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Using human posture to control multi-rotor drones

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***Abstract*—This study aims to explore the application of pose recognition technology in drone control. We deployed the YOLOv8 pose model in the Jetson Nano equipped on a ZD550 multi-rotor drone, enabling it to run deep learning models for pose recognition. In our experiments, we designed various poses and the drone successfully recognized our body poses during flight.**

I. Introduction

Currently, there are three methods to achieve precise drone landing: GPS, remote controllers, and RTK technology. However, each of these methods has its limitations. GPS is not accurate enough, remote controls are challenging for beginners, and RTK requires specific equipment setups. In this study, we propose using human body poses to guide the drone (as shown in Fig. 1). We use the AI model on multi-rotor drone to recognize body postures of the ground commander (as shown in Fig. 2), then executes movements such as forward, backward, left, right, stop, and descend until the drone lands precisely at the designated spot.

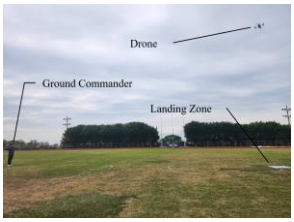

Figure 1. Experimental process


Figure 2. Multi-rotor drone

II. Methods and Results

In this study, we defined six commands for drone landing tasks: forward, backward, left, right, down, and stop (as shown in Fig. 3), each associated with specific body poses. For example, when the ground commander observes that the drone is directly above the landing zone, he can show a posture with both elbows and both shoulders at 180°, indicating the "down" command, prompting the drone to descend. To recognize body poses, YOLOv8 pose model [1, 2] is used to detect the 2D coordinates of 17 keypoints (as shown in Fig. 4). To obtain the angle of a joint (e.g. right elbow) we use the following dot product formula:

$$\theta_8 = \cos^{-1}\left(\overrightarrow{P_8P_{10}} \cdot \overrightarrow{P_8P_6} \Big/ \left|\overrightarrow{P_8P_{10}}\right|\left|\overrightarrow{P_8P_6}\right|\right) \quad (1)$$

where $P_6 = (x_6, y_6)$ 、 $P_8 = (x_8, y_8)$ 、 $P_{10} = (x_{10}, y_{10})$ represent the 2D coordinates of the right shoulder, right elbow, and right wrist detected by YOLOv8, and $\overrightarrow{P_8P_{10}} = (x_{10} - x_8, , y_{10} - y_8)$, $\overrightarrow{P_8P_6} = (x_6 - x_8, y_6 - y_8)$. Through this method, we can calculate the angles of the left and right elbows as well as the left and right shoulders in each frame of the video, thereby obtaining the command instructions.

To enhance the accuracy of recognizing the ground commander captured from high altitudes, we employed the Region of Interest (ROI) technology [3] to enhance the accuracy. The flowchart is shown in Fig. 5. If no person is detected, the ROI is locked in the center of the image; when a person is detected, the ROI is set close to the person and has a range of approximately three times the person's height to maintain tracking accuracy (as shown in Fig. 6).

Pose/Command	Joint Angle	Pose/Command	Joint Angle
 Forward	①right-elbow≅180° ➔∠68(10) ≅180° ②left-elbow≅180° ➔∠579≅180° ③right-shoulder≅90° ➔∠86(12) ≅90° ④left-shoulder≅90° ➔∠75(11) ≅90°	 Backward	①right-elbow≅90° ➔ ∠68(10) ≅90° ②left-elbow≅90° ➔ ∠579≅90 ③right-shoulder≅90° ➔ ∠86(12) ≅90° ④left-shoulder≅90° ➔ ∠75(11) ≅90°
 Left	①right-elbow≅180° ➔ ∠68(10) ≅180° ②left-elbow≅180° ➔ ∠579≅180° ③right-shoulder≅90° ➔ ∠86(12) ≅90° ④left-shoulder≅0° ➔ ∠75(11) ≅0°	 Right	①right-elbow≅180° ➔ ∠68(10) ≅180° ②left-elbow≅180° ➔ ∠579≅180° ③right-shoulder≅0° ➔ ∠86(12) ≅0° ④left-shoulder≅90° ➔∠75(11) ≅90°
 Stop	①right-elbow≅180° ➔ ∠68(10) ≅180° ②left-elbow≅180° ➔ ∠579≅180° ③right-shoulder≅0° ➔ ∠86(12) ≅0° ④left-shoulder≅0° ➔ ∠75(11) ≅0°	 Down	①right-elbow≅180° ➔ ∠68(10) ≅180° ②left-elbow≅180° ➔ ∠579≅180° ③right shoulder≅180° ➔ ∠86(12) ≅180° ④left-shoulder≅180° ➔ ∠75(11) ≅180°

Figure 3. Six commands for drone landing tasks

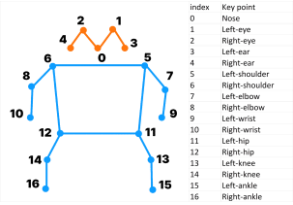

Figure 4. 17 Keypoints of YOLOv8

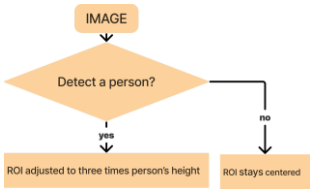

Figure 5. Flowchart of ROI

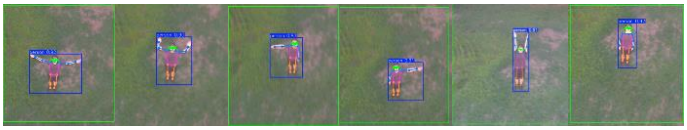
Forward Backward Left Right Down Stop

Figure 6. Experimental results

III. Conclusion

This work explores the application of pose recognition technology in drone control. We successfully made the drone recognize six commands in the air, proving the feasibility of this technology.

References

[1] M. Hussain, "YOLOv1 to v8: Unveiling each variant–a comprehensive review of YOLO," *IEEE Access*, no. 12, pp. 42816-42833, 2024.
[2] C. Dong and G. Du, "An enhanced real-time human pose estimation method based on modified YOLOv8 framework," *Sci Rep*, no. 8012, 2024.
[3] A. Kumar, R. Chandel, and M. Singh, "Image processing technique for tracking and counting of vehicles using ROI," *PEEIC*, pp. 981-986, 2023.