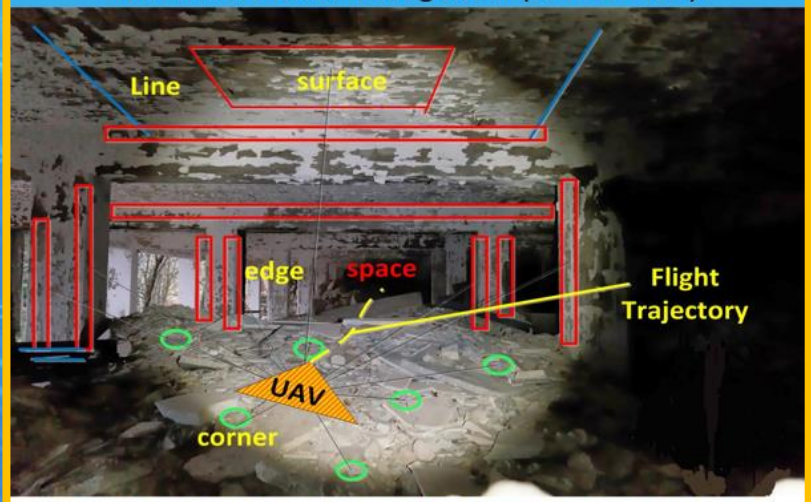


UAV-Quadrotor TOP VIEW



Length: 600mm Wide:600mm
Maximum weight: 4000g

Simultaneous Localization and Exploration Oriented Visual Navigation (SLAEOVN).



Visual Navigation – environment landmarks feature detection

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