SYNOPSIS

Title : **Personal Digital Notebook**

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Objective: To design and develop, from scratch, a handheld device that aims to be a low cost digital substitute to conventional notebooks for note-taking.

Background Information:

Rapid technological strides have brought about a radical transformation in almost every sphere of our lives, however, it is only over the last few years that technology was initiated in the education sector. According to Ministry of HRD 2005 report, India had nearly 12 crore students pursuing higher education, with about 71% of them belonging to semi-urban and urban areas. With around Rs 1500 Crore spent annually on notebook and stationary industry in India, our concept of digital notebook is an attempt to find a pragmatic replacement to conventional notebooks, leading to considerable money savings and thereby, indirectly conserve our environment, money and energy. With the concept of digital notebook holding relevance to working professionals too, the advantages of commercializing the technology is limitless. With provisions to add several additional features like Audio recoding, Bluetooth or Ethernet cards, the use of digital notebooks can make learning a hassle free experience. Digital Notepad is intended to be a one time investment for a student, eliminating the need to purchase new paper pads after completion of the old.

Introduction:

At the topmost level, the device is basically a touch screen interfaced to a processor, with sufficient memory space and a USB Host. The device dimension will be around 7" x 5" and the processor to be used is an AD Blackfin531 DSP processor. The application software to be used in the device will be of interactive nature, and is proposed to be based on a Linux platform. The application is to be developed on Qtopia, a linux based application development software using Graphics C++ and Qt scripts. The application is a simple single purpose application with facilities to open, save and modify files, similar to an MS Paint application. Rather using handwriting recognition software and algorithms, we intend to associate the file as an image file following the joint photographic experts group (*.jpeg) standards. The user will use his finger/stylus, and the absence of handwriting recognition algorithms would mean that the user would be free to follow his own style while note making. When all the screen space has been used up, the user will have an option to save it and start with a fresh screen. The provision of a USB OTG adds power to the device, for all the files saved can be effectively ported to a desktop at the end of the day. The device will have the provision to include SD memory cards that are easily available in the market.

Plan of Action:

1. Install Qtopia SDK as well as Open source onto a Linux workstation
2. Develop the intended paintbrush application using Qtopia
3. Install ADI-PCI-JTAG Emulator card and Analog Devices VDSP++
4. Test the evaluation board using JTAG and VDSP++
5. Port DAS U-boot (Bootloader) to the target board. This will facilitate porting of the kernel to the board
6. Now, port uCLinux kernel using Boot prompt (Bootloader). The porting of Linux is a complex process that involves following stages:
    i. Setup a minimalistic kernel system and add all device specific files by using the make xconfig utility and compile it to create a kernel image.
    ii. Create a root filesystem(create an empty file and format it)
    iii. Optimize the code.
    iv. Create mount points and images. Mount device files and virtual file systems.

7. Test the working of the application with a touch screen interfaced with the workstation. Use tslib files for the same.
8. Calculate the foot print area of the application. Minimize the footprint area of the application.
9. Design the complete schematic of the intended hardware.
10. Obtain the layouts and then fabricate the multilayered board. (Outside current scope)
11. Source components, build the device and repeat steps 6, 7 & 8.

Technical Details:

Hardware involved:

The application developed in Qtopia or Matchbox with Linux as OS will be ported on the ADSP-BF533 EZ-KIT Lite which is the evaluation board for BF533 processor. The board features are as follows:

• Analog Devices ADSP-BF533 processor
- Performance to 756 MHz
- 160-pin Mini-BGA package
- 27 MHz CLKIN oscillator

• Synchronous Dynamic Read Access Memory (SDRAM)
- MT48LC16M16 –32 MB (16M x 16-bits)

• Flash Memory
- 2 MB (512K x 16 x 2chips)

• Analog Audio Interface
- AD1836 – Analog Devices 96 kHz audio codec
- 4 input RCA phono jacks (2 channels)
- 6 output RCA phono jacks (3 channels)

• Analog Video Interface
- ADV7183 video decoder w/ 3 input RCA phono jacks
- ADV7171 video encoder w/ 3 output RCA phono jacks

• Universal Asynchronous Receiver/Transmitter (UART)
- ADM3202 RS-232 line driver/receiver
- DB9 male connector

• LEDs
- 10 LEDs: 1 power (green), 1 board reset (red), 1 USB (red),

6 general purpose (amber), and 1 USB monitor (amber)

• Push Buttons
- 5 push buttons with debounce logic: 1 reset,

4 programmable flags

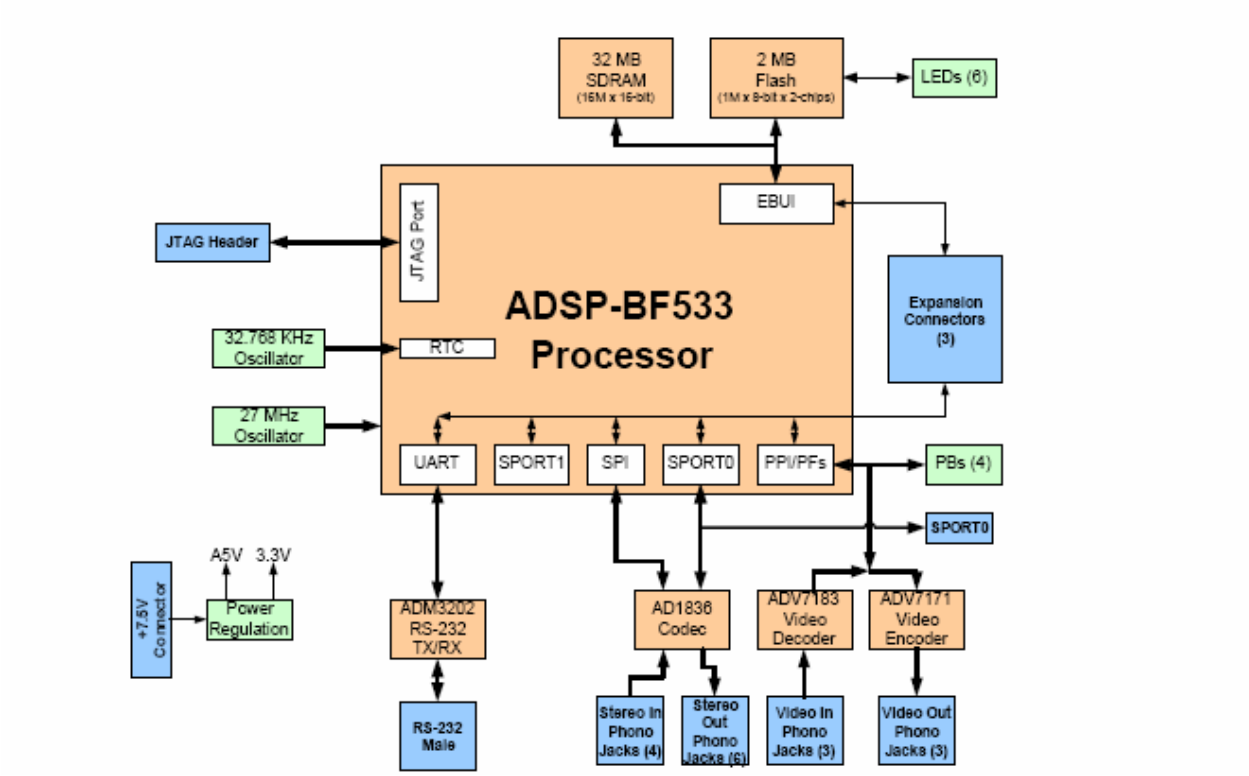
• Expansion Interface
- PPI, SPI, EBIU, Timers2-0, UART,
  Programmable flags, SPORT0, SPORT1

• Other Features
- JTAG ICE 14-pin header

The EZ-KIT Lite board has two Flash memories with a total of 2 MB of memory. The Flash memories can be used to store user-specific boot code,
allowing the board to run as a stand-alone unit. The board also has 32 MB of SDRAM, which can be used by the user at runtime.

System Architecture:

The EZ-KIT Lite has been designed to demonstrate the capabilities of the ADSP-BF533 Blackfin processor. The processor has IO voltage of 3.3V.
The core voltage of the processor can be supplied from either the internal voltage regulator or a fixed 1.4V external regulator. If the processor is operating at speeds greater than 600 MHz, it is necessary to use the 1.4V regulator.



ADSP-BF533 EZ-KIT Lite schematics:-

1. DSP:-

The schematic for the DSP of the board is provided in the appendix (Ref pg: 92, BF533)

2. LCD:-

As our application involves the use of a touch screen and an LCD, the schematic for interfacing an LCD screen is as provided in the schematic (Ref pg: 120, BF548). The given schematic is for a BF548 evaluation board. However, the schematic for BF533 evaluation board can be safely assumed to be similar.

Progress So Far:

We have successfully so far managed to develop our intended application using Qtopia on our workstation. On the hardware front, we have decided on our evaluation board to be used (i.e. BF533 EZ-KIT). We have tested the board for its functionality. We have

also ported the Bootloader and uCLinux kernel to the board. We are currently on porting the required files and interfacing the touchscreen to the board using a BW TV.

SCREENSHOT OF APPLICATION