Application Note

BRT_AN_016

FT9xx Active Image Display

Version 1.0

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This Application Note describes an Active Image Display implemented with an FT9xx device and an FT8xx touch screen. The virtual keyboard behaves as a display for images generated by a host computer and provides control instructions to the host from the touchscreen.

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Table of Contents

1 Introduction

This Application Note describes a display device implemented with an FT9xx device and an FT8xx touch screen. The device behaves as a display for images generated by a host computer and provides control instructions to the host from the touchscreen. The device is connected via USB to the host computer.

The display can be programmed to display any JPEG image from the host and a host-side application which renders web pages is provided with the application note code.

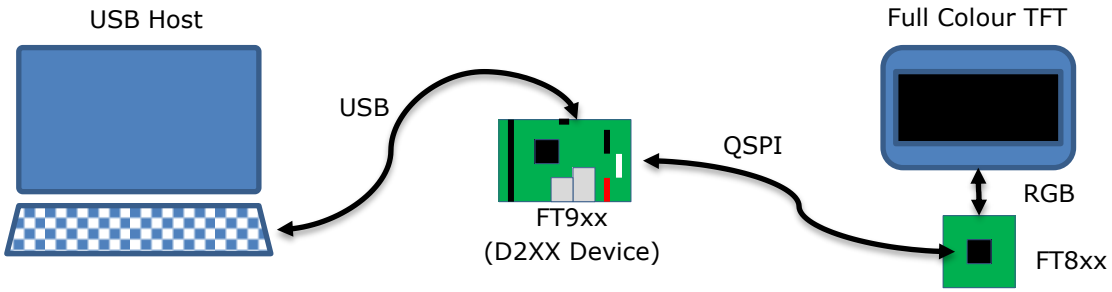

Figure 1 - Block Diagram

The FT9xx presents a D2XX interface to the USB Host computer. The FT9xx provides a bridge to the QSPI connection to the FT8xx device. The FT8xx device controls the TFT display and the touchscreen interface on the display.

The document should be read in association with the example code provided in the references section.

1.1 Overview

This document describes the design and implementation of the FT9xx Active Image Display code. The FT9xx Active Image Display allows a user to:

- Display JPEG images on a touchscreen display device.
- Connect the device to a host via USB.
- Interact with the host using the touchscreen device.
- Control the image displayed by sending control information to the host.

This document is intended to demonstrate the capabilities of the FT9xx family of microcontrollers by emulating USB devices and interfacing to FT8xx display ICs.

Third-party open source code is used to implement this application note:

- Printf – tinyprintf.
- PhantomJS

Links to resources for these libraries are in Appendix A – References.

1.2 Scope

The application note implements a USB device which has a D2XX interface to the host PC. The FT9xx program detects a JPEG image in the data stream received from the host by the D2XX device and controls an EVE display on the FT9xx's QSPI interface.

Generation of JPEG images is handled by third party software. Decoding the JPEG image is performed by the FT8xx IC on the EVE module.

Simple feedback from the touchscreen is sent back to the host when a valid touch event on the EVE module is detected. Further processing of touch events (e.g. scrolling) is beyond the scope of the project.

1.2.1 Features

The application note shows how to implement a USB device using the D2XX library and interface with an FT8xx family display IC.

The USB device interface is used to receive JPEG images from the host and send touchscreen events back to the host.

The FT8xx interface demonstrates communication with the display IC co-processor including reading touch events and decoding JPEG images.

1.2.2 Possible Enhancements

This application note can be seen as a start for customisation or extension. Some example enhancements could be:

- More features for image display e.g. overlaid controls for scrolling.
- Wait cursor to indicate data sent to host and new image expected.
- Touchscreen decoding for drag, double-click or other gestures.
- Data entry option for display (keyboard or keypad) to allow more information to be returned to the host.
- Implementing remote wakeup to allow the keyboard to wake the host.
- Faster display updates.

2 Project Overview

The project files for the application are divided into the following folders.

Folder	Description
Source	Application source code and abstraction files.
Includes	Application specific header files.
Images	JPEG images for this application.
EVE	EVE API libraries.
lib	Library files.
lib\tinyprintf	tinyprintf library.

Table 1 - Project Files Overview

2.1 Sources Folder

The main part of the application is found in the "Sources" folder. This is split into 3 main sections and has 3 source code files.

- The "main.c" file is generally responsible for the FT9xx setup, detecting JPEG images in the data stream and forwarding touchscreen events;
- The "eve.c" file performs all FT8xx operations and is responsible for displaying the JPEG images and detecting touchscreen events..

The other files in this folder are:

- "images.c" contains JPEG images encoded into C array declarations. These images are displayed by the FT8xx display.
- "crt0.S" a modified startup file (in FT9xx assembly language) to allow the application to write to a protected section of FlashROM on the device.

Files in these folders use the "Includes" folder for application specific header files.

2.2 EVE Folder

This folder holds the FT8xx API code which abstracts the FT8xx register and processing list writes into C functions. The API code is similar to the code used in other FT8xx example projects.

2.1 Images Folder

The FT8xx can display JPEG images. This folder contains the raw JPEG images which are encoded into the "images.c" file in the "Sources" folder.

The method for converting these to C code is as follows. Use the HexEdit utility to open the JPEG file, Select All, then select Edit -> Copy As… -> C Source. The C code can be pasted into a source file to be used in the application.

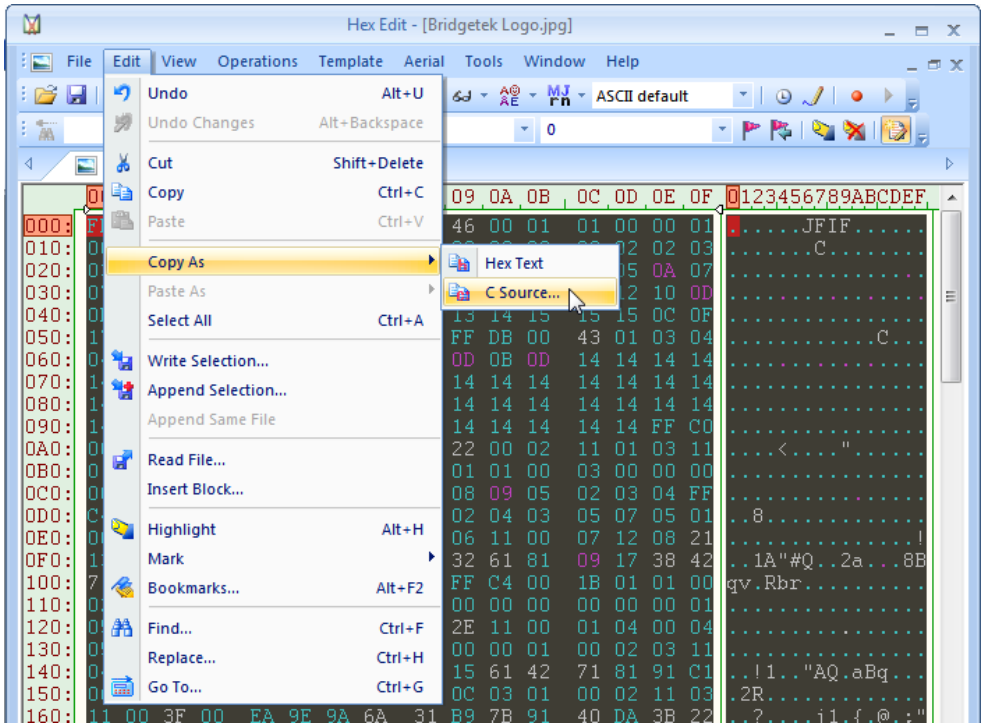

Figure 2 - HexEdit Copy As C Source

If the code is declared as "**const uint8_t __flash__**" then it will reside in Program Memory and not be copied to RAM.

3 Using the Active Image Display

3.1 Required Hardware

The application note is intended to be used on an ME812A-WH50R or ME813A-WH50C EVE development module with an MM900EVxA, MM900EV-Lite or MM930Lite MCU module. The application note is written to work on an 800 by 600 display. Changes to the EVE module or FT9xx device can be made in the "FT_platform.h" file in the "Includes" folder of the source code.

The MM900EVxA module connects directly to the EVE development module with a set of pin headers. The QSPI interface on the FT9xx device is taken through the pin headers to the FT81x on the EVE module. The host PC connects via USB to the MM900EVxA module.

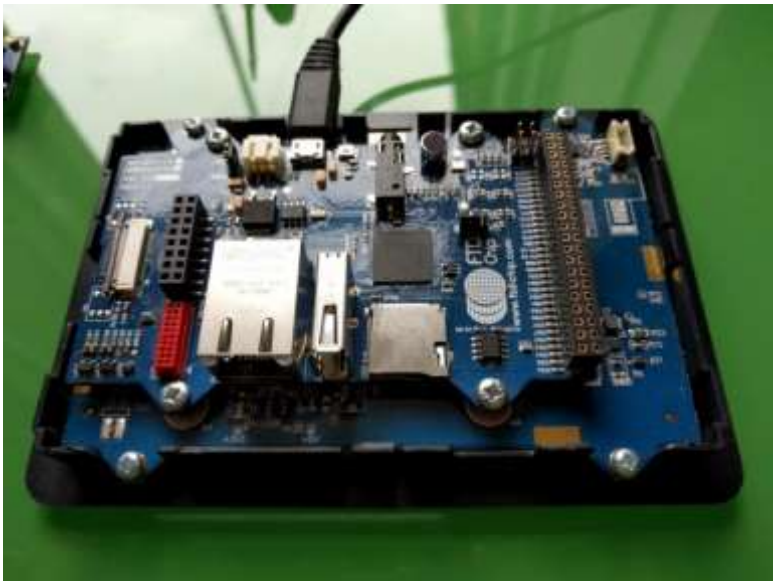

Figure 3 - MM900EV2A and ME812A-WH50R module

3.2 Use of Application Note Software

The Active Image Display will wait until it is connected to a host. The FT81x display will indicate this with the Bridgetek logo and the caption "Waiting for host…".

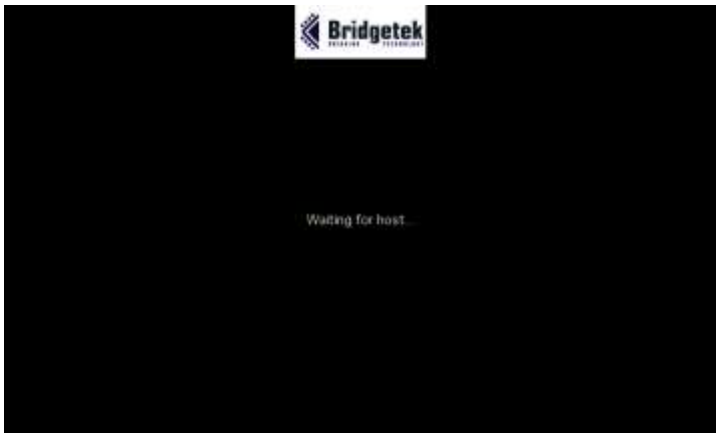

Figure 4 - Waiting for Host Screen

Once the host is connected then it will wait for JPEG images to be sent by the host PC. The on-screen message will change to "Waiting for images…".

3.3 Host Side Software Example

The host side software provided will implement a simple web browser interface on the active display device. Touches on the display will be translated into clicks at the equivalent place on the displayed web page allowing for limited navigation.

The PhantomJS application is used as a 'headless' web browser and screenshots are taken at appropriate times. The JPEG screenshots are sent to the active display via the ftTTYUSB utility. Events from the touchscreen are received from ftTTYUSB and sent as clicks to the PhantomJS web browser.

3.3.1 ftTTYUSB.exe

This program establishes a conduit between a console application on the host PC and a D2XX device on the USB. It takes stdin from the console or files and sends the data to the D2XX device, and it takes data from the D2XX and outputs it to stdout or a file.

In this application it is used to send JPEG images from a file to a D2XX device. It monitors the file for changes and when a change is detected then it will send the contents of the file. It can use stdin (i.e. pipes) form the command window but there are several limitations on PhantomJS which make monitoring a file for changes slightly easier.

When data is received from the D2XX device it is sent out on stdout to the command window.

The full source code for ftTTYUSB is included in the zip file for the application note. Details of the command line options for the utility are found by typing "fttyusb.exe --help" from the commands prompt.

The user is required to import the ftTTYUSB project into Eclipse and build it in order for the ftttyusb.exe to be created.

3.3.2 PhantomJS

PhantonJS is a widely used tool for web site testing and automation. It is a 'headless' web browser and has the capability of being scripted.

A script to take a web page and render it to a JPEG file with the capability of navigating when a click is received from the ftTTYUSB utility is included in the source code for the application note. This script is called "activedisplay.js".

Command line options for the script are displayed with the "--help" option.

For this example the stable release PhantomJS 2.1.1 was used. Neither the executable code nor the source code for PhantomJS is included in the application note.

The user is required to download PhantomJS. The phantomjs.exe could be placed at the following location or could be added to the system PATH environment variable:

.\BRT_AN_016_FT9xx_Active_Image_Display\pc

Version 2.1.1 or later is required. See http://phantomjs.org/

3.3.3 Command Lines

In general the PhantomJS script for this application note is run like this:

```
phantomjs.exe activedisplay.js –p “BRT_AN_016 A” http://www.brtchip.com
```

The ftTTYUSB.exe program and the activedisplay.js script would be in the current directory. The PhantonJS executable could be on the system PATH or in the current directory.

To run the script within the example ‘pc’ folder, the command could be:

```
phantomjs.exe phantomjs\activedisplay.js -u ftTTYUSB\Debug\ftttyusb.exe -p
"BRT_AN_016 A" http://www.brtchip.com
```

Figure 5 - Application Note displaying the BridgeTek Website

4 Contact Information

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Distributor and Sales Representatives

Please visit the Sales Network page of the Bridgetek Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A– References

Document References

FT90x Product Page

FT93x Product Page

FT900/901/902/903 Datasheet

FT905/906/907/908 Datasheet

FT930/931/933 Datasheet

FT81x Product Page

FT81x Datasheet

FT9xx Development Modules

MM900EVxA datasheet

AN_324 FT9xx User Manual

AN_365 FT9xx API Programmers Manual

BRT_AN_016 FT9xx Active Image Display Source Code

Acronyms and Abbreviations

Terms	Description
API	Application Programming Interface
EVE	Embedded Video Engine
HID	Human Interface Device (Keyboard, Mouse etc)
IC	Integrated Circuit
JPEG	Joint Photographic Experts Group
MCU	Microcontroller Unit
QSPI	Quad Serial Peripheral Interface
RAM	Random Access Memory
TTF	Thin Film Transistor
USBD	Universal Serial Bus Device

Appendix B – List of Tables & Figures

List of Tables

List of Figures

Appendix C– Revision History

Document Title: FT9xx Active Image Display
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Clearance No.: BRT#084
Product Page: http://brtchip.com/i-ft9/
Document Feedback: Send Feedback

Revision	Changes	Date
1.0	Initial Release	2017-07-06