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# Design and implementation of indoor visual autonomous navigation system for quadrotor UAV based on binocular camera and IMU

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## Introduction

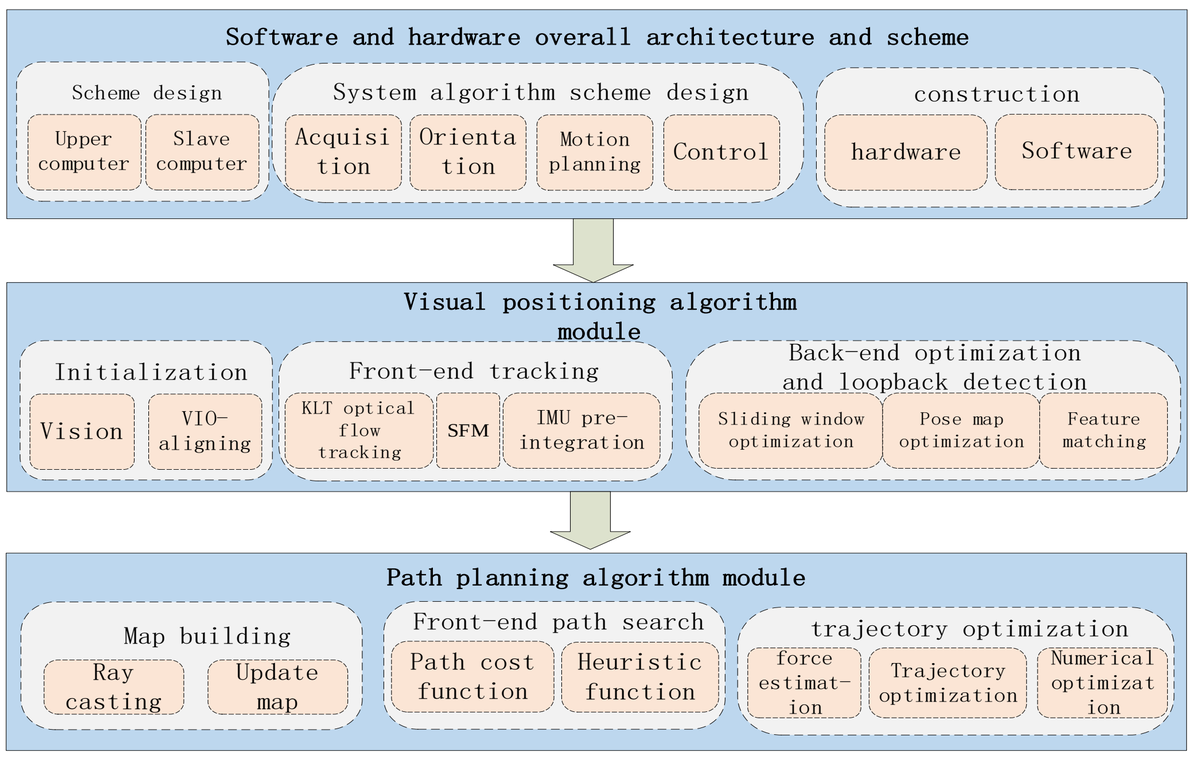
- Developing drones capable of autonomous navigation in complex indoor environments [1] is a long-term challenge, and the limiting factor for autonomous flight in arbitrary, unknown environments is combining rapid perception with effective planning.
- The sensing system [2] must be robust to interference under conditions such as sensor noise, body vibration and changes in light intensity.
- An effective planner is necessary to find a dynamically feasible and collision-free path.

## Objective

With the limited computing power of onboard computers, it becomes difficult to achieve reliable perception and planning at low latency and high speeds.

## Methodology

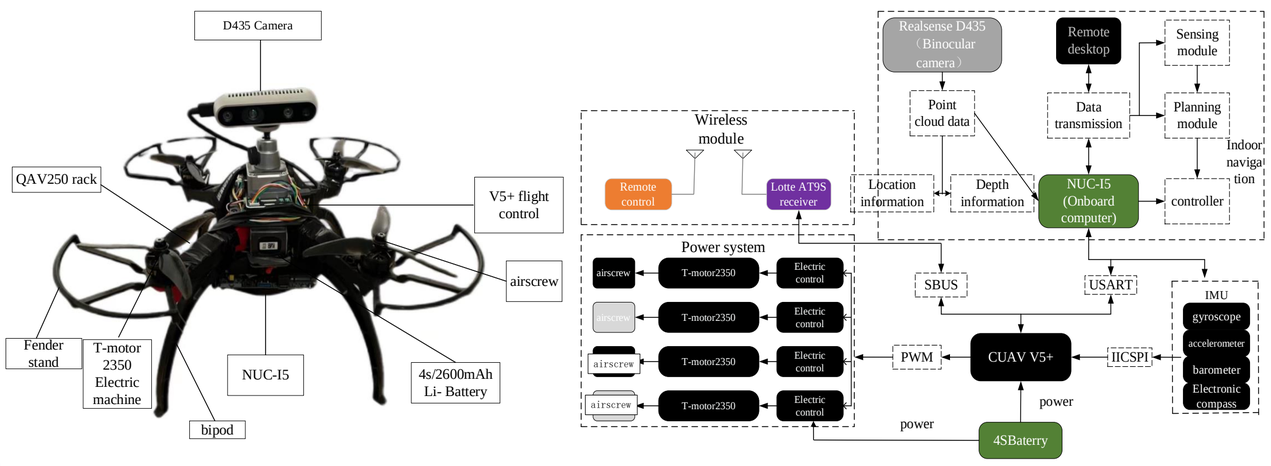
- The overall framework of the whole system is designed, including the vision-based unmanned aerial vehicle autonomous navigation software scheme and the design of unmanned aerial vehicle hardware verification platform.




- This paper studies the positioning technology of binocular VIO multi-sensor fusion of UAV, and adopts the tight coupling and loose coupling technology to integrate the IMU data.
- The path planning algorithm module adopts a path planning algorithm based on ESDF mapping information, which greatly reduces the calculation time.

## Results

- The image below shows the finished product of the assembled drone. In order to prevent sudden power loss during the flight of the drone, the onboard computer and flight control unit of the drone are installed with a voltage regulator module.

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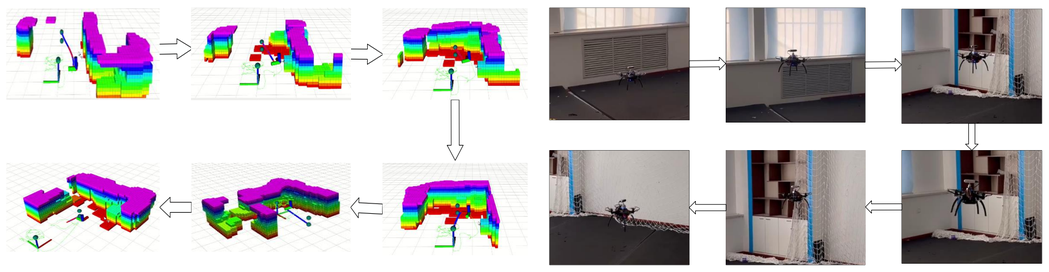
## 1. Verification experiment

- In order to test the performance of the system in a full range, the flight was designed in a complex scene, which was in a large laboratory with Windows, cabinets and artificially set up some flying obstacles. Several autonomous flights of the UAV were carried out, mainly testing the direct flight and turning flight of the UAV on the flat ground, and testing its flight under strong light conditions and low light conditions.

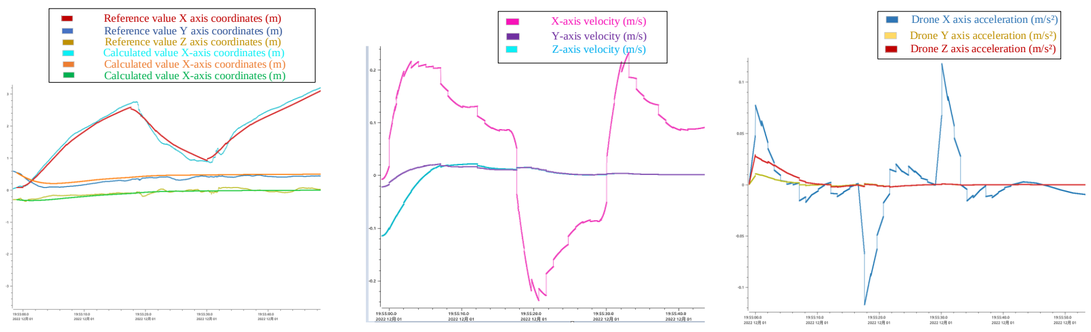


Visualization of flight process in complex scenes

Shows the real flight process of complex scenes

## 2. Experimental results of autonomous flight of UAV in complex environment

- The following is a visual display of UAV flight experiment results in complex scenes to evaluate the flight stability and position estimation accuracy of the UAV, as well as to evaluate the flight characteristics and autonomous navigation performance of the UAV under different lighting conditions.




(a) UAV position change (b) Uav speed variation (c) Uav acceleration change

- The experimental results show that the UAV autonomous navigation system performs well in complex indoor environment. Its stability and position estimation accuracy are high, and it can accurately avoid obstacles and complete complex tasks.

## Discussion and Conclusion

### 1. Discussion

- Designed a quadrotor UAV based on binocular camera and IMU.
- Evaluates the performance of these algorithms in detail, and ensures the high efficiency, stability, accuracy and reliability of the system through the accurate analysis of each index.

### 2. Conclusion

- By realizing the autonomous navigation and path planning of UAV in indoor environment, the application range of UAV will be further expanded. In general, this study provides a strong theoretical support and practical basis for indoor autonomous navigation technology of quadrotor UAV.

## References

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