Implementing a resistive touch screen solution quickly and easily

Source: Microchip Technology

Touch screens are user-friendly input devices that are becoming widely accepted in everyday human-machine interaction. From large industrial machines to grocery store check-out lines, all the way down to cell phones and personal media players, touch screens are quickly becoming the standard interface between humans and machines.

It is important to understand that there is not a single perfect touch technology that fits every design and application. The three primary touch technologies each have different strengths and weaknesses. This chart highlights the main topics for consideration when choosing a touch technology: Cost/Optics/Sensor Life/ Integration Ease/ Multi Touch capability/ and Touch Object (the user input method)

	Resistive	Surface Capacitive	Projected Capacitive
Cost < 6"	Lowest	N/A	Low
Cost > 10"	Lowest	Medium	High
Optics	75%	90%	90%
Screen Life	Good	Better	Better
Integration Ease	Best	Medium	Low
Multi-Touch	Limited	No	Yes
Touch Object	Finger / Stylus Glove	Finger	Finger

Touch Technology Comparison Chart

Resistive technology easily dominates the touch market, accounting for over 80% of all touch designs, as it boasts several desirable qualities: low cost, ruggedness, ease of integration and the ability to use any type of user input method (gloved hand/ stylus/ finger). The only major drawbacks for resistive technology are the optical quality of the sensor and its limited multi touch capability. This article will discuss the basic theory of resistive touch technology and address the crucial role of the resistive touch screen controller within a completed touch system, focusing on the embedded market.

Resistive Touch Technology

Resistive 4, 5, and 8-wire touch sensors consist of two facing conductive layers, held in physical separation from each other. The force of a touch causes the top layer to move and make electrical contact with the bottom layer. Touch position measurements are typically made by applying a linear voltage gradient across a layer or axis of the touch sensor. The touch position voltage for the axis can be measured using the opposing layer.

The basic decoding of an 8-wire sensor is similar to a 4-wire. The difference is that an 8-wire sensor has four additional interconnects used to reference sensor voltage back to the controller. A touch system may experience voltage losses due to resistance changes in the bus bars and connection between the controller and sensor. The losses can vary with product use, temperature and humidity. In a 4-wire sensor, variations in the losses manifest themselves as error or drift in the reported touch location. An 8-wire touch sensor automatically adjusts for the changes, with the additional four reference lines. The reference lines allow the controller to know what the voltage is, at the touch sensor bus bars.

5 wire resistive technology is a bit different, designed to allow damage to the top layer without interfering with the touch solution. The voltage is not directly applied to the edges of the active layer as it is for 4-wire and 8-wire sensors. Instead, the voltage is applied to the corners of a 5-wire sensor. To measure the X-axis, the left edge of the layer is driven with 0 Volts (ground) using connections to the upper left and lower left sensor corners. The right edge is driven with +5Vdc using connections to the upper right and lower right sensor corners. To measure the Y-axis, the top edge of the layer is driven with 0 Volts (ground) using connections to the upper left and upper right sensor corners. The bottom edge is driven with +5Vdc using connections to the lower left and lower right sensor corners.

Resistive Touch Electronics

Most resistive "touch controllers" on the market are basic analog-to-digital converters. They convert the raw electrical data from the sensor to a digital signal. The basic analog-to-digital converters can handle this operation, but still require more development to make them work properly as a touch screen controller.

To measure a touch position, the controller must drive the X axis and then the Y axis, creating a voltage divider where the voltage is sensed off the non-driven axis. While on the surface this is a simple concept, the sensor contains both resistive and capacitive elements that must be taken into account when designing this type of a device. These elements cause an associated RC rise time that varies both with pressure and the aging of the sensor. The analog-to-digital converter logic must be designed with this rise time in mind. In addition, filtering algorithms must be implemented to eliminate any invalid electrical data from the sensor. Calibration routines must

Down" touch status. The range for X-axis and Y-axis coordinates is from 0-4095 (12-bit) . The realized resolution is 1024, as this product currently defines, in a non-calibrated state, bits X1:X0 and Y1:Y0 as zeros.

The Configuration Registers allow customization of aspects of the AR10000 controller. The default values have been optimized for the most popular applications and are automatically used unless users choose to change them. Key Configuration Registers include:

also be defined, and then implemented, to map the electrical data to the visual display. Often, the analog-to-digital converter logic is designed around the characteristics and anomalies of a particular sensor. This can cause the integrator to pigeon-hole themselves into a single sensor sourced for the system. This can quickly turn sour, should the sensor no longer be sufficient for the system. This could be due to environmental damage to the sensor, manufacturer changes, or trying to implement the controller in a different application that requires a particular sensor construction, optic qualities, or durability. This then forces more engineering time to develop more algorithms to compensate for a different sensor to create a functioning system again.

mTouch AR1000 Resistive Touch Screen Controller

In response to these needs, Microchip introduced the mTouch AR1000 Analog Resistive Touch Screen Controller. The AR1000 controllers provide universal 4-, 5- and 8-wire sensor support, as well as support for SPI, I2C and UART communication interfaces.

The host system will present commands to the AR1000 controller over SPI, I2C or UART, including:

Enable Touch / Disable Touch, enter Calibrate mode, Register Read / Register Write, EPROM Read / EPROM Write.

Touch coordinates are sent from the AR1000 controller to the host system in a 5-byte data packet, which contains the X-axis coordinate, the Y axis coordinate, and a "Pen-Up / Pen

Touch Threshold Register – sets the threshold for a touch condition to be detected as a touch.

Sensitivity Register – sets the level of touch sensitivity.

Sampling Fast / Sampling Slow Registers – sets the sampling rates.

Accuracy Filter Fast / Slow Registers – sets the level of enhancement filters for slow / fast touch movement.

Speed Threshold Register – determines if a touch movement is considered fast / slow.

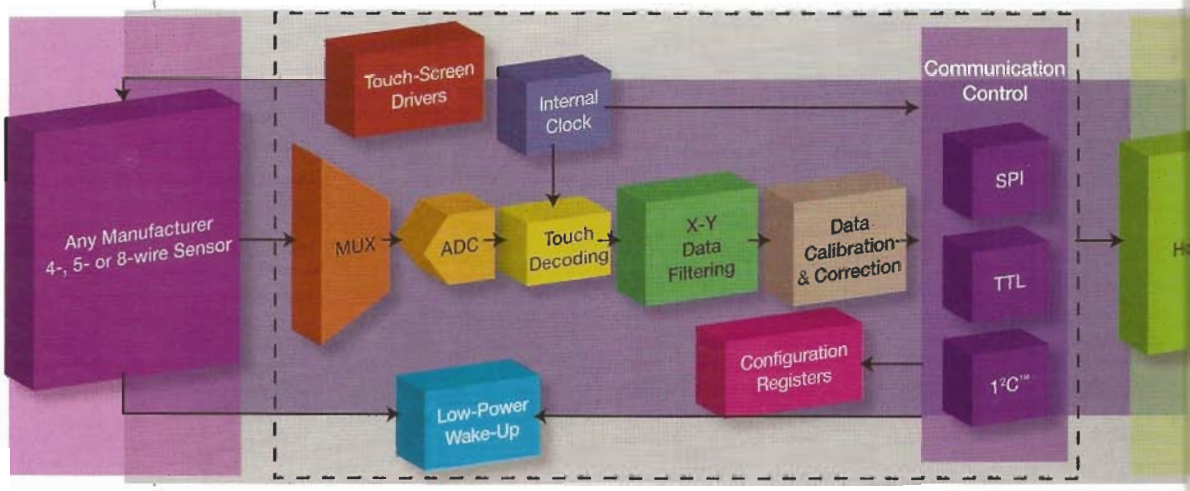
Sleep Delay Register – sets the time duration with no touch or command activity that will cause the controller to enter a low power sleep mode.

Pen Up Delay Register – sets the duration of a Pen Up event that the controller will allow.

Touch Mode Register – configures the action taken for various touch states, Pen Down, Pen Movement & Pen Up.

Calibration Inset Register – defines the expected position of calibration points, allowing calibration points to be moved to suit the application .

The mTouch AR1000 Development Kit (DV102011) allows users to



mTouch™ AR1000 Series Resistive Touch-Screen Controllers

quickly evaluate these new devices. The kit includes the AR1000 development board, a 7" four-wire resistive touch overlay, a PICkit Serial Analyzer and all necessary interface cables, as well as a CD containing technical documentation and all necessary software. The CD also includes an easy-to-use AR1000 configuration utility, which has a Graphical User Interface (GUI) that enables designers to test all user-configurable options with the AR1000 controllers. ■

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