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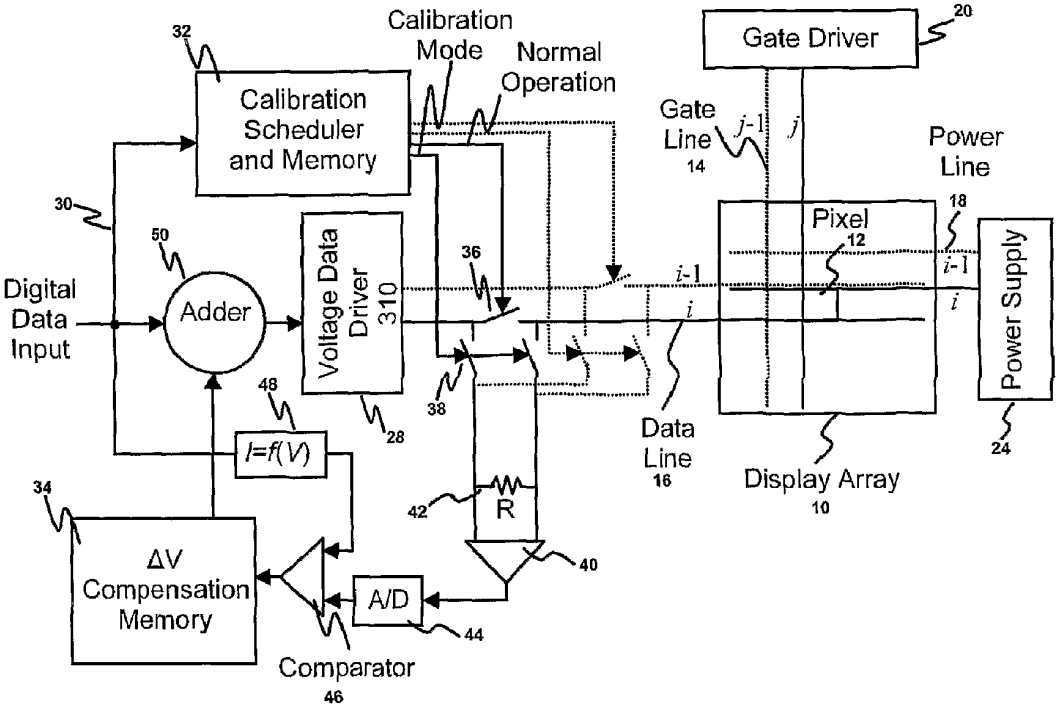
(54) Title: METHOD AND SYSTEM FOR PROGRAMMING, CALIBRATING AND DRIVING A LIGHT EMITTING DEVICE DISPLAY



(57) Abstract: A method and system for programming, calibrating and driving a light emitting device display is provided. The system may include extracting a time dependent parameter of a pixel for calibration.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method and System for Programming, Calibrating and Driving a Light Emitting Device Display

FIELD OF INVENTION

[0001] The present invention relates to display technologies, more specifically a method and system for programming, calibrating and driving a light emitting device display.

BACKGROUND OF THE INVENTION

[0002] Recently active-matrix organic light-emitting diode (AMOLED) displays with amorphous silicon (a-Si), poly-silicon, organic, or other driving backplane have become more attractive due to advantages over active matrix liquid crystal displays. For example, the advantages include: with a-Si besides its low temperature fabrication that broadens the use of different substrates and makes feasible flexible displays, its low cost fabrication, high resolution, and a wide viewing angle.

[0003] An AMOLED display includes an array of rows and columns of pixels, each having an organic light-emitting diode (OLED) and backplane electronics arranged in the array of rows and columns. Since the OLED is a current driven device, the pixel circuit of the AMOLED should be capable of providing an accurate and constant drive current.

[0004] U.S. patent No. 6,594, 606 discloses a method and system for calibrating passive pixels. U.S. patent No. 6,594, 606 measures data line voltage and uses the measurement for pre-charge. However, this technique does not provide the accuracy needed for active matrix, since the active matrix calibration should work for both backplane aging and OLED aging. Further, after pre-charge, current programming must be performed. Current-programming of current driven pixels is slow due to parasitic line capacitances and suffers from non-uniformity for large displays. The speed may be an issue when programming with small currents.

[0005] Other compensation techniques have been introduced. However, there is still a need to provide a method and system which is capable of providing constant brightness, achieving high accuracy and reducing the effect of the aging of the pixel circuit.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to provide e method and system that obviates or mitigates at least one of the disadvantages of existing systems.

[0007] In accordance with an aspect of the present invention there is provided a method of real-time calibration for a display array having a plurality of pixel circuits arranged in row and column, including the steps of: generating a priority list of pixels, which is used to prioritize pixels for calibration based on display and previous calibration data, the priority list being used to select one or more (n) pixels which are programmed with currents higher than a threshold current for calibration; selecting **n** pixels in a selected column of the display array from the linked list; implementing programming to the pixels in the selected column, including: monitoring a pixel current for the **n** pixels and obtaining calibration data; updating a compensation memory based on the calibration data for calibration; sorting the priority list for the next programming.

[0008] In accordance with a further aspect of the present invention there is provided a system for real-time calibration for a display array having a plurality of pixel circuits arranged in row and column, each pixel circuit having a light emitting device and a driving transistor, the system including: a calibration scheduler for controlling programming and calibration of the display array, including: a priority list for listing one or more pixels for calibration based on display data; module for enabling, during a programming cycle, calibration mode for one or more pixels in the selected column, which are selected from the priority list, and during a programming cycle, enabling normal operation mode for the rest of the pixels in the selected column; a monitor for monitoring a pixel current for the pixels in the calibration mode through the selected column; a generator for generating a calibration data based on the monitoring result; a memory for storing calibration data; and an adjuster for adjusting a programming data applied to the display array based on the calibration data when the pixel on the normal operation mode is programmed.

[0009] In accordance with a further aspect of the present invention there is provided a system for a display array having a pixel circuit, the pixel circuit being programmed through a data line, the system including: a data source for providing a programming

data into the pixel circuit; a current-controlled voltage source associated with the voltage source for converting a current on the data line to a voltage associated with the current to extract a time dependent parameter of the pixel circuit.

[0010] In accordance with a further aspect of the present invention there is provided a system for a display array including a plurality of pixel circuits, each pixel circuit including a driving transistor, at least one switch transistor, a storage capacitor and a light emitting device, the system including: a monitor for monitoring a current or voltage on the pixel circuit; a data process unit for controlling the operation of the display array, the data process unit extracting information on an aging of the pixel circuit, based on the monitored current or voltage and determining a state of the pixel circuit; a driver controlled by the data process unit and for providing programming and calibration data to the pixel circuit, based on the state of the pixel circuit.

[0011] In accordance with a further aspect of the present invention there is provided a method of driving a display array, the display array including a plurality of pixel circuits, each pixel circuit including a driving transistor, at least one switch transistor, a storage capacitor and a light emitting device, the method including the steps of: applying a current or voltage to the pixel circuit; monitoring a current or voltage flowing through the pixel circuit; extracting information on an aging of the pixel circuit, based on the monitored current or voltage and determining the state of the pixel circuit; providing operation voltage to the pixel circuit, including determining programming and calibration data for the pixel circuit based on the state of the pixel circuit.

[0012] In accordance with a further aspect of the present invention there is provided a method of driving a display array, the display array including a plurality of pixel circuits, each pixel circuit including a driving transistor, at least one switch transistor, a storage capacitor and a light emitting device, the method including the steps of: applying a current or voltage to the light emitting device; monitoring a current or voltage flowing through the light emitting device; predicting a shift in the voltage of the light emitting device, based on the monitored current or voltage and determining the state of the pixel circuit; and providing, to the light emitting device, a bias associated with the shift in the voltage of the light emitting device.

[0013] In accordance with a further aspect of the present invention there is provided a system for driving a display array, the display array including a plurality of pixel circuits, each pixel circuit including a driving transistor, at least one switch transistor, a storage capacitor and a light emitting device, the system including: a monitor for monitoring a current or voltage on the pixel circuit; a data process unit for predicting a shift in the voltage of the light emitting device, based on the monitored current or voltage and determining the state of the pixel circuit; and a circuit for providing, to the light emitting device, a bias associated with the shift in the voltage of the light emitting device.

[0014] In accordance with an aspect of the present invention there is provided a system for a display array including a plurality of pixel circuits, each pixel circuit having a driving transistor, at least one switch transistor, a storage capacitor and a light emitting device, the light emitting device being located at a programming path for programming the pixel circuit, the system including: a controller for controlling the operation of the display array; a driver for providing operation voltage to the pixel circuit based on the control of the controller; and the driver providing the operation voltage to the pixel circuit during a programming cycle such that the light emitting device being removed from the programming path.

[0015] This summary of the invention does not necessarily describe all features of the invention.

[0016] Other aspects and features of the present invention will be readily apparent to those skilled in the art from a review of the following detailed description of preferred embodiments in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings wherein:

[0018] Figure 1 is a flow chart showing a process for calibration-scheduling in accordance with an embodiment of the present invention;

[0019] Figure 2 is a diagram showing an example of a system structure for implementing the calibration-scheduling of Figure 1;

[0020] Figure 3 is a diagram showing a system architecture for a voltage-extracting, programming and driving in accordance with an embodiment of the present invention;

[0021] Figure 4 is a diagram showing an example of the extracting, programming and driving system of Figure 3 and a pixel circuit;

[0022] Figure 5 is a diagram showing a further example of the extracting, programming and driving system of Figure 3 and a pixel circuit;

[0023] Figure 6 is a diagram showing a further example of the extracting, programming and driving system of Figure 3 and a pixel circuit;

[0024] Figure 7 is a diagram showing a further example of the extracting, programming and driving system of Figure 3 and a pixel circuit;

[0025] Figure 8 is a diagram showing a pixel circuit to which a step-calibration driving in accordance with an embodiment of the present invention is applied;

[0026] Figure 9 is a diagram showing an example of a driver and extraction block and the driving transistor of Figure 8;

[0027] Figure 10 is a diagram showing an example of an extraction algorithm implemented by a DPU block of Figure 9;

[0028] Figure 11 is a diagram showing a further example of the extraction algorithm implemented by the DPU block of Figure 9;

[0029] Figure 12 is a timing diagram showing an example of waveforms for the step-calibration driving;

[0030] Figure 13 is a timing diagram showing a further example of waveforms for the step-calibration driving;

[0031] Figure 14 is a diagram showing a pixel circuit to which the step-calibration driving is applicable;

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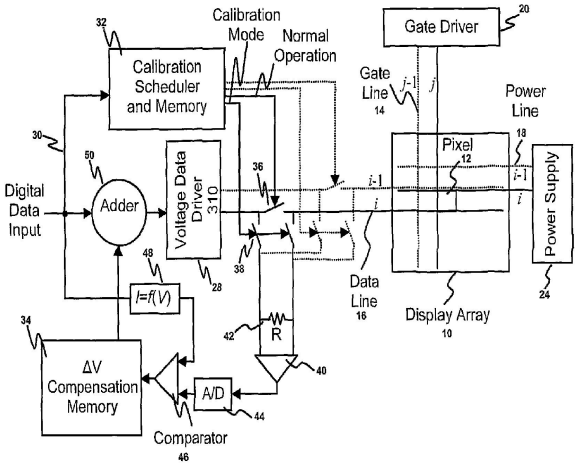
摘要(译)

一种用于显示器阵列的系统，包括像素电路，所述像素电路包括驱动晶体管，至少一个开关晶体管，存储电容器和发光器件。该系统包括用于监视与像素电路相关联的电流或电压的监视器，用于控制显示阵列的操作的数据处理单元，数据处理单元被配置为基于提取指示像素电路老化的信息。监视的电流或电压以及由数据处理单元控制的驱动器，用于基于提取的老化信息向像素电路提供编程和校准数据。



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