Research Progress and Prospects of Fruit Recognition and Positioning Technology Based on an Unmanned Aerial Vehicle Platform

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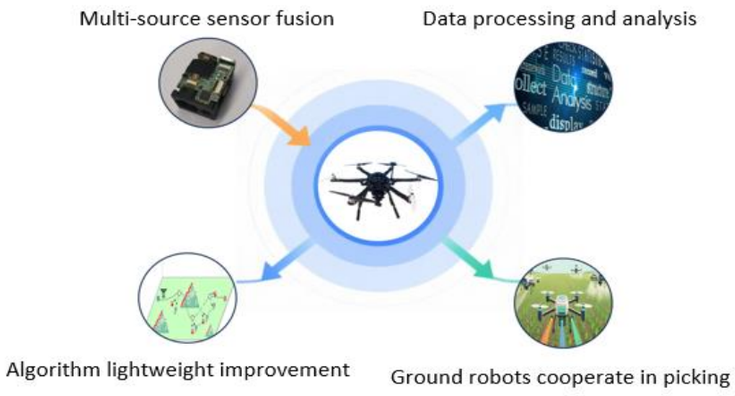
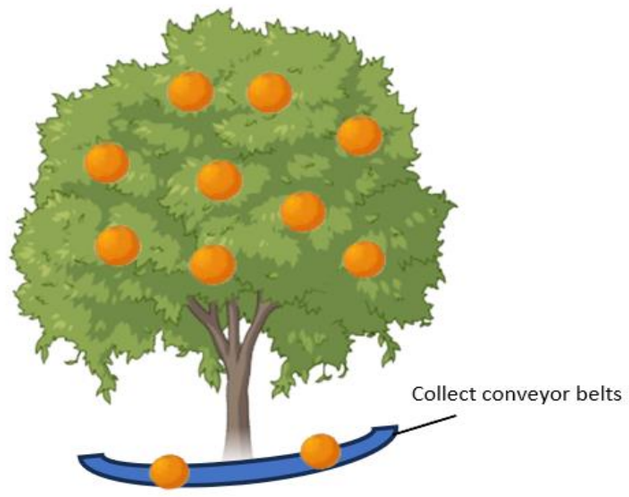
Research Background

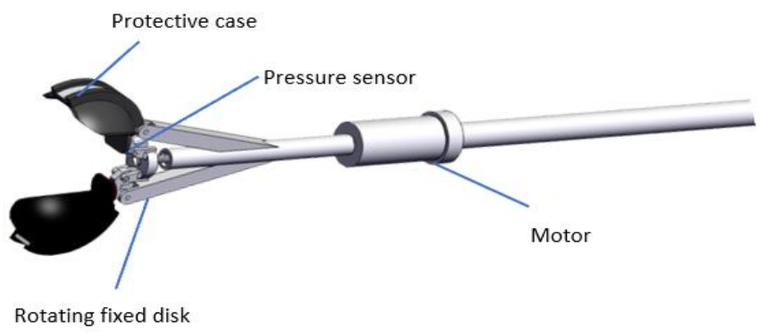
a. Multi-rotor unmanned aerial vehicle



b. Collaborative picking system

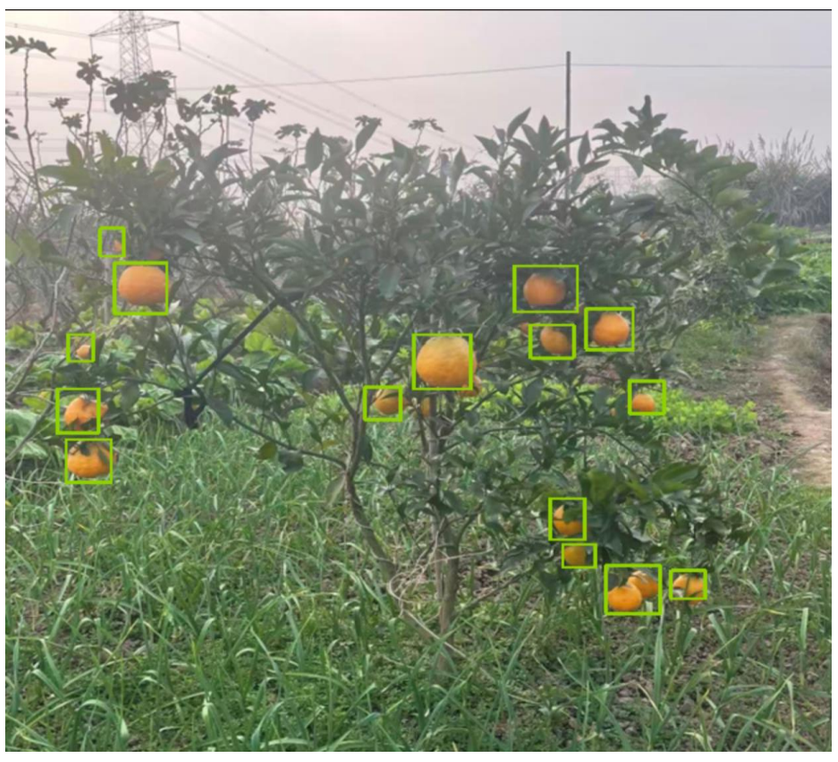


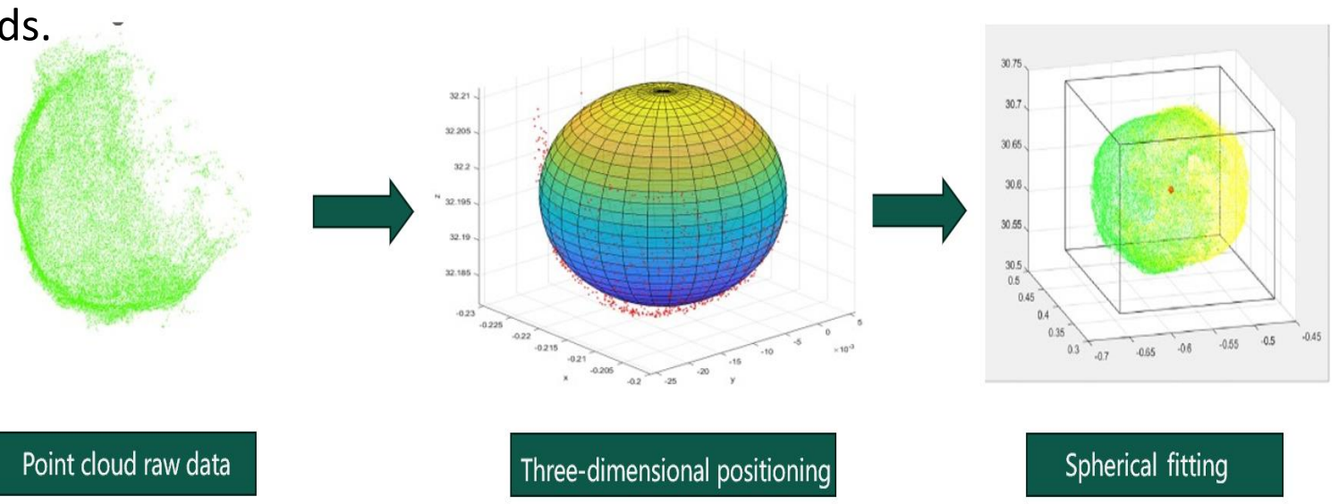
c. Picking and collection



d. Picking device

Fruit identification and location technology plays a significant role in modern agriculture, especially in smart agriculture and automated picking systems. Due to factors such as irregular fruit distribution, branch and leaf obstruction, and environmental light, traditional manual or ground positioning methods face many challenges in large orchards. Through current research on the phased achievements of fruit recognition and positioning based on unmanned aerial vehicles, the key technologies of fruit recognition and positioning are deeply analyzed. Fruit identification and location technology is a key link in smart orchards. The positioning technology based on unmanned aerial vehicles (UAVs) significantly improves the positioning accuracy in complex environments through high flexibility and multi-sensor fusion. Research shows that machine vision and multi-sensor fusion models have made progress in the positioning of fruits such as citrus and strawberries, thanks to the three-dimensional spatial flexibility of multi-rotor platforms, the efficiency of cluster operations, and their adaptability to orchards.





Technical Bottlenecks

- Poor environmental adaptability (unstable UAV flight, low sensor accuracy, short equipment life in humidity).
- Algorithm conflicts (accuracy-real-time balance issues; lightweight vs. high-precision trade-off).
- Technical & cost constraints (high costs; immature swarm control/data fusion).
- Inadequate orchard standardization.

location technology

Fruit identification

Fruit recognition technology takes deep learning algorithms such as the YOLO series and Mask-RCNN as its core, is adapted to the aerial photography scenarios of multi-rotor drones, and focuses on solving the problem of branch and leaf occlusion to ensure a recognition accuracy rate of ≥90%.

Fruit positioning technology

integrates multi-sensor data such as RGB cameras and LiDAR, combined with RTK-GNSS assisted positioning, to overcome the problem of environmental interference. It uses positioning compensation to achieve a positioning error of ≤2cm, providing precise coordinates for automated picking.

Key Breakthrough Directions

1.Optimize multi-sensor fusion and algorithms for environmental adaptability.

2.Develop lightweight, modular models (balance efficiency and precision).

3.Promote orchard planting standardization.