DOCUMENT RESUME

ED 115 213 IR 002 498

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TITLE	The Development of a Computer Controlled Super 8 Motion Picture Projector.
INSTITUTION	Texas Univ., Austin. Project C-BE.
SPONS AGENCY	National Science Foundation, Washington, D.C.
REPORT NO	EP-31-8-11-75
PUB DATE	11 Aug 75
NOTE	19p.; For related documents see IR 002 463 and 464
EDRS PRICE	MF-$0.76 HC-$1.58 Plus Postage
DESCRIPTORS	Audiovisual Instruction; Child Development; Computer Assisted Instruction; *Computers; Early Childhood Education; Educational Technology; *Films; Higher Fducation; Instructional Programs; *Observation; Photographic Equipment; *Simulation; Teacher Education
IDENTIFIERS	Child Observation Simulation; *Computer Controlled Movie Projectors; Project C BE; Super 8 Films

ABSTRACT

Instructors in Child Development at the University of Texas at Austin selected sound motion pictures as the most effective medium to simulate the observation of children in nursery laboratories. A computer controlled projector was designed for this purpose. An interface and control unit controls the Super 8 projector from a time-sharing computer communication line. The projector operates in conjunction with a computer terminal. When special control characters are received, the controller will intercept the character string and perform the necessary control commands which enable the student to locate any section of film within a specified tolerance and time interval. The system will be evaluated for cost-effectiveness as a teaching device by comparing traditional learning methods and learning by simulation. Development costs and system schematics for the projector are appended. (CH)

The Development of a Computer Controlled Super 8 Motion Picture Projector

EP-31/8/11/75

by

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*The materials contained herein were supported by PROJECT C-BE under Grant EPP71-04422, "The Use of Computer-Based Teaching Techniques in Undergraduate Science and Engineering Education," from the National Science Foundation to The University of Texas at Austin, John J. Allan and J. J. Lagowski, Co-Directors.

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How can an instructor demonstrate to a large class in Child Development the stages of human motor development? Traditionally, this and other phases of development are presented in lectures and then students are given the opportunity to observe children in a nursery school. Presumably with many hours of observation, a student will be able to see many children in various stages of development doing a variety of activities. Home Economics Departments spend large sums of money to support the nursery schools and the students spend many hours watching for some clue to how children do or do not develop.

Faculty members at the University of Texas at Austin began in the Summer of 1972 to explore ways in which the computer could help teach this important subject. Preliminary experiments using interactive programs at teletypewriters proved to be only expensive page turners. Next a series of color slides were developed for each of several children. The slides were carefully selected to depict specific developmental characteristics. This instructional medium proved to be useful, however only very limited information could be conveyed. The researchers, after analyzing the course evaluation, determined that before any significant improvement instruction could be made, a much richer medium would be necessary. Carefully selected sound motion pictures were selected as being the most effective medium currently within economic feasibility.

The desired instruction technique is a form of simulation where the student can, by the use of a more effective (cost, time, results) medium, learn at least part of what is learned with the nursery school laboratory. Students will still need to observe in the nursery school but hopefully after several hours of viewing well edited films, they will be more familiar with child behavior and more aware of the child behavior they should observe. The simulations are used for teaching in many other disciplines (pilot training, chemistry laboratory, economics, etc.), why not child development?

A teaching simulation ideally has the following characteristics:

1. Realism and authenticity
2. Learner control
3. Immediate feedback based upon learner input
4. Cost effectiveness
5. Transference of learned behavior to real situation.

For this application, realism and authenticity could only be satisfied by a very rich medium because child development is a very complex study requiring observation of motion, color, size, speech, interactions with other children, etc. These characteristics can be presented by well selected full color, sound motion pictures. Current technology presents several techniques of producing these images, i.e., video tape recording, video disc recording, and motion picture film. Because of lower equipment costs Super 8 sound motion picture film was chosen.

Learner control, and immediate feedback based upon that control, dictated that the simulator must be able to respond in a logical manner to learner inputs. Since film is the primary medium to be used, the simulator must be able to control the film presentation and select appropriate film sequences to demonstrate specific concepts as needed. Linear presentation therefore would not be adequate but instead random selection would be necessary.

Cost effectiveness and transference of learning cannot be separated since cost effectiveness must be a measure of cost per unit of learning, with the final measure of teaching effectiveness being a comparison of learning by traditional methods and learning by the simulation method. The whole objective is to keep costs low and teaching effectiveness high.

After discussion with persons knowledgeable about existing equipment and known development projects the decision was made to develop a computer controlled Super 8 magnetic sound, motion picture projector. A search for a vendor to supply such development work ended in the selection of an individual consultant willing to take the assignment as an after hours job within the budget available. The following problem definition was agreed upon:

> To build an interface and control unit which will control a Super 8 projector from a time-shared computer communication line. The projector will operate in parallel with a computer terminal. When special control characters are received, the controller will intercept the character string and perform the necessary control function (see description of control commands following). The unit must be able to locate any section of film within specified tolerance and within specified time interval.

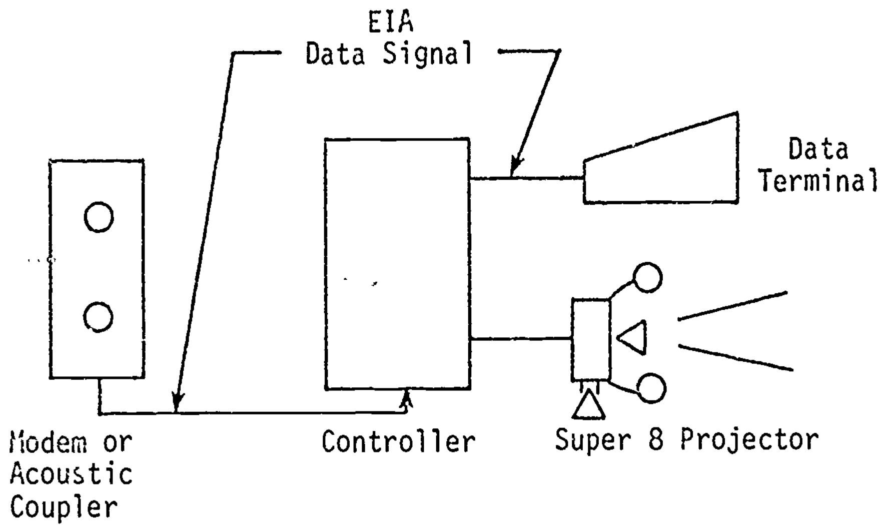

FIGURE 1

Schematic Showing System Interconnections

Project personnel agreed to select and acquire the projector and to make all mechanical modifications such that the electronic designer would only need to be concerned with supplying electrical control signals. After extensive review of commercially available projectors the Kodak Supermatic(2) Model 60 Super 8 magnetic sound projector was chosen for modification. Among the main characteristics leading to its selection were through-the-gate rewinding, automatic threading from cassettes, designed for heavy usage with 2000 hour MTBF, and completely electrically controlled instead of mechanical linkages.

Through-the-gate rewinding allows the unmodified projector to completely rewind four hundred feet of film in less than one minute without removing the film from the normal projection path. This allows a user to quickly back up a film and review any portion of it.

[2] Kodak and Supermatic are trademarks of Eastman Kodak Company.

Since the film was completely free in the rewind state it was obvious that all that needed to be done to provide fast forward movement was to add the necessary clutch and brake system to pull and stop the film just as Kodak did to rewind.

Super 8 film has one sprocket hole for each frame which provides a very suitable addressing device. Two photo diodes were installed in the film path to provide motion and direction detection. The diode spacing is two frame spacings plus one half of the sprocket hole width. By analysis of the signal coming from both diodes the logic is able to determine film direction. This addressing scheme requires no special film processing and is very precise.

With the basic projector selected and the required interface signals defined the electronic designer was able to lay out the controller block diagram and proceed with the gate-by-gate design of the required logic. The controller is designed around standard components which should be readily available should repair parts be needed. All integrated circuits, relays, and other major components are socket mounted for easy replacement.

The controller performs two functions:

1. Controls communication between the modem and the terminal, and
2. Intercepts and decodes control character sequences received from the modem generating control signals for the modified projector.

There are eight control character sequences. Each consists of a switch selectable control character (typically #) any number of ASCII[3] characters (indicated below by *), and terminated by a line feed (lf). The control character sequences are divided into these groups; control, motion, and status commands.

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[3] American Standard Code for Information Interchange is the most common communication code for data processing terminals.

COMMAND TYPE	COMMAND	CONTROL CHARACTER SEQUENCES	EXECUTION TIMING
Control	POWER	#POW*1f	Immediate
	OFF	#OFF*1f	Immediate
	STOP	#STO*1f	Immediate
Motion	RESET	#RES*1f	Continued
	SEARCH	#SEA*N*1f	Continued
	PROJECT	#PRO*N*1f	Continued
	SOUND	#SOU*N*1f	Continued
Status	REPORT	#REP*?*1f	Immediate

The commands may also be classified according to their executing timing (see column 4 above). A control character sequence is not defined until the fourth character is decoded. Immediate commands execute immediately upon decoding the fourth character while continued commands require additional time. Each continued command sets 'BUSY' upon initiation and resets 'BUSY' when completed. Only immediate commands are acted upon when 'BUSY' is set. This prevents the stacking of commands and allows interruption of continued commands by stop or the acquisition of status reports during controller operation. A summary of the command functions follows:

POWER - Turns on 110V power to projector and resets frame count register to zero. Must be first command.

OFF - Turns off 110V power to projector.

STOP - Shift to idle with light off, brake on.

RESET - Rewind film to beginning as determined by detection of leader.

SEARCH - Causes projector to move to specified frame number unless frame is off either end of film. Frame number indicated by 'N' above.

PROJECT - Project with sound to specified frame number 'N'. If 'N' less than current location no action is taken.

SOUND - Same as PROJECT except projection light off.

REPORT - Transmits six digit status report followed by a carriage return. The first character is controller status where 0 = normal, 1 = threading, 2 = rewinding, and 4 = film leader.

The modified projector receives several inputs from the controller: fast forward, normal forward, fast reverse, brake, projection lamp, sound, and AC power to projector. The projector provides five inputs to the controller: frame clock 1, frame clock 2, end of film, thread switch, and manual rewind switch. Interlocks are provided such that logic errors can not cause damage to the film or machine by simultaneous application of conflicting functions.

The system has been assembled and extensively tested for accuracy and reliability. To date, an evaluation as a teaching tool has not been accomplished. A film library consisting of six film cassettes for each of four children has been developed and evaluated for content. Students using a manually controlled projector view these films in a course and evaluation showed that learning rates were very good. Hopefully when the computer controlled system is used the first time in the Fall of 1975 teaching effectiveness will be further improved.

The present controller provides a very effective computer interface to a projector. The Super 8 was chosen for this application because of its low cost, however, other projectors or video tape systems can be interfaced. Video disc playback units can provide very rapid access to recorded material and could reduce search time drastically, however costs are currently rather high. Recent press releases indicate low cost video players are coming and that interfacing them to this controller should not be too difficult. The richness of the medium coupled with rapid access of desired material and low cost should stimulate many exciting new applications in education and industry.

Appendix A

Prototype Costs

Design, fabrication and testing of the prototype projector was a joint effort of electronic designer Roy H. Deen, who is employed by a local industry but did this project after hours, and Project C-BE personnel. The Mechanical Engineering Department Machine Shop did machining and assembly work and the University Teletype Repair Service provide some expertise as well as the use of certain test equipment and facilities. Cash expenditures are as follows:

Design consultants fees: 299 hours @ $10 (design, parts procurement, fabrication supervision, testing, documentation)	$2990
Technician: 141 hours @ $5 (fabrication and testing)	705
Machine Shop: 56 hours @ $6 (projector modification)	336
Electronic components	1374
Projector, Supermatic 60	390
Total cash expenditures	$5795

In addition to the cash expenditures listed above, Project C-BE personnel have spent approximately 100 hours on the development of specification, consultation with designers, testing, software development and documentation.

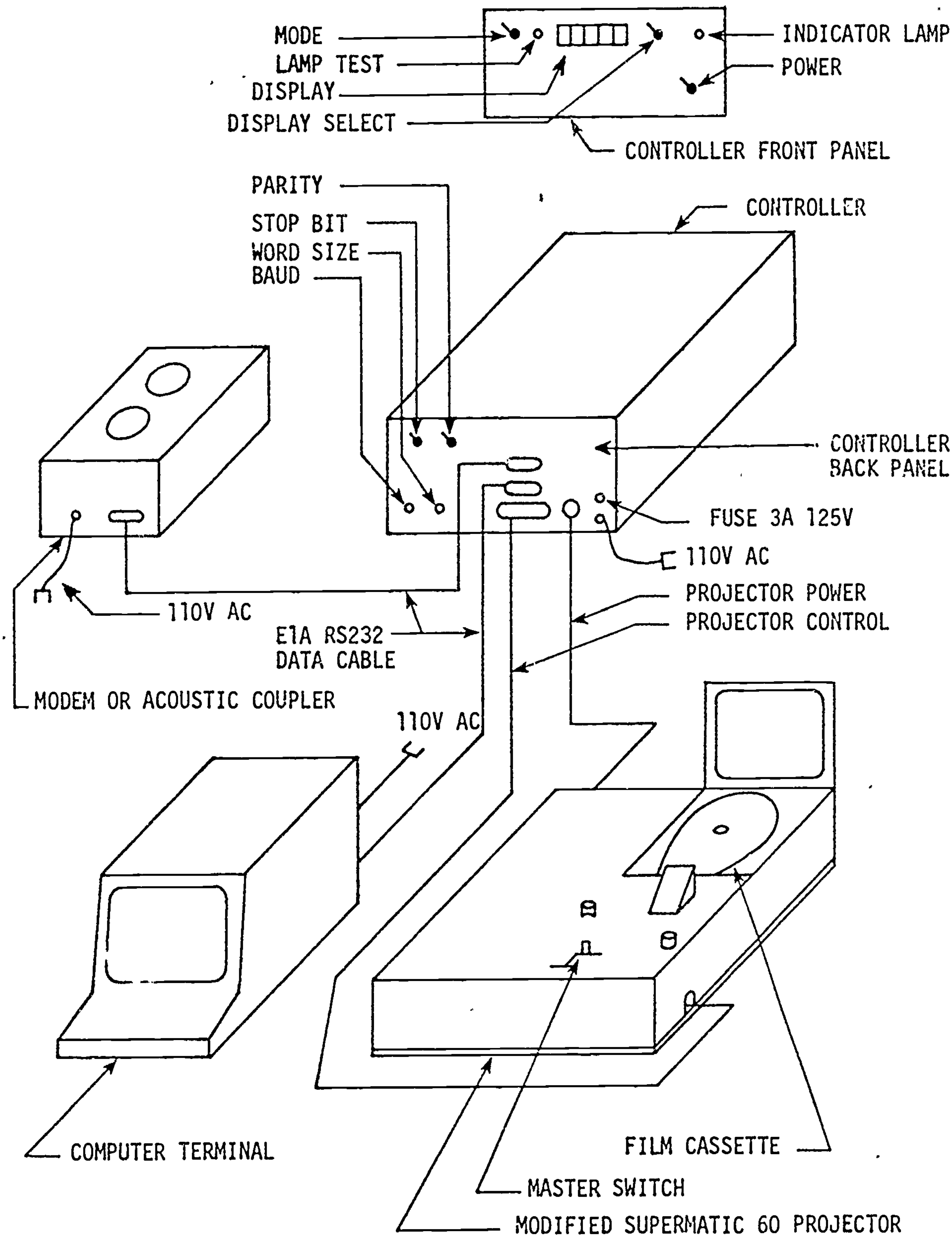
Should additional units be needed, the following cost estimate can be used:

Design consultants: 40 hours @ $10 (supervision and testing)	$ 400
Technician: 100 hours @ $5	500
Machine Shop: 30 hours @ $6	180
Component parts	1100
Projector	390
Total estimate cost for second unit	$2570

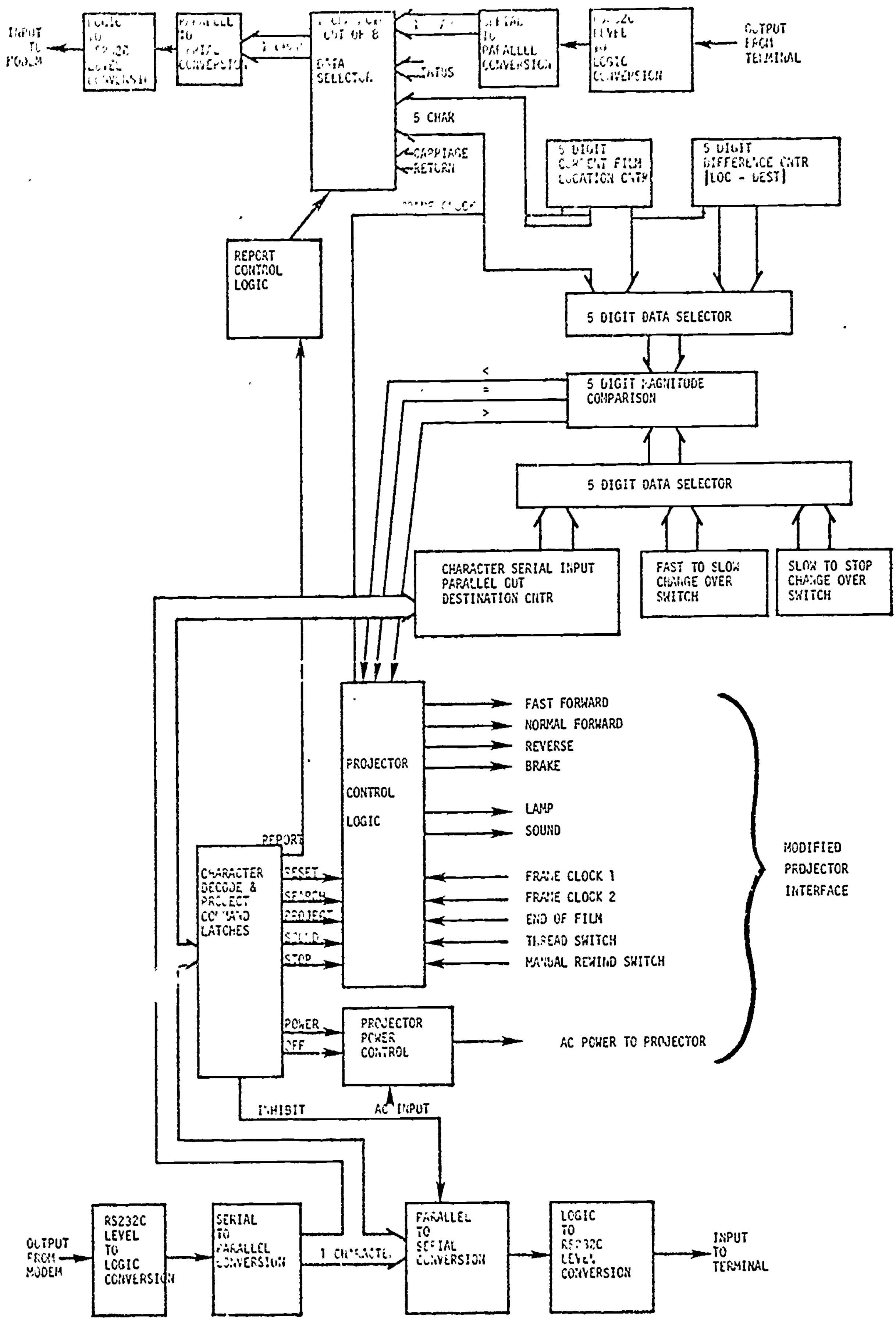
The above estimates will need to be revised to adjust for prevailing wage rates and facilities availability. The design should be reviewed and modified where prectical to use the latest commercially available conponents. A microprocessor should be considered if any quantity of unit is anticipated. See reference 4 for detailed design, assembly, operation and manitenance instructions.

Appendix B

System Schematics



SCHEMATIC OF SYSTEM SHOWING
CABLE CONNECTIONS AND SWITCHES


OUTPUT FROM TERMINAL
SERIAL TO PARALLEL CONVERSION
DATA SELECTOR
STATUS
5 CHAR
CARRIAGE RETURN
5 DIGIT DIFFERENCE CNTR (LOC - DEST)
REPORT CONTROL LOGIC
5 DIGIT DATA SELECTOR
5 DIGIT MAGNITUDE COMPARISON
<
=
>
5 DIGIT DATA SELECTOR
CHARACTER SERIAL INPUT PARALLEL OUT DESTINATION CNTR
FAST TO SLOW CHANGE OVER SWITCH
SLOW TO STOP CHANGE OVER SWITCH
PROJECTOR CONTROL LOGIC
FAST FORWARD
NORMAL FORWARD
REVERSE
BRAKE
LAMP
SOUND
FRAME CLOCK 1
FRAME CLOCK 2
END OF FILM
THREAD SWITCH
MANUAL REWIND SWITCH
MODIFIED PROJECTOR INTERFACE
REPORT
CHARACTER DECODE & PROJECT COMMAND LATCHES
RESET
SEARCH
PROJECT
STOP
POWER
OFF
PROJECTOR POWER CONTROL
AC POWER TO PROJECTOR
INHIBIT
AC INPUT
OUTPUT FROM MODEM
RS232C LEVEL TO LOGIC CONVERSION
SERIAL TO PARALLEL CONVERSION
PARALLEL TO SERIAL CONVERSION
LOGIC TO RS232C LEVEL CONVERSION
INPUT TO TERMINAL

References

1. Operation and Maintenance of the Kodak Supermatic 60 Sound Projector; Motion Picture and Education Markets Division, Eastman Kodak Company, Rochester, N.Y. 14650, Publication No. 636292

2. Service Manual for the Kodak Supermatic 60 Sound Projector; Motion Picture and Education Markets Division, Eastman Kodak Company, Rochester, N.Y. 14650

3. Parts List for Kodak Supermatic 60 Sound Projector; Motion Picture and Education Markets Division, Eastman Kodak Company, Rochester, N.Y. 14650

4. Operation and Maintenance Manual for Model S8 Projector Interface; Project C-BE, University of Texas at Austin, Austin, Texas 78212, publication number IM20/8/25/75.

5. Report in preparation by Dr. M. E. Durrett, Chairman, Department of Home Economics, University of Texas at Austin, Austin, Texas 78712. This report will cover film preparation, projector use in classes and evaluation.

COMPUTER-BASED EDUCATION COURSES

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Structural Analysis—Dr. Eric Becker

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