Above Your Hand: direct and natural interaction with aerial robot

Kensho Miyoshi
The University of Tokyo
Tokyo, Japan
miyoshikensho@ailab.t.u-tokyo.ac.jp

Ryo Konomura
The University of Tokyo
Tokyo, Japan
konomura@ailab.t.u-tokyo.ac.jp

Koichi Hori
The University of Tokyo
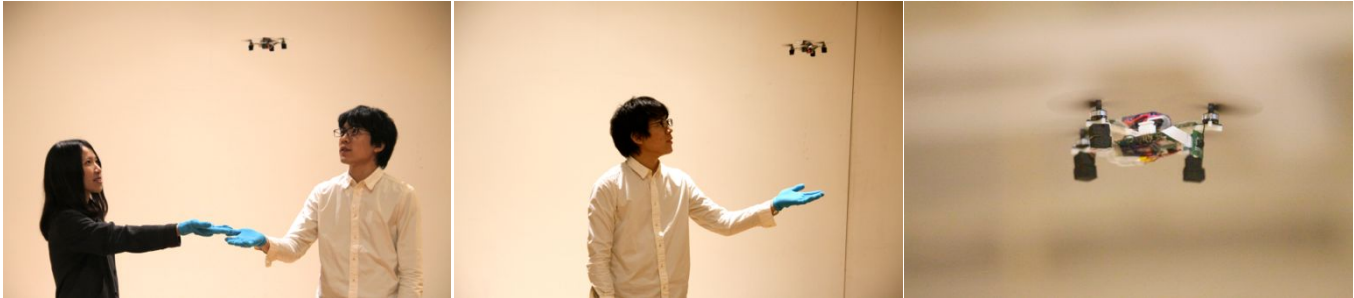Tokyo, Japan
hori@computer.org

Figure 1. *"passing" the aerial robot between two people (left), aerial robot flying above the hand (middle), our original quadcopter (right)*

1. Abstract

"Above Your Hand" is a new application of interactive aerial robot. We explore direct and natural interaction with autonomous aerial robots and its applications. The uniqueness of our approach is to use no external equipment such as controllers, motion tracking system or wireless control system.

Our original palm-sized quadcopter (Figure 1, right) flies above your hand wearing a glove of a particular color. It is capable of following your hand using two onboard cameras (Figure 1, middle). One camera is attached horizontally to the quadcopter and the other vertically. When it does not detect hands, it keeps hovering at its current location by processing the feature points of the obtained images of its environment without particular landmarks [Konomura et al. 2013, 2014]. Since all of this processing is executed inside the onboard Linux-based microcontroller, it requires no external computational control at all. This is the world-first success in both the smallness and full autonomy within the onboard computer. The smallness enables more active and closer interaction in indoor environments. Conversely our robot does not perform well in outdoor or windy environments yet.

Owing to the simple design of the interaction, it is easy for multiple people to be involved in the interaction at the same time. For example you can "pass" the flying robot to another person from hand to hand (Figure 1, left).

There have been previous works on natural interaction with aerial robots. Ng made methods to interact with Parrot's AR.Drone using Microsoft's Kinect [Ng et al. 2011]. Sanna presented a NUI framework for quadcopter control [Sanna et al. 2013]. Lementec used multiple orientation sensors to classify gestures [Lementec et al. 2004]. Since all of these methods require stationary equipment, there are naturally limitations in the available area of the aerial robots. Our approach has much potential to remove this limitation.

2. Demonstration

Attendees have only to wear gloves to experience this interaction. There is no need to stand in line to experience our application. It is welcome that multiple people join the interaction at the same time. Additionally, we demonstrate another application, "playing catch in the air" with dynamic flight and sound recognition. When you swing your hand below the quadcopter, it flies straight to the direction of swing. The quadcopter flies between remote persons just like a ball in playing catch. Using onboard microphone and sound recognition, you can command take-off and landing with your voice and blowing whistle.

3. Conclusion

We presented "Above Your Hand", a new application of interactive aerial robot. This application enables human to interact with aerial robots without any external electric devices or host machines from take-off to landing. We expect that our application will be applied in areas such as navigation, advertisement and entertainment.

References

KONOMURA, R., ET AL., K., Designing Hardware and Software Systems Toward Very Compact and Fully Autonomous Quadrotors, *IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, 2013

KONOMURA, R., ET AL., Visual 3D Self Localization with 8 Gram Circuit Board for Very Compact and Fully Autonomous Unmanned Aerial Vehicles, *IEEE International Conference on Robotics and Automation, May 31-June 5,* 2014 (to appear)

NG, W., ET AL., Collocated Interaction with Flying Robots, *RO-MAN, 2011 IEEE. IEEE*, 2011

SANNA, A., ET AL., A Kinect-based natural interface for quadrotor control. *Intelligent Technologies for Interactive Entertainment. Springer Berlin Heidelberg*, 2012

LEMENTEC. J-C., ET AL., Recognition of arm gestures using multiple orientation sensors: gesture classification, *Intelligent Transportation Systems, 2004. Proceedings. The 7th International IEEE Conference on. IEEE*, 2004