

## Developing Touch Screen based Data Transmission Using S3C2440 Processor

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### ABSTRACT

Embedded technology and people's lives have been closely related, with respect to the data transmitting and receiving. A newly designed idea is proposed in this paper with S3C2440 ARM9 processor, touch screen, GSM modem as the core components to design a common data transmission. Thus a GSM application is developed using device drivers to provide a primitive API to access the touch screen hardware for the users. The main objective is to develop data transmission using S3C2440 ARM9 processor to give good visual quality and speed for the data transmission process. Device drivers operate in kernel mode so writing, testing, and debugging drivers is a tricky task. Drivers should always be well tested before they are installed using Linux operating system. By using this method only data transmission i.e SMS receiving and dispatching is done using GSM modem.

*Keywords* -Touch screen, ARM9, GSM modem, RS232, Mobile phone.

### I. INTRODUCTION

In recent years, embedded systems have become a centrally important aspect in a wide variety of applications, such as studying environmental phenomena, mapping and managing large-scale systems, aiding security, data services and other fields. Embedded controllers are said to have a market share of 98% or more of the global processor market, implying that less than 2% of all processors are employed in traditional computers. The ever decreasing costs and form factor of digital "intelligence" together with increased capabilities have led to a world of pervasive computing. A widely shared view is that pervasive computing is the next major evolutionary step in information technology, merging the notions of networks and computers with everyday devices. One aspect of this evolution is the

rise of new, and partially unique, data service issues. At the same time, data services have been gaining popularity in cellular networks since they were first introduced through the circuit-switched connection. As cellular carriers, however, start deploying the packet data service such as Global system for mobile communications (GSM), carriers can provide data services in a more bandwidth-efficient way over the cellular network, thereby increasing the radio resource utilization. SMS (short message service) is an improved paging service using the GSM capability to send alphabetic/numeric [6]. In general, SMS Gateway and the Terminal Way are the main two ways to send SMS messages from a computer to a mobile phone. The so-called Terminal Way is the way by using terminals controlling through cable connected computer through the equipments, such as GSM MODEM to transfer the message, which is more appropriate used in industrial/organizations control.

### II. SYSTEM DESCRIPTION

Here we discuss about the design methodology of touch screen based data transmission. The hardware design consists of S3C2440 ARM9 processor with touch screen, serial port, GSM modem, GSM mobile as shown in the figure.1. The touch screen is interfaced to mini2440 development board. And the developed drivers for data transmission are loaded onto ARM9 board using Qtopia operating system which runs on Linux kernel [8]. The data receiving and transmitting in the SMS format is done by using GSM modem. GSM modem is connected to board through RS232 as shown in figure.1. The on board UART interfaces UART0 and UART1 to connect PC COM ports. UART0 is used to perform command line operation of the board on PC and UART1 is used to communicate with PC from board using touch screen.

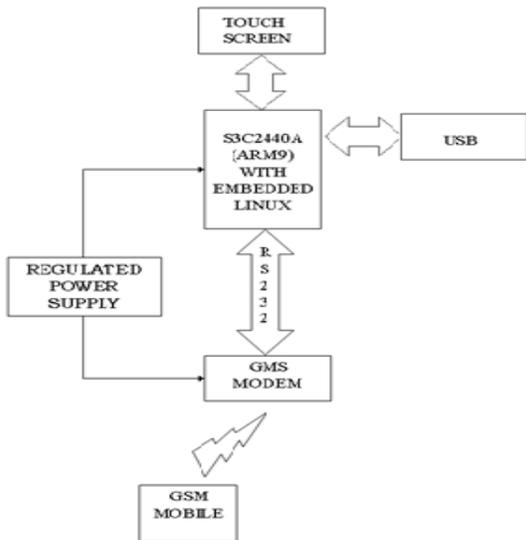


Fig 1 Block diagram of Data transmission system using ARM9

### A. S3C2440 ARM microprocessor

Implementation of drivers to touch panel for the Samsung's S3C2440 is to be develop ARM9 architecture and Samsung's S3C2440A 16/32-bit RISC microprocessor. Samsung's S3C2440A is designed to provide hand-held devices and general applications with low-power, and high-performance micro-controller solution in small die size. The ARM processor is a Reduced Instruction Set Computer (RISC). The S3C2440 is a 32 bit microcontroller that internally integrates ARM920T of the ARM Company [9]. ARM920T implements 5-stage pipeline architecture and separate 16KB Instruction cache and 16KB Data cache which are used for faster performance. The S3C2440 have some integrated on-chip functions such as LCD controller, RAM controller, 3 paths UART, 4 paths DMA, 4 path with PWM of Timer, parallel I/O port, 8 channels of 10-bit ADC, the interface of touch screen, I2C interface, two USB interface controllers, two channels SPI, the main frequency of S3C2440 up to 400MHz [4]. The Figure. 2 show the MINI2440 on-board peripherals layout.

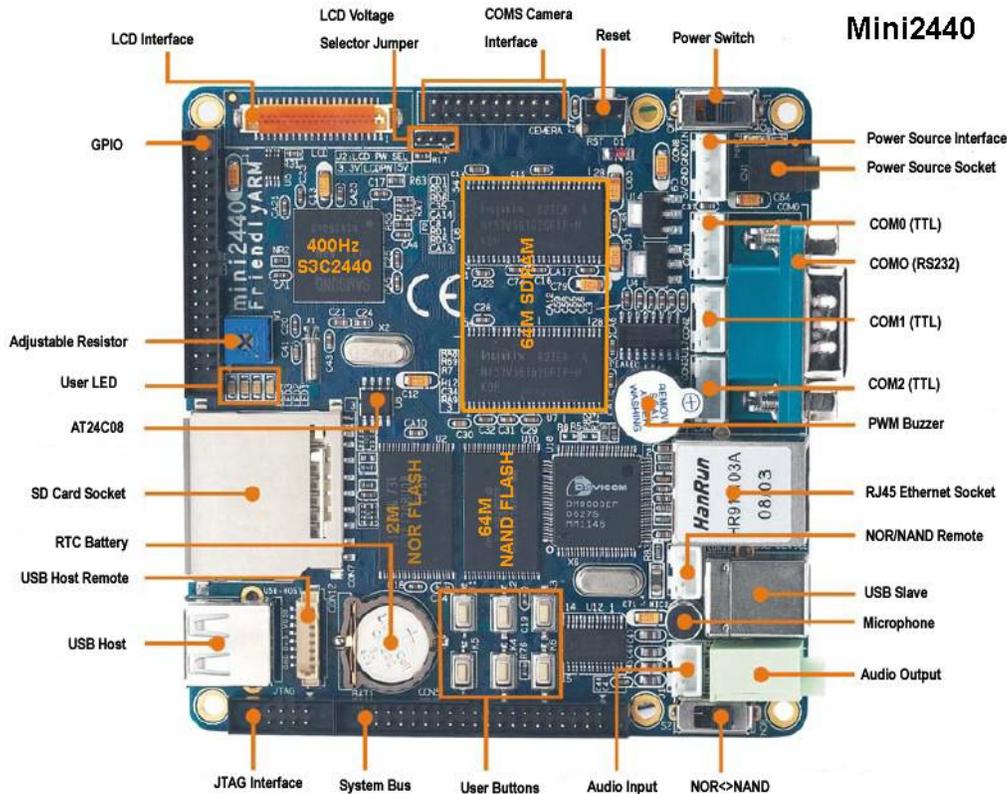


Figure. 2 MINI2440 on-board peripherals layout

**B. Four Wire Resistive Touch Screen**

Four-wire resistive touch panel uses the principal of voltage drop to detect the coordinate on the panel. The structure of 4-wire resistive touch panel consists of electrically conductive film as top layer,

electrically conductive glass as bottom layer, and spacer dot between the two layers. During operation, a 5V electrical current is applied to the conductive

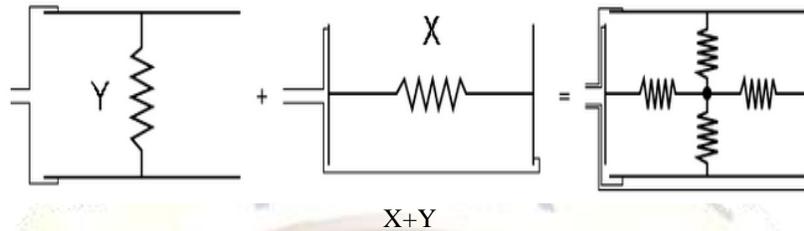
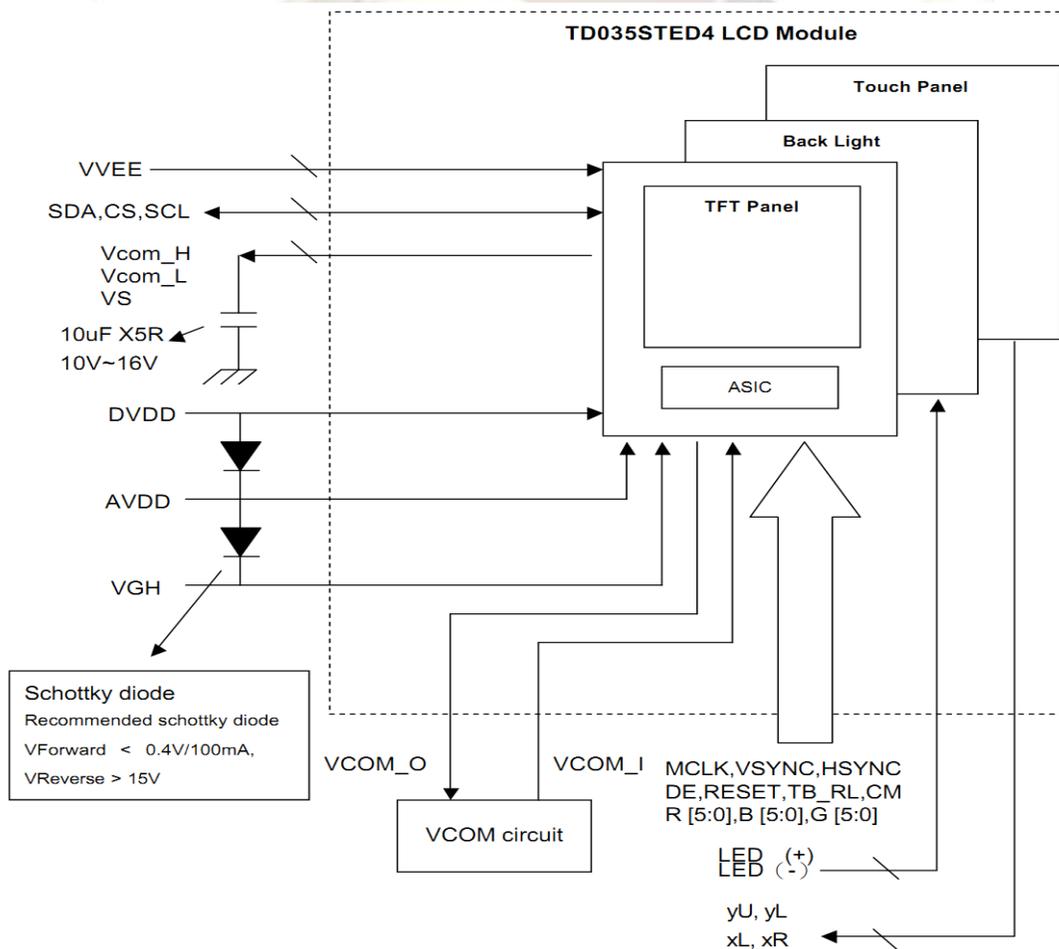


Fig 3 Diagram of 4Wire Resistive



film and conductive glass [3]. When the user presses the touch panel with finger or stylus, voltage change occurs. This action triggers top conductive film to provide X (or Y) axis and bottom conductive glass to

provide Y (or X) axis, thus report back the coordinate of the touch taken place as shown in figure.3.

### C. Universal asynchronous receiver/transmitter (UART)

A universal asynchronous receiver/transmitter, abbreviated UART is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with communication standards such as EIA RS-232, RS-422 or RS-485. The universal designation indicates that the data format and transmission speeds are configurable and that the actual electric signaling levels and methods typically are handled by a special driver circuit external to the UART. A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART, or DUART, combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called USARTs (universal synchronous/asynchronous receiver/transmitter).

### D. GSM modem

A wireless modem is a type of modulator-demodulator which connects to a wireless network instead of using telephone or cable television lines. A

mobile Internet user can connect using a wireless modem to a wireless Internet Service Provider (ISP) to get Internet access. Mobile phones, smartphones, and PDAs can be employed as data modems to form a wireless access point connecting a personal computer to the Internet (or some proprietary network) [4]. In this use the mobile phone is providing a gateway between the cellular service provider's data network technology and Point-to-Point Protocol (PPP) spoken by PCs.

Almost all current mobile phone models support the Hayes command set, a standard method of controlling modems. To the PC, the phone appears like an external modem when connected via serial cable, USB, IrDA infrared, Bluetooth wireless. This GSM modem is used to send and receive data using AT commands such as

AT+CNGS = Send Message.

AT+CNGF = Preferred Message format.

AT+CNGR = Read Message.

AT+CNGD = Delete Message.

AT+CNMI = New Message Indication.

AT+CPMS = Preferred Message Format.



Figure.5. GSM modem

## III. COMPILING AND LOADING DEVICE DRIVER MODULE

Write module program by opening any text editor and save the file with extension ".c". This module can be compiled by giving its name to makefile in

"/linux2.6.32/drivers/input/touchscreen" folder of the kernel source tree and add the following lines to "kconfig" file in the same directory.

```
config TOUCHSCREEN_S3C2440
    tristate "Samsung S3C2440 touchscreen
input driver"
    depends on MACH_MINI2440 && INPUT &&
INPUT_TOUCHSCREEN && MINI2440_ADC
    help
    Say Y here if you have the s3c2440
touchscreen.
    If unsure, say N.
    To compile this driver as a module, choose M
here: the
    module will be called s3c2410_ts.
```

Add the following line in the "MAKEFILE" of same directory

```
obj-
$(CONFIG_TOUCHSCREEN_S3C2410) +=
s3c2410_ts.o
```

### A. Installing linux on MINI2440

Now install Linux operating system on our board. To do this first we need source code of VIVI Bootloader, Linux 2.6.32 and Qtopia rootfilesystem and arm-linux-gcc-4.4.3 cross compiler tool chain.

• **Installing Tool chain**

1. Download arm-linux-gcc-4.4.3.tar.gz compressed file from friendly arm website.
2. Create a directory “/usr/local/arm”
3. Extract files to this directory by using the command  

```
#cd /usr/local/arm  
#tar zxf arm-linux-gcc-4.4.3.tar.gz
```
4. Now set environmental variables for arm-linux-gcc-4.4.3.tar.gz  

```
#export  
PATH=/usr/local/arm/4.4.3/toolchain/bin:$  
PATH
```

**B. Compiling Boot loader, Kernel and Root File System**

**1. Bootloader**

The role of Bootloader is to

- Copy kernel to RAM from flash memory, and execute kernel.
- Initialize hardware.
- Bootloader has the function that writing data to flash memory.
- It provides interface to send commands to target board or to inform user’s state of target board.

Vivi is Bootloader made to use exclusively at ARM line processor. Because vivi supports only serial interface, to communicate between host PC and embedded system, you have to connect host PC to target board by serial cable.

After setting up our cross compiler tool chain now compiles our source code to arm target board. Vivi source file is compressed with tarball ‘s3c2440\_vivi\_r1.0.tar.bz2’ [1],[3]. Extract it executing following command.

```
#tar jxvf s3c2440_vivi_r1.0.tar.bz2
```

Go to ‘s3c2440\_vivi\_rel’ directory created after extracting the tarball and then execute the ‘make menuconfig’ command.

```
#cd s3c2440_vivi_rel  
# make menuconfig
```

Please Select ‘Load an Alternate Configuration File’  
Please enter the path of the configuration file to load ‘arch/def-configs/smdk2440’  
Select ‘Exit’ and then ‘Yes’ to save your new kernel configuration. Finally save the set points and compile vivi by executing ‘make’ command.

```
# make
```

**2. Compiling Kernel**

Kernel source is compressed by the name of ‘linux-2.6.32.16.tar.bz2’. Extract this bz2 file by executing

the following command. After extracting the kernel tarball file ‘linux-2.6.32.16’ directory will generate [1].

```
# tar jxvf linux-2.6.32.16.tar.bz2  
# cd linux-2.6.32.16
```

Set the values by executing ‘make menuconfig’ command. You can load default-configuration-file that is composed with values optimized to target board. In the case of kernel, default-configuration-files are located in ‘linux-2.6.32.16’ directory. Copy the file “config\_mini2440\_t35” to “config” file.

```
#cp config_mini2440_t35 config
```

Now type

```
#make menuconfig
```

And select ‘Load an Alternate Configuration File.’  
Enter the file “config”. select ‘ok’ and select ‘exit’ and click ‘yes’. Now type the command

```
#make  
#make zimage
```

Kernel image will be created in the directory “arch/arm/boot” if the make command is successful [1].

**3. Porting Linux**

To port linux on our board first install usb drivers provided with the board to connect through usb cable and set the development board to NOR flash to start the system update and installed NAND flash [13].

Installing Linux system is mainly the following steps:

- Zoning on the NAND flash
- The installation of Bootloader
- The installation of core documents
- File system installed

**IV. DEVELOPING QT APPLICATION FOR MINI2440**

Here are the steps of creating a GUI application for Friendly arm board. You should have development tools ARM-Linux GCC 4.4.3 and ARM-Qtopia 2.2.0 already installed. The following are the steps

1. Open Qt designer which is available with "ARM-Qtopia 2.2.0".
2. With Qt Designer create the main form.
3. Create a script file "build" for building the application.
4. Create a script file "formuic" for compiling the .ui form file.
5. Run the script.

6. Create two files main.cpp , MainWindowImp.h and MainWindowImp.cpp
7. Generate the .pro (project) file using the qmake tool.
8. A project file serial.pro has been created.
9. Open it with the text editor.
10. Build the application.

The following procedure step describes how to upload these files onto our development board.

**Qtopia file system**-Create the serial Desktop file, it Takes the binary file and then open hyper terminal using serial cable connect it to the COM0 of mini2440 and COM port of the PC to change the attributes of the uploaded file. It should become executable in order to run our application.

```
[root@FriendlyARM /]# cd /opt/Qtopia/bin/
[root@FriendlyARM bin]# chmod 777
serial
```

Restart the board there will be a separate icon of gsm connectivity. Now the board is ready for the application purpose.

1. Connect mini2440 to PC COM port using COM0. Use TTL to RS232 logic converter circuit and connect COM1 to PC COM port. Using COM0 of mini2440 we can use command line interface of the mini2440 Qtopia operating system. We use COM1 to check data transmission between PC and mini2440.
2. It will show a graphical window. Touch on "setting" now select com port "/dev/ttySAC1" and baud rate "115200" and touch on "OK".
3. Open hyper terminal in the pc and give name to the connection click OK.
4. Select com port from menu of the hyper terminal click OK. Give the details of the connection baud rate 115200, data bits 8, stop bits 1, parity none and flow control none click OK.
5. Now enter the data and sent it to the board in this way we can transfer or receive the data from mobile

## V. RESULTS

Data transmitting from ARM9 board to GSM mobile in SMS format using GSM modem as shown in figure 6. In ARM9 board data is to entered and sent. Mobile is displaying the received data through sms.



Figure. 5 Sending data from ARM9 board to mobile

## V. CONCLUSION

The method mentioned above is the way of summarizing in the realization process of data transmission in sms format using GSM modem, by using Linux operating system. GSM modem performs the data transmission using AT commands.

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