13.1/9:00 A.M.: An Outdoor Large Screen Color Display System

Koichiro Kurahashi, Kikuji Yagishita, Nobuo Fukushima and Hiroo Kobayashi
Mitsubishi Electric Corporation, Tokyo, Japan

Introduction

A large screen color display system, named "Diamond Vision", has been developed. The display screen consists of a matrix array of small,high brightness light emitting tubes and can present sharp color pictures even in full daylight.

There has been installed many video display systems for various outdoor video services such as in sports stadiums,racetracks,or advertizing media. These previous systems consist of an array of incandescent lamps,and have some problems especially in displaying color pictures such as insufficient color quality,high power consumption etc.

To overcome these problems,we have developed light emitting tubes. And arranging these tubes in matrix array,a display system capable to present natural color pictures with low power consumption has been realized.

Description of the system

The system configuration is shown in Fig.1. The function of the system are,for example in sports stadiums,introduction of players, instant replay of big plays,cheering and/or advertizing. Various video equipment and message generators are deviced for these purpose. The display screen consists of a matrix array of the light emitting tubes.

(1) Light emitting tube

New light emitting tubes are developed for specific application to the Diamond Vision. The light emitting tube is a flood-beam CRT having a single phosphor of R,G or B for each tube. The envelope of the tube is a colored glass bulb to maintain the contrast under high incident light flux. Each tube works as a single picture element whose color is one of three primary colors, R,G or B.

The developed light emitting tubes have the chracteristics shown in Table 1,and best suit to outdoor color displays. Features are;

(i) high brightness ensures sharp pictures even in full daylight,

(ii) high luminous efficiency; each tube consumes only about 2 watts,

(iii) chromaticity coordinates are the same as color picture tube,yielding natural color,

(iv) fast response ensures 60-field/sec operation,

(v) long operating life more than 8K hours.

(2) Arrangement pattern of tubes

For improving picture quality for the display screen of limited number of tubes, the arrangement pattern of Fig.2 is introduced. From the result of evaluation of the picture quality using simulated pictures of various arrangement patterns and small screen working models, the pattern of Fig.2 is found best concerning the picture sharpness and the color mixing. The sharpness perception in human vision much depends on green component. For the R-G-B-G quadruple pattern of Fig.2 in which the ratio of G tubes to R and B tubes is 2:1:1,the density of G tubes is more than that of conventional R-G-B triplet pattern,and the sharpness is improved.

The pattern of Fig.2 has another merit concerning the brightness. The maximum obtainable brightness of each tubes in producing "white" is the lowest for G tube,R and B tubes have margins in thier maximum brightness. So by increasing the ratio of G tubes to R and B tubes ,it is expected to increase the maximum brightness of white peak up to the brightness which would be limited by the maximum brightness of R or B tube.

(3) Displaying gray levels(ref.)

For obtaining gray levels, the Diamond Vision uses the time modulation method, in which each tube is associated with 1 bit memory and operated in on-off mode. And on-time duration is controlled to be proportional to the video signal amplitude,thus the average brightness of the tube is proportional to the signal amplitude.

Input video signal is color-demodulated to generate three color-video signals. Each color-video signal is then sampled,binary coded and stored in frame menory. The addresses of the frame memory uniquely correspond to the location of the tubes in the matrix array. A controller reads the coded signals from the frame memory repeatedly in the sequence given for controlling gray levels, and tests the condition whether on or off pulse is to be generated to the corresponding tubes. By scanning the entire frame memory and distributing on or off pulses to the tubes,color video picture with gray levels are reproduced.

With the method, it is easy to extend the on-time duration of the tube to full field period for maximum signal amplitude, the tube may be fully in on-state enabling the full use of the luminous output of the tube.

Fast respose of the tube ensures the accurate operation and 32 levels are realized.

(4) Screen size, viewing distance

The Diamond Vision is designed for use in open spaces,so preferable viewing distance is between 75-200m. Over 75m,color mixing is expected and color dots composed by tubes do not distract picture quality.

Standard screen sizes are illustrated in Fig.3,ranging from 5.8m*8.7m to 11.6m*17.3m.

Number of tubes is,for example,160*240 (=38,400) for 7.2m*10.8m screen.

Conclusion

The first system has been installed at the Dodger Stadium in Los Angeles.(Fig.4) Sharp pictures and sophisticated video programming have been very attractive to many audiences.

Acknowledgement: Development of the Diamond Vision is due to many people who have enguaged in development project. The authors express thier thanks to project members, and also to people who have supported the project.

Reference: K.Kurahashi et al,"Plasma Display with Gray Scale",1973 SID Symposium, 7-2, May,1973,New York.

Type Size	Flood-beam CRT 28.6mm$^{\Phi}$*132mm		
	R	G	B
Phosphor	Y_2O_2S:Eu	Gd_2O_2S:Tb	ZnS:Ag
Brightness (nit)	4,200	8,000	1,700
Chrom.coor. (CIE) x y	0.61 0.35	0.31 0.59	0.15 0.06

Table 1: Light emitting tube

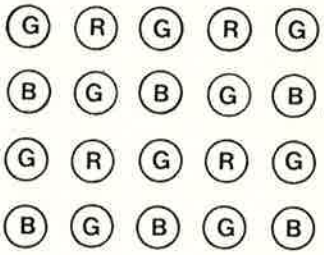

Fig.2: Arrangement pattern of tubes

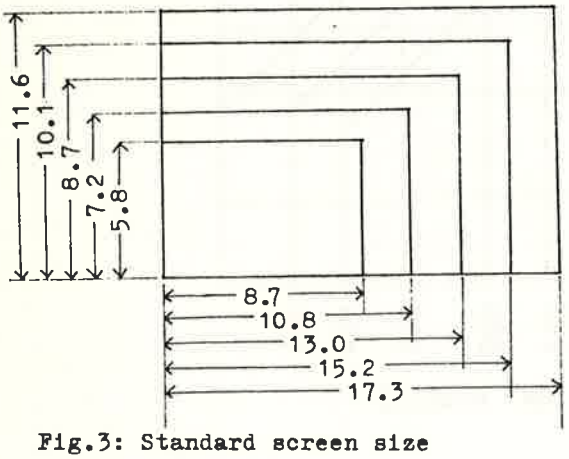

Fig.3: Standard screen size

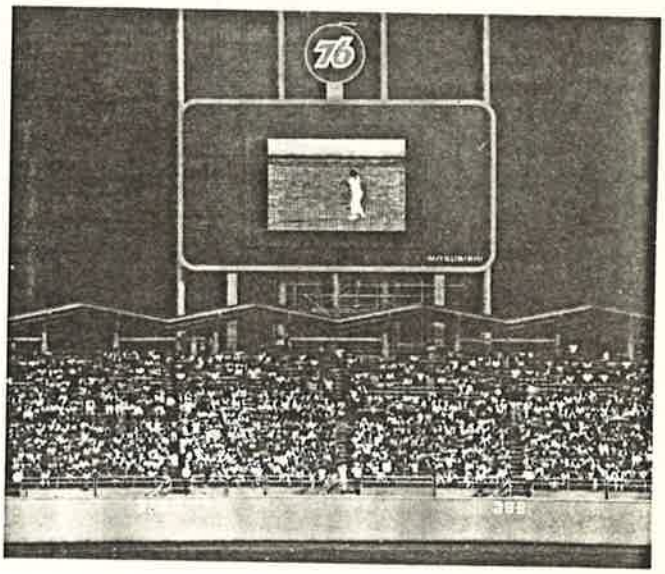

Fig.4: Diamond Vision installed at Dodger Stadium

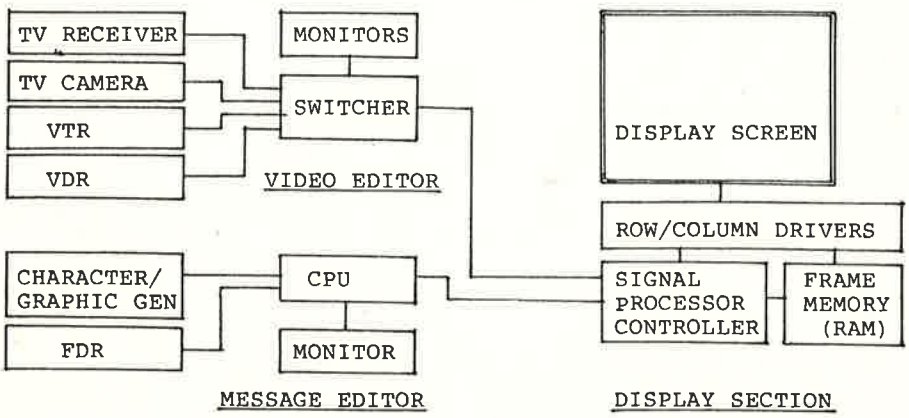

Fig.1: Simplified diagram of Diamond Vision