Osprey White Paper:

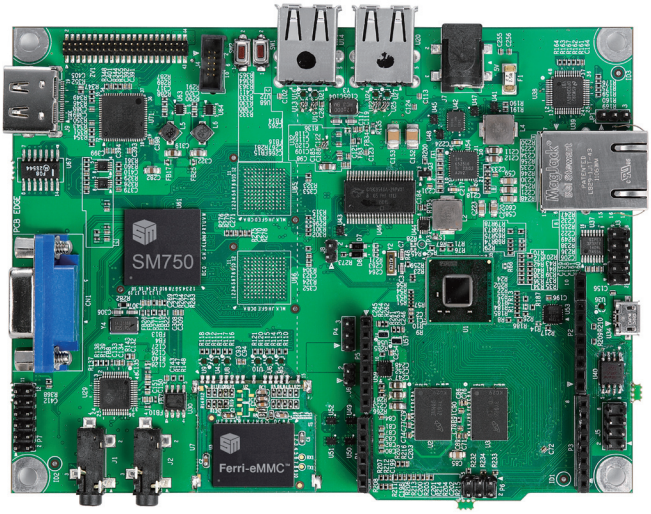
Silicon Motion's State of the Art Visual IoT Platform

Introduction

The emerging IoT market is inspiring ideas for many diverse devices communicating over the Internet seamlessly. However, IoT products are divergent, and standardization among devices and data is yet to be established. This leaves the designer with many challenges, one of which is deciding on the best platform for designing products and applications. For a visual IoT platform the key elements include an industry-standard processor, robust I/O, visual display, panel interface (including touchscreen capability) and reliable system storage. Silicon Motion's Osprey industrial IoT offers these features in a visual IoT application platform.

Osprey was built from the ground up to meet industry-standard hardware and to meet industrial requirements (including component products designed for reliability and product life cycle). Industrial IoT products require more demanding standards. The advantage of Quark's x86 instruction set architecture and robust I/O make Osprey an efficient SoC processor with widely available software, operating systems, and application development tools, while meeting the rigorous requirements of industrial operations products.

Silicon Motion's power-efficient SM750 embedded graphics processor can drive two independent displays each from VGA up to Full HD 1920x1080 resolution via dual analog or dual digital RGB outputs, all while burning typically less than one watt. SM750's ZVport enables streaming of video data directly to the frame buffer memory.



Silicon Motion's Ferri-eMMC™ is optimally designed for a wide range of embedded applications and is fully compliant with the industrial standard eMMC/JEDEC 4.5 protocol. Inheriting the best technology from the Ferri™ family, it features advanced NAND management, error correction, bad block management, and health monitoring, enabling Ferri-eMMC™ to deliver more robust data integrity and protection. With high reliability NAND management and customizable firmware design, Ferri-eMMC™ is unequaled in non-volatile storage for today's cutting-edge industrial embedded applications.

Osprey unites proven industrial-designed components to simplify design, lower power, and reduce BOM with the advantage of speeding time-to-market.

SiliconMotion

TABLE OF CONTENTS

Industrial IoT Opens New Market Opportunities for a Variety of Products

Industrial IoT has a vast system scope and includes combinations of sensors, processors, connectivity and storage technology that allows data sharing across multiple computing platforms and enables faster analytics that can be used to optimize systems and performance. Although analytics in the cloud is available, many systems require intelligence at the edge and a human-machine interface for monitoring, control and connection to local servers.

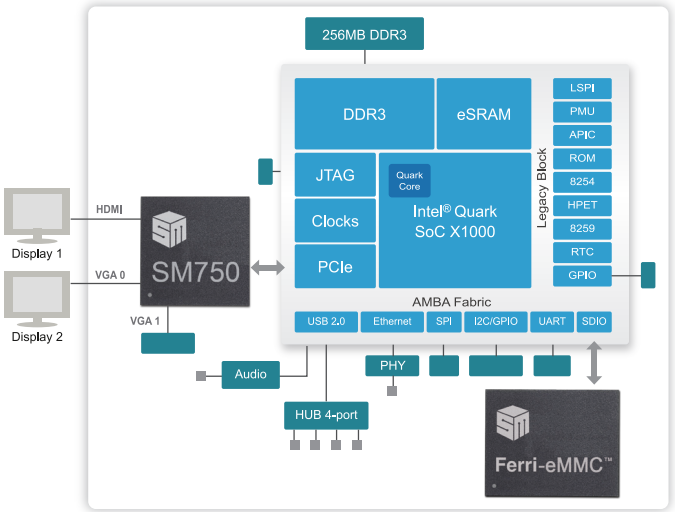
Human machine interface (HMI) devices such as home monitoring, industrial control, smart signage, smart elevators, and smart vending machine are only a few of the products considered. Many interesting applications with new product ideas are still to come. Your smart elevator could recognize you and select your floor automatically. In the future, products for industrial and medical segments will play important roles, as well as consumer applications. A combination of technology and products that make business sense is what will gain traction in the industrial IoT market. Industrial IoT products require strict quality and reliability, coupled with longer life cycles. This requires components designed for industrial applications.

The Osprey Visual IoT Platform

Since IoT is in early stages, researchers must establish standards between applications and data among connected devices. The best way to do that is to start with a set of standards for industrial-designed components. Osprey uses best-in-class components such as Quark, Ferri-eMMC and SM750 embedded graphics to establish an ideal small form factor, low-power computer display platform. A 4-port USB Hub and Audio are designed-in to provide a robust set of functions and interfaces.

Now that gesture-based GUIs are ubiquitous today, Osprey enables visual and touch interaction for an ideal visual IoT product development platform. Interactive touch displays are efficient ways for users to communicate with an IoT device. Osprey is an open platform supporting Linux and Qt frameworks, and the fact it supports x86 ISA means broad software support from operating systems to applications.

Osprey System Diagram



Osprey Feature Description

Intel Quark X1000 is a 32-bit Pentium class SoC and has a well-established base of existing x86 software. Quark includes a broad set of I/O, such as Ethernet, USB Host and Device, Serials, SPI, SDIO, and GPIO ports, to list a few. A PCI-e port is used to interface to the SM750 GPU, and the SDIO interface connects to Ferri-eMMC. Also Osprey takes advantage of its compatibility with the Arduino Shield card connector, as does Intel's Galileo system, supporting the familiar Arduino integrated development environment. The Shield I/O cards enable support for wireless (Wi-Fi, Bluetooth, Zigbee), sensors, relays, motor control, networking and other devices. The Arduino shield ecosystem uses cards compatible with the existing Arduino Uno R3 pin layout (the Arduino 1.0 pinout).

Ferri-eMMC™ combines industry-proven controller technology, NAND Flash and components into a single industry-standard 100-ball 1.0mm pitch BGA package, providing a more flexible PCB design and low-cost manufacturing in a JEDEC 4.5 protocol compliant device.

Features include:

- Advanced ECC management, including error correction, bad block management and health monitoring, provides robust data protection and integrity.
- DataRefresh and Early Retirement ensure data reliability, plus advanced protection against an unstable power supply or sudden loss of power.
- Advanced wear leveling distributes program/erase cycles across all NAND flash devices, and combined with a low write amplification index, it maximizes the memory life span.
- Available in both commercial (-25°C to 85°C) and industrial temperature grades (-40°C to 85°C)
- Available in 2GB to 32GB configuration
- Secure erase and multi-user data security zones allow controlled user access to secure data zones.

Ferri-eMMC supports HS200 and has both MLC and SLC mode operation, with performance on sequential reads of 140MB/sec read and up to 75MB/s write in 16GB SLC mode. SMI offers customizable firmware that supports self-monitoring, analysis and health status reporting.

The SM750 embedded graphics processor supports two independent displays outputs via:

- Dual Analog RGB Video (each triple-8-bit DACs) up to 300MHz. Osprey connects one to a standard 15-pin VGA connector and the second to a pin header.
- Dual Digital Video RGB outputs (2x 18-bit or single 24-bit). Osprey uses 24-bit for HDMI output.
- Resolution support from VGA 640x480 up to Full HD 1920x1080. Single display up to 1920x1200.

The SM750s 2D engine includes front-end color space conversion (CSC) with scaling and programmable CSC support via raster operations. The video pipe also supports back-end YUV-to-RGB conversion with XY scaling, and the hardware Video Overlay feature supports back-end CSC and scaling as well.

A Zoom Video port (ZVport) interface enables an external digital video source or MPEG decoder to input data directly to the frame buffer. The ZV port can capture/stream one 16-bit or two separate 8-bit digital video sources. The format can be RGB or YUV, with added support for front-end color space conversion. The SM750 can capture and display dual independent video graphics images for a wide range of visual applications.

Osprey Open Platform – Visual IoT Applications

Entry-Level Human Machine Interface (HMI) is an ideal application for the Osprey open platform. IoT devices need a human interface to access the system infrastructure, and a small footprint, low power visual touch system is perfect for local user interface control. You can build applications by connecting a touch panel display to Osprey. A touchscreen can connect to the built-in USB Hub or via serial port. The USB Hub ports are useful for additional devices, including scanners, printers or card readers. Entry-level signage products can achieve a low power, small footprint product using components designed for industrial applications. Industrial HMI, test equipment, POS and medical panel devices are well-suited for product applications based on the Osprey platform.

Industrial versus Consumer IoT – Variation in Requirements

Consumer IoT applications like Touch Displays in Smart Appliances and Smart Displays want devices with low power, small form factor and low cost-to-development products that connect to the Internet, control network devices, access email, play music videos, and connect to the cloud and social networking apps, all without the need for another PC or computing device. Simple visual user interface applications are abundant, and Osprey offers a visual IoT platform ready for product application design and development. Imagine a home appliance control panel that also acts as a digital picture frame displaying digital photos, including the volume taken by our smartphones and tablet devices today. The display can also sleep when no one is around and respond with a motion-sensory wake-up when someone is in the area.

In a manufacturing environment, Osprey can provide a display for the operator interface and a second display-driven video by an inspection camera on the assembly line. The captured video can be scaled and displayed in a window on the operator panel along with the HMI control, while a high-resolution version can drive a second display for better definition. Sensor and diagnostic data, both local and through the network, can be viewed across two displays, providing more real-time information to the operators, improving efficiency and productivity. These are a few of the many product ideas that Osprey can help become reality.

Summary

Osprey's reduces the product development cycle with an industrial-ready platform solution for connected applications and visual IoT products. Using three key components designed for industrial applications, Quark X1000, Ferri-eMMC, and SM750 embedded graphics, Osprey meets the demands of small form factor, low power and budget for visual IoT applications built on proven technology. These devices have a life cycle commitment to meet industrial applications and are offered in industrial temperature grades. Osprey is an open platform designed for industrial-strength product development, allowing faster introduction and deployment of IoT products.

For more information about Intel Quark, please go to **http://www.intel.com/content/www/us/en/embedded/products/quark/overview.html**

For more information about Osprey, please go to **http://www.siliconmotion.com/EW_Pages/Osprey_v1.html**

SMI is a member of Intel IoT Solutions Alliance along with other global member companies that provide scalable, interoperable solutions that accelerate deployment of intelligent devices. Close collaboration with Intel and Alliance members provide technology that enables innovative products and allows developers to deliver first-in-market solutions.