with touch screen **100**, in accordance with an embodiment of the present invention. The exemplary controller shown in FIG. **7** includes 64 I/O pins, some of which connect to LED selectors **160** and PD selectors **170**, and some of which receive touch signals.

[0081] Controller **150** shown in FIG. **7** may be an MSP microcontroller, manufactured by Texas Instruments Incorporated of Dallas, Tex.

[0082] ii. LED Selector **160** and Shift Register **110**

[0083] Reference is now made to FIG. **8**, which is a diagram of shift register **110** for an array of 16 LEDs **130**, in accordance with an embodiment of the present invention. Shift register **110** is connected to controller **150** via the LED_CTRL signal shown in FIG. **7**. Integrated circuit IC1 drives 8 LED switches A via corresponding push-pull drivers denoted LED_D00 thru LED_D07; and integrated circuit IC2 drives another 8 LEDs switches A via corresponding push-pull drivers denoted LED_D08 thru LED_D15.

[0084] In accordance with the embodiment shown in FIG. **8**, shift register **110** is implemented in IC1 and IC2, wherein the lower 8 bits of shift register **110** are stored in IC1, and the upper 8 bits are stored in IC2. Bits are shifted from IC1 to IC2 via the connection shown in FIG. **8** exiting IC1 at Q7S and entering IC2 at DS.

[0085] Referring to the LED_CTRL signals, when L_SCLR_N is low, all LEDs **130** are turned off. In accordance with an embodiment of the present invention, L_SCLR_N resets shift register **110**; i.e., resets circuits IC1 and IC2.

[0086] Reference is now made to FIG. **9**, which illustrates a waveform for activating LEDs, in accordance with an embodiment of the present invention. FIG. **9** illustrates the use of LED_CTRL signals L_SI, L_SCK, L_RCK, L_SCLR_N and L_EO_N from FIG. **7**.

[0087] As shown in FIG. **9**, at time t1 a low L_SCLR_N signal turns off all LEDs by resetting shift register **110**. At time t2, a bit value of 1 is entered into shift register **110** by signal L_SI. Thereafter, at each cycle of L_SCK the data in shift register **110** is shifted one position further into the register, and a new L_SI bit is entered into the first bit of shift register **110**. After six L_SCK cycles, corresponding to time t3, the bit value of 1 arrives at bit position 6, corresponding to LED06. A high L_RCK signal activates the LED drivers using the data in shift register **110**, driving push-pull driver LED_D06 high, and thereby activating a respective one of switches A and turning on LED06. A subsequent L_SCK cycle, corresponding to time t4, advances the bit value of 1 one bit position further. A subsequent high L_RCK signal activates the LED drivers again, with the bit value of 1 at position 7 and a bit value of 0 at position 6, thereby turning on LED07 and turning off LED06 via respective switches A.

[0088] In distinction to the embodiment shown in FIG. **1**, in accordance with another embodiment of the present invention, four LEDs **130** are placed in the four corners of a touch screen, and plural PDs **140** are arranged along the four sides of the screen, as shown in FIG. **10**. When an LED **130** is lit, it projects an arc of light substantially parallel to the surface of the screen. The PDs **140** detect respective portions of this light, according to the positions of the LED **130** and the PDs **140**. The four LEDs **130** suffice to determine the screen coordinates of an object, such as a finger, placed over a portion of the screen, based on the light intensities detected by the PDs **140**.

[0089] In yet another embodiment of the invention, the LEDs are inter-connected with the topology of a matrix, and each I/O connector transmits a signal to an entire row or an entire column of LEDs. Such a topology provides an advantage in reducing the total number of I/O connectors required, thereby reducing the cost of the electronics. In this regard, reference is now made to FIG. **11**, which is a diagram of an LED driver matrix **200** for a touch screen, in accordance with an embodiment of the present invention. FIG. **11** shows how 16 LEDs are controlled by using only 4 VROW signals and 4 VCOL signals. Each VROW signal controls a respective one of four connections via switch **210**, and each VCOL signal controls a respective one of four connections via switch **220**. Switches **210** and **220** are connected to respective pins in controller **150**. Switches **210** and **220** are similar to LED switches A shown in FIG. **12**.

[0090] Matrix **200** includes 16 LEDs and 8 IO connectors. More generally, matrix **400** may include an m×n array of mn LEDS and m+n IO connectors. In distinction, prior art LEDs required two IO connectors apiece. As such, it will be appreciated by those skilled in the art that matrix **200** reduces the number of IO connectors required from 2 mn to m+n. In turn, this reduces the cost of touch screen **100**, since the IO connectors are a significant part of the bill of materials.

[0091] As shown in FIG. **11**, each LED is accessed by selection of a row and a column IO connector. Four push-pull drivers are used for selecting rows, and four push-pull drivers are used for selecting columns. A designated LED is activated by driving the appropriate push-pull driver for its row to high, and driving the appropriate push-pull driver for its column to low. FIG. **11** shows the second from left push-pull driver driven low, and the second from top push-pull driver is driven high. Correspondingly, the LED circled in FIG. **11** is activated.

[0092] It will be appreciated by those skilled in the art that the row and column coordinates of the LEDs are not related to the physical placement of the LEDS and the push-pull drivers. As such, the LEDs do not need to be physically positioned in a rectangular matrix.

[0093] In another embodiment of the present invention, current source drivers are used instead of push-pull drivers. In yet another embodiment of the present invention, current sink drivers are used instead of push-pull drivers. In yet another embodiment of the present invention, some of the push-pull drivers are combined with current source drivers and others of the push-pull drivers are combined with current sink drivers.

[0094] iii. LED Current Switches A

[0095] Reference is now made to FIG. **12**, which is a diagram of LED switches A, in accordance with an embodiment of the present invention. LED switches A are push-pull drivers that control LEDs **130**. These push-pull drivers control gates of power transistors in each of the LED circuits LED00-LED15. In systems where the LED drivers supply sufficient current to operate LEDs **130**, switches A may be removed, and LEDs **130** may be controlled directly by LED selectors **160**.

[0096] iv. LED Current Limiters B

[0097] Reference is now made to FIG. **13**A, which is a diagram of current limiters B, used for limiting and directing current to LEDs through VROW and VCOL, in accordance with an embodiment of the present invention. As shown in FIG. **13**A, a transistor **300** controls the current issued via VROW to the row LEDs 0-7 along the top of touch screen **100** (FIG. **5**), by a signal denoted ROW_EN_N. Similarly, a second transistor (not shown) controls the current issued via VCOL to the column LEDs 8-15 along the right side of touch