Paper presented at the 22nd Asian Conference on Remote Sensing, 5 - 9 November 2001, Singapore.

A River Monitoring System Using UAV and GIS

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KEY WORDS: river monitoring, GIS, unmanned helicopter, digital video camera

ABSTRACT: A large part of the water resources in Taiwan comes from hundreds of rivers. In order to keep the water supply always in its best and cleanest condition, one of the routine works of the local EPA (Environmental Protection Administration) is to send its patrolmen out to cruise along the riverbank regularly. Even though the local EPA typically puts a lot of effort into the patrol works, the illegal dumping activities are frequently found in the remote areas along the riverbank. In an attempt to find the dumping spots along the riverbank the EPA of Taoyuan County and National Central University are cooperating to develop a river monitoring system. From the long-term experience, the dumping sites often hide in areas beyond the patrolman's reach, for example, the areas behind the forest where the patrolman is unable to discover on the ground. Therefore, the expectant goal of the river monitoring system is proposed to observe the river from the sky, hoping to find the blind spots of the routine patrol operation. The proposed system basically consists of a unman helicopter equipped with GPS and digital video camera, and river-associated GIS. The unmanned helicopter is employed to aid the patrolman to obtain the aerial video data of the suspected spots, while the GIS is used to produce a spatial information system for integration the aerial video images with the related digital data. An experiment is under way for a river in Taoyuan County. The primary results indicate that the proposed river monitoring system is able to add some new discoveries for the conventional ground patrol works.

1. Introduction

In order to protect the rivers in Taiwan from being polluted, local EPA make regular patrols of riverbanks. The content of the routine work is that the patrolman walks along riverbank to view the condition of dumping garbage and draining polluted water. The traditional way of patrolling is often confined to the limited roads, which reach to the river, so that the patrolman can only monitor the region, which he can arrive. The problem still exists because of monitoring incompletely. In order to make the work achieve its effect, we use unmanned helicopter equipped with digital video camera (DV) and GPS to replace the traditional way of patrolling. Comparing with the traditional way of ground patrolling, the unmanned helicopter with a wide-angle lens has a superiority of 400 m operating radius and 50m heights. Hence we can get large range of spatial information in short time. Getting the coordinate of unmanned helicopter by GPS that makes the patrolman know well about the range of patrol and improves the work become more efficient.

2.Hardware Of The System

2.1 About the carrier

This system uses unmanned helicopter to be the carrier. Unmanned helicopter has the advantages of little limit on landing point, high mobility and it can hover over the river. Because the unmanned helicopter takes off and lands vertically, so when the patrolman wants to acquire data from the sky, all he needs to do is to find an open space about 3m*3m and he can prepare taking off. This advantage makes patrol more efficient when receiving short notice to arrive at the scene, the patrolman can start searching for the evidence immediately.(Munson 1999)
Another advantage of the helicopter is its mobility. The helicopter raises the eyeshot of the patrolman to a 100-meter height and crosses the obstacles by the riverbank. When there is no road reaching to the riverbank, what the patrolman needs to do is to use remote control and let the helicopter fly across the obstacle. While finding dubious pollutants, the helicopter can hover in the sky or fly around the pollutants to collect the images. This advantage makes the 2D evidence searching become 3D evidence searching and it is easy to realize the amount and

the distribution of pollutants. (Figure 1)

2.2 About the sensor

The unmanned helicopter can be equipped with two kinds of sensors, one is digital video camera (DV) and the other is analogic camera. Both of them can be equipped with wide-angle lens and infrared lens according to special conditions. When needing continuous images, the patrolman can use DV. But the number of pixels restricts the resolution of DV, so when demanding higher resolution images he can use camera. The patrolman wears goggles when shooting. A CCD with about 330000 pixels installs beside the sensor and it transmits the images of the goggles forthwith by microwave. After the unmanned helicopter takes off, the patrolman can see the view of the sensor detecting in the goggles. Hence the patrolman can tell the pilot how to correct the route to shoot the much more useful information. By the way the patrolman can also use remote control to operate the angle of the sensor so that he can try to lock the target and let the image stay more stable.

2.3 About GPS receiver

In addition to shooting images, the time and the position of shoot are important information when analyzing. The unmanned helicopter equips with GPS receiver, which updates every second. (Montgomery 1996, Kornfeld 1998) When the patrolman use DV, the GPS data are recorded on the audio channel of the DV tape. After finishing montage, the coordinate data of images are downloaded via the COM port of PC when the film is playing. Owing to the process of encoding might lose a little data, so when the receiving program detects the data which is not complete, the program will create a fictitious data, which is fabricated according to the prior data and the following data. If the patrolman uses camera to take picture, the coordinate of picture will be recorded in the flash ROM at the moment of pressing shutter. He can also download the data from the flash ROM to the PC.

3.Software Of The System

3.1 The input data

The input data of this application program are the images and the corresponding coordinate. After the patrolman finish shooting he can use the DV card to capture the data on the DV tape to the hard discs. He can use program to compile the film and compress the data into the AVI format. After that the coordinate data can be captured from the audio channel and exchanged to a text file. If the image data are photographs, the patrolman has to contrast the number on the film with the index number in the coordinate file so that he can get the corresponding coordinate of the photographs. Therefore he needs to build up a link file to connect the image file which is established by scanning the photograph with the coordinate.(Figure 2,Figure 3)

3.2 About this system

This system is based on GIS and combines the images with coordinates, the user can inquire about this system and the patrolman can update this system. The system uses the GIS map to be the base map so that the user can know where the image was captured. The user can describe the attribute of any film or any photograph. When the user wants to investigate the film data or photo data in this system, he only need to choose the image label in the index window and the images will show automatically.

4.Conclusions

This study proposes a new spatial data collection system to add a three-dimension view for river patrol operation. The system includes an unmanned helicopter equipped with digital video camera, GPS, GIS, and spatial data integration tools. The main function of the system is designed to aid the river patrolman to observe the river from the sky and to find the blind spots of the routine patrol operation. The test result of the purposed system indicates that the river patrol operation can be extended from the ground to the sky.

Reference

K. Munson , “Janes’s Unmanned Aerial Vehicles and Targets”, International Thomson Publishing Company, United Kingdom,1999.
P. Y. Montgomery ,”Carrier Differential GPS As a Sensor for Automatic Control”, Ph. D. Dissertation, Stanford University,1996.
R. P. Kornfeld, R. J. Hansman “Single Antenna GPS Based Aircraft Attitude Determination”, Institute of Navigation-National Technical Meeting, Long Beach CA USA, PP.1-10, January 1998.

Figure.1 the figure shows the unmanned helicopter under operation.

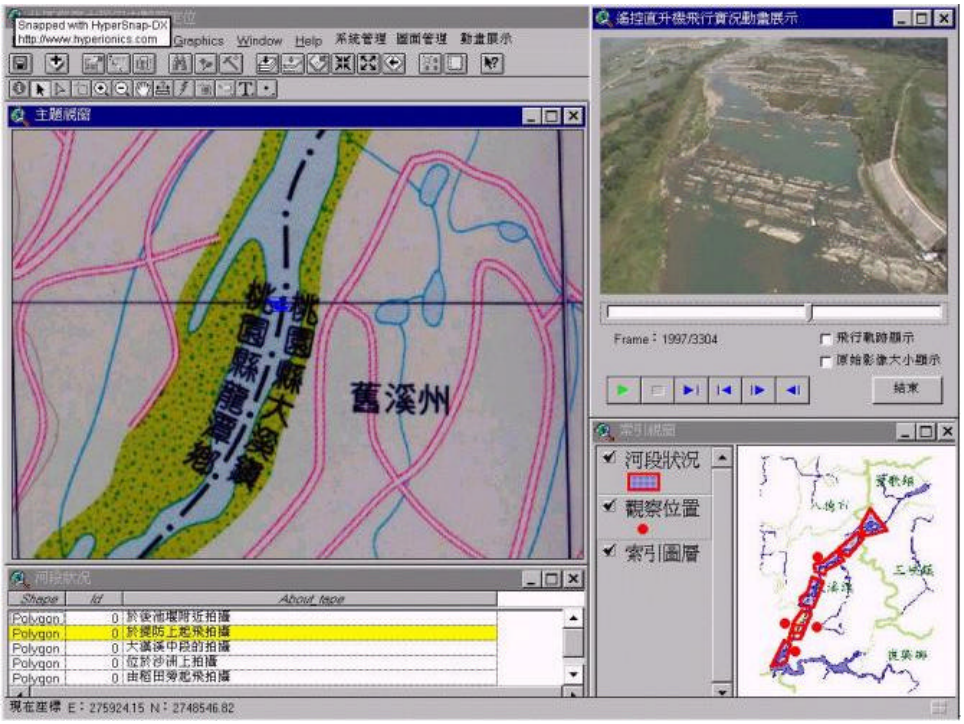

Figure 2 the window view of the river monitoring system(?)

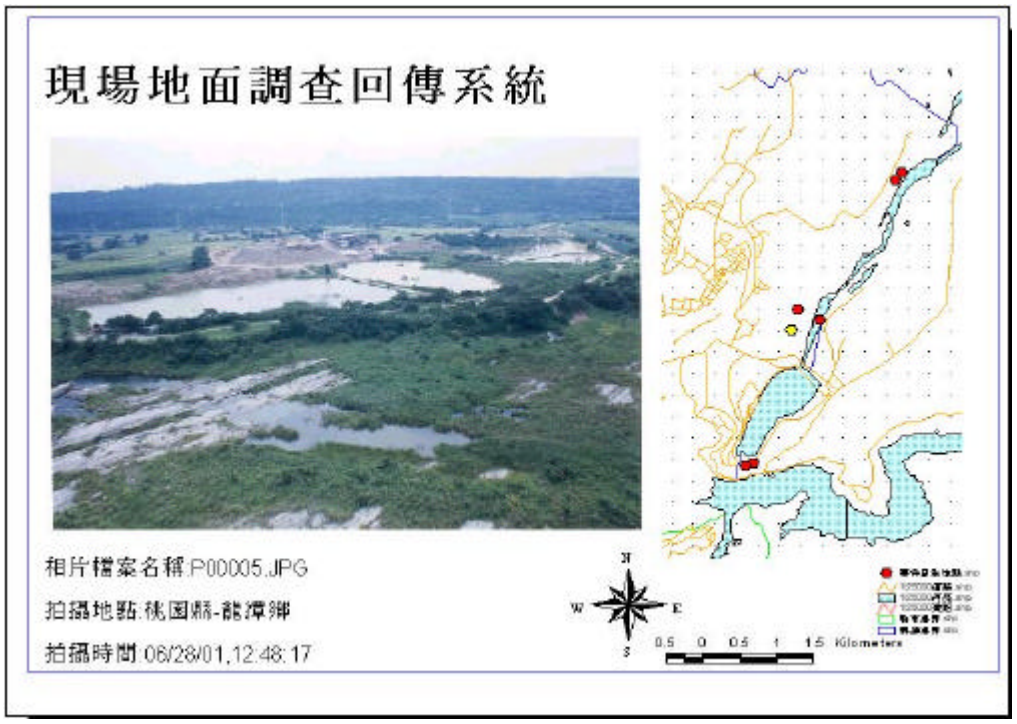

Figure 3 the window view of the river monitoring system(？)