Application of Computer Vision Technology in UAV

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Abstract. With the improvement of computer ability and the rapid development of computer vision technology, UAV has been widely used in other industries from the initial military field. At present, the most widely used UAV navigation is the global positioning system (GPS) of the United States, which can be easily interfered by human beings, resulting in certain errors. At present, there are four landing methods for manned aircraft, but no matter which one is, its concealment is poor. At the same time, compared with manned aircraft, UAV is generally smaller in size, so it is unable to follow the domestic microwave radar equipment in China. Through literature review, the origin and development of UAV and computational vision technology are comprehensively reviewed. The application of computer vision technology in agriculture, power, transportation, environmental protection, rescue, entertainment and other fields in recent years is summarized. The relevant survey data are analyzed and presented in the form of chart. Through the data, we can clearly find that the combination of computer vision and UAV still has a lot of room for improvement in the future.

Keywords: UAV; Computer Vision; Autonomous Application

1. Introduction
In the field of computer vision, the development of object recognition algorithm framework has become stable, and the current computer vision can be applied to most scenes.

Unmanned aerial vehicle (UAV) is a kind of small robot which has the functions of flight, vertical take-off and landing, and good maneuverability. After integrating computer vision technology, it is widely used in UAV navigation, positioning landing, flight obstacle avoidance, visual simultaneous localization and mapping (SLAM), etc. UAV object recognition and tracking technology uses UAV as a carrier, combined with computer vision technology, in the flight process, combined with flight altitude and angle of view, extract the image features of the target object and process the feature information. At the same time, combined with the relative position control algorithm, the tracking function is realized.

2. Computer Vision and System Composition
Computer vision, also known as machine vision, is mainly to study the use of computers to simulate human visual function, extract valuable information from the image of objective things, process and identify, and ultimately used for actual detection, testing, navigation or control.

PC is used to complete image processing and decision-making, and output control signal.
According to the output of the PC actuator. The software of computer vision system is installed in PC, including image processing system and decision-making system. The former is used to process and recognize the input image, smooth out the noise of the image, improve the recognition ability of the image, extract the features of interest, and get the description equation of the features in the image; the latter uses the knowledge of photogrammetry to calculate and judge according to the feature description equation, and outputs the control signal to drive the actuator.

2.1. Technology Introduction Based on Digital Image Processing

For digital image processing, it is mainly to use a certain device to collect the image information, and then effectively convert it into digital signal. After receiving certain digital signal, the computer can play the system function through special machine equipment.

Specifically speaking, in the process of its application of digital image processing technology, there are mainly the following aspects. However, in the actual processing process, its subjective consciousness is relatively strong. Second, effective restoration of image information, we all know that UAV in the actual process of relevant information collection, there will be incomplete image information, in this case, the application of image restoration technology system becomes very necessary. Thirdly, the image information is compressed effectively. Some image information takes up too much space and the information coding is too scattered, which requires the scientific processing of image compression technology.

2.2. Technology Introduction Based on Visual Tracking

For visual tracking technology, it plays an important role in daily production and life. It can not only effectively monitor the operation of its video, but also play an important role in virtual reality and 3D reconstruction.

According to the different purposes and needs, it can be divided into two forms in actual use. First, the related information and trajectory can be obtained directly from the image information, without additional processing and transformation steps. Second, it can not be directly obtained, but according to certain image model, it can effectively extract the relevant motion estimation, video, etc. in this process, according to certain motion characteristics, the actual motion trajectory is effectively analyzed.

3. Related Principles of Computer Vision Technology Operation

Computer vision technology as an important part of modern science and technology, in the actual operation process, it needs to rely on certain principles for related guidance.

And the realization of the basic principles to the related goals also needs certain machine equipment media to achieve effectively, such as visual sensing equipment. Therefore, in order to better the system application of computer vision technology, we should actively analyze and study its basic operation principle, so as to better promote the long-term and healthy development of computer vision technology in China.

3.1. Acquisition and Analysis of Sequence Images

In the actual process of effective application of computer vision technology, the first thing to do is to obtain and recognize the sequence images systematically. According to the relevant image information between the image frames, the specific tracking object and analysis target are identified and analyzed systematically.

Under its basic principle, the related graphic information can be transformed organically. Generally speaking, the continuous sampling rate should be controlled at 25 frames per second, that is to say, the sampling interval is 0.04ms, so as to better realize the basic goal of real-time sharing and information processing, and promote the progress and development of computer vision technology. In order to achieve autonomous landing, UAV must have the ability of autonomous navigation. The attitude and orientation of UAV is the key to realize UAV landing. The introduction of computer vision to UAV
landing is to use the rich information of vision to obtain the attitude and orientation of UAV.

3.2. Visual Object Tracking Method
For visual tracking, its main purpose is to effectively track and analyze the moving objects, so as to effectively guarantee the safety and reliability of its operation. Specifically speaking, its basic methods mainly include the following aspects.

First, optical flow method. Optical flow method is mainly for the two-dimensional motion field of the moving object, under the assumption of its basic motion trajectory for effective analysis, but its optical flow field can also represent the situation in the three-dimensional motion field, in which a constant constant is needed to support it effectively, so that its motion trajectory in the plane can be analyzed scientifically. The basic calculation formula is as follows:

\[ I(x, y, t) = I(x + \delta x, y + \delta y, t + \delta t) \]

The second is the method of image background modeling, which mainly uses certain machine equipment to effectively detect the basic situation of the moving object. After the establishment and improvement of the basic model of image information, the actual situation and the situation of the model should be carefully compared, and the corresponding foreground target object should be determined according to the actual results. Only by using the basic tracking objects can we collect the relevant useful image information on this basis, and then achieve the relevant goals. After determining the basic tracking target. Use the following formula: \( \hat{\theta}(y) \equiv \rho(\hat{\theta}(y), q) \). So as to effectively guarantee the safety and stability of UAV operation.

4. Combination of Computer Vision and UAV
The combination of computer vision technology and UAV gradually expanded from the original aerial photography to other projects.

The application of UAV aerial photography in field mapping not only shortens the operation cycle, but also greatly improves the mapping accuracy. With the needs of social development, the combination of UAV and computer vision is not only used for topographic mapping, but also often used to obtain natural disasters and deliver food and water to disaster areas through independent application.

4.1. UAV Autonomous Refueling Based on Computer Vision
UAV is used to refuel in the air. Aerial refueling refers to that the aircraft refuels other aircrafts during flight. Currently, there are two kinds of autonomous aerial refueling technology in the world. One is plug cone tube type, which is called soft refueling.

The refueling hose is released through refueling pod. The pilot of the receiving aircraft controls the aircraft to connect the receiving probe with the refueling cone sleeve, and the one-way valve in the cone sleeve is opened come on. Its advantages are that it can refuel multiple aircraft at the same time, and can also refuel the helicopter. The disadvantage is that the refueling speed is slow, and it is greatly affected by the turbulence of the air, and it has high technical requirements for the pilots of the receiving aircraft.

Refueling docking is mainly completed by personnel. It has the advantages of fast refueling speed and low technical requirements for pilots of receiving aircraft, but it can only refuel one aircraft at a time, and can not refuel helicopters.

4.2. Vision Based Autonomous Landing of UAV
Autonomous takeoff and landing is one of the most basic and key technologies. Even if there is no operator to operate, UAV can also land through inertial navigation, GPS navigation and computer vision technology navigation, in which inertial navigation error is large, while GPS navigation is relatively mature, and computer vision technology is a new technology.

In the process of UAV autonomous landing, the attitude angle of UAV is obtained by computer
vision technology. By using MATLAB to process the gray image, the horizon in the image is detected to control the UAV landing. The robustness of computer vision technology is not good when it is just used in UAV landing. In recent years, the robustness of UAV landing has been improved rapidly.

4.3. Vision Based Autonomous Landing of UAV
The combination of UAV and computer vision technology is not only used for aircraft refueling, take-off, landing technology, but also used in many other industries.

In addition to weed detection, infrared equipment installed on UAV can monitor crop pests, water shortage and fertilizer shortage, and even predict the possibility of forest fire, and accurately feed back the geographic information to the control platform through UAV system, which is a successful example of the combination of computer vision and UAV in agriculture. With UAV as the platform, equipped with visual system, the pedestrian flow can be detected and tracked. In specific occasions, the application can help to avoid trampling and other dangerous events in the crowded area, and help to maintain public safety.

5. Conclusion
The prospects of computer vision and UAV are very broad. With the continuous development of technology, UAV technology is expected to make greater breakthroughs in deep learning.

For example, UAV replaces the manual delivery mode of couriers to carry out fixed-point delivery. In the security industry, the captured information is read by the UAV camera and sent back to the console through the UAV system, so as to realize the single person to multi area security monitoring, or combined with street cameras to track fugitives and missing women and children. In this paper, the review and evaluation of UAV and computer vision technology will help people to deepen their understanding of UAV. The novel applications proposed in this paper can provide innovative points for UAV research enthusiasts. At present, there are few literatures about UAV rescue and positioning after mine disaster, and the research in this field is not deep enough. How to realize the combination of UAV and computer vision technology more intelligently is the focus and difficulty of future research.

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