Research Diary

Design and Fabrication of Autonomous Passenger Drone

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Drone technology has witnessed remarkable developments over the past decade. The military, logistics, agricultural, healthcare, and entertainment industries have demonstrated extensive use of unmanned aerial systems. Additionally, advancements in electronic technology have made autonomous drone research and development economically feasible. It is anticipated that autonomous manned aerial vehicles will become indispensable for urban transit and disaster management in the future. This project aims to design and build a passenger drone with complete autonomy. This unmanned aerial vehicle would be powered by rechargeable batteries and could take off and land vertically.

A modular design concept was developed for autonomous passenger drones, as shown in **Figure 26**. There are three significant modules existing in the proposed concept which are the vehicle with the power unit, the autonomous navigation system, and the passenger cabin. A hexadeca-copter configuration has been found to be appropriate for a given payload based on commercially available motor and propeller units. Various scenarios of operating the passenger drone from the user's perspective have been shown. Cabin designs have been shown with mock-ups to understand the design language and use case scenarios. We demonstrated a combined system of IMU odometry and visual odometry, called the Visual Inertial Navigation System (VINS), which is an optimization framework for odometry. Odometry integration with LiDAR is in progress to detect the obstacles. A simple and easily adjustable airborne Mobile Mapping System (MMS) to observe the environmental data with sensor fusion was developed.

We tested various state estimation methods involving only GPS, GPS + IMU, Monocular Camera + IMU based odometry, and stereo Vision-based approach with different Mapping techniques like octo Map and RTAB Map. We have built Autonomous navigation and avoidance system that generates a smooth collision-free trajectory based on gradient-based approaches and developed a long-range Obstacle Avoidance system to avoid structures such as buildings from a distance afar using a Monocular camera and a Deep Network.

Monocular visual-inertial navigation for urban scenes is another pipeline we developed to tackle challenges of planning and localization involving bad GPS, invisible ground planes, and texture-less areas where standard methods of localization are known to drift away, and also tackled planning challenges involving uncertain Map, tight spaces and SLAM failure.

Simulation studies were conducted for long-range wireless communication links using a combination of standard environments. A small-scale drone assembly project is underway, with ground testing set to begin this month. A multi-disciplinary team from IIT Hyderabad, IIIT Hyderabad, and IIIT Sri City collaborated to execute the current project.

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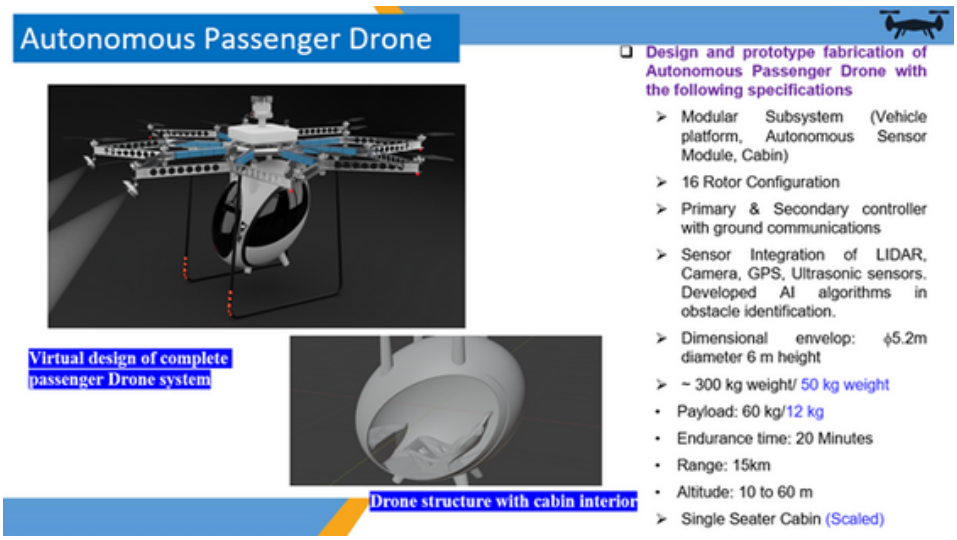

Figure 26: Virtual design of complete passanger Drone System & Drone structure with cabin