Considerations for Microprocessor-based Terminal Design

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Abstract
We discuss the design of hardware and software for inexpensive microprocessor-based terminal/microcomputers. Such devices are fundamentally microcomputers that have been adapted, with specialized software, to operate as remote terminals for a host computer. The discussion centers on a specific video terminal designed and constructed by the authors. This terminal is based on the Intel 8080 microprocessor and is equipped with software sufficient to emulate the characteristics of standard video terminals required by several available screen-oriented text editors in common use at sites throughout the ARPAnet. We have found that the microprocessor adequately serves as the controller for such terminals, and that a software-based approach to the design of such terminals offers substantial advantages in capabilities, flexibility, and cost over the hardware-based approach. We suggest guidelines for future designs of microprocessor-based terminals on the basis of our experience designing and using the terminal described here.
In order to take full advantage of the flexibility afforded by microprocessor-based designs, we have implemented the capability to download and execute 8080 programs written and assembled on a host computer. This allows the user to customize and extend the features of his terminal. At the same time, it provides access to the 8080 as a microcomputer with the software development tools and mass storage provided by the host computer. The terminal is thus a complete, stand-alone microcomputer system specially configured for its role as a terminal.
For more detail, see:
Reid G. Smith and Tom M. Mitchell, CONSIDERATIONS FOR MICROPROCESSOR-BASED TERMINAL DESIGN. STAN-CS-78-696 (Stanford Heuristic Programming Project Memo HPP-78-22), Dept. of Computer Science, Stanford University, November 1978.
A Microprocessor-based Terminal

A MICROCOMPUTER ADAPTED VIA SPECIALIZED SOFTWARE TO OPERATE AS A REMOTE TERMINAL

MICROPROCESSOR FOR EMULATION OF TERMINAL (SOFTWARE-BASED DESIGN)

MICROPROCESSOR FOR LOCAL COMPUTATION
Terminal Requirements

SUPPORT SCREEN-ORIENTED EDITORS
   (TV-EDIT or E)

FULL-ASCII CHARACTER SET
80-CHARACTER LINE WIDTH
8-BIT TRANSMISSION
INSERT AND DELETE CHARACTER
INSERT AND DELETE LINE
ERASE TO END OF LINE
BLANK SCREEN
CURSOR ADDRESSING (relative and absolute)
DISPLAY MODES (e.g., dual intensity)

LOW-COST
Block Diagram

- CPU: 8080
- Memory: 2K EPROM, 2K RAM, 4K RAM
- Interfaces: Keyboard Interface, Line Interface, Priority Interrupt
- Generation: TV Signal Generation
- Control: Memory Control
- Modem: 1200/150 Modem
- Buses: S-100 Bus
Software

PRIMITIVE TEXT-PROCESSING OPERATIONS
(e.g., insert and delete line)

LOCAL MONITOR
STORE SCREEN
RECALL SCREEN
TRANSMIT SCREEN
SELECT DISPLAY MODE
LOGOUT JOB
GO TO ADDRESS
The System As A Terminal

ADVANTAGES OF A SOFTWARE-BASED DESIGN

COST
(for primitive text-processing operations)

CAPABILITIES
(e.g., macros)

FLEXIBILITY
(e.g., customized functions)

DISADVANTAGE
SPEED ??
The System As A Microcomputer

SOFTWARE DEVELOPMENT ON THE HOST
VIRTUAL TERMINAL

LOCAL EDITING
SHARED EDITING

( GOOD LOCAL FILE SYSTEM ESSENTIAL )
Using The Host For Software Development

WHY?

MASS STORAGE – FILE SYSTEM
HIGH-QUALITY EDITORS
COST

REQUIREMENTS:

CROSS-ASSEMBLER
DOWNLOADER

USEFUL IDEAS:

TERMINAL SOFTWARE FOR LOCAL USE
VIRTUAL TERMINAL
Suggestions For Future Designs

ESSENTIAL FEATURES

HARDWARE

80-CHARACTER LINES
AT LEAST 24 LINES
VARIABLE DISPLAY MODES

SOFTWARE

INSERT AND DELETE CHARACTERS AND LINES
CURSOR ADDRESSING

DESIRABLE FEATURES

HARDWARE

VARIABLE TYPE STYLES
STORAGE AND RECALL OF MULTIPLE SCREENS

SOFTWARE

SPLIT-SCREEN MODE

TREND

TOWARE LONGER WORD-LENGTH PROCESSORS
AS TERMINAL CONTROLLERS
Summary

MICROPROCESSOR-BASED TERMINALS

SOFTWARE-BASED DESIGN

CLOSE INTERACTION BETWEEN HOST AND MICROCOMPUTER
FOR SOFTWARE DEVELOPMENT AND
DYNAMIC CUSTOMIZATION OF
TERMINAL FEATURES