Autonomous Drone

Engineering, Construction, and Programming of a Fully Autonomous Drone

Objective

The ideal delivery drone is engineered with profitability, safety, and privacy in mind. However, the latter is often disregarded, and cameras are used to detect obstacles. The objective of this project was to engineer, construct, and program a fully autonomous drone that does not rely on cameras to detect obstacles.

Approach

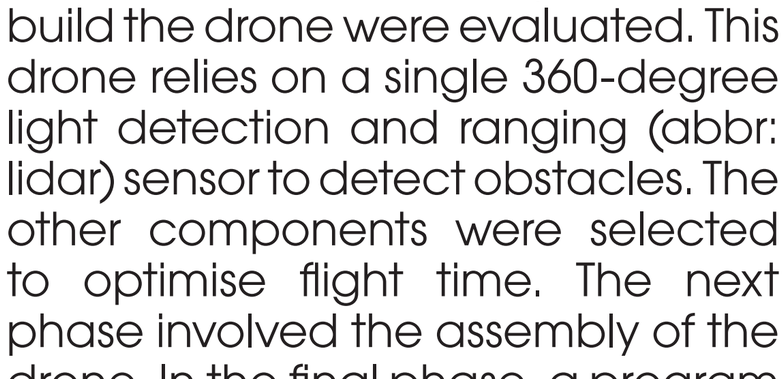
In the first phase, a concept was developed to detect possible collisions and the components to build the drone were evaluated. This drone relies on a single 360-degree light detection and ranging (abbr: lidar) sensor to detect obstacles. The other components were selected to optimise flight time. The next phase involved the assembly of the drone. In the final phase, a program was developed in the computer language C++ to allow for fully autonomous flight. This program runs on a Raspberry Pi that acts as a companion computer. Several safety measures were implemented to prevent crashes. Additionally, a simulation helped test changes made to the program.

Conclusion

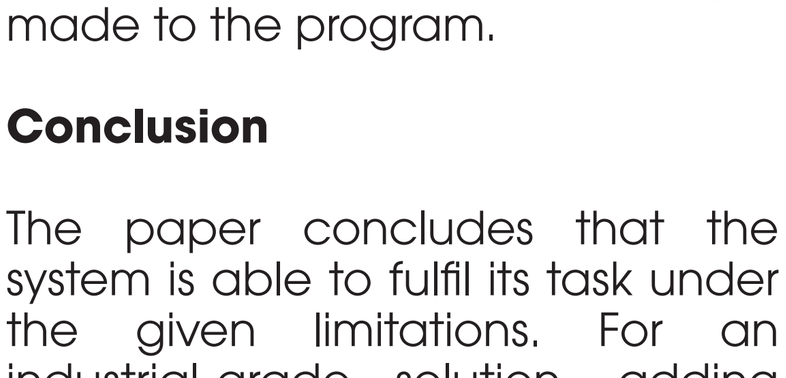
The paper concludes that the system is able to fulfil its task under the given limitations. For an industrial-grade solution, adding more sensors is a must. While multiple lidar sensors appear to fulfil both the aspect of safety and privacy, they are not economically viable. A camera can offer more protection at a cheaper price.

```
oid waypoint_mode(Autopilot_Interface &api, ldlidar::LiPkg*

    std::cout << "[Waypoint Mode] start" << std::endl;

    for (int i = 0; i < waypoints->size(); i++) {

        //initialize mavlink_set_position_target_local_ned_t
        mavlink_set_position_target_local_ned_t sp;

        //altitude correction
        if (abs(api.current_messages.local_position_ned.z -

        //fly to next waypoint
        std::vector<mavlink_local_position_ned_t> intermedia

        //save path adjustment
        if (intermediate_waypoints.size() > 2)···

        std::cout << "[Waypoint Mode] waypoint reached" << s
```

Code snippet of the waypoint mode function in C++.



AirSim is a simulation made by Microsoft built on Unreal Engine.



First manual test flight with stabilisation provided by the Flight Controller.

Kantonsschule Rychenberg

Testflight

Simulation

Author: Matteo Giger
Supervisor: Michael Oettli
2nd Supervisor: Dr. Cyril Caspar