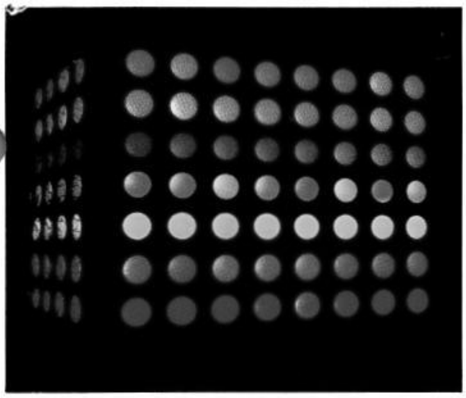
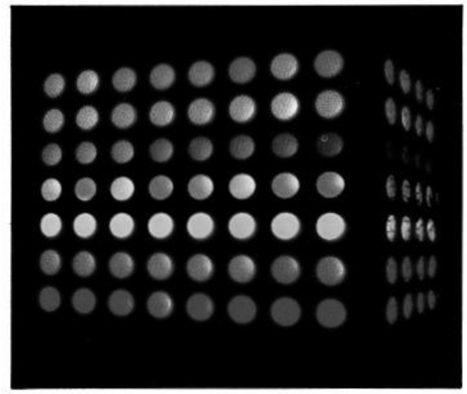


Designing a Disco Control System



By John Gaudio

I was a senior electrical engineering student at the University of Colorado when my associate Jim Brown approached me with the desire for a lighting system to serve as the primary visual entertainment in this new discotheque. We looked at the available equipment, considered variations on standard martix schemes, tone-encoded controllers, discrete digital controllers, and the like and I even laughingly suggested that we just use a computer so we wouldn't have to worry about the details until we had to program it. The more I thought the less I laughed and the more excited I became. It was a damn good idea.

My background was primarily digital electronics and computers. I'd designed lighting for bands and several school productions from the time I was 16, and a couple of theatrical lighting courses at C.U. were of considerable help, but I'd never tackled a project quite like this before. It had to work well and look good the first time. There wouldn't be a second chance.

C.Y.A. is an acronym commonly used by engineers to label those things included in a design "just in case they're needed." It is simultaneously a highly technical engineering term describing the first rule of any design. Cover Your Ass! It was with this foremost in my mind that the electrial engineer in me designed a control system to cover the south end of a northbound lighting designer. After all, I was wearing that hat too. The concept is simple.

Treat the system as a tool, making that tool so easy to use, and so flexible, that the designer keeps every option at his/her fingertips. The implementation of this concept in a real product required the totally independent control of 1,800 circuits in combination with a modular design scheme allowing considerable expansion. There's no reason to limit everyone to 1,800 circuits.

Obviously the standard practice of sending a separate pair of wires from some controller to each of the circuits was out. A fortune in cable not to mention the impossible task of installation made that solution laughable. Fortunately though, through the magic of electronics it's possible to send all these signals over ten pairs of low voltage control lines. This is accomplished by multiplexing. That is, each of a large number of signals must wait its turn to be transmitted over the control lines. The signals for eight circuits can be sent in less than a microsecond, (one millionth of a second), and stored near the device being controlled.

This makes it possible to update 8,000,000 circuits in a single second or, more practically, to update nearly 67,000 circuits once during each half cycle of the sixty cycle power line. A more sophisticated multiplexer design could increase this considerably, but for most applications that's not required.

Thus attained our goal of flexibility by allowing each element in the system a unique independent control channel. We also created an economical and practical means of transferring the large amounts of data required. This of course requires that a tremendous amount of information be generated. To update 1,800 lamps once each half cycle, (120 times each second), requires 216,000 decisions be made every second. Each decision must take into account a number of factors: the system must analyse the music, keep track of pattern sequences, in some cases generate pattern sequences from the music, and manipulate all these options according to instructions from the operator. Certainly this requires something more than the standard controllers commonly used today. These requirements are met by the stored program digital computer.

This in itself is probably the most versatile tool yet developed by man. The term "computer" has been abused in our industry. It is commonly used to describe any piece of electronic equipment that uses digital circuitry — from simple chasers and color organs on up. The computer to which I refer is a true, stored program digital computer. It is capable of performing diverse tasks from complete bookkeeping and general ledger systems to playing games such as blackjack and startrek. It is by taking full advantage of the capabilities of such a tool that the flexibility of this overall control system is attained.

At this point in the game the patch panel becomes totally obsolete. It is no longer necessary for lamps be grouped and regrouped for specific effects via such a slow and cumbersome means. It becomes a simple matter of telling the computer which lamps you wish to as-

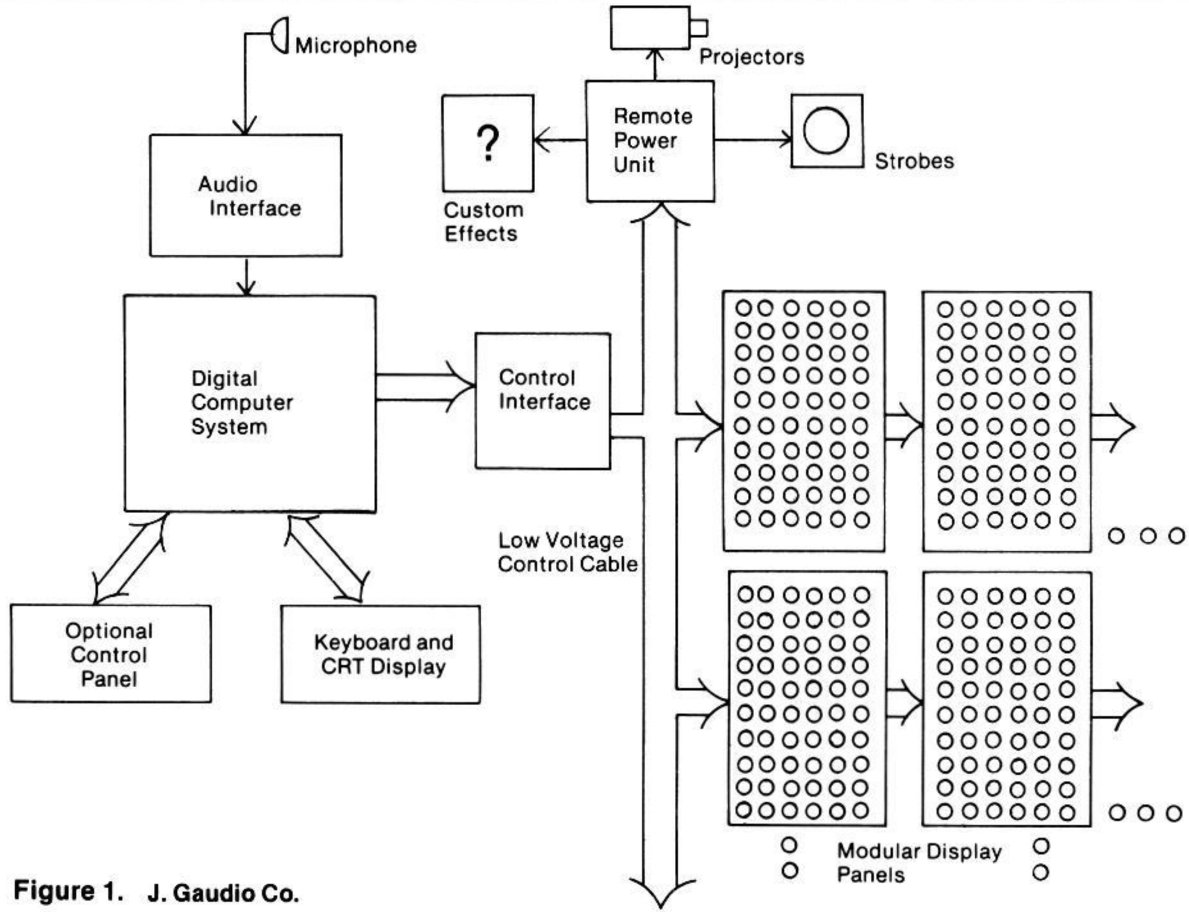


Figure 1. J. Gaudio Co.

sociate with a given group. The computer then stores this information along with that of all other groups you might wish to use. This is done in such a way that the information can be recalled and used to implement a pattern in just a few thousandths of a second. If new groups (a group simply defines a pattern when controlling lamps) are needed, it's a simple matter to store the required data in the system. These patterns are then manipulated by sets of instructions stored in the computer. These instructions constitute the programs or software of the system. It is the computer's ability to interpret these programs in combining with the lighting, the designer's ability to create and modify a literally unlimited number of programs, along with a scheme to independently control every element in the system that allows this great flexibility. A block diagram of the system is shown in Figure 1.

The first display to use such a system in the discotheque was of the scoreboard type, covering some sixty feet of the north wall in a Colorado club called Orville's Hangar. This display is nearly eight feet tall and consists of 600 lighting units (see photo page 39). Each lighting unit contains three lamps in the primary colors, along with a means of mixing the light from these lamps to yield the remaining colors. This requires a total of 1,800 lamps, each of which is independently controlled by a microprocessor-based digital computer. The operator simply selects a single number and one of the many programs is immediately implemented. By playing the typewriter-like keyboard as if it were an organ, with each stroke a whole new set of patterns appears.

These are just a few of the rudimentary functions of the system, all of which can be taught to a new operator in less than ten minutes. The experienced operator — anyone who has worked with the system for a few days — can specify hundreds of options to control speed, color, and pattern type within a given program, and can combine up to three such programs yielding any of several million possible displays. With a few days of diligent training and some practice, the advanced operator can reprogram the presets and create simple animation effects from the console. Finally the expert creates totally new software allowing him control of every element in the system. The expert is also able to add new equipment such as strobes, projectors, and additional panels due to the system's modular design.

John Gaudio holds a B.S. in Electrical Engineering from the University of Colorado. Since that time he has designed and manufactured the modular microprocessor-based lighting control system discussed in the article, and acted as a consulting engineer and software engineering on several other projects. He can be contacted at: J. Gaudio Company, P.O. Box 1901, Greeley, Colorado 80632.

An example: Shortly after Orville's opened in 1977, the owner asked that I implement a chaser around the display. The standard approach to this problem would have required 136 feet of chaser-strips, a controller, wiring, mounting, and painting. The cost for such an effect would have been in excess of $1,000. With only ten hours of programming, and at a cost of only $250 for the programmer's time, a five channel, multi-colored reversing chaser was created. The outermost ring of lighting units served as display, both color and direction were determined by the music, and the owner was delighted. It is this sort of flexibility that allows a lighting designer the freedom not available with any other lighting method. □