Development of an Outdoor Mobile Manipulation UAV to Remotely Sense & Collect Environmental Data

Abstract
With the large growth of using UAV for Remote Sensing, the area of specimen retrieval has largely been left unexplored. The contents of this paper discuss the preliminary advancements of an Outdoor Mobile Manipulation Unmanned Aerial Vehicle (MM-UAV). Discussed is the use of a modular framework for such a MM-UAV, as well as the initial attempts at various in-flight manoeuvres for inspection of a horizontal wastewater pipe.

System Architecture
The system architecture for the MM-UAV consists of a modular framework to allow for robust system expansion. This approach relies on a primary meta-controller that aggregates data, making all other data available for the interface controllers. This design method is based around the optimum use of the Robotic Operating System (ROS).

Test Case
The MM-UAV was modified to allow for a small camera to be placed at the end effector, with the goal of visually inspecting a wastewater pipe for a blockage.

Results
The system provides a live video stream which displays the view as can be seen at the end effector. The MM-UAV was able to successfully hold position in an outdoor environment, compensating for light wind, while the camera was used to visually inspect the inside of a horizontal 200 mm wastewater pipe.

Summary
Although the system was modified for the specific task of pipe inspection, the system can be easily expanded to meet the needs of general mobile manipulation. Future developments will focus on autonomy and the inclusion of optimal control methods to more accurately control the MM-UAV.

System Design
The platform utilises the following hardware:
- Airframe: DJI F550
- Autopilot: Pixhawk Pxn4
- Manipulator: Custom Dynamixel Assembly
- On-Board CPU: Odroid U3
- Software: Robotic Operating System (ROS)

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