**overview**

Drone express delivery of packages through unmanned low-altitude air vehicles operated by radio remote control devices and self-provided program control devices is automatically delivered to the destination. Its advantages lie in solving distribution problems in remote areas, improving distribution efficiency, and reducing Labor costs. Drone delivery not only drastically reduces distribution costs, but also increases efficiency and solves distribution problems in remote areas. At present, companies including Amazon and DHL are testing many drone distribution shipments. At present, drones used for business testing are mainly quadrotor or onto-wing type. The flying height is less than 1,000 meters. The flying radius is about 10 kilometers and the load are within 10 kilograms. The drone is very suitable for the delivery of remote areas and emergency items and can effectively improve the distribution efficiency and reduce manpower and transport costs. The delivery drone uses an eight-rotor aircraft, equipped with a GPS-controlled navigation system, an iGPS receiver, various sensors, and a wireless signal transmitter and receiver. The Drone has multiple flight modes such as GPS self-control navigation, fixed-point suspension, and manual control. It integrates a variety of high-precision sensors such as triaxle accelerometers, triaxle gyroscopes, magnetometers, barometric altimeters, and advanced control algorithms. The drone is equipped with a black box to record status information. At the same time, the drone also has the function of out of control protection. When the drone enters an out of control state, it will automatically maintain accurate hovering, and the out-of-control timeout will fly to the express delivery distribution point. Drone transmit data through 4G networks and radio communication remote sensing technologies and dispatch centers and self-service courier cabinets, send their own geographical coordinates and status information to the dispatch center in real time, receive instructions from the dispatch center, and receive the destination coordinates. Later, it will use the GPS autonomous navigation mode to fly. After entering the target area, it sends a landing request, a local mission report, and a local operating status report to the destination courier. After receiving the landing request response, the courier guides the drone in the express cabinet. Top landing platform landing, loading and unloading courier, and rapid charging. The Drone sends a request to the destination transcribing cabinet again after the non-response request timeout expires. After three timeouts, the drone sends a landing request exception report, a local task status report, and a local operation status report to the dispatch center to request an instruction. The drone will fly to the express delivery distribution point after losing contact with the dispatch center or experiencing an abnormal failure.

**Motivation**

With the development of artificial intelligence and other technologies, the future technological disadvantages will be further compensated. From manned operations to remote operations to autonomous flights, the transportation of future drones will become more frequent. At the same time, with the upgrade of energy storage technology, the endurance capacity and load capacity will be further enhanced, and the use of Drone in the future will further expand.

In remote areas, the volume of deliveries is small, the distance is far away, and the cost is high. Moreover, the logistics cost is mainly in the distribution link of the last mile. The data shows that in 2016, the global logistics cost is nearly 80 billion US dollars, of which the last one-kilometer transport accounts for the proportion of the total cost. 50%. Therefore, express logistics companies have enough internal driving forces to reduce costs and increase efficiency.

**a. The shortest straight-line distance**

Drone has a straight line in the air, the shortest distance, almost ignoring the terrain, there is no traditional express delivery route limitations. In the case of DHL's transport in the German towns, the air transport restrictions have more freedom than traditional methods. Take China Post as an example in the pilot project in Anji County, Zhejiang Province. It takes 40 minutes from Hangzhou Hang Zhen to Qi guan Village by car to deliver parts and it takes only 15 minutes to open the drone route. Therefore, the advantage of drones ignoring terrain is even more pronounced in remote areas.

**b. Lower operating costs:**

Relatively low cost, saving manpower and time costs. According to a study by New York financial research firm Ark-invest, Amazon's delivery service can reduce the cost of delivering small parcels to only about $1. In contrast, Amazon uses conventional delivery services in New York and other cities within one hour. The cost of each delivery is up to 7.99 US dollars.

**c. High efficiency and speed:**

At present, the mainstream speed of drones in the logistics industry ranges from tens of kilometers to hundreds of kilometers per hour. Taking DHL as an example, the third generation of multi-rotor Drone PARCELCOPTER has reached 70km/h. Moreover, Drones have expanded the efficiency of space use (from flat to three-dimensional) without risk of traffic jams. Therefore, no aircraft will greatly increase distribution efficiency.

**d. Suitable for small batch, high frequency transport:**

According to Amazon statistics, about 85% of express items are lighter than 5 pounds (about 2.27Kg), which means that many items can be delivered without aircraft. According to the data from the State Post Office, the total number of courier shipments in 2017 will reach 36 billion, and the Institute expects the number of per capita parts to reach 26. Therefore, small batches and high frequency are the key features of express logistics. Compared with other distribution methods, drones have unique advantages in efficiency and cost.

**e. Ideal for delivery in remote areas and emergency items:**

Disregarding the advantages of terrain, it can fully reach the distribution needs of remote mountainous regions. China Post opened the first drone distribution route in the Andizhan Village area of ​​Zhejiang Province and piloted remote regional distribution services. DHL uses drones to deliver medicines to customers who live on the island, and like Amazon Prime Air's launch of 30 minutes, it also gives full play to the speed of drones and provides customers with more time-efficient delivery. service.

**Landscape**

DJI drone technology is very mature. Leading position in the world. DJI drones can be used for reference. The main competitor is Amazon Prime Air. Amazon drones can be delivered within 30 minutes from order placement to delivery. It is an important part of Amazon's future e-commerce logistics. Amazon Prime Air is currently mainly used in the suburbs, can cover some rural areas, and plans to deliver goods in urban areas in the future, so that drones can put parcels on the roof. However, the prerequisite for completing the distribution within 30 minutes is that drones can fly 15 miles. The obvious fact is that not all the customer's designated delivery locations are within 7.5 miles of Amazon's warehouse. You can't expect the drone to be ready at all, just wait for the customer to load the package to the customer's home immediately after completing the payment. There are too many preconditions for the delivery of drones, and Amazon has not announced any response in these areas. Drone transport projects can carry greater weight and more transit time than Amazon drones. On the other hand, drone projects are more intelligent.