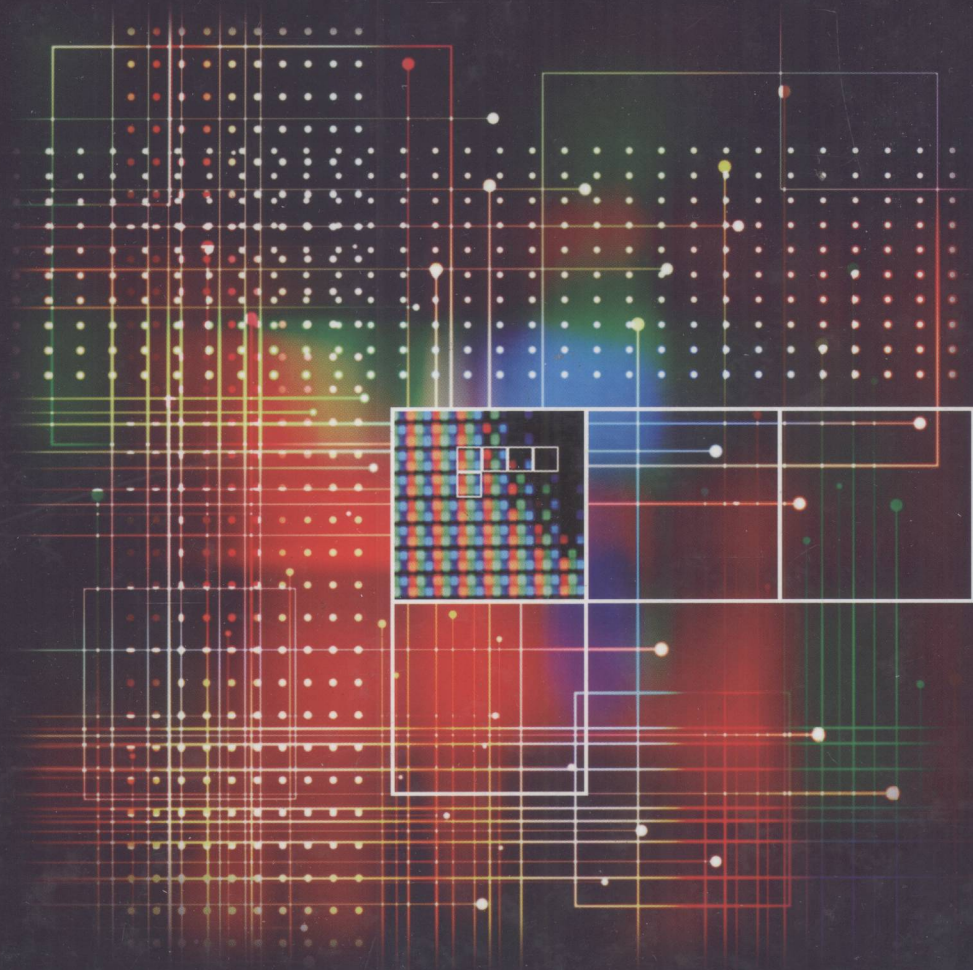


Mobile Displays

Technology and Applications

Edited by

Achintya K. Bhowmik | Zili Li | Philip J. Bos



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Series Editor's Foreword

A transformation is taking place. Hitherto, mobile displays were regarded as the poor cousins of larger, higher resolution, faster, wider color gamut monitor and TV displays, being smaller, with lower resolution, slower response times, narrower viewing angles and less saturated colors. Now, with the advent of high bandwidth mobile communications, innovative low energy ICs (often developed specifically for mobile applications) and new architecture and display developments, the world is changing. Mobile devices are increasingly becoming the drivers of new product opportunities. One might argue that this transformation is already well underway; mobile phones now combine telephony with still and video photography, touch, email and TV. In our increasingly mobile-centric world, customers in growing numbers now expect that all information — telephony, text, email, audio, radio, TV and video — should not just be accessible on mobile devices, but should be accessible at high audio and visual quality. That is the demand. Satisfying it will be far from easy, but such is the scale of research, development and product introduction that changes are now taking place and will accelerate.

A large measure of enthusiasm is required to push developments into new product opportunities. This can sometimes lead to an overstatement of opportunities and, of course, the manipulation of product specifications is as rife in this highly competitive market as in others, so it is important that a book such as this presents a rational discussion of the visual requirements and the limitations of the often small displays used in mobile devices in terms of pixel density, luminance or reflectance, dynamic range and gray level capabilities; Chapter 2 does this elegantly. There follow chapters which describe how liquid crystal, viewing angle control and backlight technologies, developed primarily for non-mobile applications are being adapted and optimized for the mobile market. Then the extent to which the mobile market is increasingly driving its own developments begins to become apparent, with chapters on low power electronics, mobile-specific serial interface architectures and innovative pixel designs which can reduce pixel count requirements whilst maintaining display legibility. Note that two serial interface architectures are described. There is competition here as well as between different display technologies. Indeed, one might speculate that serial interfaces developed for low power consumption, low connection cost and mechanical flexibility might begin to find application in the increasingly cost and power conscious non-mobile markets. A chapter on the use of polysilicon backplane technology to produce an entire system on glass elaborates on the benefits of being able to add such function as scanner and touch input capability whilst still being able to minimize the mass, volume and the number of interconnections in a mobile device.

Then a number of new or less-established display technologies, OLED, Electrophoretic, Bistable Cholesteric and Nematic LCs and Electrowetting, are described. All but Electrowetting have found application in fixed devices, but it is reasonable to assume that all these technologies will find major, probably their dominant, applications in the mobile sector because of low power requirements

combined with good visual performance. 3-D is discussed, albeit with a rather low expectation of finding wide application soon, but it is interesting to see that 3-D techniques could be developed for lightweight low power devices. Chapters on eyewear displays and scanned beam projectors follow and the book concludes with a chapter on polymer backplane active matrix technology, which is now moving from development into production, bringing the prospect of rugged, thin and flexible displays a step closer.

This is a substantial book and it covers its broad subject matter in considerable depth and detail. Inevitably with such a large multi-author volume, there is some overlap between chapters but this has the advantage that each chapter is substantially self-contained, avoiding the need for the reader to keep referring from one chapter to another. Most chapters include a detailed theoretical and technical description of their subject before progressing to descriptions of products and applications, so the reader has considerable choice at which level to read the book. As the editors remark in their Preface, this is the first comprehensive treatment of all aspects of mobile display technology to be published in a single volume. Achintya Bhowmik, Zili Li, and Phil Bos have done an excellent job in bringing this project to a successful conclusion. Written by acknowledged experts in their fields, as new technological developments begin to find their way into mobile products, this book will fill a much-needed gap in the literature.

Anthony Lowe
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Preface

The mobile display industry has been witnessing a rapid growth in recent years, spurred by the tremendous proliferation of mobile communications and computing applications. This has been exemplified by the over 1 billion units of mobile phones and over 100 million units of mobile computers sold in 2007, besides other categories of mobile devices such as MP3 players, digital cameras, PDAs, GPS map readers, portable DVD players, electronic books, etc. This has fuelled a significant investment into the research and development of the display technologies needed to meet the requirements of this burgeoning product category, with key research labs across the display industry and academia producing many exciting technological advancements.

Although at first glance one may think of the mobile display as just a smaller and portable counterpart of the large displays such as the desktop monitors or the flat panel televisions, the widely varying usage and viewing conditions coupled with the stringent power consumption and form factor constraints impose a different set of challenges for the mobile display. Thus, the architects and designers of the mobile devices are increasingly demanding unique attributes for the mobile displays, thereby setting them apart from the domestic tethered terminals and requiring specific developments in the technology. As a result, the display technologies have been advancing rapidly to keep pace with the evolving mobile communications and computing devices. Besides the impressive advancements in the incumbent active matrix liquid crystal display (AMLCD) technologies, the mobile display arena has also been a hotbed for the exploration and development of new technologies, including the emerging active matrix organic light emitting diode (AMOLED) displays, eyewear and mobile projector displays, as well as the flexible displays, among many others.

The objective of this book is to present a comprehensive coverage of the mobile display in a single volume, spanning from an in-depth analysis of the requirements that the displays must meet, through current devices, to emerging technologies. Some of the topics covered are: applications of mobile displays; human-factors considerations; advances in liquid crystal display technologies; backlighting and light manipulation techniques; mobile display driver electronics and interface technologies; as well as detailed analysis of a number of new display technologies that have been emerging in recent years with promises to bring unique capabilities to the landscape of mobile devices and applications. While there are a number of excellent books on display technologies that cover the fundamentals and applications in many other areas, there is, surprisingly, no title dedicated to the important category of mobile displays. Thus, we believe this book will benefit the reader by providing a detailed update on the state-of-the-art developments in this burgeoning field. The chapters have been authored by well-known experts working in the field, selected from both industry and academia in order to present a balanced view of both the fundamentals and applications to benefit both the general and the expert readers.

We are grateful to the authors who worked with us diligently to produce high-quality chapters with in-depth and broad coverage on the various topics related to all aspects of the mobile display, including both technology and applications. We would especially like to thank the series editor, Anthony Lowe, for his encouragement to pursue the idea of this book, and for his conscientious editing of the final manuscript. We thank the colleagues who assisted us in shaping the outline of this book, especially Thomas Holder of Intel Capital who helped enlist authors to cover several of the emerging technologies. We also appreciate the support that the staff at John Wiley have provided us throughout this project. Finally, we would like to thank our wives Shida Tan, Min Jiang, and Barbara Bos for their support and patience during the course of preparation of this manuscript.

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Contents

About the Editors	xv
List of Contributors	xvii
Series Editor's Foreword	xxi
Preface	xxiii
1 Introduction to Mobile Displays	1
<i>Zili Li, Achintya K. Bhowmik, and Philip J. Bos</i>	
1.1 Introduction	1
1.2 Advances in Mobile Applications	2
1.3 Mobile Environment and its Impact on the Display	5
1.3.1 Illumination Considerations	6
1.3.2 System Power Considerations	8
1.3.3 Display Resolution Considerations	11
1.4 Current Mobile Display Technologies	11
1.4.1 Overview	11
1.4.2 Operational Modes of LCDs	12
1.4.3 Viewing Angle and Illumination of AMLCDs	14
1.4.4 Display Driving Electronics	15
1.5 Emerging Mobile Display Technologies	16
1.5.1 System-on-Glass Technologies	16
1.5.2 Organic Light-Emitting Diode (OLED) Displays	17
1.5.3 Bistable Displays	19
1.5.4 Electrowetting Displays	19
1.5.5 Three-Dimensional (3D) Displays	19
1.5.6 Beyond Direct-View and Rigid Displays	20
1.6 Summary	21
References	22
2 Human Factors Considerations: Seeing Information on a Mobile Display	23
<i>Jim Larimer</i>	
2.1 Introduction	23
2.2 The Perfect Image	27
2.3 The JND Map and Metric	27

2.4	Image Bandwidth or Considering a Display or the Eye as an Information Channel	28
2.5	The Control Signal and Scaling for Rendering	29
2.6	Jaggies	30
2.7	Hyperacuity	32
2.8	Bar Gratings and Spatial Frequency	33
2.9	Three Measures of Contrast and Weber's Law	34
2.10	Contrast Sensitivity Function (<i>csf</i>)	36
2.11	Veiling Ambient Light: Contrast Reduction from Glare	38
2.12	Dither: Trade Offs between Spatial Scale and Intensity	39
2.13	Three Display Screens with Text Imagery	41
2.14	Color	43
2.15	Making Color on Displays	47
2.16	Luminance and Tone Scale	47
2.17	Concluding Remarks	50
	References	50
3	Advanced Mobile Display Technology	53
	<i>Kee-Han Uh, and Seon-Hong Ahn</i>	
3.1	Introduction	53
3.2	Advanced Mobile Display Technology	55
3.2.1	Liquid Crystal Display Mode	56
3.2.2	Operating Principle of VA Mode	57
3.2.3	Super PVA (S-PVA) Technology	59
3.2.4	Mobile PVA (mPVA) Technology	61
3.2.5	Transflective VA LCD for Mobile Application	64
3.2.6	Backlight	65
3.2.7	Substrates	66
3.2.8	Drive Electronics	66
3.2.9	Triple-Gate	68
3.2.10	ALS (Active Level Shifting)	68
3.2.11	hTSP (Hybrid Touch Screen Panel)	69
3.2.12	ABC (Adaptive Brightness Control)	70
3.3	Summary	72
	References	72
4	In-Plane Switching (IPS) LCD Technology for Mobile Applications	75
	<i>InJae Chung, and Hyunki Hong</i>	
4.1	Introduction	75
4.2	LCD Modes	76
4.3	Operational Principle of IPS Mode	80
4.3.1	Voltage Transmittance Relation	80
4.4	LC Equation of Motion under an Electric Field	82
4.5	Schematic Diagram of IPS Pixel Structures	85
4.6	Characteristics of IPS Mode	88
4.6.1	Response Time Characteristics	88
4.7	Light Efficiency	89
4.8	Viewing Angle Characteristics	90
4.9	Color and Gray Level	91

4.10	IPS Mode for Outdoor Applications	93
4.11	Summary	94
	References	95
5	Transflective Liquid Crystal Display Technologies	97
	<i>Xinyu Zhu, Zhibing Ge, and Shin-Tson Wu</i>	
5.1	Introduction	97
5.2	Classification of Transflectors	98
5.2.1	Openings-on-Metal Transflector	98
5.2.2	Half-Mirror Metal Transflector	99
5.2.3	Multilayer Dielectric Film Transflector	100
5.2.4	Orthogonal Polarization Transflector	100
5.3	Classification of Transflective LCDs	102
5.3.1	Absorption Type Transflective LCDs	102
5.3.2	Scattering Type Transflective LCDs	104
5.3.3	Reflection Type Transflective LCDs	106
5.3.4	Phase-Retardation Type Transflective LCDs	108
5.4	Discussion	126
5.4.1	Color Balance	126
5.4.2	Image Brightness	127
5.4.3	Viewing Angle	127
5.5	Conclusion	127
	References	129
6	Wide Viewing Angle and High Brightness Liquid Crystal Displays Incorporating Birefringent Compensators and Energy-Efficient Backlight	133
	<i>Claire Gu, Pochi Yeh, Xingpeng Yang, and Guofan Jin</i>	
6.1	Introduction	133
6.1.1	Overview	133
6.1.2	LCD Performance Limitations	134
6.1.3	Solutions	135
6.2	WVA (Wide-Viewing-Angle) LCDs with Birefringent Compensators	135
6.2.1	Overview	135
6.2.2	Extended Jones Matrix Method for Analyzing Large Viewing Angle Characteristics	136
6.2.3	Viewing Symmetry in LCDs	154
6.2.4	Birefringent Compensators for Liquid Crystal Displays	158
6.2.5	Summary of Section 6.2	188
6.3	High Brightness LCDs with Energy-Efficient Backlights	188
6.3.1	Overview	188
6.3.2	Backlight without Optical Films	190
6.3.3	Polarized Light-Guide Plate Based on the Sub-Wavelength Grating	194
6.4	Conclusions	208
	Acknowledgements	208
	References	208
7	Backlighting of Mobile Displays	211
	<i>Philip Watson, and Gary T. Boyd</i>	
7.1	Introduction	211
7.2	Edge-lit Backlight Components and Function	213