

A Design of New Air Ground Cooperative Unmanned Transportation System

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Abstract

With the development of science and technology, the shortage of human resources in the labor market and the increase of human costs, intelligence, intelligence and unmanned logistics have become the mainstream development trend. This paper introduces a new type of space ground coordinated unmanned transportation system, which aims to solve the problems of liberating labor, reducing the operating costs of logistics enterprises, reducing the contact between people, and impeding the spread of the COVID-19 epidemic. This paper introduces the research background and advantages of the system, and describes the selection and working principle of the system in detail.

Keywords: UAV, UGV, Air ground coordination, Transportation

1. Introduction

With the shortage of the labor market and the rising labor costs, the traditional logistics has gradually become unmanned and intelligent. In recent years, UAVs have been widely popularized and used, especially by many large companies for express delivery and emergency response of the last kilometer of the city [1]. During the outbreak of COVID-19 in 2020, JD will use unmanned aerial vehicles to transport drugs and food in areas with serious epidemic. This will replace the traditional logistics blocked by the epidemic. The UAV carries a large number of sensors, making it multi-dimensional and highly flexible. Therefore, the UAV can provide mobile sensing resources with the same characteristics for mobile swarm intelligence [2][3].

Through the existing mobile awareness resources (UAV, UGV) to obtain awareness, and through the deployed mobile Internet to communicate, a new awareness mode - air ground cooperative mobile group intelligence awareness has been formed. Based on this technical background, the air ground cooperative new unmanned transportation system is developed.

This design has the following advantages:

On the technical level, overcome the characteristics of small load of UAV and limited sensing range of intelligent vehicle, and combine the advantages of large sensing range of UAV and strong loading capacity of intelligent vehicle.

At the social level, the new unmanned transportation system of air ground coordination greatly reduces the participation of people in the distribution link, and reduces the probability of traffic accident risk during transportation while liberating productivity.

In the context of the epidemic, unmanned distribution can change the previous face-to-face logistics terminal distribution scenario, reduce personnel contact, and to some extent, block the spread of the epidemic.

At the economic level, the new unmanned transportation system of air ground coordination can broaden the scope of logistics distribution space, fundamentally improve the efficiency of logistics distribution, control the consumption of human costs during logistics distribution, ensure that the logistics industry can better adapt to the needs of social

modernization and improve the comprehensive benefits during logistics distribution.

2. Overall design scheme

The new air ground cooperative unmanned transportation system includes UAV unit, ground station unit and intelligent vehicle group. The UAV unit and the intelligent vehicle unit are connected with the ground station unit through the communication module. The UAV unit can communicate with each other and the UAV can transmit information to the leader intelligent vehicle unit. The UAV unit is mainly responsible for two aspects, one is to detect the position between the transportation target and the UAV, and assist the unmanned vehicle group to carry the transportation target; the other is to be responsible for transmitting the ground information around the unmanned vehicle group to the leader's intelligent vehicle during the transportation, and assist the intelligent vehicle group to perceive the ground information around to ensure safety. The ground station unit is responsible for monitoring the working status of the UAV and the intelligent vehicle group and selecting an optimal transportation route for the UAV and the intelligent vehicle group. The unmanned vehicle group is responsible for transporting goods along the optimal route selected by the ground station. The leader unmanned vehicle receives the transmission information from the ground station unit and the UAV unit to avoid obstacles. The follower unmanned vehicle makes adjustments according to the multi-agent consistency algorithm, so that the entire unmanned vehicle group can stably and quickly transport the target goods (overall structure Fig. 1 (a) (b) (c) (d)).

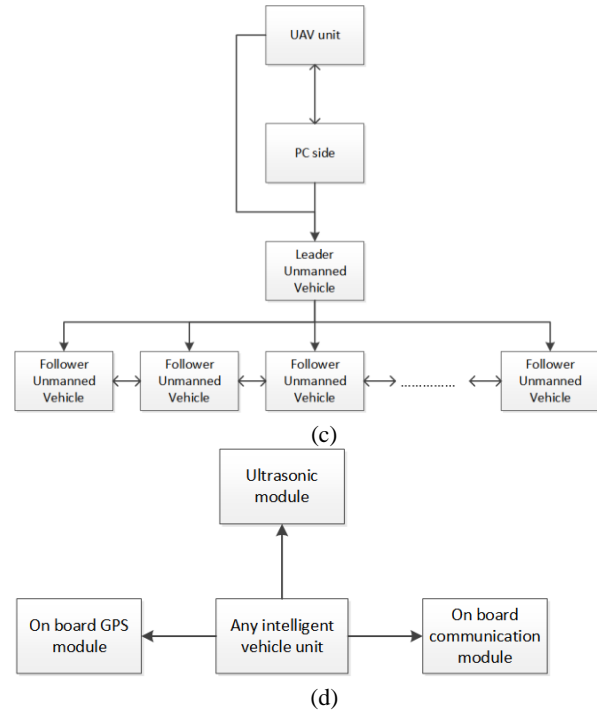
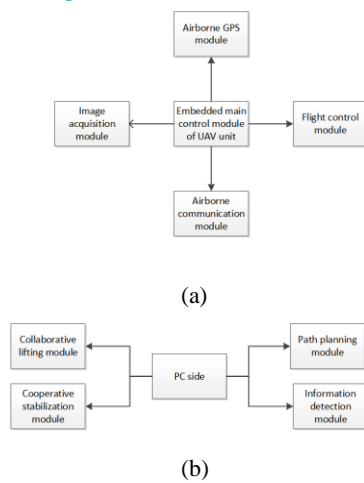


Fig.1. Overall structure

3. Device selection

Device selection is shown in Table 1 and Table 2.

Table 1. Device Selection of UAV

UGV	Pixhawk four rotor aircraft
Battery	5200mah 3S lithium battery
Flight control module	Pixhawk 2.4.8 Flight control module
Camera lens	SJ5000
GPS module	NEO-M8N GPS module
Image processing module	STM32(1)+Opencv3.4.1
The wireless data transmission module is connected with the main control module.	

Table 2. Device Selection of UAV

Control module	STM32F103ZET6 microcontroller
On board communication module	STM32 (2) sets up LAN through router for communication between smart cars; The wireless data transmission module is connected with the ground communication module.
GPS module	NEO-M8N GPS module

4. Technical realization principle

4.1. Target cargo handling

The transportation target and destination are given. The ground station sends path information to the UAV and UAV according to the location of the transportation target, so that the UAV and UAV can fly near the transportation target.

The UAV identifies the transportation target through the image processing module to make the UAV fly above the center of the transportation target.

The UAV sends the image information of the transport target to the ground station through the wireless data transmission module, and the ground station commands the unmanned vehicle so that the midpoint of each side of the transport target is directly below, which is convenient for the subsequent stable transport of the transport target. And set the height..

The ground station sends a command to command the unmanned vehicle group to lift objects together. Fig. 2 is the schematic diagram of lifting scheme and Fig. 3 is the lifting scheme flow chart.

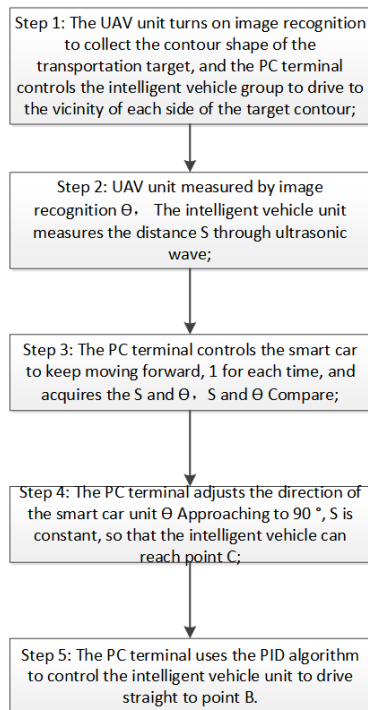


Fig.2. The schematic diagram of lifting scheme

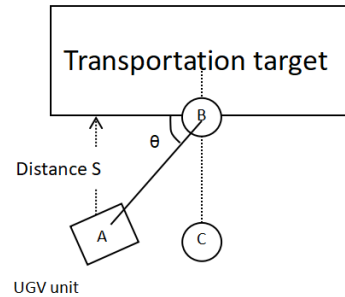


Fig.3. The lifting scheme flow chart

4.2. Target cargo transportation

The ground station unit plans an optimal path according to the map, integrating the location information of the transportation target and the location information of the transportation destination, and transmits it to the UAV and the unmanned vehicle group through the wireless data transmission module. The UAV and the unmanned vehicle group travel to the destination according to the optimal path.

Note: (1) In the transportation process, the UAV transmits the ground information to the leader's UAV. The leader's UAV avoids obstacles according to the ground information transmitted by the UAV, and the follower's UAV maintains the formation of the unmanned vehicle group according to the multi-agent consistency algorithm.

(2) The ground station unit monitors the operation status (operation speed, coordinate displacement of the intelligent vehicle set relative to the center of the transportation target, etc.) of the UAV and the intelligent vehicle set in real time, monitors the pressure between the UAV and the target cargo, and can intervene in the control of the UAV and the UAV at any time. The priority of the control of the UAV is higher than that of the UAV. Fig. 4 is the overall schematic diagram of the system.

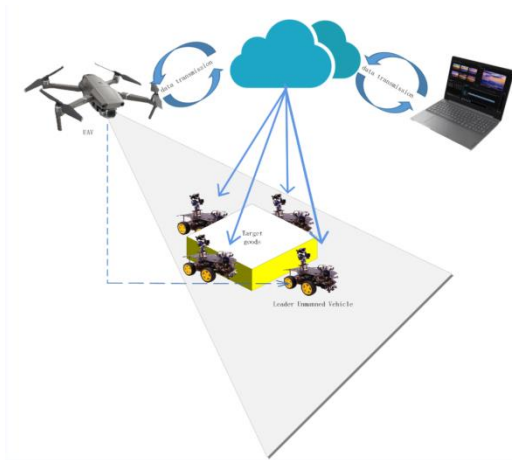


Fig.4. the overall schematic diagram of the system

4.3. Target goods release

When arriving at the destination, the unmanned vehicle group will run to the designated place, unload the goods at the same time, and the UAV and the unmanned vehicle will enter the standby state.

5. Conclusion

This paper designs a new type of air ground unmanned transportation system, and explains its working principle. Most of the current application modes are based on a single agent, and the system designed in this paper can fill the gap of space ground cooperative transportation. Considering the huge development prospect in the field of air ground coordination, I hope this design can provide some reference for technicians in related industries.

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Authors Introduction

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