Development and Simulation of Embedded Software for VGA Controller

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Abstract– **Embedded systems today are most versatile at development and are most popular in many day-to-day applications. The reduction of an entire CPU-based-motherboard to a small portable system is possible due to the use of High Speed Arm based Microcontroller (lpc2148). This application dedicated board is used for presentation purposes which is compact, small enough to fit in a packet. This system has its own set of software drivers and utilities for connection to USB devices and Human Interface Device (HID) which makes it highly compatible to any set of mass USB mass storage devices. The HID can be a keyboard or a mouse but in this board it is simple push buttons.**

I. INTRODUCTION

Embedded systems are revolving around us into various products. Every 18 months the transistor density increases as per moors law and we able to have a better features of the peripherals within the microcontroller. A V**ideo Graphic Array is** expansion peripherals available on LPC2148 which generates a feed of output images to a display. Most VGA offer various functions such as accelerated rendering of 3D scenes and 2D graphics, MPEG-2/MPEG-4 decoding, TV output, or the ability to connect multiple monitors. When computer architecture had been built it needs to support the compiler constructs to support the higher language constructs. Compiler developers are team of people who understands the architecture to build the efficient compilers.

II. ARCHITECTURE DESIGN

A. System Design

VGA (Video Graphics Array) is the most popular interface in many embedded systems widely.

It provides for users to show information, or to interact with a system. VGA monitor controller is a logic circuit to control VGA interface signals.
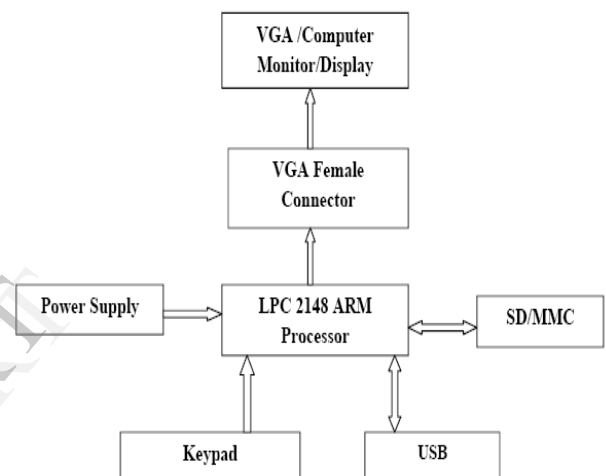

Block diagram of System

The board however, on development stage can be used for more than just one purpose as similar to the CPU. It has an audio port and on-board human device interface buttons. The board however, on development stage can be used for more than just one purpose as similar to the CPU. It has an audio port and on-board human device interface buttons. Currently there are Projectors which support direct USB mass storage interface. There are projectors which provide interface for I/O Devices such as keyboard mouse directly.

B. System Requirement

- Windows XP
- Serial or Parallel port
- USB port
- A VGA cable
- DB-9 straight Full and Half modem serial cable

III. HARDWARE VERIFICATION AND IMPLEMENTATION

A. Functional Diagram of LPC2148

VGA INTERFACE
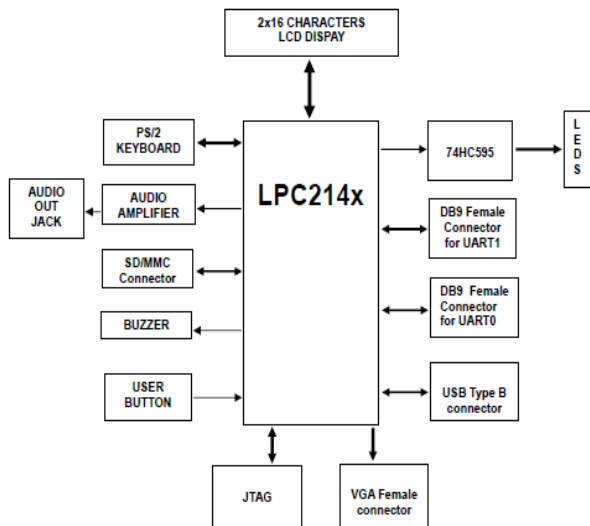
BlueBoard-LPC214X is a evaluation board for LPC2148 ARM7TMDI based microcontroller. TheLPC2148 microcontroller has 512KB of internal flash and 32+8K RAM. TheLPC2141/2/4/6/8 uses one bank of Flash memory, compared to the two banks used on predecessor devices. It includes three 128-bit buffers called the Pre fetch Buffer, the Branch Trail Buffer and the data buffer. When an Instruction Fetch is not satisfied by either the Pre fetch or Branch Trail Buffer, nor has a pre fetch been initiated for that line, the ARM is stalled while a fetch is initiated for the 128-bit line. If a pre fetch has been initiated but not yet completed, the ARM is stalled for a shorter time. Unless aborted by a data access, a pre fetch is initiated as soon as the Flash has completed the previous access.

B. SD/MMC Connector

Insert a SD card in the SD card holder (J24), the status of the SD card will be displayed on LCD upon power cycle or reset of the Blue Board. If the SD card is inserted properly "SD card – OK" is displayed on LCD else it displays "SD card- Not OK". During manufacturing the board is tested with Kingston's 1GB SD card.

C. VGA Connector

Connect the VGA connector on board (J17) to the computer monitor. A default image will appear. This confirms the working of VGA interface. Please note that to test the VGA interface the user has to power cycle the Blue Board or reset it. The VGA is active only for few seconds.
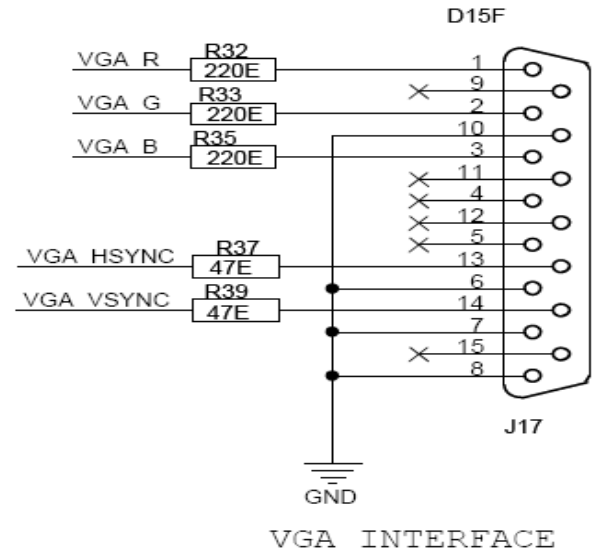
IV. PROGRAMMING THE KIT

The kit can be programmed through serial port using 'Flash Magic'. 'Flash Magic' isa freeware windows utility used download the hex file format onto the kit. The FlashMagic utility is provided in CD along with the KIT. If your PC does not have a serialport; use a USB to serial converter to download the hex file using the Flash Magic utility.

- The simple steps to follow to program the kit using Flash Magic utility.
- Run the FlashMagic.exe under 'LPC2148_EDU\Tools\Flash Magic'
- Change the settings as shown below
- Now, click on Browse for the HEX file to be downloaded, the sample hex files can be found in the CD at 'LPC2148_EDU\Hex files\Experiments'
- Now make the Kit enter the ISP programming Mode.
- Programming mode you need to follow the simple steps mentioned below
  - TURN OFF the kit using the Power Switch
  - Press the ISP button and hold it
  - Now TURN ON kit
- Now click on Start to program the board and wait for the programming to be complete.

V. FLOW CHART OF A VGA CONTROLLER

Initially when power is on, Embedded Board Kernel debugger programmed in the **LPC2148 uC** will configure the hardware and boot (load) the Operating System (OS). The booting of Operating system will also load the necessary applications and drivers for the respective hardware. When we connect USB mass storage device such as Pen Drive, first it will check the device connected is configured or not. If it is not configured then LED connected to USB_UP_LED pin of LPC2148 will glow.

This means that the drivers are not available in OS for connected device.

On the other hand if device is already configured i.e. drivers are present in OS then Operating System will scan the data stored on Pen drive and from that it will access the .ppt files (MS Office files)& automatically open the file through the Embedded Office Software. If suppose connected USB mass storage device contains multiple .ppt files (MS Office files) then the OS promotes the user which file is to be display i.e. the OS provides the list of all .ppt files (MS Office files) on USB mass storage device.

Now if user wants to open another .ppt file (MS Office files) from USB mass storage device, it is programmed to the scan from Desktop Slide Show application. So the system will again scan the entire USB mass storage device display the list of all .ppt files (MS Office files) stored on USB mass storage device.

As previously mentioned the Display Device act as an output and it is used to display the GUI of OS as well as the files which are opened through Embedded Office. Here we are going to consider a LCD projector as a Display Device which will take RGB input from LPC2148. For that purpose we will design OS which will continuously out the QVGA signal at LCDOUT pins of LPC2148. This QVGA signal will be given to ADV7125 which is Triple input 8 bit video DAC. The 8 bits of each color i.e. RGB from LPC2148 are given to ADV7125 which will convert these 8 bits of each color in RGB signal i.e.it will produce a pixel of 24 bit each (24 bpp).

It has 4x4 keypad as another input device which will use to control some functions of OS as well as of embedded office application. eg. Page UP, Page Down, Select, Escape, Close, Scan, etc.
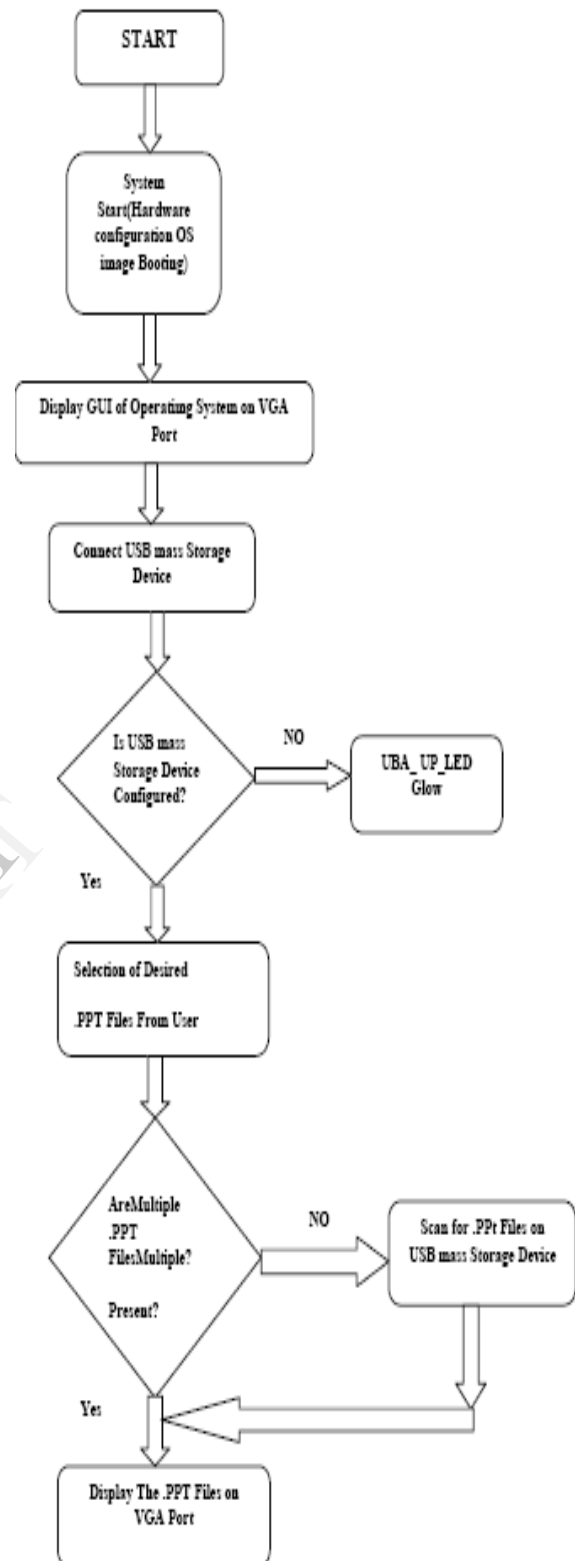
VI. CONCLUSION

Conversion of an image files (BMP or JPG) to its equivalent HEX format. Coding & compilation of VGA driver is completed. The VGA connector display a Red, Green, Blue color lines in the monitor/display devices. The application part; display the SD/MMC card images in the screen/display devices. Displaying image as an output on the TFT-LCD screen. Addressing a maximum resolution of 240x320 without any flickering for the output image

displayed. Any higher resolution above 240x320 can be displayed but with the compromise of flickering effect observed. This will however be not a problem when the image is to be displayed via the VGA port. Initialization of USB Mass Storage Device. The USB-MSD is powered up when connected to USB Port
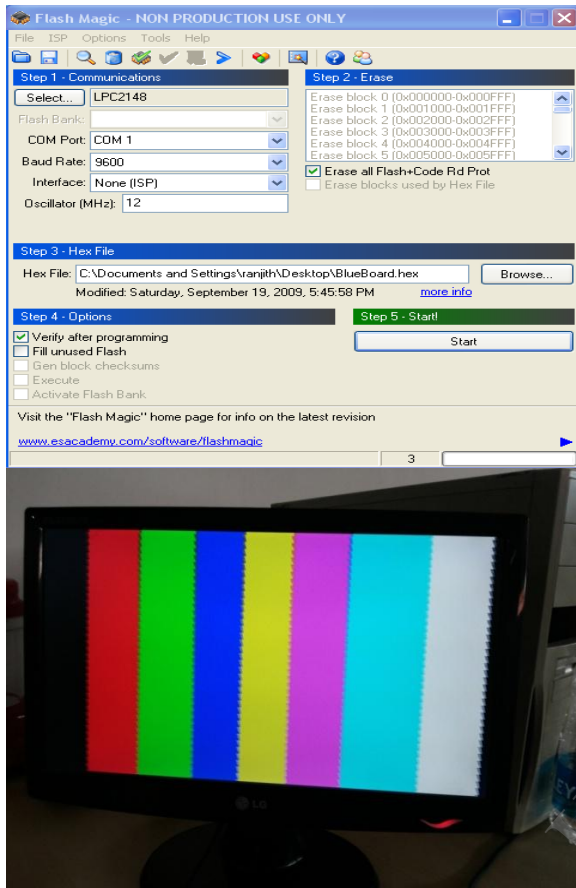
VII. REFERENCES

1) Arm System Developer's Guide By Andrew N. Sloss , Dominic Symes& Chris Wright.

2) CAST. High Resolution Display Controller – Datasheet. Technical report, October 2010.

3) Think Silicon Ltd. Think LCD Display Controller – Product Specification. Technical report, 2010.

4) Xilinx. XPS Thin Film Transistor (TFT) Controller v1.00a. Technical report, Product specification, July 2008.

5) Richard Herveille. VGA/LCD Controller v2.0. Technical report, 2009.

6) VESA. Monitor Timing Specification Version 1.0 Rev. 0.8. Technical report, September 1998.

7) SECONS Ltd. VGA Signal Timing. Technical report, 2008.

8) Javier Valcarce Garcia. Monochrome Text-Mode VGA Video Display Adapter. Technical report, 2009. Van-Huan Tran and Xuan-Tu Tran. CoMoSy: a Flexible System-on-Chip for Embedded Applications. Journal for Research, Development and Application on Information and Communication Technology, 2, 2011.

9) J. Tschanz et al., "A 45 nm resilient and adaptive microprocessor core for dynamic variation tolerance," in IEEE ISSCC Dig. Tech. Papers, Feb. 2010, pp. 282–283.

10) J. Tschanz et al., "Tunable replica circuits and adaptive voltage-frequency techniques for dynamic voltage, temperature, and aging variation tolerance," in IEEE Symp. VLSI Circuits Dig., Jun. 2009.

11) D. Bull et al., "A power-efficient ARM ISA processor using timingerror detection and correction for timing-error tolerance and adaptation to PVT variations," in IEEE ISSCC Dig. Tech. Papers, Feb. 2010, pp. 284–285.

12) A. Drake et al., "A distributed critical path timing monitor for a 65 nm high performance microprocessor," IEEE ISSCC Dig. Tech. Papers, 2007.

13) J. Tschanz et al., "Adaptive frequency and biasing techniques for tolerance to dynamic temperature-voltage variations and aging," in IEEE ISSCC Dig. Tech. Papers, Feb. 2007, pp. 292–293.

14) M. Nakai et al., "Dynamic voltage and frequency management for a low power embedded microprocessor," IEEE J. Solid-State Circuits, pp. 28–35, Jan. 2005.

15) C51 & MDK Keil Manual.

16) Mass Storage Device Driver Programming Guide.

17) Embedded LPC2148 Development Board Manual comprising:
   a) TFT-LCD manual.
   b) USB specifications.
   c) Debugging Manual.

18) Datasheets and User manuals:
   a) LPC2148.
   b) ADV7125.
   c) LM3526.

19) Websites:
   a) http://infocenter.arm.com/
   b) http://www.nxp.com/
   c) http://micrium.com/page/
   d) http://www.usb.org/
   e) http://en.wikipedia.org/

20) "Power Optimization of the ARM7TDMI-S Microprocessor in 90nm CMOS Process", by Dimanarig, Mendoza, Moscoso, Recla, Systems J., vol. 40, no. 2, pp. 310- 327, 2001.