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ASTROS - A TELESCOPE CONTROL SYSTEM FOR A SMALL RADIO TELESCOPE

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ABSTRACT

We developed a telescope control system called ASTROS for the VST1 and VST2, which are specially designed radio telescopes to make a survey and have a 60-cm main dish. ASTROS is designed on the distributed intelligence concept and structurized programming. The hardware of the system is composed of several intelligent devices connected with de facto standard interfaces and main control unit is PC. The program is coded in the C language and its structure is object oriented in order to make easy to replace the component devices. ASTROS is now running on two twin telescopes, VST1 and VST2. VST1 is installed at Nobeyama in Japan and VST2 is installed at La Silla in Chile. They are making a galactic plane survey in CO (J=2-1) with 9 arcmin beam semi-automatically.

Key Words : control system, radio telescope

I. INTRODUCTION

It is important for a small group of astronomers both to develop a telescope controlling system with few efforts and to make routine observations automatically. A radio astronomy group in Institute of Astronomy, University of Tokyo has developed two twin radio telescopes called as VST1 and VST2, which are abbreviations for Very Small Telescopes Nos. 1 and 2, respectively. These telescopes are specially designed to make a galactic plane survey in the CO (J=2-1) transition with 9 arcminute beam. They are installed at Nobeyama in Japan and La Silla in Chile (Handa et al. in press). The first result of the telescopes has been published (Handa et al. 1993; Sakamoto et al. 1995; Oka et al. 1996). Rather large beamsize is designed for large area mapping. It also makes easy to design a telescope controlling system because of rough accuracy. Because our survey is unbiased and rather regular, it is easy to make observations automatically. Under these conditions we newly designed and developed a telescope control system for a small radio telescope called ASTROS, which is abbreviation for Automated Small Telescope Radio Observation System. In this paper we present the basic concepts to design ASTROS and its present status.

II. BASIC CONCEPTS OF THE SYSTEM

We took the following two basic concepts both for hardware and software for ASTROS.

1) The whole system is composed of several devices which correspond to definite functions. This makes easy to replace the component devices.

2) Each component device is arranged from commercial packages as much as possible. This reduces tasks to develop the whole system. This is effective because some component devices have sufficient performance if they are not based upon the latest technology. Some devices which were developed by ourselves were arranged to have a de facto standard interface.

III. DESIGN OF THE SYSTEM

(a) Hardware Structure

In these days we can easily get intelligent devices with reasonable price. This makes us to build a distributed intelligence system easily. ASTROS is composed of 7 intelligent components; the main control unit, the data storage unit, the antenna drive unit, the receiver control unit, the radio optics control unit, the data acquisition & backend control unit, and the system clock calibration unit. Most devices are selected from commercial packages. Only if we could not find a proper device with sufficient performance, then we made the proper devices by ourselves with some intelligence and standard interface. The connection between these intelligent devices is de facto standard. All component devices have either IEEE-488 multi-purpose bus interface, RS-232C serial communication line, or ethernet. The whole system connection is shown in fig 1. The acquired data can be accessed through the Internet. The system clock is finally calibrated by the GPS signal.

The distributed intelligent system makes small load for the main control unit. Actually PC with 80286 CPU is sufficient for the system of VST1 & VST2.

(b) Software Structure

The control programs are fully coded in the C language. The softwares are structurized and composed of

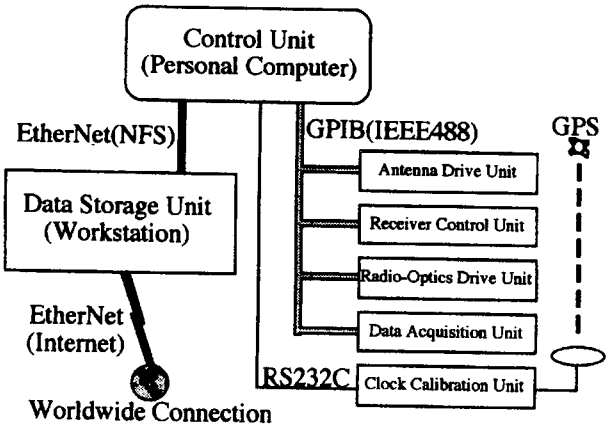

Fig 1: Hardware system of ASTROS for VST1 & VST2

many modules. Interfaces of all modules are designed to adjust for the standard guide line which is fixed before coding by ourselves. The OS of the main control unit is DOS. An event driven loop structure works sufficiently well under a single task OS because of the distributed intelligent system. Whole program size is about 300 kBytes in ASCII source code. Typical size of an observation program is 160 kBytes in executable binary code.

In the automatic observation mode the device control programs are driven by a task control program as a child process. The task control program executes observations according to a control time table file which is given by a human observer beforehand.

The control time table file and acquired observational data are stored on the data storage unit. This unit is actually a UNIX workstation connected to the Internet. Therefore the system can be controlled by transferring and/or editing these files through the Internet from a remote site. This is not a fully interactive control system but sufficiently controllable for regular observations like a survey work. The advantage of this batch control is that it can be work well even the network band is very narrow. Actually the Internet between Tokyo and La Silla is insufficient width for fully interactive data transfer.

(c) User Interface

The user interface is fully character-based to reduce computer load and network traffic. Control files including the control time table file are fully written in ASCII text. Through the Internet the control procedure can be easily changed. At the console of the main control unit (PC) all required status is shown in a single page of the PC screen, size of which is 80 by 24 characters. This screen is designed under color coordinates. Similar kind of information is displayed in the same color.

The observation status is noticed also by sound. Each status has its own music. The human observer sitting at the main console can recognize the observation status without watching the screen continuously. It reduces stress of an observer on duty.

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