Reduction Of Flickering In Moving Message LED Display Boards.

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Abstract

The main problem observed in LED display boards is flickering. The types of display boards present are multiplexing and non multiplexing display boards. This paper gives various causes for flickering due to persistence of vision and various parameters like refresh period, scroll delay, intensity level of leds and many other factors .In this paper there are some conclusions that are derived based on testing of different types of display boards with different intensity levels, scroll delays and refresh periods. Based on the observations in each case we derived a range of scroll delays for a particular refresh rate in order to reduce flickering both for multiplexing and non multiplexing display boards.

Key words: Flickering, eliminating ghost image effect , Spectral luminous efficiency, scroll delay, refresh period ,intensity of led display boards.

I.Introduction

Theoretical study for the reduction of flickering in LED displays:

Basically leds in displays flicker due to many reasons and effects. Eyes consist of rods and cones. L cone--red, M cone--green, S cone--blue Cones are sensitive to relatively narrow wavelengths (recognise colour) For rods the sensitivity is high but they don't discriminate wavelength. Each type of cell integrates signal differently. Rod receptors capable of detecting single photon ,with time constant of 200msec in mammals .Cones have much better time resolution than rods do.

CFF:(critical flicker frequency)

Critical rate above which the flicker ceases.For both rod- and cone-mediated vision, the fusion frequency increases as a function of illumination intensity, until it reaches a plateau corresponding to the maximum time resolution for each type of vision. Rod mediated vision reaches a plateau at 15Hz. cone mediated vision reaches a plateau at 60Hz..

Spectral luminous efficiency: (K_λ)

Differs for rods (scotopic vision) and cones (photopic vision) K_λ for photopic vision as 683 lumens/watt at 555 nm**.** $K_\lambda = K_m V_\lambda$ **,**where $K_m = 683$ lm/W **,**V_λ = the value of the photopic spectral luminous efficiency function for that wavelength

For scotopic vision, spectral luminous efficacy is denoted by K'_λ, and can be calculated using the following equation

$K'_\lambda = K'_m V'_\lambda$ Where $K'_m = 1700$ lm/W at 510 nm

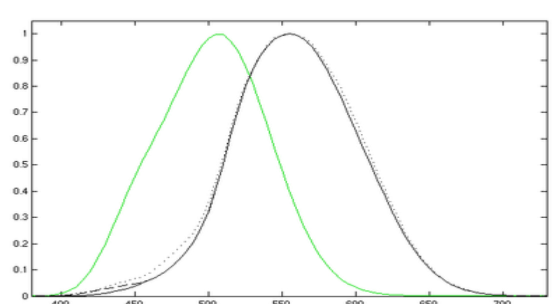


Fig:Variations in spectral response at wavelengths greater than 400 nm under various conditions

II.Flicker:

Light flicker refers to quick, repeated changes in light intensity. Some of the laws related to flicker fusion frequency are as follows

THE FERRY-PORTER LAW:

According to the Ferry-Porter law, the CFF (critical flicker fusion) is a linear function of the logarithm of the source luminance , I.

CFF = A log (I) + B

Where A and B are constants.

The Ferry-Porter law indicates that the higher the light intensity is, the higher the CFF.

Factors affecting CFF

Retinal Position:

Since the CFF is different for rod and cones, the CFF for the test field will depend on the proportion of rods and cones being stimulated. Because the proportion of rod and cones change with eccentricity.

Note that the Ferry-Porter Law applies over a decreasing range as the eccentricity increases and that temporal resolution is poorer for eccentric locations .

figure shows the distribution of rods and cones in the retina. This data was prepared from histological sections made on human eyes.

Notice that the fovea is rod-free and has a very high density of cones.

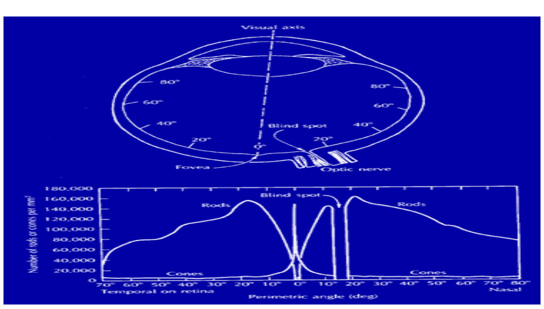


Fig: Variations in spectral response at wavelengths greater than 400 nm under various conditions

The Talbot-Plateau Law describes the brightness of an intermittent light source which has a frequency above the CFF. This law states that above CFF, subjectively fused intermittent light and objectively steady light.

The Brücke-Bartley (brightness enhancement) effect is a phenomenon related to the Broca-Sulzer effect. When the frequency is gradually lowered below the CFF, the effective brightness of the test field begins to rise.

For a 50% Duty cycle and 100% Modulation depth the observation are as follows:

Flicker was directly visible at frequencies of 60 Hz and lower, and was invisible at frequencies of 100 Hz or higher.

Indirect perception of flicker through stroboscopic effects was strongest when waving one's hand underneath the luminaire, where multiple finger patterns were strongly evident to most people, even at 300 Hz

Mitigation of stroboscopic effects can be accomplished through decreasing modulation depth, by ensuring that light sources do not switch entirely off when they flicker. Avoiding low duty cycles near 10% may help prevent visual discomfort.

Piéron's Law:

This law states that mean response times (MRT) decrease as a power law with increasing stimulus intensity I

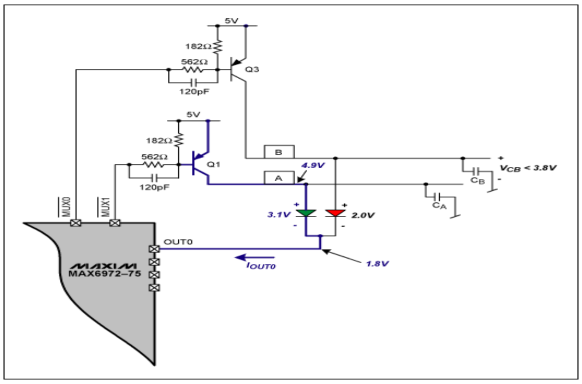
MRT = $\alpha I^{-\beta} + \gamma$.

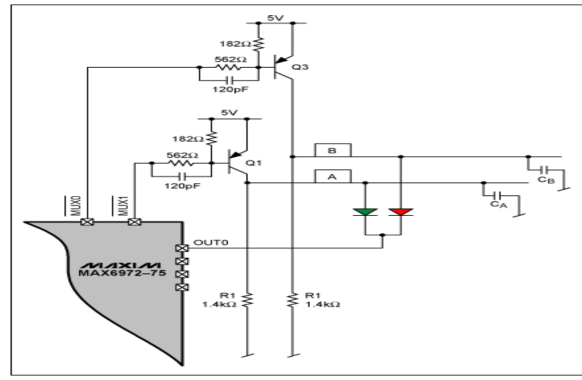
Here α and β are scaling parameters that determine the slope of the function and γ is an intercept.

III.Ghost image effect:

An afterimage or ghost image or image burn-in is an optical illusion that refers to an image continuing to appear in one's vision after the exposure to the original image has ceased.

However, improperly designed LED-multiplexing circuits can create ghost images. Ghost images result when parasitic current flows through LEDs that are intended to be in an off state.





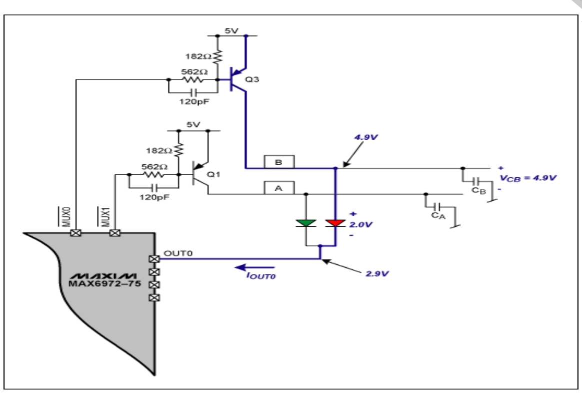
For example consider a circuit:

Faint ghosting images from parasitic currents can occur when the multiplexing changes phases from MUX0-bar to MUX1-bar and vice versa.

In the following examples, a red LED is driven by MUX0-bar through Q3 and a green LED is driven by MUX1-bar through Q1.

The voltage VCB on the parasitic node capacitance remains at 4.9V since there is no discharge path.

When Phase 1 begins, MUX1-bar is asserted low, Q1 turns on, the anode of the green LED is connected to 5V, and the OUT0 current driver is activated for the selected LED



Eliminating Ghost-Image Currents:

The ghost-image currents can be eliminated by providing a discharge path for the parasitic node capacitances and providing a time for the discharge to occur. This is accomplished by adding resistors R1 and R2

IV.PRACTICAL OBSERVATION TO REDUCE FICKERING IN MOVING MESSAGE LED DISPLAY BOARDS

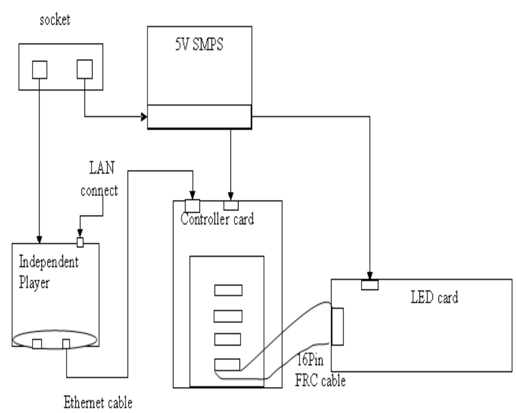
Testing to observe the scrolling display with different intensities and colour brightnesses:

- Tested the non multiplexing white LED display board with varying intensities and scroll speeds. Flickering was observed at low scrolling speeds of the range 40-30msec.
- Flickering was not observed at the speeds of 30-18msec.But beyond 18 msec the scroll speed is too fast to read the message.
- To observe the flickering in scrolling message display, we need to vary the parameters like intensity of the scrolling message ,scrolling speed ,refresh rate, multiplexing number etc.
- We can vary the display intensity and refresh rate using TX software.
- The set up required to test with this software are:

1.5V SMPS

2.Independent player
3.Controller card
4.LED display card
5.16 pin FRC cable
6.Ethernet cable
7.LAN connection to independent player

SET UP FOR TESTING WITH TX SOFTWARE



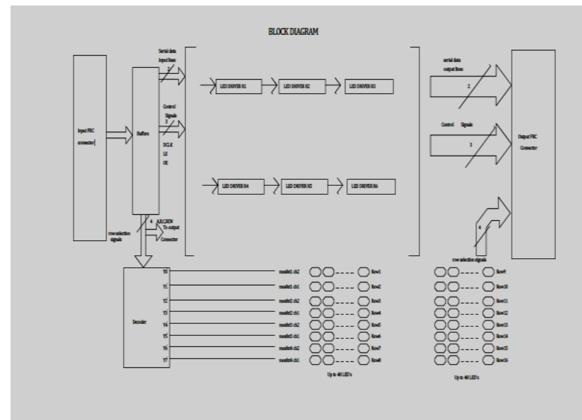
Procedure:

1. Firstly we need to arrange the setup with all the connections properly done.
2. Then switch on the power supply and establish he communication between our system and the independent player.
3. Then load the project file and open it.If the communication is properly present then the project file will be loaded to the display card.
4. We can vary the refresh rate and colour brightness.
5. The background and text message can be entered using the PC manager.
6. Upon testing the scrolling message with various intensities and refresh rate ,I observed that there was no flickering present at all the intensities and refresh rates because the scrolling speed was constant.
7. So , we need a code to display a scrolling text on the display board with varying scroll speed,varying intensity and varying refresh rate.
8. Also recorded the scrolling messages with different intensities in a camera to observe the difference in viewing with naked eye and by seeing the recorded display.
9. We can observe reflection of light of the letters of high intensity when they are recorded.

We can't vary the scroll speeds and refresh rates using TX software so we need to develope a code to display a scrolling text for testing.The controller used is LPC2368 and it is used for the LED card 1318.

To know the connections between the controller and the LED card, analyzed the schematics of 1318 LED card and 936M controller card and traced out the connection between the two.

Basic block diagram of 1318 LED card:



The 26 to 16 pin FRC cable is used to connect the LED card and the controller card.
The 16 pins of led I/P connector are connected to the last 16 pins of the controller card using the FRC cable.
We can achieve the varying scroll speed using the Timers.
Then started testing the LED card(1318) for different combinations of intensities, scroll delays and refresh periods
Setup Required:

1) LED card 1318

2) General purpose controller 936M

3) 5 V SMPS

4) 232 cable

5) Keil software

Procedure for testing the multiplexing board:

Firstly we need to check whether the 232 cable is working or not by using the TALK software tool. After that we need to connect the cable to the communication port of the computer and the other end is connected to the controller card where a slot is provided for it. Then connect the power supply to the LED card and the controller card, also connect the LED card and the controller card using the 16 to 16 pin FRC cable. Then switch on the power supply and take the controller to ISP (in system programming) by grounding the pin of the controller which is for ISP purpose. In ISP mode dump the code into the controller and then press reset button. Now the code is dumped into the controller and hence the message is transferred onto the display board. Then modify the intensity, refresh period and scroll delays in the code and the again dump the code in controller and noted down the observations. Continued this procedure for various combinations of intensities, refresh periods and scroll delays. Noted all the observations. Also recorded the display for various parameters in a camera. After completing the testing , prepared a report on it and compared the theoretical laws and practical results.

Conclusions from testing:

1) From the testing of LED display board with different intensities, scroll delays and refresh periods we can conclude as below:

Refresh rate(msec)	scroll delay for any intensity(msec)
1	30-40
0.5	16-32

For a refresh period of about 1msec the message seem to be distorted in some cases whereas for a refresh period of 0.5 msec the distortion of message is reduced. For a refresh rate of 0.135 the leds appear as a continuous line. But for the above mentioned range of scroll delays there is smooth scrolling,message is readable and there is no flicker.

2) As the intensity increases the flickering increases even for a less scroll delay (i.e...higher frequency) so the FERRY PORTER'S law has been proved)

3) As per the studies the human flicker fusion threshold is 62.5msec(flash duration) which is also proved to be correct because in any case for a scroll delay of above 60msec the human eye can detect the flickering.

4) Pieron's law is also satisfied because as the intensity increases the time taken to respond decreases, clarity of the message increases and is clearly visible over a distance than compared to lower intensities.

Then tested non multiplexing boards with the existing code. Tested the white LED card with different intensities ,scroll delays and refresh periods. The text and intensities can be varied using Arm Display software tool for this code.

Set up required:

1)LED card 1289

2)1769 controller card

3)5 V SMPS

4)232 cable

5)16 to 16 pin FRC cable

6)Keil software

7)Arm Display software

Procedure for testing the non multiplexing board:

Firstly we need to check whether the 232 cable is working or not by using the TALK software tool. After that we need to connect the cable to the communication port of the computer and the other end is connected to the controller card where a slot is provided for it. Then connect the power supply to the LED card and the controller card, also connect the LED card and the controller card using the 16 to 16 pin FRC cable. Then switch on the power supply and take the controller to ISP (in system programming) by grounding the pin of the controller which is for ISP purpose. In ISP mode dump the code into the controller and then press reset button. Now the code is dumped into the controller and then enter the text in Arm Display software. The intensity can be varied using this software itself and the scroll speeds should be varied in the code .Repeat this procedure for various combinations of intensities, refresh periods and scroll delays.

Conclusions from testing:

REFRESH RATE(msec)	SCROLL DELAY(msec)
16	6 to 4
14	10 to 8
12	10 to 8
10	10 to 8
8	12 to 10
6	18 to 12
4	26 to 18
2	48 to 32

From this we can conclude that as the refresh period decreases the scroll delay increases for which there is a smooth scrolling display. There is no flickering observed for the above refresh rates in corresponding range of scroll delays.

V.References:

[1] www.yorku.ca/eye/blochlaw.htm

[2]en.wikipedia.org/wiki/Luminous_efficacy

[3]Critical Flicker-fusion Frequency in Man :Daniel P. Bobon, Helmut Ott, H. Holmberg

[4]neuronresearch.net/vision/files/photopiceffic.htm

[5]ec.eepw.com.cn/mfmember/download/userid/28/id/743

[6]Adler's Physiology of the Eye :Paul Leon Kaufman, Leonard A. Levin, Albert Alm, M.D., Siv F. E. Nilsson, James Ver Hoeve

[7]webvision.med.utah.edu/book/part-viii-gabac.../temporal-resolution/

[8]hyperphysics.phy-astr.gsu.edu/hbase/vision/retina.htm

[9]www.ncbi.nlm.nih.gov › Journal List › J Physiol › v.160(2); Feb 1962

[10]www.grandwell.com/viewing_angle_brightness.php

[11]tomstafford.staff.shef.ac.uk/docs/css09_stafford.pp