THE VARIETY OF TICCIT SYSTEMS — AN OVERVIEW

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The TICCIT Model

MITRE's TICCIT program began in 1968 with the hypothesis that coupling television displays to a time-sharing computer system would result in a computer-based instruction system low enough in cost to permit schools to provide a significant quantity of individualized instruction to a large number of students. The subsequent TICCIT effort has demonstrated this hypothesis to be correct, and has led to the development of a model for this technology (See Figure 1) that has been shown by the ten TICCIT systems in operation and under construction to have a wide range of options which match a wide range of instructional and general purpose environments.

The TICCIT Systems

Three TICCIT systems have been built for the community college project sponsored by the National Science Foundation. As Shown in Figure 2, these systems are designed to deliver individualized computer-assisted instruction to up to 128 students simultaneously. At the heart of the system is a dual processor minicomputer system with a disc based storage capable of storing 75 million bytes of programs and instructional data plus student records for 3000 students, 10,000 graphic displays and 2 1/2 hours of digitized audio.

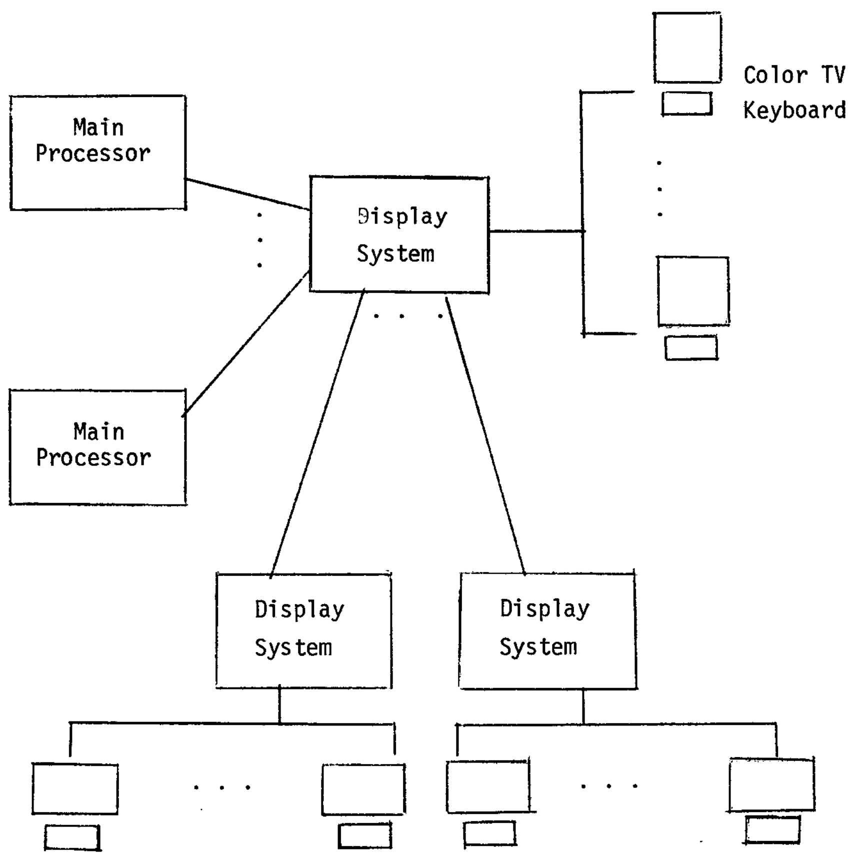

Figure 1
The TICCIT Model

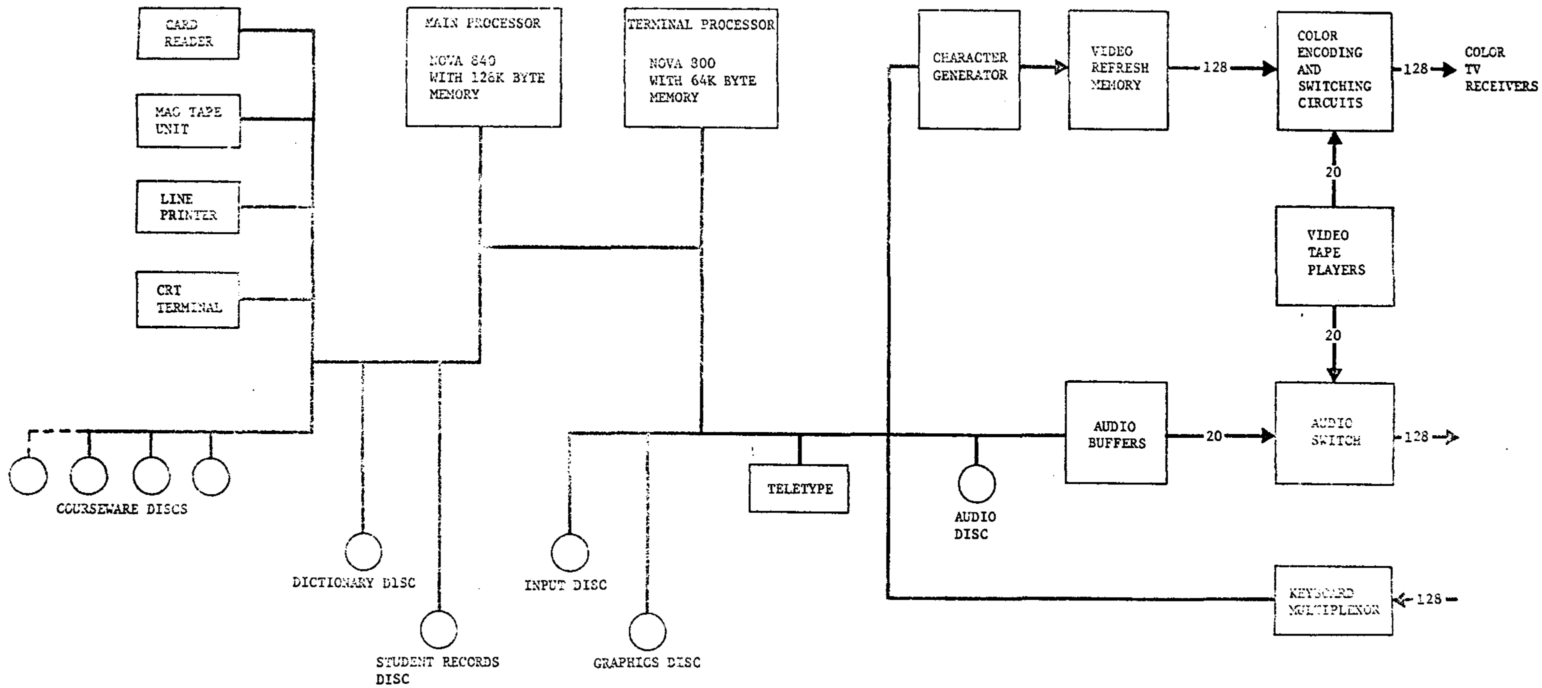

Figure 2
TICCIT System Block Diagram

The output of the computer system passes through the MITRE designed refresh system to the student terminal. A single character generator converts computer character strings to raster scan bits and color control bits, which are stored in the refresh memory of the appropriate terminal. The character generator is programable, providing a very large set of characters, sizes, and fonts. Arbitrary bit patterns can be defined to create graphics. The standard character size provides 43 characters per line and 17 lines. Seven colors are available, and color is stored for top and bottom halves of each character position.

The student terminal consists of a modified color television set and a keyboard. In addition to the computer generated video and audio, the terminal can be used to present videotaped materials to the student.

Two systems developed for the Navy, one operational at North Island Naval Air Station, California, and one under construction for Cecil Field, Florida, are identical to the community college systems except that they have only 32 terminals and no audio. Similarly, a small eight terminal TICCIT Laboratory is operational at MITRE without audio or video tapes.

The TICCIT Laboratory system also serves as the main processor in support of a remote TICCIT system that supports four terminals. The remote system contains a terminal processor with a cartridge disk for graphics, a character generator and a four terminal refresh system. It is housed in a ruggedized cabinet so that it can be easily shipped from one site to another. Currently, it is at the Air University, Maxwell Air Force Base, Montgomery, Alabama. The connection between the MITRE computer and the remote computer is via a 2400 baud telephone link.

A system designed for the New York State Education Department Office for Education of Children with Handicapping Conditions is currently operating in Amherst, New York, delivering instructional materials, games, and other computer services to homebound children and their families via the local commercial cable television system. As shown in Figure 3, a TICCIT terminal processor and refresh system are used to interface a Hewlett-Packard 2000F Time-Shared Basic System to the cable. A terminal in Amherst consists of the viewer's own home unmodified T.V. set and a keyboard, which is acoustically coupled to the users telephone. The character generator has been modified to permit variable width characters required due to reduced bandwidth of the cable system and the home T.V. sets. In order to modulate the refresh memory output onto the cable using standard modulations, it was necessary to engineer a colorizer which combines luminance and chroma signals into a single NTSC compatible signal.

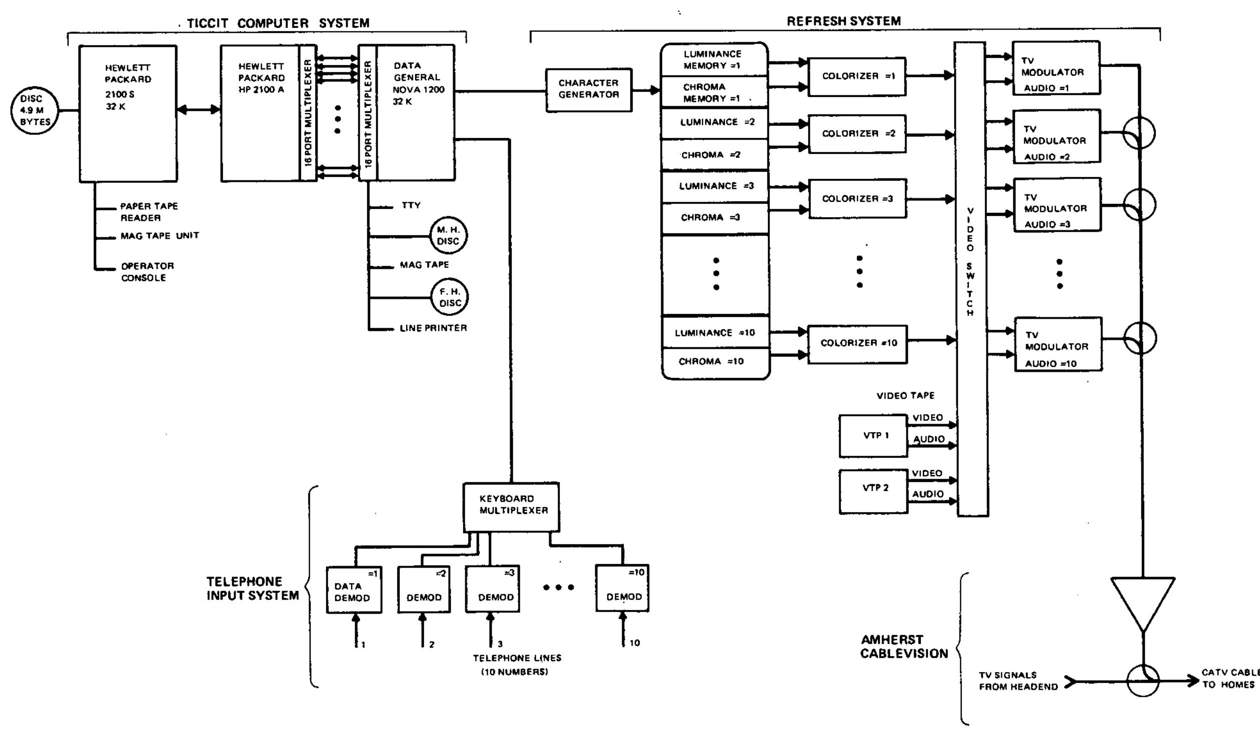

Figure 3
Amherst TICCIT Interactive TV System

A system under construction for the Model Secondary School for the Deaf (MSSD), Washington, D.C., is also cable television based. The system at MSSD is built around a cable plant made up of five parallel cables, four downstream and one return, each with a 36 channel capacity. One cable contains off-air television channels, locally originated programs from the studio at MSSD, channels from the Gallaudet College cable system and video tapes. Two of the cables are used to implement a video phone capability. The remaining two cables carry computer generated signals.

Three types of terminals may be connected to the cable system at MSSD. A T.V. set equipped with a set top converter may be connected to the cable that has the one-way mass distribution signals. Interactive terminals will consist of a T.V. set, a keyboard, and a terminal controller. The controller will allow the computer to select cable and channel automatically to give the user the program he has asked for using his keyboard. Some interactive terminals will also have a video phone accessory consisting of a T.V. camera, a modulator and a microphone.

The computer system for MSSD includes all the components of the community college system (Terminal Processor, Main Processor, Disc Drives, etc.) plus many new features. A second main processor will be the Gallaudet College Computer Center's PDP-10. There will be no need for the video tape switch, but the video tape players will be computer controllable. A standard communication interface will connect to telephone lines and printers located remotely around the MSSD building.

The terminals in the MSSD TICCIT system can be used for watching commercial television and other scheduled programs, for dial access video tape viewing, for communicating with others inside and outside the MSSD campus, for computer assisted instruction and for student and administrative general purpose computing.

The communications functions include terminal-to-terminal keyboard interactions with other terminals at MSSD or with any teletype on the teletype-for-the-deaf network, video phone service between MSSD terminals so equipped, and a mailbox service for personal message and junk mail distribution.

The CAI data base will include all of the community college TICCIT materials, some math drill materials now operating on the PDP-10 and a variety of MSSD produced multimedia materials to be developed.

The general purpose computing uses of the system will initially consist primarily of administrative functions now running and under development on the PDP-10. A BASIC interpreter will be added to the TICCIT system which will be used to support some CAI activities, as well as student computing.

The tenth TICCIT system, called MITS, serves as a front end processor for MITRE's IBM 370/145. This system is essentially a terminal processor configuration supporting 16 color TICCIT terminals, plus 20 other hard wired and dial-up terminals and three real-time computers used in other MITRE laboratories.

<u>TICCIT Courseware</u>

TICCIT is more than just hardware systems. On the community college project alone, more than $1.5 million has been spent on the definition, design and development of course structures, authoring methods, and instructional materials for pre-calculus mathematics and English composition and grammar.

English and mathematics have the first and second greatest enrollment in community colleges, with most students needing work in high school-level algebra and English composition and grammar. The courses developed are quite standard, although the English course required some novel approaches to adopt the subject to computer presentation.

The TICCIT courses are mainline courses. That is, most students receive all of their instruction from the TICCIT system. The role of the teacher is changed to that of a tutor, advisor, diagnostician and problem solver for individual students whenever the need arises.

The structure of the TICCIT courseware is based on the assumption that in complex cognitive learning (which includes mathematics and English grammar and composition) the way subjects are taught is independent of what is taught. TICCIT courses are organized into a heirarchy with four levels: courses are divided into units, units into lessons, and lessons into segments. Each segment consists of a single generality or rule explained in four styles, plus a file of instances of the student either as examples or practice problems which test the students understanding of the concept. Additional components which round out the course structure include introductions to units and lessons; statements of objectives; lists of prerequisites; feedbacks to questions; help in understanding the relation of an example or practice problem to the rule; heirarchy diagrams called maps, which show the student the structure of the materials, where he is in those materials, and how well he is doing; and tests.

Each of these components is available to the student if and when he wants to look at it. Special keys on the keyboard gives the student direct access to each of the segment components under learner control. He may see as many examples or practice problems as he chooses, review the rule as often as he likes and take the test whenever he wants to. The system keeps track of what the student is doing, and an advisor program makes suggestions from time to time. There is also an ADVICE key on the keyboard to allow the student to solicit comments on strategy and progress.

Courses being designed by the Navy and the Air University follow the same structure. The Navy courses have a somewhat different flavor, however, since the TICCIT system is used heavily for computer-managed instruction (CMI) as well as CAI.

Four courses are being developed at North Island for crew training on the S3A aircraft. Part of the training program includes operation of a flight simulator, as well as actual aircraft operation. Additionally, a large body of training materials exist in the form of workbooks. Consequently, some of the lessons being written for TICCIT include instructions to the student to use other off-line media.

The Air University is currently developing two training courses, one in food service and one in supply processing.

The instructional materials in use on the Amherst, New York, system were not produced as part of any TICCIT related effort. There, courseware is written in BASIC and comes from the standard libraries available from Hewlett-Packard and elsewhere.

TICCIT Users

As of this writing (October, 1975) there are over 1000 students taking courses on six TICCIT systems around the country. Nine hundred of these are at the two community colleges, and another 150 at Brigham Young University. Much smaller numbers of students are using the systems at North Island NAS, Amherst and MITRE. At North Island the students are flight crews learning a new aircraft. At Amherst, they are children with handicaps severe enough to keep them out of school. The students at MITRE are taking one of the community college math courses.

In addition to students, authoring personnel are using TICCIT systems to write new materials and to revise existing courseware. Originally, a team of about 40 people at Brigham Young University developed most of the community college materials. Currently, there are about 10 part-time people at each of the colleges who are working on revisions and new material. The Navy has a team of about 20 people developing their four courses; about six people at the Air University are involved with the development of their two courses.

The users of MITS at MITRE are, of course, not students, but rather engineers and other users of the 370. The TICCIT terminals provide them with color, graphic and overlay capabilities not found in most other remote terminal systems.