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Introduction

The main objective of this book is to present methods to drive a liquid crystal display (LCD). Chapter 2 is devoted to introducing the device itself. Starting with the basics of matrix addressing, the chapter prepares the reader by introducing fonts and formats, liquid crystals and some electro-optic effects. It is by no means complete and the goal is to give a flavour of electro-optic effects and display devices that need to be addressed using the knowledge gained from this book. Addressing techniques are reviewed in Chapter 3, starting with a discussion of the need for nonlinear elements for matrix addressing, the cross-talk in a matrix LCD and the need for direct current (DC) free waveforms across pixels in an LCD. Chapter 3 also provides a historical perspective of methods to drive an LCD and points out some problems and limitations of matrix addressing.

Addressing techniques presented in this book are broadly classified into three major divisions. Chapters 4 to 12 are devoted to multiline addressing, Chapters 13 to 17 discuss methods to display grey shades and Chapters 18 to 20 introduce methods to drive displays with short response times.

Chapter 4 introduces the binary addressing technique, which departs from the conventional approach of selecting one address line at a time. The binary addressing technique is based on Rademacher functions, an orthogonal function. Chapter 5 introduces orthogonal functions and the role of orthogonal functions in multiplexing and matrix addressing. The active addressing technique, a direct application of compact orthogonal functions, like Walsh functions and Hadamard matrices to select all rows in a matrix LCD, is presented in Chapter 6. Active addressing can multiplex a large number of address lines but demands a large number of voltages in the addressing waveforms and a new architecture that integrates frame buffer memory with column signal generator. Hybrid addressing techniques are presented in Chapters 7 to 12. The improved hybrid addressing technique presented in Chapter 8 is the first multiline addressing to overcome all the limitations of the binary addressing technique. It is the most general method used to drive the matrix LCD and all other addressing techniques can be viewed as a special case of the improved hybrid addressing technique. The sequency addressing technique presented in Chapter 11 is also a hybrid addressing technique that uses compact orthogonal functions to select a few address lines. Selecting all rows simultaneously is useful in restricted pattern addressing as described in Chapter 12.

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Chapter 13 provides a review of methods to display grey scales. The number of voltage data waveforms is proportional to the number of grey shades in the case of amplitude modulation presented in Chapter 14. Amplitude modulation serves as a reference to compare other grey scale methods but it is too complex to implement along with multiline addressing. On the other hand, the successive approximation method discussed in Chapter 15 needs simple drivers and the number of time intervals is proportional to the logarithm of the number of grey scales. The successive approximation method does not increase the driver circuit in combination with line-by-line as well as multiline addressing. The cross-pairing method of Chapter 16 takes less time intervals to display grey scales as compared to the successive approximation method and is easy to implement in combination with line-by-line addressing. The cross-pairing method is difficult to implement with multiline addressing. Line-by-line and multiline versions of wavelet-based addressing techniques are introduced in Chapter 17.

Bit slice addressing, multibit slice addressing and micro pulse width modulation are discussed in Chapters 18 to 20 respectively. Micro pulse width modulation is especially useful in reducing power consumption of backlight without sacrificing image quality when displays have a short response time in the range of 100 μ s. Bit slice addressing as well as micro pulse width modulation are useful to display grey scales with fast bistable displays like the digital micro mirror device and ferroelectric LCD.

Chapter 21 compares all the addressing techniques to help a designer choose an appropriate addressing technique for an application. Chapter 22 focuses on reducing power dissipation in drivers whereas Chapter 23 illustrates methods to save power consumption of backlights in an LCD. Chapter 24 is devoted to describe drivers for the LCD. Methods to combine passive and active matrix addressing and a few suggestions to cope with the ever increasing demand on resolution and size of matrix displays are presented in Chapter 25.

Most of the effort in this book has been directed towards providing information that cannot be found in other books on addressing liquid crystal displays. An in-depth analysis of hybrid addressing makes no assumptions (not even the orthogonal nature of Rademacher functions) and cannot be found elsewhere. The book is full of tables, figures and examples of benefit to those who would like to skip the analysis.