

A Method for Forest Fire Detection Using UAV

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Abstract. This software provide functions on processing UAV (unmanned aerial vehicle) aerial image data according to the requirements of forestry area application on UAV platform. It gives a real-time and remote watch on fire in Greater Xing' an Mountains, simultaneously the UAV is flying and getting the aerial data, helping users quickly master the number and location of fire points. Monitoring software covers functions including fire source detection module, fire location module, fire range estimation module, and report generation module. Mutual cooperation among the various modules improves operational efficiency and detection reliability of the system.

Keywords: Forest Fire Detection, UAV Aerial, Monitoring software

1 Introduction

Real-time fire monitoring has always been an important difficulty in protecting forests, especially for the big forest, because monitoring out of time often causes significant economic losses. So "Early Detect, and Early Rescue" is the purpose of forest fire prevention and control for forestry sector. With the development of the UAV technology, remote sensing, and information processing technology, it has been feasible to real-time process and analysis image, which can detect the fire by using the aerial images of large forest areas.

UAV, shorted of unmanned aerial vehicles, is also called as Aerial Robotics. It is composed of vehicle internal automatic control system for autonomous control and execute task or external control by remote station transmits the control instruction to operation mission, mainly by the aircraft carrier, power systems, navigation and control system, the take-off and the recovery device and other electronic, and also can carry the detection equipment etc. [1-3].

There are many kinds of UAV. According to the mode of flight, UAV can be divided into fixed wing unmanned aircraft, Rotor UAV, unmanned airship etc. And according to the characteristics of the design and task classification, UAVs generally include persistent type without one aircraft, tactical UAV, a miniature unmanned aircraft, pocket UAVs and so on. Because the miniature unmanned aircraft vehicle

has the advantages of low cost, small volume, light weight, flexible, landing with relative few restrictions, and can adapt to the complicated and changeable environment advantage, make it become the main research directions of the current air robot research, and in the practical application, because of the high flexibility and strong adaptability, the miniature unmanned aircraft in the military and civilian have a wide application prospect. So miniature unmanned aircraft is used as the UAV for our application of forest fire detection.

UAVs are widely used in many kinds of applications. UAV is mainly used for low altitude reconnaissance; electronic jamming task in military .It not only can reduce the casualties during reconnaissance process, but also can greatly improve fight efficiency. In addition, unmanned vehicle can also be used for target indication and biochemical weapons detection. The unmanned vehicle's advantage is particularly prominent when it fights in the city. It can fly in slow speed, in order to avoid hitting buildings; it can fly to large buildings on hold for urban reconnaissance mission in the civil context. The UAV can be used to the communication relay, environmental studies, natural disasters monitor and support; the UAV can also be used for border patrol, agricultural survey, and large-scale ranch and forest fire detection.

Fire is a regular occurrence in forested landscapes throughout the world. Worldwide, a large number of fire disaster annually happened in fire-adapted ecosystems in large areas of Africa south of the equator, central Asia, southern South America, Australia, and many areas of the boreal forest in Russia and Canada. Therefore, the use of UAV to detect fire source becomes exceptionally significance. Many foreign researchers took deeply research and experiments in the recent twenty years. According to the advocacy of the NASA many universities in the United States and personnel carry out the research and application on UAV and have made breakthrough progress.

Our software meets the requirements of fire detection, analyzed and identified by real-time transmission infrared and visible light of video data. According to the telemetry data, it completes the situation assessment and the geographical location of the fire, and ultimately generates fire detection report for the command and control center. The software shows the characteristics of high detection speed, high precision, wide measurement range, can effectively provide helpful guidance for the forestry sector, save manpower and material resources and improve work efficiency.

The second part introduces the overall design of the software; the third part give a real knockdown to the design of each module; and the fourth part is to introduce the system use case, and the fifth part is the summary.

2 The overall design of the software

2.1 Software interface relationship

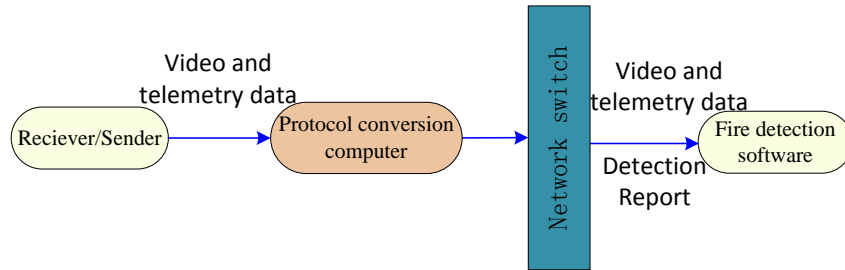


Fig. 1. Software interface relationship

Network communication using TCP/IP protocol, transceiver transfer remote image data from the plane through the net export to the protocol conversion computer, then transfer image data to fire monitoring software by switch, or by optical fiber network (Figure 1).

2.2 The information flow of software modules

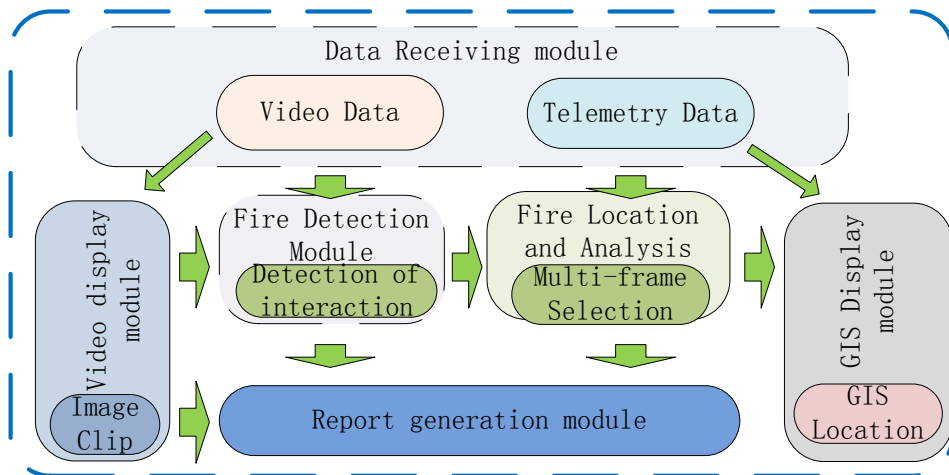


Fig. 2. The information flow of software module

The software includes data receiving module, fire detection module, a video playing module, the fire source location and analysis module, GIS display module and

report generation module. The information flow between the modules showed in Figure 2. Data receiving module receives the video and telemetry data from the UVA; Video play module decode video and refresh display. According to the user need to call the fire detection module, display real-time detection results in the video and provide screenshot function; the fire source location and analysis module calculate the geographic coordinate of fire source according to the test results and the telemetry data.

Software design tool

This software is developed using C++ language in Microsoft Visual Studio 2010 platform, dependent on the opencv image processing library and Kakadu video decoder.

The interface

Software main interface as shown in Figure 3, consists of four parts of A, B, C, D and E, Respectively is the menu, fire source video display area, GIS map display area and status bar.

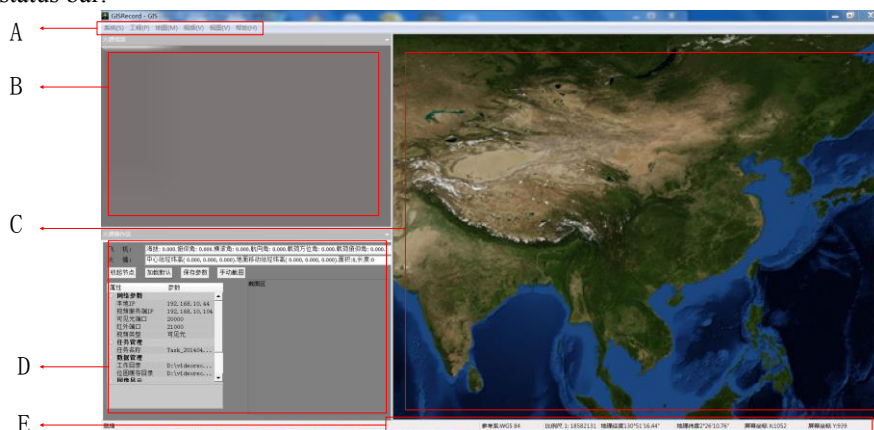


Fig. 3. The interface

3 Module design

3.1. Data receiving module

Via TCP/IP protocol, it continually receives raw data of telemetry image from fixed station. And then these data, including infrared and visible light data, are saved to local disk in mj2k format.

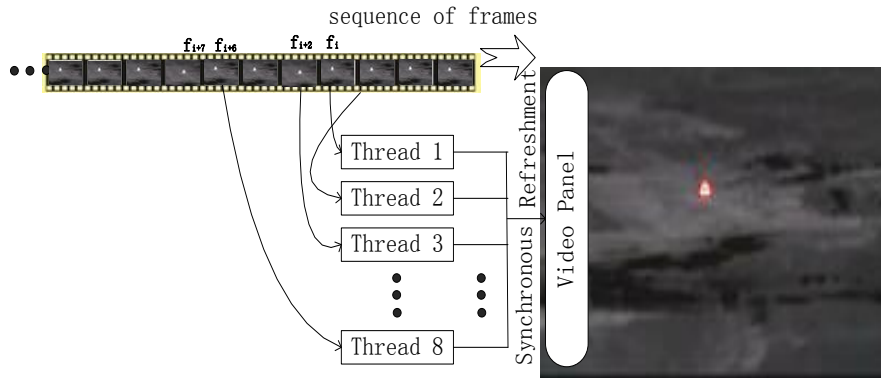


Fig. 4. The video refreshes method

3.2 Video play module

In the video play module uses 8 threads on the playing area to refresh the display interface. At first, Each thread decode frame of the new mj2k format video, then transform into a same size picture, and call the fire detection module, circle the fire source area in the picture if there exist , finally paste it into the video refresh area. All the threads of video refresh zone are synchronous (Figure 4).

Video play module also provides a screenshot function which can be used to generate test report.

3.3 The Fire detection module

The Fire detection module is called before in the video refresh, according to the user interaction, the working mode of the Fire detection module can be divided into the automatic detection and artificial auxiliary detection. Automatic detection mode detects the whole picture under the condition of user not to circle source area, segment and highlight the edge of the suspected source area. Auxiliary detection is performed by fire detection in a rectangular box user circled; this method can further confirmation of the suspected source of fire, segment and highlight the edge if the fire source is confirmed.

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