DEVELOPMENT OF A MONITORING SYSTEM INTEGRATED AIRBORNE VIDEOGRAPHY AND GPS

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ABSTRACT

In recent years, airborne videography is widely used for monitoring of the environment and natural resources, such as rivers, forests, ocean, and so on. Although airborne videography has a low resolution than aerial photographs, it can effectively reduce the cost of continuous monitoring of a wide area. Furthermore video images can easily be processed with a personal computer. This paper introduces an airborne video system for monitoring of ocean environment.

This system consists of two sub-systems. The one is a data collection system that is composed of a video camera, a Global Positioning System(GPS) and a personal computer. This sub-system records information of the environment by video images and their corresponding location data. A GPS system is used for calculating location data and navigating the airplane to the destination of monitoring sites. The other is a data management system. This sub-system retrieves images from video tapes, and draw up reports on ocean environment. Both sub-systems run on a personal computer with Microsoft Windows 3.1. This system can also be used for management and planning of road environment, marine resources, forest resources and for prevention of disasters.

1. INTRODUCTION

It requires difficult time and labor work to manually monitor environment of wide and long areas such as ocean. Our previous experiences have shown that this monitoring method is not cost-effective and is not accurate on locations. A more efficient method of environmental monitoring is to make use of aerial photographs which are used in interpretation analytic work. In recent years, video technology for public welfare and broadcast job has made rapid progress and has been greatly improved. As a result, this technology is being used in many fields. It is considered possible to apply airborne videography to monitoring work by the following factors.

a) Quality of a video camera and a VTR is getting higher and higher.
b) Cost of a video camera and a VTR is getting lower and lower.
c) Development of a CCD and a high-speed shutter.
d) Development of detection devices for various wavelength bands.

The location information of video signals can be easily calculated as digital information at real time by a navigation system with a GPS. At the same time, the data processing technology has started to shift from analog to digital. Personal computers are getting cheaper in price, more powerful in data processing, and easier in operation and maintenance. As a result, multi-media (digital) technology has made significant progress, which makes it possible to process video images easily even in a personal computer environment. In particular, with the popularization of all kinds of window systems, many graphics processing libraries have become available. For example, two windows can be opened on the display for simultaneous arranging of both a base-map and a video image.

By making use of the technologies mentioned above, we have developed an airborne video system for monitoring of ocean environment. Environment monitoring data can be efficiently analyzed by using this system. And also it can be used for spatial information retrieval and image database construction for GIS or LIS. The configuration and the major functions of this system are discussed in the following sections.

2. THE VIDEO DATA COLLECTION SYSTEM

When the video data ,which is collected by an airplane for the environment and natural resources monitoring, is analyzed, it is very important to acquire the location information of object points. In the case of ocean and snow mountains, this process becomes even more difficult. To solve this problem, we have developed a video data collection system. The major features of this system are as follows:

a) Acquisition of the location information at real time
b) Synchronization of the video images and their corresponding location data
c) Precise navigation of the airplane to the destinations for data collection
d) Specification of necessary location for the video images taken during the flight

the maximum scale showing the all islands.

(4) Navigation
Based on the current position of the airplane, this function calculates and indicates the bearing and the distance up to the next destination that has been input in advance.
Figure 3 shows examples of the navigation information map.

3. THE VIDEO IMAGE DATABASE SYSTEM

To analyze ocean environment with video images, the system that manages video tape images is required. This system is designed to manage video images and location information collected by the video data collection system.

3.1 System Configuration

Figure 2 shows the configuration of the video image database system. This system is composed of a VTR, a personal computer (NEC PC9821Xa) built in a video capture board (CANOPUS Power Movie), a video computer interface box (SONY VBOX) and a color printer (EPSON MJ500C). This system runs on Microsoft Windows 3.1.

3.2 Major Functions

(1) Management of Video Images
This function manages video images which should be analyzed relating to location information. Furthermore, the locations are displayed on a track map.

(2) Fast Retrieval of Video Images
This function allows to automatically retrieve and display video images from video tapes by selecting a location displayed on a track map. The video images are retrieved by controlling VTR.

(3) Print of the Airplane's track
This function allows to select and print out the airplane's track.

(4) Drawing Up of Reports
This function allows to draw up reports on ocean environment with an image and a map. A digital video image and a location map automatically are made, then inserted into a report form. By only input of analysis conclusions into the form, the report is complete. Furthermore the completed report can be printed.

4. CONCLUSIONS

An airborne video system has been developed to acquire the real-time information of ocean without detailed analysis using multi-spectral scanner. This system has been proven to be more effective and more accurate than using aerial photographs without a GPS when the target of monitoring is long and continuous recording of detailed information is necessary. Since the location information of the video recording is stored together with the corresponding images, this system also realizes fast retrieval of location information. Besides analysis of the target area, the collected video images can also be used in generating easy-to-understand multi-media presentations for the residents of the monitored area. Tests of all the functions of this system have proven that it can provide useful information about ocean management for ocean administrators. This system is also considered to be applicable to the following related fields: the survey of Class A rivers, simulation and evaluation of river improvement, vegetation plant geography, survey of surface soil, soil moisture on riverbed, rapids and pool and so on.

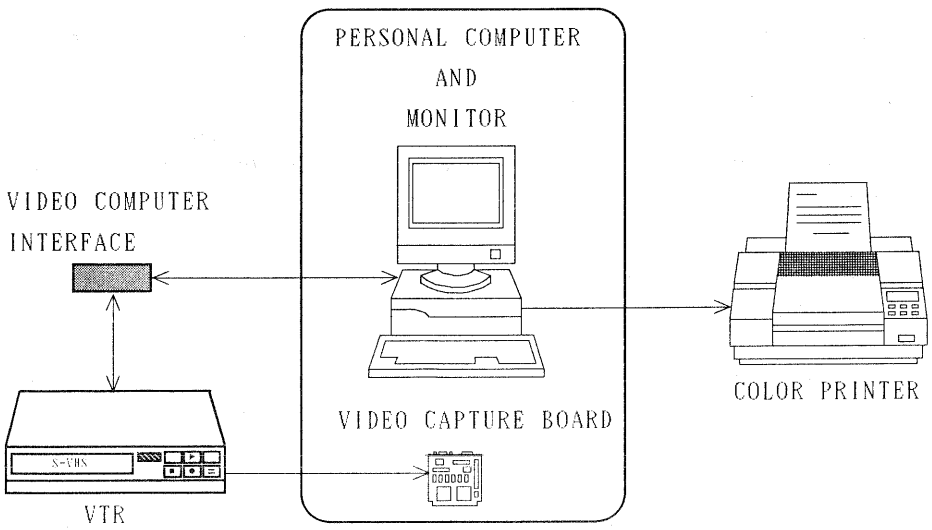


Figure 2 Configuration of The Video Image Database System

2.1 System Configuration

Figure 1 shows the configuration of video data collection system.
This system is composed of a video camera, a VTR, an airborne GPS (GARMIN GPS100AVD), a personal computer (NEC PC9821Xa) with built in an 232c-ports extended board, a video board(CANOPUS SuperCVI-II), a video computer interface box (SONY VBOX), and a monitor. There are also several Microsoft Windows 3.1 based applications for integrating all the hardware and processing of the collected data. The airborne GPS in this system uses point positioning method to acquire latitude and longitude data which are stored in the personal computer. The video camera is fixed onto a vertical mount with a HASSELBLAD camera.

2.2 Major Functions

The developed system has two kind of functions. The one is data collection function, which is designed to collect images and locations. The other is flight navigation function, which is designed to guide the airplane to the destinations for data collection.

2.2.1 Data Collection Function

(1) Acquisition of the current position
This function acquires the current position of the airplane once in a second from an airborne GPS.

(2) Synchronization of Video Images and Locations
This function creates a video image of the corresponding position and ocean at real time (30 frames per a second). The position, the time and the date are recorded on every video image (frame image). At the same time, the location information, the time and the date are stored in files.

(3) Specification of Locations for Analysis
This function allows to specify a location that should be analyzed. When the location is specified, this function stores the location information, the date, the time and the counter of the VTR tape are stored a file for further analysis. At the same time, the location is displayed on a navigation information map. The counter of the VTR is acquired automatically with a video computer interface box.

(4) VTR Control
This function allows to control the VTR by a personal computer, such as rewinding and recording.

2.2.2 Flight Navigation Function

(1) Input of Date and Time
This function allows to input the date and the time of the flight to set a clock of personal computer right.

(2) Display of an Aviation Route
This function allows to input and select a scheduled aviation route. After selecting the route, the flight route is displayed on a navigation information map.

(3) Display of The Current Position
Based on the data acquired from an airborne GPS, this function indicates the current position of the airplane on a navigation information map. The map is scrolled automatically with according to the airplane's position. Furthermore, it also displays the coastline and the prohibited territory as the background of the map. The navigation information map covers all of Japan's islands and can be displayed in five scale levels, with

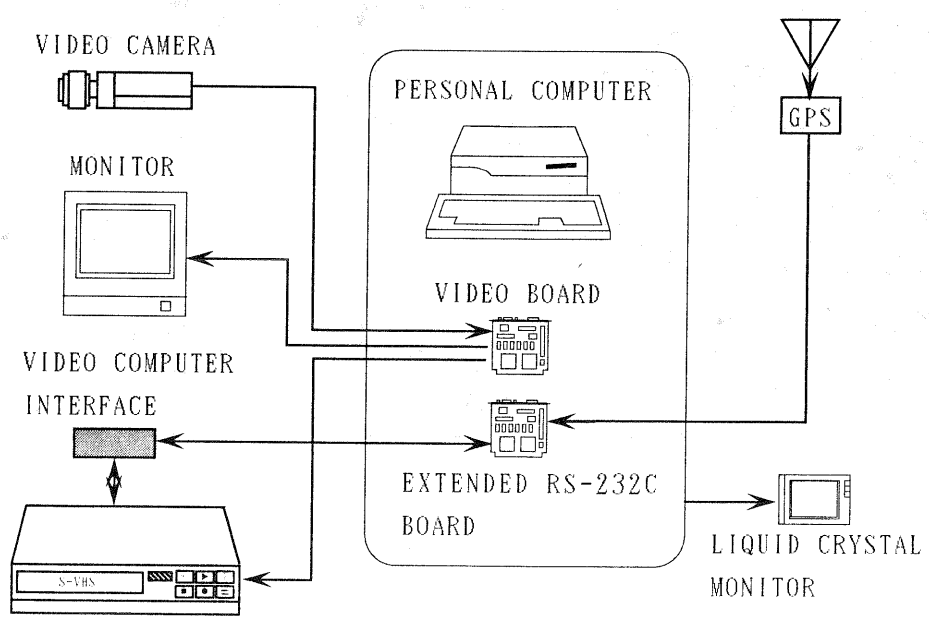
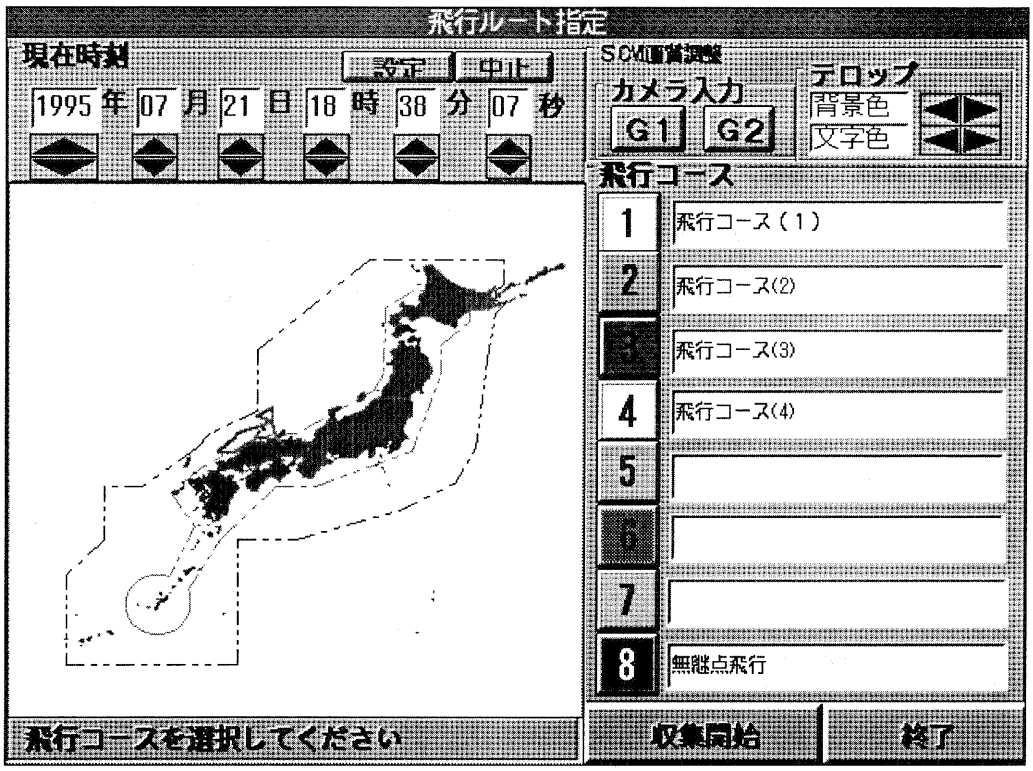


Figure 2 Configuration of The Video Data Collection System



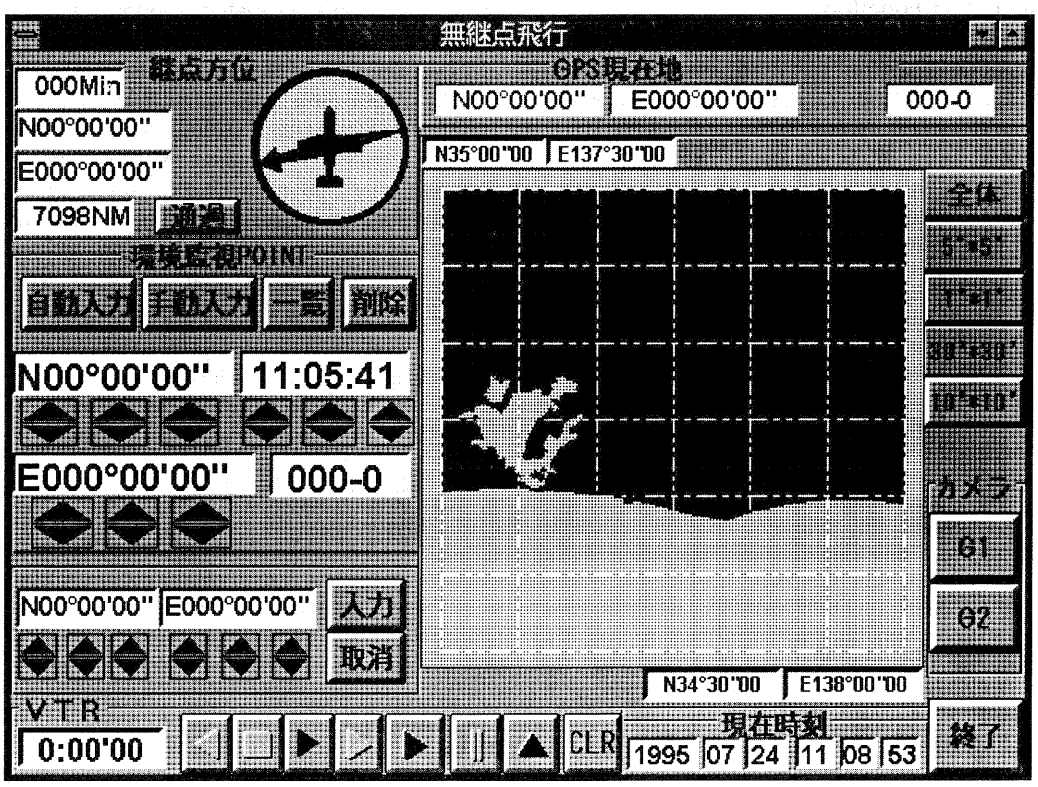


Figure 3 Examples of The Navigation Information Map

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