

TOUCH-BUTTON SYSTEM IN THE TRISTAN CONTROL SYSTEM

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ABSTRACT

A touch-button system is used to control the TRISTAN Accumulation Ring. The system consists of hardware and software sub-system. The hardware sub-system is composed of touch-panels, touch-panel controllers, touch-panel interface CAMAC modules, color character video RAM CAMAC modules and color video monitors. The software sub-system is composed of touch-panel data-module, touch-panel functions, video RAM data-module, video RAM functions, touch-button data-module and touch-button functions. These routines are called by application programs written in the NODAL language.

INTRODUCTION

The TRISTAN Accumulation Ring(AR) is operated at the TRISTAN Control Room (TCR) by using mini-computer network¹. The operator's console is installed in the TCR and mini-computers are in the computer room next to the TCR. Three sets of operator's console are prepared for the AR operation. The console for an operator consists of two Touch-Panels(TPs), one or two graphic display monitors and ten TV monitors. The TP at his left-hand side is used for menu-selection and the other one at his right is used for command inputs. Under a TP, there is a color Video Display Unit(VDU) which is driven by a color Character Video RAM Module(CVRAM) in the CAMAC crate. The CVRAM generates alpha-numeric characters with eight foreground colors and eight background colors. Whole area of the TP is illuminated in bluish-white from the ergonomic point of view.² On the menu panel, 42 buttons can be displayed and each one can contain 27 characters. On the other hand, one can use operation switches up to 72 or alphabetic keyboard of "qwerty" type on the operation panel. The data-modules and functions are prepared for the programmers who write TRISTAN operation programs.

HARDWARE

The hardware configuration of an operator's console is shown in Fig. 1. The touch-button switches are displayed on the screen of the VDU through the CVRAM module installed in the CAMAC crate connected to the console computer via CAMAC serial highway. The TP mounted on the screen is connected to the Touch-Panel Controller(TPC) module which converts analog voltage signal into digital value and send it to the Touch-Panel Interface Module(TPIM) in the CAMAC crate.

CHARACTER VIDEO RAM MODULE

The CVRAM module is a double-width CAMAC module which generates special RGB separated video signals for the TP or standard NTSC composite video signal. The video signals for the TP is non-interlaced and its vertical and horizontal frequencies are 45.66Hz and 19.2kHz respectively. The CVRAM display 2560 characters(80 chars.x 32 lines) in a screen with 8 foreground and background colors. Each character is expressed in 8-bit code and formed in 9 x 12 dots. Not only the upper and lower case alphabetic characters but also the Greek characters and other useful semi-graphic symbols are stored in the character generator ROMs. It is also possible to display a character in double-width and blinking modes.

TOUCH-PANEL

Each of the TP used is a model E271-13SM touch sensor of Elographics Co. Ltd. This panel has a rounded base glass of which surface is uniformly coated with resistive material and a sheet of plastic which is coated with conductive material. These two surfaces are separated by many small separators as shown in Fig. 2. If an operator touches the panel, the plastic sheet is bent against the glass and the conductor is forced to contact with the resistive surface and picks up the voltage divided by the resistive coating proportional to the position of the touched point. This voltage is sent to the TPC to be converted into digital value. The sensitive area of the TP is 252(H)mm x 192(V)mm and the resolution is not less than 4.6mm in both x and y co-ordinates.

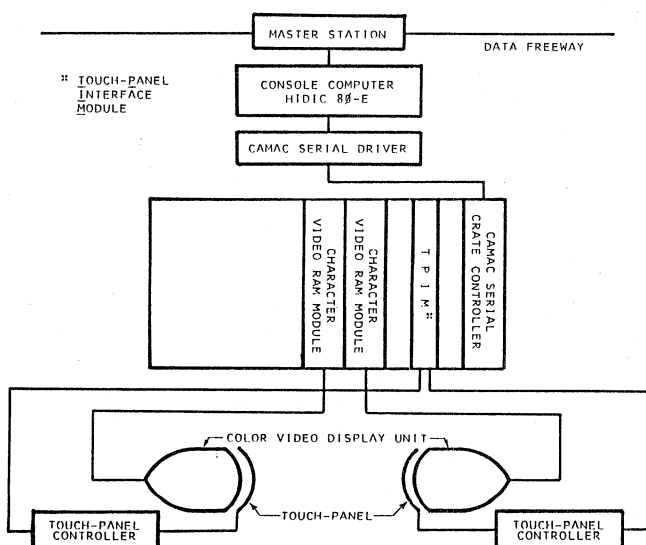


Fig. 1. Hardware configuration of an operator's console.

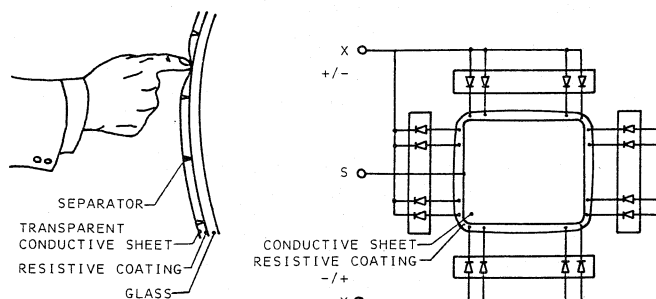


Fig. 2. Structure of the touch-panel.

TOUCH-PANEL CONTROLLER

The TPC is a CAMAC module but it uses only power lines of the CAMAC dataway. This module contains a modified circuit board of E270-61 touch sensor controller of Elographics Co. Ltd. The modifications were done in two points. One is the physical modification by cutting the board and replacing circuit components suitable for mounting in the single width CAMAC module. The other is the modification of the program for the micro-processor stored in the ROM. The program was changed to fit our purposes after some tests. i.e. as it is found that it is better to take position data after several A/D conversions instead of taking an average.

The TPC works in two modes, namely, single and stream modes. In the former mode, only one data pair(x and y co-ordinates) is taken at each touch of the panel. In the latter mode, the data pair is periodically taken as long as the panel is touched.

TOUCH-PANEL INTERFACE MODULE

The TPIM is a CAMAC module which receives 8-bit parallel data from the TPC module mentioned above. Two 12-bit data of x and y co-ordinates are sent in four sequential 8-bit data. This module sets a flag if it receives the four data in pre-determined time to tell the programmer that it received the data successfully. The received data are latched in a 24-bit register and can be read through the CAMAC dataway by one CAMAC read cycle. If the contents of the register are read, the module can accept next data, otherwise the module ignores any data from the TPC. The module has a mode flip-flop for controlling single/stream mode of the TPC.

SOFTWARE

Fig. 3 shows the configuration of the software of the touch-button system. It is classed into three groups. One is the touch-button data-module and functions which does not use hardware directly. The other two are the TPC data-module and functions and the CVRAM data-module and functions which handle CAMAC modules. The data-module and the functions of each group refer and maintain corresponding data table which keeps common information of hardware and software. The name of the data-modules and the functions are listed in Table.

CHARACTER VIDEO RAM MODULE

A data module and more than twenty functions are prepared for the CVRAM module. As the CVRAM can be used for generating NTSC standard video signals for information display on commercial TV monitors mounted on the console or for broadcasting them through the CATV network in the laboratory,³ several function programs useful for writing messages on the screen like CRT terminals.

In the data-table, the status word and the CAMAC external address data for calling the ESONE subroutines are stored.

TOUCH-PANEL

A data-module and a function are prepared. The data-module handles mode of operation, i.e. single or stream mode. The function reads the x and y co-ordinates of the touched position.

The data-table keeps the status of the touch-panel and the CAMAC external address data for calling the ESONE subroutines.

TOUCH-BUTTONS

A data module and more than thirty functions for the touch-buttons use the CVRAM programs and the TP programs in combination. A set of a CVRAM and a TP is handled as a unit and a unique unit number is given to it. The touch-button functions are called mainly with the button number instead of character position. There are two modes of operation of touch-buttons. One is the menu selection mode and the other is command-input mode. In the menu-selection mode shown in Fig. 4-1, up to 42 buttons can be displayed on the screen and each button can contain message of 3 lines of 9 characters. This menu-buttons are used mainly to select a program or an accelerator component to be controlled. In the command-input mode, one can display operation panel shown in Fig. 4-2 to input on/off/reset and up/down commands or decimal/hexadecimal data, or typewriter keyboard panel shown in Fig. 4-3 to input messages or file names, etc. The data-table keeps the touch-button status, unit numbers of TP and CVRAM, mode of touch-button, number of touch-buttons, status of each button, names of the buttons.

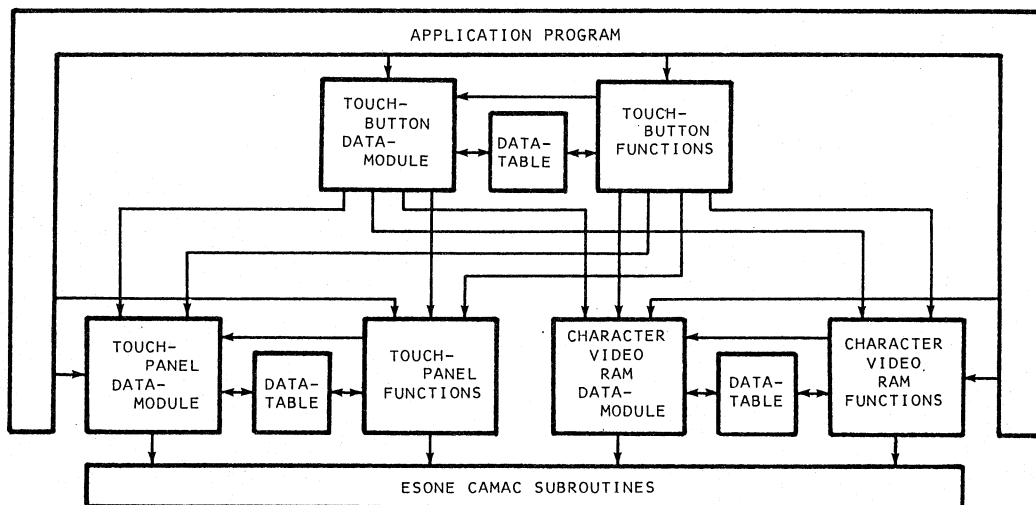


Fig. 3. Software structure of the touch-button system.

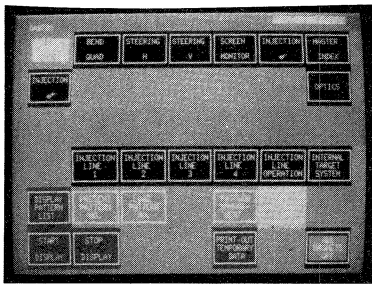


Fig. 4-1. An example of the menu-selection panel.

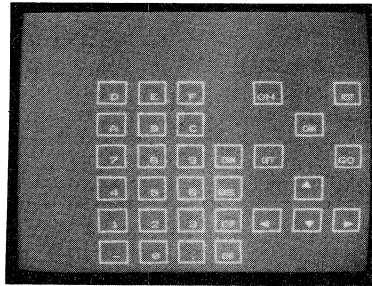


Fig. 4-2. Command-input panel.

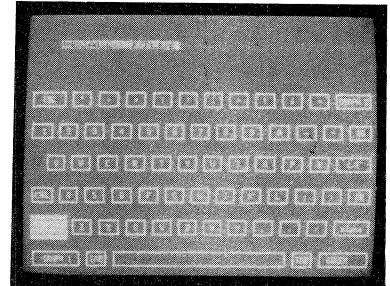


Fig. 4-3. A keyboard panel.

Table. List of data-modules and functions.

GROUP	DATA-MODULE	FUNCTION
CVRAM	CVRAM	CVCLR CVCHG CVBEL CVBSY CVADR CVCSR CVRED CVWRT CVCOL CVFGC CVBGC CVBLK CVDBL CVSCR CVCNV CVMRG CVDIV CVLIN CVOUTS CVOUTD CVTYPE CVCRLF
TP	TPANL	TPRED
TOUCH-BUTTON	TBUTN	TBCNCT TBSENS TBINIT TBDELT TBERAS TBBLNK TBFRAM TBCOLR TBNAME TBMESS TBPOS TBSTAT TBEL TBSAVE TBOPER TBALPH TBINPN TBINPS TBPOT TBGET TBWRT TBRED TBCOL TBFGC TBBGC TBBLK TDBDL TBOUTC TBOOTS TBOUOTD TBMESC TBTIME TBCSR TMAKE TBAWAIT

OPERATION

When the initial touch-button program "TAOP00" is started from the NODAL console terminal, the master index screen shown in Fig. 5-1 is displayed on the left-hand side panel and the right-hand side panel is cleared. In the master index, there are buttons to select secondary index panels of the groups of the accelerator components, e.g. AR injection, AR magnet, AR RF, AR beam monitor and controls groups. From the secondary index the operator can select a program of the next layer, a device control program. Therefore, as shown in Fig. 5-2, there are only three levels of the programs in the TRISTAN touch-button program tree. The short overhead time and minimum number of touches for an operator to reach the lowest level is considered as one of the most important points in designing a control system. At the device control level, one can select an accelerator element in the panel like Fig. 5-3 and the operation panel like Fig. 4-2 will appear on the right-hand panel and he can power on/off, reset, or change parameters of the device by up/down or ten-key input.

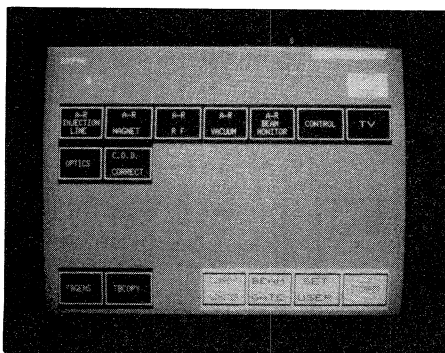


Fig. 5-1. The master index panel.

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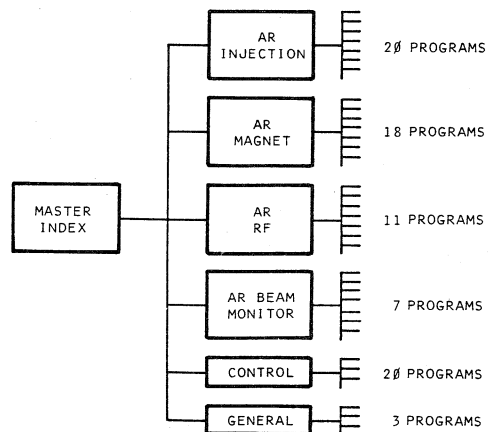


Fig. 5-2. TRISTAN touch-button program tree.

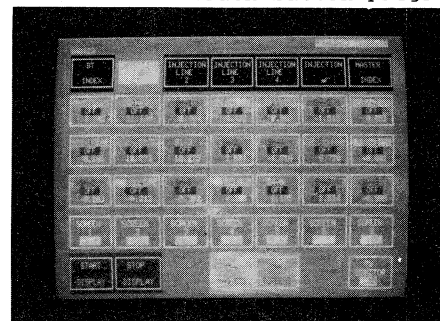


Fig. 5-3. An example of device-selection panel.