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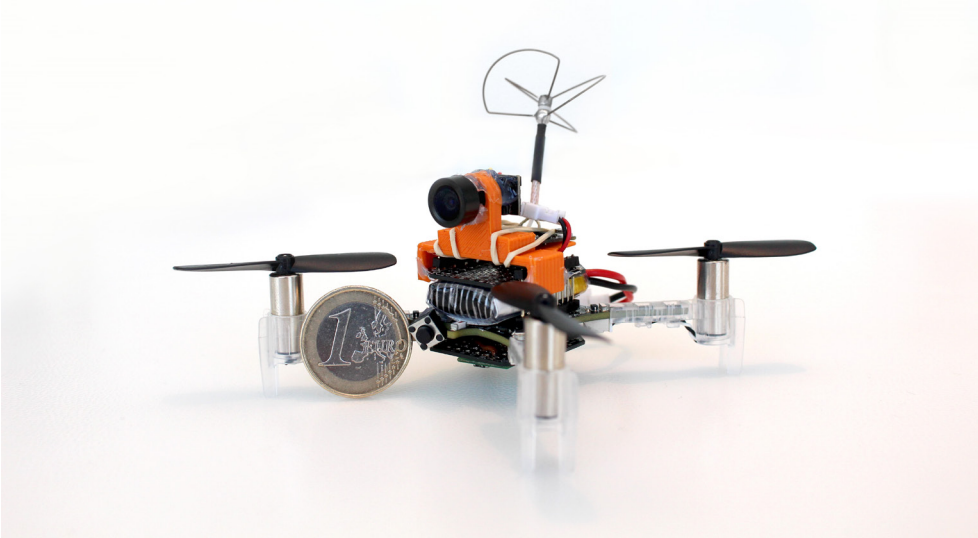

Fig1. CMosquitoII prototype. The UAV is a modification of the Crazyflie 2.0.

CMOSQUITOII

COMPANION DRONES FOR RETAIL

CMosquitoII is a software based route manager to manoeuvre a small Unmanned Air Vehicle (UAV) in tightly constrained environments. This framework is suitable to answer relevant operational challenges on the retail domain.

Motivation

Indoor applications for UAVs are limited due the challenges arising of the inherent GPS-denied environment and the requirements of highly refined control dynamics and strategic mission planning. This project aims to overcome those challenges by presenting a modular architecture that allows a user to manoeuvre an UAV using high level commands. This approach will ultimately simplify the development of UAV applications. The advantages of a modular and simplified architecture allow to answer several use cases, such as ambient assisted living, search and rescue and retail applications. This project presents a more focused application in retail, namely inventory monitoring.

Approach

The platform chosen for the proposed solution was the Crazyflie 2.0. This platform is an extremely light and a low profile nano quadrotor that can safely fly indoors and even in crowded surroundings.

The "brain" of the proposed system runs on the robotic operating system (ROS) environment, which is an open-source, meta-operating system for robotic platforms. The ROS stack allow the communication of the three main tasks: control of the UAV, navigation and the user interface.

Contact

Rua Alfredo Allen, 455
4200-135 Porto, Portugal

+351 220 430 300
info@fraunhofer.pt
www.fraunhofer.pt

Commands Available

The system exposes several services through sockets:

- Initialization
- Take off
- Land
- Go To
- Go Relatively To
- Make trajectory
- Set Home
- Go Home
- Save Location
- Go To Location
- Change Tolerance

Future Work

CMosquitoII allows a user to perform simple motions with the Crazyflie 2.0 in an indoor environment.

However, the project would still benefit from several additions:

- Obstacle avoidance
- High Dynamic Range
- Map reconstruction and online trajectory planning

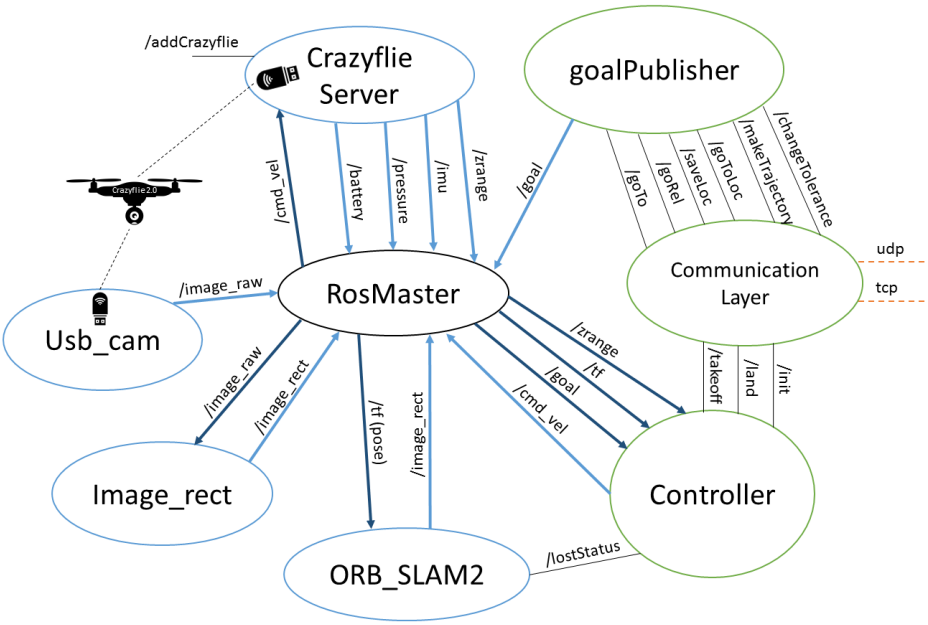

Fig2. System architecture. The controller and the goal publisher make several services available to the implemented communication layer which makes them available through sockets.

In order to establish indoor navigation, a visual odometry algorithm was used. The ORB-SLAM2 uses simultaneous location and mapping (SLAM) and loop closure techniques. This algorithm allows an estimation of a camera's motion by analysing its video feed.

Since the Crazyflie 2.0 does not provide any image source, it was equipped with a small analogue camera, a wide angle lens and a small transmitter. Considering the extremely low payload capabilities of the Crazyflie 2.0, the whole video system was kept lightweight, with a total weight of about 5 grams.

System Operation

The system architecture is composed by several nodes. The "controller" node receives the current position of the Crazyflie and outputs the necessary flight commands to move it to the desired location. In turn, the desired location is outputted by the "goal publisher" node which changes the current waypoint in real time so the Crazyflie flies the required motion.

Retail

The issues of out-of-stocks on the shelf and products' displacement is one of the pressing problems that retailers face in store operations.

This projects tries to answer the inventory monitoring challenge of the retail scenario. By means of providing the correct waypoints in order to travel the aisle with the appropriate speed and direction, it is possible to retrieve images of the products. Applying to the acquired images similar methodologies to ShopView, it is possible to detect out of stock occurrences.

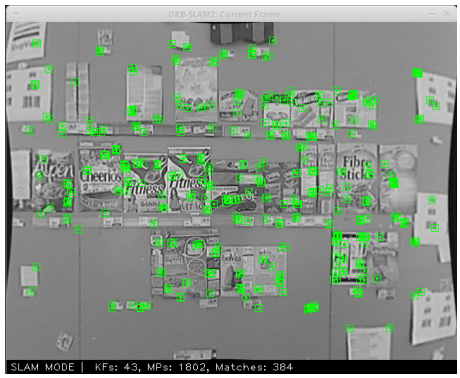

Fig3. ORB-SLAM2 extracting features from the live video feed.