The design of remote-control system for photographic equipment

To cite this article: Yang Lan et al 2019 IOP Conf. Ser.: Mater. Sci. Eng. 569 042017

View the article online for updates and enhancements.
The design of remote-control system for photographic equipment

Yang Lan¹, Shuxiang Song¹, Jianping Jiang², Xiao Su², Haiying Xia¹

¹NO.15 Yucai Road, Guangxi Normal university, Guilin, Guangxi, 541004, Qixing District, China
²Guilin Zhishen Information Technology Co., Ltd., Guilin, Guangxi, 541004, Qixing District, China

*Corresponding author’s e-mail: ly_lanyang@126.com

Abstract. In demand of remote control of photographic equipment, we design a remote-control system for photographic equipment. The system uses the stabilizer as the platform to realize the transmission of the state parameters of photographic equipment and stabilizer to the mobile device by the self-designed wireless communication interaction protocol and control protocol. It can also control the camera equipment and stabilizer according their states. The test results show that the remote-control system of the photographic equipment designed in this paper meets the design requirements, facilitates the user's surveillance filming work and harmonizes the user experience.

1. Introduction

The pan-tilt system[1] is usually used for auxiliary video equipment for video recording and photo shooting. The pan-tilt system includes a connection device for fixing the photographic equipment and a power device connected to the connection device, and the power device usually includes three shafts and the connecting arm between the shafts. The movement of the power device can drive the connecting device to move, thereby driving the photographic device fixed on the connecting device to move[2]. In addition to the handheld pan-tilt system, users can also place the pan-tilt system outside of its visible or touchable range for video recording or photo shooting. However, in this case, it is difficult for user to monitor the video or picture taken by the photographic equipment, so the effect of the video or picture cannot be controlled. Therefore, there is a need for technology that is capable of monitoring photographic equipment beyond the user's visual or touchable range. Currently, electronic devices such as smart phones and tablets are becoming more and more powerful. In addition to being able to play videos and pictures, it is also possible to have remote control, data processing, data transmission and other functions by installing some applications. In addition, the existing smart phones and tablets also have some sensors. Among them, there is audio recording software, post-editing software, music production software, arranger software, virtual instrument software, tuning software, audio testing software, and so on. Almost all the professional work that can be done on the computer (desktop) has been transplanted on your phone or tablet. Therefore, users expect to be able to use these portable electronic devices to monitor the photographic devices outside the viewing range or the touchable range. How to apply these electronic devices to the shooting of videos or pictures is an urgent problem to be solved.

In order to solve the above technical problem, an embodiment designed provides a method of
monitoring a photographing apparatus, wherein the photographing apparatus is fixed to a pan-tilt system. The design mainly includes three functions. One is receiving an encoded control command; one is decoding the encoded command to obtain the control command; The last one is performing operations on the photographic equipment or the pan-tilt system according to the control command.

2. Overall Design

Our design of this system is shown in Fig.1. It mainly includes photographic equipment, PTZ system and mobile equipment. Photographic equipment is used to collect image and audio information; the PTZ system is used to control the photographic equipment on the one hand and to encode the image or audio information on the other hand; mobile devices are utilized to monitor the real-time display of targets. The video collected by the photographic equipment is sent to the PTZ system via USB communication. The PTZ system compresses and encodes the video information and then sends it to the mobile device through wireless communication. The self-designed App of the mobile device receives the video information and decompresses it. Then the video information is displayed. In addition, users can operate the App to specify the target to be monitored.

![Figure 1. System chart](image)

Next, we focus on the design of PTZ system and App on mobile devices, and the PTZ system should be compatible with various types of photographic equipment.

2.1 The pan-tilt system

Fig.2 shows the structure of the pan-tilt system. The PTZ system consists of the human-computer interaction module, the image transmission module, USB port, WIFI interface, the control module and the state acquisition module. The Hi3516A chip is used as the main control chip.

![Figure 2. PTZ system](image)
The USB interface is connected to the photographic device, and the goal is to upload images of the photographic device and receive control commands of the camera system, such as power-on, power-off, photographing, and screen recording. The WIFI interface is used for communication with the mobile device, including the image information transmitted by the PTZ system, the PTZ information, and the states of the photographic device, and the control commands of the mobile terminal to the PTZ. The human-computer interaction interface can directly control the operation of the photographic device and adjust the angle of the photographic device. The control module includes the control of the PTZ and the photographic equipment. The control of the PTZ system is realized by controlling the manipulator to achieve the purpose of target tracking. The photographic equipment is mounted on the state plate so that the acquired parameters are closest to the actual parameters of the photographic equipment. The Image transmission module is shown in Fig. 3. The image master unit of the PTZ system compresses and encodes the captured video or image. It uses H.264+AAC for video encoding and is packaged in TS stream format, thereby transmitting to mobile devices via wireless communication.

![Image transmission module](image)

**Figure 3. Image transmission module**

### 2.2 The mobile devices

In our system, the app installed on the mobile device is used to operate and control the photographic equipment and the pan-tilt. In Fig. 5, it shows the App page on the mobile device. Firstly, user selects the link mode between the mobile device and the PTZ. In order to make the App interface rich and has better compatibility, it is designed as a widely used Bluetooth interface and WIFI interface. Similarly, the PTZ system is also designed with a Bluetooth interface and a WIFI interface. Users can select their own required functions on the mobile device, such as taking pictures, recording, monitoring (following), clearing the screen and other functions. Both the photographic device and the control operations on the pan-tilt system can be operated indirectly on the mobile device.

![The mobile device](image)

**Figure 4. The mobile device**
3. The realization of target remote following

The monitoring algorithm mainly includes extracting the feature points of the target image region. The feature extraction uses SIFT algorithm[3] to detect local features. It has scale invariance, even if you change the degree of rotation, image brightness or shooting angle, you can still get a good detection effect.

The algorithm flow chart is shown in Figure 6. The processing module receives the compressed data of the video or picture from the PTZ system and decompresses it, and sends it to the display module to determine whether to perform the target following. Then it judges whether there is a specified follow target, extracts the picture frame SIFT feature[4], matches the target feature, calculates the target position, finds the position difference between the target position and the picture center, calculates the corresponding control parameters through the position difference, and finally controls the parameters sent to the PTZ.

Figure 5. Implementation of following algorithm

The display module receives a tracking indication from the user by pressing the switch that enters or exits the tracking shooting, acquires an area selected by the user on a picture frame displayed, and
sends the selected area to the processing module. Subsequently, the processing module extracts the SIFT features of the target image in the frame selection area, and calculates the position of the target image in the picture frame. After obtaining the position of the target image in the picture frame, the processing module further calculates a position difference between the target image and the center of the picture frame. To enable the target image to be close to the center of the picture frame, the processing module determines a control command according to the position difference. The control module of the PTZ system can operate the PTZ system according to the control command to make the target image close to the center of the picture frame. After determining the control command, the processing module encodes the control command using a predetermined encoding rule and transmits the encoded data to the pan-tilt system.

To optimize the algorithm, the picture frame is converted into the YUV format to reduce the calculation amount of the feature extraction while ensure the playback effect. In addition, the picture frame can be converted into a grayscale image, and scaling is performed to further reduce the amount of computation of feature extraction. However, the feature extraction algorithm has high resource consumption. The design estimates whether the target image is outside the next picture frame according to the position of the target image in the historical picture frames. If the speculation result indicates that it is not located outside the next picture frame, the frame may jump. The control command is generated by the processes of feature extraction, feature matching in the next picture frame. To estimate whether the target image is located outside the next picture frame, the main process includes calculating a displacement amount of the target image in the historical picture frames (a displacement amount of the target image between adjacent picture frames), averaging the obtained displacement amount, and predicting whether the target image will move outside the picture frame in the next picture frame. For example, if the target image in the current frame is 0.5 cm away from the right edge and the target image moves 0.6 cm each time in the historical frame, the predicted target image will be moved out in the next frame.

4. Conclusions
The PTZ system of surveillance photography designed in this paper is in response to the needs of market development. We detail the operation and control of the photographic equipment of the mobile device by the PTZ system, realize the integration of real-time monitoring and photography, which can meet the needs of photography or monitoring for the users. The system has great use value in practical application.

Acknowledgements
This work was supported by major special projects of Guangxi science and technology (NO. AA18118009).

References
[1] Gong Z, Gao T, Rao J, et al. An attitude estimation system for Pan&Tilt system[C]// IEEE International Conference on Industrial Technology. 2010.
[2] Leccese F. Remote-Control System of High Efficiency and Intelligent Street Lighting Using a ZigBee Network of Devices and Sensors[J]. IEEE Transactions on Power Delivery, 2012, 28(1):21-28.
[3] Kumar P, Henikoff S, Ng P C. Predicting the effects of coding non-synonymous variants on protein function using the SIFT algorithm[J]. Nature Protocols, 2009, 4(7):1073-1081.
[4] Yao L, Hao F, Zhu Y, et al. An architecture of optimised SIFT feature detection for an FPGA implementation of an image matcher[C]// International Conference on Field-programmable Technology. 2009.
[5] Sugita H, Taguchi A. Chrominance signal interpolation of YUV4:2:0 format color images[C]// Nonlinear Signal & Image Processing, Nsip Abstracts IEEE-EURASIP. 2005.