Microcontroller for Automation Application

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A microcontroller for automation application is currently being developed. It is basically an 8-bit microcomputer with a 40K byte random access memory/ read only memory, and can control a maximum of 12 devices through standard 15-line interface ports.

I. Introduction

A breadboard microprocessor controller was used in an RF automation demonstration held in June 1975 at the Mars Station, DSS 14. The controller was used to control two Subcarrier Demodulator Assemblies (SDAs) upon receiving macro commands from a master PDP-11 computer. The controller that configured, calibrated, monitored, and provided failure backup for the SDAs performed flawlessly throughout the demonstration. It was then decided to repackage the controller in a more suitable form for future applications.

II. Description

The microcontroller shown in Fig. 1 is actually a small computer designed around the Intel 8080 microprocessor chip. Many of the various modules that comprise the computer portion of the microcontroller have been purchased from Intel Corp. These include the central processor unit (CPU), random access memory (RAM), read only memory (ROM), and input/output (I/O) modules. Other modules such as the 4-port, 15-line interface module, and the hardware bootstrap module are built at JPL. All modules plug into a chassis containing a module cage, power supplies, and various connectors and switches. The microcontroller fits into a standard 48-cm (19-in.) RETMA rack. It is 22 cm (8-3/4 in.) high and 48 cm (19 in.) deep.

The primary function of the microcontroller is to control various subassemblies that have a standard 15-line interface port. The microcontroller can communicate with a maximum of 12 ports. Although the microcontroller is intended to be a stand-alone controller, peripheral equipment is required during program development. The microcontroller will interface with a teletype (TTY), a video display terminal, a high-speed paper tape reader, and a high-speed paper tape punch.

The microcontroller module cage contains a modified Intel Intellec 8/mod 80 motherboard. Modifications were made to provide a larger memory capability, which consists of up to ten 4K RAM or ROM memory modules (see Fig. 2). The module cage also holds three I/O modules that interface with the TTY, video display terminal, and the high-speed paper tape punches and readers. one of the I/O modules drives three 15-line interface modules, each of which controls four 15-line interface ports. The hardware bootstrap module contains a number of special circuits that include (1) a selectable address hardware bootstrap loader, (2) a status lamp display driver, and (3) a power supply monitor to determine if all required voltages are present.

Programming can be accomplished using either assembly language or PL/M high-level language. In either case, several software aids are available to the user. Residing in the JPL Univac 1108 computer, there are three programs helpful to the user. They are: (1) a PL/M Compiler, (2) a MAC 80 Assembler, and (3) an 8080 Simulator. The use of these programs along with the 1108's text editor and permanent file system makes programming relatively easy.

The user may also elect to develop his program using the resident (paper tape) assembler and text editor. While this is satisfactory for short assembly language programs, larger programs are developed more efficiently on the 1108, since paper tape handling is not required.

A system monitor program is supplied on ROMs with every microcontroller. This resident program performs many housekeeping functions; the most important are tape loading and punching, and modifying and displaying on a CRT or TTY, the contents of various registers and memory locations. Other software currently being developed consists of memory diagnostic routines, I/O diagnostic routines, CPU diagnostic routines, string manipulation routines, 15-line interface drivers, and mathematical functions.

Controls and indicators on the microcontroller are minimal and are located behind a door on the front panel. There is an ADDRESS SELECT switch. The address corresponding to each switch position is listed on a card on the rear of the door. When the BOOT switch is depressed, a GO TO instruction is issued into the CPU causing the program to jump to the designated address. This feature allows the user to immediately jump to specific routines such as the System Monitor, I/O diagnostic, memory diagnostic, or the user program. The PWR lamp indicates that all required voltages are present, i.e., +5 Vdc, +12 Vdc, and -9 Vdc. The eight status lamps are under user software control. Normally, they are used to indicate the condition of various flags in the user's program. Initial application of power automatically starts the microcontroller at the selected address.

III. Summary

The microcontroller with its power supply monitor and memory, I/O, and CPU diagnostics has been designed to provide a very reliable unit. All modules with the exception of the power supplies are plug-in modules. With the help of the resident diagnostics, a defective module can be isolated and replaced in minutes. Program development cost and time should be minimal through the use of common software routines and other program development aids. The cost of the microcontroller will be $5,000 to $10,000, depending on the memory and I/O requirements. Programming and operation manuals are also available.

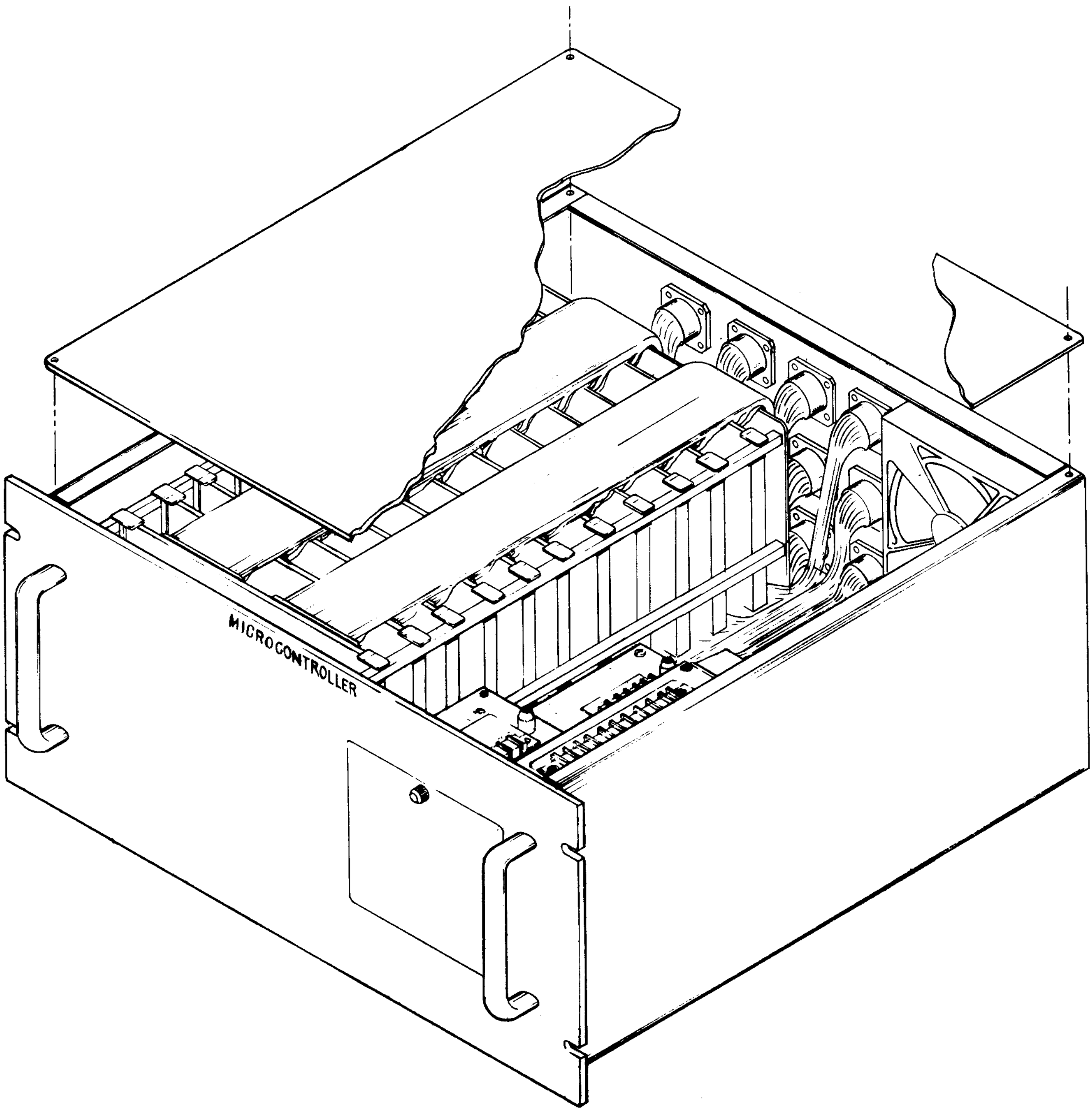

Fig. 1. Microcontroller

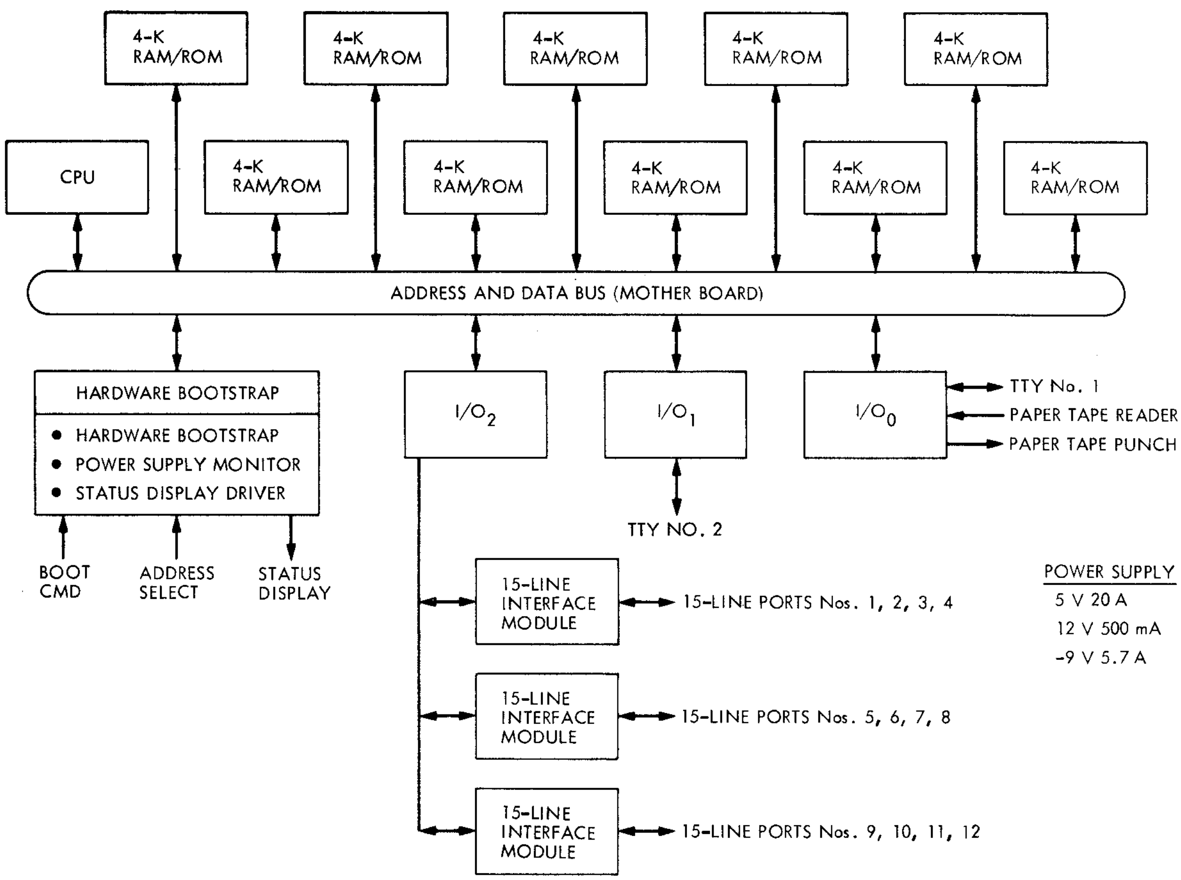

Fig. 2. Block diagram, microcontroller