



Designing Feature-Rich User Interfaces for Home and Industrial Controllers

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We have all become familiar with intuitive user interfaces on our smartphones, tablets, and personal media players. Yet these concepts are still being introduced in the world of many home controls or industrial automation applications. The use of MIMIC diagrams and traditional switches and rotary controls are still commonplace on much industrial equipment. Most home thermostats are still mechanical. There are some very good reasons for this. Gloved hands, moisture, and condensation can play havoc with touchscreen controls. The industrial operating environment may dictate large switches for these reasons. Safety considerations may warrant the use of traditional control mechanisms such as switches.

Nevertheless, equipment manufacturers are keen to update both the functionality and cosmetic aesthetics of their products. Industrial automation equipment is increasingly networked. For home automation applications there is a need to provide an integrated display and control function for heating and ventilation, media-center and smart-energy monitoring. You need a higher performance microprocessor, but with a more intuitive, easy-to-understand user interface (UI).

When embarking on a new control panel application, embedded developers are likely to select a microprocessor device rather than a microcontroller. This is dictated by the processing power required for the connectivity and by the need to manage a TFT LCD screen and its associated UI. An example is the Atmel® SAMA5D3 MPU, based on an ARM® Cortex®-A5 core. It's 65nm low-power process geometry delivers up to 850 DMIPS (drhystone million instructions per second) at 536 MHz and up to 1,328 MB/s at a 166 MHz bus speed.

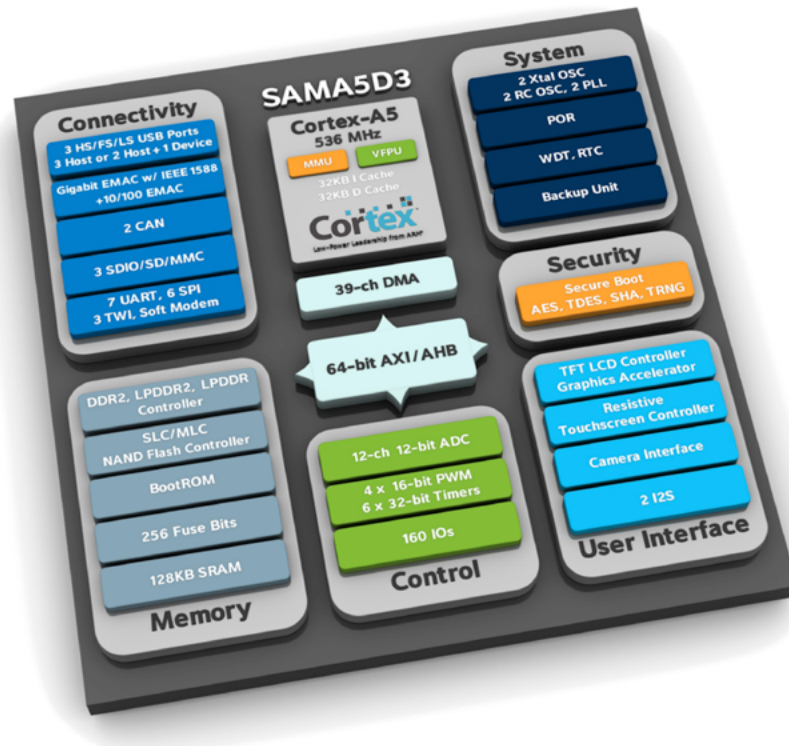


Figure 1 - The SAMA5D3 MPU has the power to allow sophisticated connectivity and a complex LCD user interface.

The SAMA5D3 also features a floating-point unit (FPU) for high-precision compute-intensive applications. Its 24-bit TFT LCD controller has a graphics accelerator for image composition. Optimized for use in industrial control and HMI (human-machine interface) applications, the device has a comprehensive set of peripheral interfaces including dual Ethernet, high-speed USB, and dual CAN. One of the Ethernet ports supports Gigabit Ethernet with real-time stamping to IEEE1588.

Selecting the ideal processor performance criteria is sometimes difficult. Depending on the specific application it may warrant use of an RTOS (real-time operating system) or a full OS such as Linux or Windows CE. This choice alone can have a significant bearing on your DMIPS requirement. Using Linux typically would put an overhead of at least 300 to 400 DMIPS on the processor. A simple low-memory-footprint RTOS requires 50 DMIPS. The UI decisions also require performance considerations. For a UI

library such as Qt, an overhead of 80 to 100 DMIPS would suffice. Without a doubt, you need to carefully consider the human machine interface aspects of an industrial control or home automation panel. The processing power needs to be able to drive a high-resolution screen and render complex and reality-like animation. Ideally the selected MPU should have an accelerated graphics processing capability.

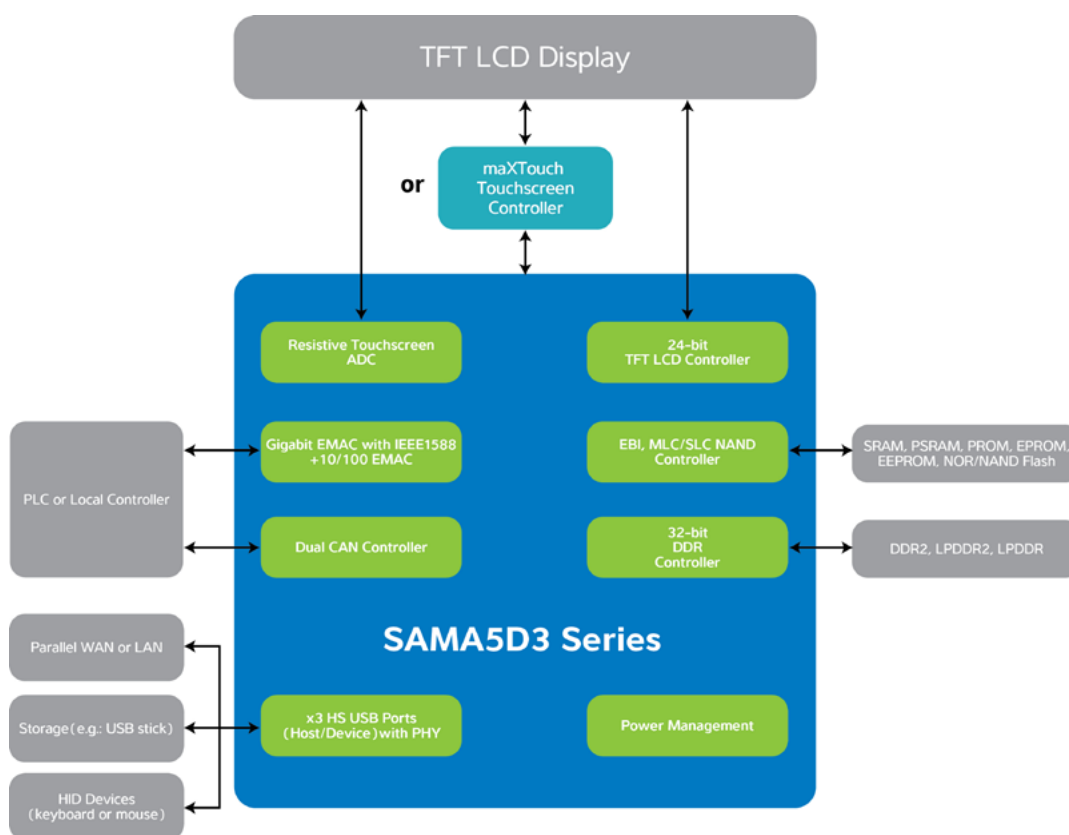


Figure 2 –A SAMA5D3 provides most all the functions needed by a Process Control or HMI controller. A maXTouch IC will add capacitive touch panel support.

The Atmel SAMA5D3 MPU is an ideal candidate for your control panel designs. With its Cortex-A5 core and vector FPU it can accelerate graphics processing. Coupled with the 32-bit DDR (dual data rate) controller performing up to 1,328 MB/s, it has the performance to drive a high-resolution screen display via the 24-bit TFT LCD controller block. Resistive touchscreen support is integrated into the device. Alternatively, you can interface to an external Atmel maXTouch capacitive touchscreen controller.

To assist your development of the UI, Atmel has partnered with TimeSys to port the Qt framework and its comprehensive range of development tools. Qt is a cross-platform application framework that has quickly established itself as a reliable, easy-to-use toolkit to develop complex graphical user interfaces. Using C++ or QML, developers can develop intuitive HMI/UI screens using the Qt Creator application.

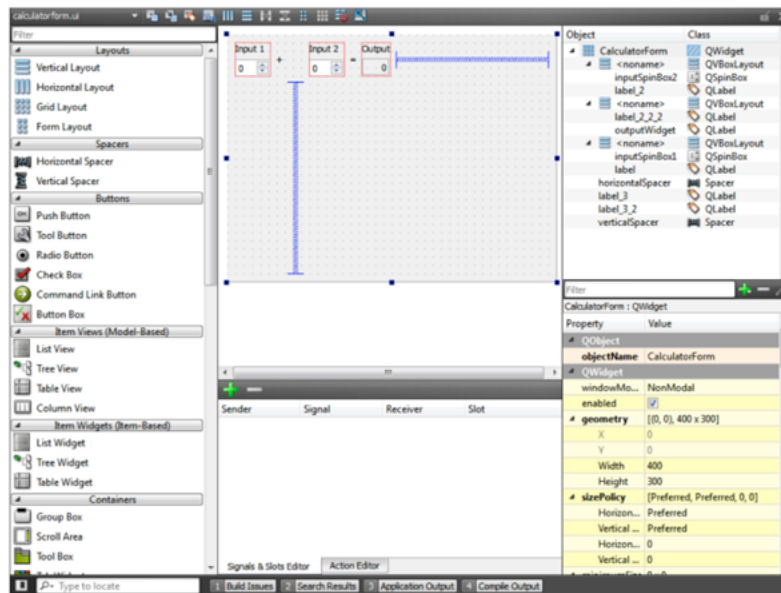


Figure 3 – The Qt Creator tool helps you design sophisticated graphical user interfaces.

Qt is based on a comprehensive set of widgets that you use to create a GUI screen design. Within the Qt Creator development environment, the Qt Designer tool allows you to lay out the interface design and plan the human interaction. With excellent support for multimedia and 3D graphics, all the traditional concepts of text entry, check boxes, and radio buttons, allow the easy creation of industrial interface designs.



Figure 4 – The SAMA5D3 and the Qt development environment lets you quickly design complex user interfaces.

The Qt Designer creates C++ code that integrates into your application. Another interesting feature of Qt is QML (Qt Modelling Language). QML is a Java-script based declarative language used for designing interfaces. QML defines all the necessary visual graphical interface elements to create and animate visual interaction and the calling application.

Atmel provides a number of comprehensive evaluation kits so that developers can quickly trial their UI designs and applications. The home automation application of Figure 4 is included with Atmel's SAMA5D31 evaluation kit. The evaluation kit provides an ideal platform on which to prototype UI designs. Incorporating a SAMA5D31 embedded MPU running at 536 MHz, 512 MB DDR2, and 2 Gb NAND Flash, the kit also has a 5-inch WVGA resistive TFT LCD module with four QTouch keys. The kit also is well-equipped with software. Atmel includes and supports a free Linux distribution that covers all of the A5 SoC (system on a chip) peripherals within the Linux kernel, in addition to bootloaders such as AT91Bootstrap, U-Boot and Barebox. Atmel provides a free software development kit (SDK) based on Qt for rapid UI design. This SDK includes demos, widgets, background images, a set of icons, and useful graphical elements. Using these proven elements, you can quickly develop, test and modify a customized user interface.



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