e-Paper for the IoT

Turnkey Kit Makes It Easy to Add e-Paper Functionality to Internet of Things and Other Applications

Contributed by Electronic Design Solutions LLC

Electronic paper, or e-Paper, displays offer designers the ability to add printed-page readability to a wide range of applications. They feature high contrast for visibility in direct light and low-power operation that results in longer battery life. A significant benefit of low-power displays is that they can display the last reset and trap error before entering power down, which is extremely valuable for tracking down system reset issues. Adding wireless connectivity to e-Paper displays enables them to be updated remotely to create innovative Internet of Things and embedded applications such as medical devices, inventory and pricing labels, baggage tags, industrial control devices, household appliances and other consumer products, and more.

Electronic Design Solutions LLC, a Microchip Design Partner, has recently introduced an open-source, wireless e-Paper development kit that offers designers a head start on creating these types of applications. The **e-Paper Display Demo Kit** integrates low-power operation, Lithium-ion battery management, MiWi™ protocol and Bluetooth® wireless connectivity, USB functionality, and much more in a handheld form factor. It includes a low-power 1.44" e-Paper display from Pervasive Displays which offers a 180° viewing angle and high-resolution graphics and text that can be read in sunlight.

Several Microchip devices are highlighted in this development kit to enable its many capabilities. A feature-rich, 16-bit **PIC24FJ256GB106** microcontroller with USB On-the-Go is central to the design. A compact and high-efficiency MCP1640 DC-DC converter is used as part of the battery-management system. Two Microchip memory devices are also included in the design. The SRAM device buffers the display image while the non-volatile EEPROM stores the device ID, operating parameters and connection tables.

e-Paper Display Demo Kit: Front View with Overlay (left); System View with Bottom Cover Removed (right)

The wireless connectivity is provided by two different Microchip modules. The **MRF89XAM9A** is a 915 MHz radio transceiver module that supports Microchip's MiWi networking protocol

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for short-range applications. It has an outdoor range of 300 feet. A separate breakout board contains the Bluetooth module and USB features. The **RN4020** Bluetooth Low Energy module establishes communication over a UART connection while the USB connections enable either device or host modes.

The firmware is written in C and the project is built using Microchip's Application Library framework, including the Graphics Library, MiWi Development Environment stack, USB stack and File I/O (Memory Disk Drive) stack. The code structure is non-blocking, and the cooperative multitasking that is enabled by the state machine approach eliminates the need for a commercial RTOS.

The e-Paper Display Demo Kit integrates all this functionality into an off-the-shelf enclosure that allows for either two AAA batteries or a lithium Ion power source. A 20 pin, 1.27 mm micro header allows the kit to be interfaced into your own custom hardware. An adapter board with a MikroElektronika mikroBUS™ socket is also planned to be released in April 2016.

For more information, visit **Electronic Design Solutions' website**, where you can download a comprehensive User Guide, the kit schematics, and other documents or order a kit to help you get started on creating your innovative wireless e-Paper project.