THE TOUCH TERMINAL

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The "Touch Terminal" is a microprocessor based intelligent terminal specially geared to the control of complex processes. It would be ideally suited to the control of a high energy physics experiment. It incorporates three of the features which have made the SPS control system a successful and widely acclaimed means of accelerator control. These are a "touch panel" with computer writable legends, a full graphics display screen, and a high level interpretive programming language. It can be used in two modes. Firstly as a peripheral to any host computer, so providing the host with touch panel and display facilities at minimum overhead. Secondly it can be used as a stand alone system with its own high level NODAL language. The terminal is compact and uses an internal 11 slot CAMAC bus. This enables the power of the terminal to be increased by adding appropriate CAMAC modules. A CAMAC controller using a powerful microprocessor provides the intelligence for the terminal operation.

1. INTRODUCTION

Physics experiments are growing in size, in the number of people involved, and in the period of time for which they run. The control and operation of such experiments can therefore benefit from the techniques which have been developed over the last ten years for the control and operation of accelerators. Indeed CERN's newest machine, the Antiproton Accumulator, is very comparable in size with many experiments currently envisaged.

The man-machine interface is an important part of accelerator control systems. It aims to achieve maximum operation efficiency from staff of limited knowledge and capabilities. In large experiments where each collaborator may only know intimately his own section of the experiment, and may only be on duty infrequently, a powerful man-machine interface could also be important.

Large accelerators use big control rooms with large specially developed consoles. The "Touch Terminal" brings the essential features of such control rooms down to a size and cost appropriate to a physics experiment or a small machine. Three touch terminals are used for local control of the Antiproton Accumulator, and four are in use in the SPS control room to supplement the main consoles.

The main features supplied by the touch terminal are touch panel selection of actions, and full graphic colour displays. Its main use is as a peripheral to the experiment control computer. It also has a stand-alone capability with a built-in NODAL interpreter.

2. THE TOUCH TERMINAL

The touch terminal proper is a 5 unit high 19 inch rack mounting chassis which can be installed in a console or rack for use with other equipment. Figure 1 shows the bare chassis. Alternatively the unit can be installed in a stand alone case as shown in figures 2 and 3. On the front right is a television screen overlaid by a transparent "touch panel". The touch panel has 16 touch sensitive areas for signalling choices to the computer. Legends can be written under these software "buttons" to indicate the choices available. The TV screen can also be used for full graphic and character displays. On the left of the front panel is a free area which can be tailored to a specific application. The figures show the digit selection and display panel developed for the first application of selecting analog signals in the SPS control room. Four bare chassis are installed in the SPS consoles for subsidiary duties.

The touch terminal can drive one or more additional displays for more demanding applications. Figure 3 shows a terminal with one additional full graphics monochrome display. Three such units were used in the local control room of the Antiproton Accumulator for the initial commissioning and operation. A terminal with a 7 colour full graphics display was shown at the poster session.

3. THE MICROPROCESSOR

The main novelty in the touch terminal is the use of a microprocessor to manage the touch buttons, displays, etc., and then to provide a simple and convenient interface to the host computer. The most popular connection is the "series VDU connection". Here the touch terminal is put in series with the host computer's normal VDU (Visual Display Unit or terminal). Characters from the host computer are normally read by the microprocessor and just passed on to the VDU. Similarly characters from the VDU keyboard are just passed back to the host. Thus no new hardware or system software is required in the host computer. The microprocessor, however, is programmed to recognise certain character sequences as "escape sequences" which it will interpret itself to draw displays, legends, etc., instead of passing them on to the VDU. Similarly the touch terminal can insert its own characters on the touch of a button, which can then be interpreted in the host user program.

This use of the microprocessor makes the full facilities of a touch terminal available on any computer with a simple terminal. More important, it avoids the problems of cost, system programming, and memory space allocation, encountered when interfacing special devices to complex computer systems.

The microprocessor also provides the terminal with a powerful stand alone capability. The unit demonstrated at the poster session was operating in stand alone mode. A typical use is in equipment or sub-system testing. Here the equipment is directly connected to the touch terminal, together with a VDU. The full facilities of the touch terminal can then be used to aid the testing and commissioning process. An inbuilt interpreter is provided for the NODAL language used to control the SPS. A "file module" is also built in so that programs can be saved as they are developed on the VDU. A built-in assembler is provided for fast loop tests.

The microprocessor used in current terminals is the National Semiconductor PACE 16 bit processor. Work is proceeding on a version based on the Motorola 68000. This will provide a substantial increase in speed which will allow higher baud rate connection to the host computer (currently 2400). In stand alone mode it will give the terminal the power of many mini-computers.

4. THE MINI-CAMAC BUS

The touch terminal is built in modular fashion using standard CAMAC modules. Figure 1 shows the layout. At the rear left are 11 CAMAC slots which take standard CAMAC modules. The power supply is at the rear right behind the TV monitor. Two of the slots are used for the Independent Crate Controller which contains the microprocessor and its memory (32 k bytes EPROM, 24 k bytes RAM). This leaves 9 slots for the displays, touch buttons, connection to the host computer or test equipment, etc.

The use of CAMAC was dictated by the desire to use the standard man-machine interface modules developed for the SPS main control room which is CAMAC based. It has several other advantages however. The size of the modules fits well with the compact shape of the terminal (see figure 1) and 11 CAMAC boards can hold a lot of electronics. New facilities can easily be added from the wide range of CAMAC modules available. Connection to equipment on test, or the other CAMAC serial loops, system crates, etc. can be done using available CAMAC modules. Any CAMAC modules developed specially for the touch terminal, such as the microprocessor crate controller, can be re-used in other CAMAC environments. Finally maintenance and development can benefit from available CAMAC expertise.

5. THE DISPLAYS

The displays are based on standard European 625 line TV. This can provide a maximum resolution of 768 by 576 points. The standard monochrome and colour displays used in the touch terminal provide a resolution of half of this, namely 384 by 288 points. This is adequate for control type applications, efficiency scans, simple plots and histograms, etc. It should not be confused with the very high resolutions and power required for track reconstruction applications.

6. ACKNOWLEDGEMENTS

The authors would like to acknowledge the important part played by their colleagues in the development of the touch terminal. D. Bakker was responsible for the chassis, the file module, and the special analog signal front panel. L. de Jonge designed the full graphics display module and the button/LED display interface. M. Flückiger designed the rounded character generator which is used for the touch screen display when an additional full graphics display is provided. R. Lauckner wrote the mathematical function package for stand alone use of the terminal, and P. Mills wrote the file handling system.

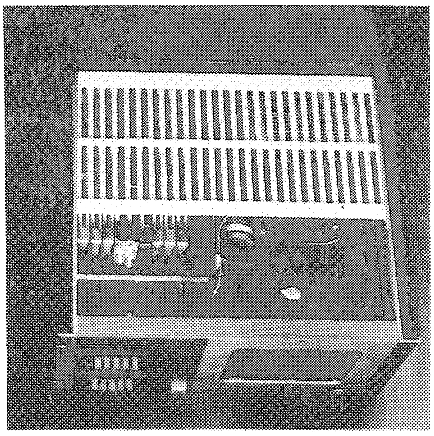

Fig. 1 Touch Terminal Chassis

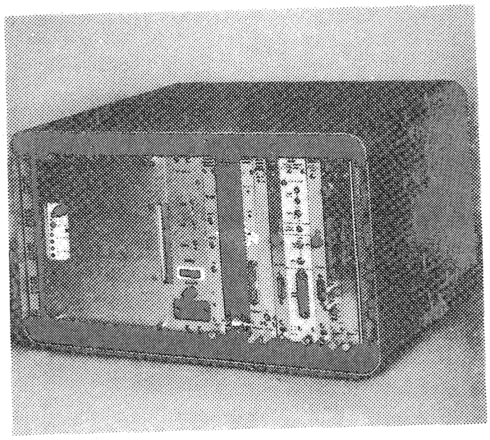

Fig. 2 11 Slot Mini CAMAC

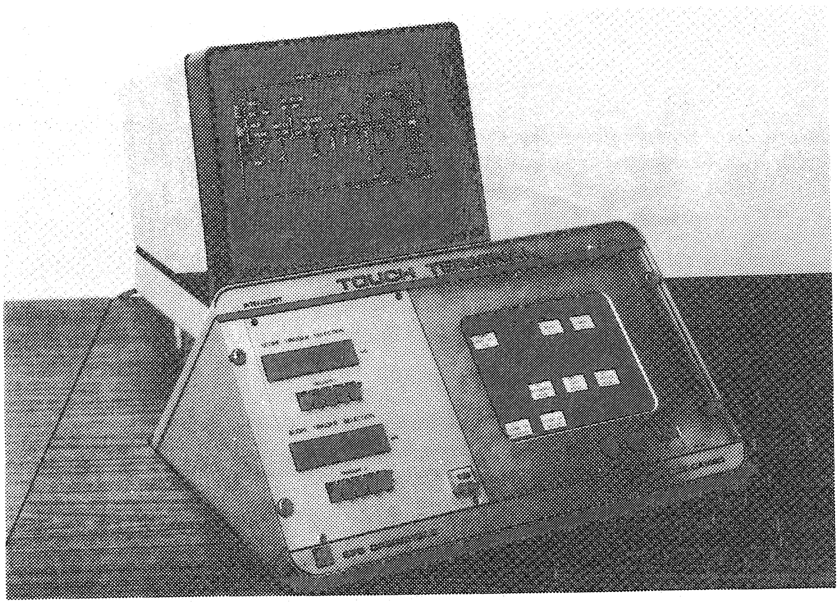

Fig. 3 Touch Terminal with Additional Display