Study on MLCD System Architecture and Picture Quality Improvement

Hao Xing*, Xiaolong Chen, Yixuan Lin, Jianjiao Wang, Kai Wang, Yu Wu
*** Shenzhen TCL China Star Optoelectronics Technology Co., Ltd, Guangdong, China**

Abstract

With the development of display technologies, the demand for super-sized displays is strong increased. To meet the requirement of super-sized display, the video wall, which can be roughly divided into LCD splicing and MLED splicing, is usually used. For LCD video wall, there are black edges and seams. For MLED splicing, the pitch is large, and cost is high.

We combine the LCD and MLED display to form a whole display called MLCD. Compare to the common LCD/MLED splicing display, MLCD can meet the requirement of super-sized display, and without the grid-shaped black edge at the same time. Furthermore, in order to improve picture quality, we developed some key technologies to avoid non-alignment and tearing.

Author Keywords

MLED, MLCD, video wall, grid-shaped black edge

Introduction

To release information at public area, like airport, shopping mall, even meeting room and lecture theatre, larger and larger size displays are required. While the largest LCD display is 115'' because of the limitation of producing equipment. To solve the contradiction of the requirement and technology, brand manufacturers usually produce video wall, which is composed by several displays to form a single one, to meet the command of large size display.

There are two different directions of video wall: composed by LCD displays and by MLED displays. For LCD video wall, the total cost is quite low, but because of the BM of LCD, there are grid-shaped black edges. Now the minimum of BM may 0.6mm, even less, but never can be eliminated. In this way, the whole picture is cut into several parts, as shown in Fig1. For MLED video wall, it consists of standard small MLED blocks, and the pitch between pixel in or out of the block is the same. In this way, the whole picture on the screen is not been torn, as shown in Fig2. While, now the most products of MLED is P0.9~P1.25, which is much larger than LCD display(< 0.5mm). And the product is much more expensive than LCD display as well.

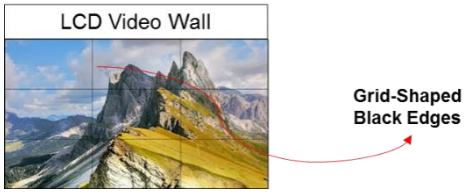

Fig1. 3x3 LCD Video Wall

Fig2. MLED Video Wall

To respond the trend of super-sized displays, CSOT proposed a method for video wall, which uses the LCD and MLED for hybrid splicing. The advantages of the LCD and MLED are taken into consideration to form a video wall with high image quality, low cost, and zero stitching. Actually, the product has been already produced by CSOT, named MLCD.

MLCD System Architecture

The MLCD is displayed in a mixed mode with the LCD and MLED. The MLED display is attached on the LCD border, so that there is no stitching. In order to display the complete picture on the MLED and LCD display at the same time, a video splicing system is used to properly split and cut the input content. Also, it aligns the content to the LCD and MLED displays without miss or loss. Meanwhile, the output signals of the LCD and MLED displays are processed synchronously to ensure that the dynamic picture is not torn.

As shown in Fig. 3, to divide the input signal into LCD and

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MLED display, the video splicing system is used to cut and align the content. Meanwhile, it also can improve the picture quality by CSOT algorithms, and sync the output signals from different displays.

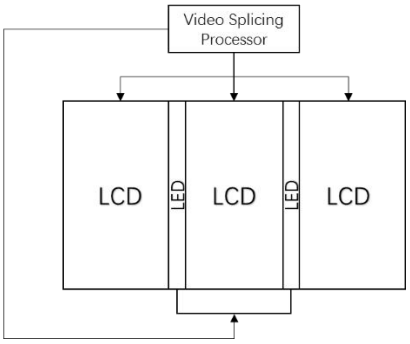

Fig.3 MLCD System

Screen Matching

The MLCD is displayed by splicing multiple display blocks, and the MLED display covers part of the LCD display. Therefore, a proper calculation method is required to cut the input image properly and put it on the corresponding display screen. Importantly, the images at the splicing edge must be aligned properly and continuously. As shown in Figure 4, the display area is divided into several parts: the green part indicates the MLED display W, the slashed part indicates the part X of the LCD AA area covered by the MLED, and the blue part indicates the LCD screen which the resolution is H x V.

Take the UD LCD as an example, as shown in Figure 4, if the width of the MLED is 40-column Pixels, and the part covering the AA area is 5-column Pixels, the overall resolution of the video wall is as below:

【(3840*2+40)-(5*2)】*2160=7710*2160.

Furthermore, it can be noticed that some active area of LCD is covered by MLED. In order to keep the whole picture continuously, the picture data need to be repeated on the area covered by MLED display.

In another case, as shown in Fig 5, when LCD is vertical placed, the data input direction is 90 degrees to the picture showed on MLCD. So, it is necessary to rotate the input data pattern to keep the whole picture in the right way.

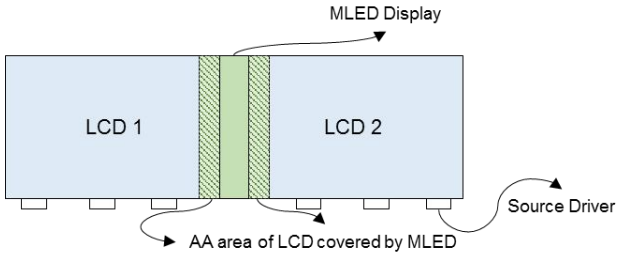

Fig.4 MLED Display is 40(RGB) pixels, LCD1 & LCD2 is 3840*2160(RGB) pixels, LCDs are covered 5(RGB) pixels by MLED

Synchronization

LCD and MLED are different emitting materials. As shown in Fig.3, there are usually 2 frames delay on MLED display, while it is 0 frame on LCD display. As a result, when moving pattern displayed on the video wall, it will be torn.

Fig.5 Synchronization for MLED and LCD

Furthermore, the driving method of LCD and MLED is different. As shown in Fig.4, LCD is active matrix driving from the opposite side of source driver to source driver [2]. From the 1st line to the last line, it takes 8.3ms(120Hz). But MLED is PWM driving, and the display is divided in to several sections. All sections scan at the same time, and takes 0.52ms(1920Hz) from the 1st line to the last line.

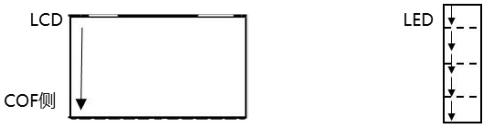

Fig.6 Scanning Method for MLED and LCD

For example, when water droplet drops from the top the display, the picture is torn because the MLED display is delayed to LCD, as shown in Fig.7. For another instance, when the picture changes from white to black, the MLED is black at the changing moment, as shown in Fig.7.

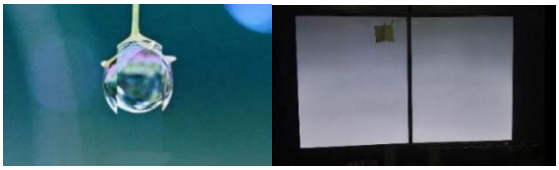

Fig.7 The picture is torn or not sync because of MLED delayed to LCD

In order to keep the MLCD display fluently and without tearing, we need to adjust the data output timing between MLED and LCD displays. As shown in Fig8, for vertical splicing, the scan direction of LCD is perpendicular to the MLED display. At this time, the MLED on the right side and LCD splicing parts are basically scanned at the same time. In this case, the left LED scanning finished at the start of a frame, while the LCD finished at the end of frame, which means one frame delay of LCD and LED display. Considering both scanning direction and driver method, we advanced the left LED by 1 frame and the right LED 2 frames in video splicing system. In this way, picture synchronization is achieved without tearing.

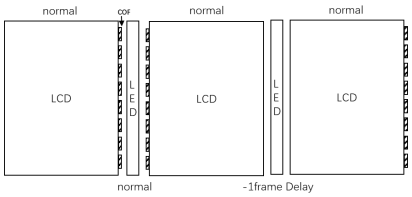

Fig.8 Synchronization for MLCD

Results

In the past, MLED video wall is the only choice for none stitching super-sized display, people have to suffer high cost, heavy load and none-health displays. MLCD Star Display, make it possible that LCD can display super-sized display without grid-shaped black edges. As well as the cost is much lower than MLED video display.

Picture Quality Advantages

On MLCD, there is no stitching, no black border, continuous picture, and no breakage or tearing. Furthermore, LCD and MLED are two different light emitting media, and their display effects are different. However, by CSOT algorithm, the difference between the materials can be reduced apparently, which achieves E2000[1]<0.5.

Demonstration

CSOT has already produced the Star Display with 1x2 156'' 32:9 display, and 1x3 150'' 16:9(almost) display. Furthermore, a new format 1x2 130'' 16:9 will be exhibited in Y2025 Q1.

Fig.9 1x2 156'' MLCD Display

Fig.10 1x3 150'' MLCD Display

Reference

[1] CIE Technical Report: Improvement to Industrial Colour-difference Evaluation. CIE Pub No 142 — 2001 ［R］. Vienna，Austria: Central Bureau of the CIE，2001.

[2] Qungang Ma, "TFT-LCD 原理与设计"，Publishing House of Electronics Industry, 2011-9