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EMBEDDED LINUX BASED GRAPHICS LCD APPLICATION DEVELOPMENT

Mrs. D.K.Shende[1]*, Mrs.S.S.Barve[2] and Mr.S.B.Mule[3]

1 - Assistant Professor, SIT, Lonavala
2 - Assistant Professor, MAE, Aalandi
3 - Assistant Professor, SCOE, Pune

ABSTRACT

Linux is a popular operating system for embedded systems. Linux has come a long way since its humble beginnings in 1991. Today Linux supports a very wide range of platforms, from Embedded Systems based on ARM, PowerPC, Intel, and Hitachi microprocessors. It also served as a launch pad for the open source movement, and consequently leads to great interest. This paper describes one such application of Linux of generating software for interfacing Graphics LCD using hardware ARM9 Single Board Computer. Uses sensor card to get data. This data will be from various sensors. This data is to be shown on the LCD. For some data will have to do perform some calculations and then display on the LCD. Data will be updated every second. This will involve interface of Color LCD, keypad, encoder. This will also require interface with PC for future expansion to create interface with Webpage.

1.1 INTRODUCTION

Embedded Linux Based GLCD application development project is used for interfacing the sensor data card with ARM9 processor based Single Board Computer and displays the records on Graphics LCD (GLCD) with read-through of upper and lower limit of incoming data through two encoders and indicating the same on GLCD.

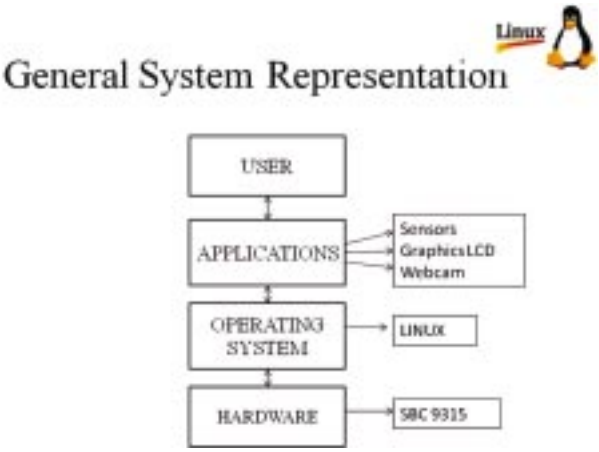
Sensor data card consist of all together four sensors-Temperature, Pressure, Humidity, Distance respectively. Sensed parameters coming from Temperature, Pressure and Humidity sensors are analog data which is given to SBC9302 processor through ADC and Distance sensor data is serial data directly in centimeter which is given to processor through serial port. The precise data coming from all four sensors are displayed on 320 X 240 Graphics LCD in different graphical format. Before displaying data on GLCD all sensed parameters are first set to Upper and Lower Limit by two encoders. These two encoders set the upper and lower limit by two Knobs respectively. Output parameter fluctuate number of pulses which are directly dependant on the knob position. GLCD also shows indication of over and under measurement status after doing respective calculation.

We can develop all of our code on your PC and the embedded system has full access to all of the files on your PC. This is not helpful in all systems but under certain circumstances it is very helpful. Linux provides such access. Due to its open source nature, Linux has a highly qualified code base. The Kernel can be very small; it could fit onto a single 1.4MB floppy disk drive, while including all the fundamental operating system tasks. It is highly portable; it is available for almost every microprocessor system in existence today. It is highly supported; it draws on the open source community across the globe for both development and support. It supports a multi-user environment with a built in Capability to concurrently execute applications belonging to 2 or more users. It also supports multiprocessor systems, is well documented.

*dkshende@gmail.com

1.2 GENERAL SYSTEM REPRESENTATIONS

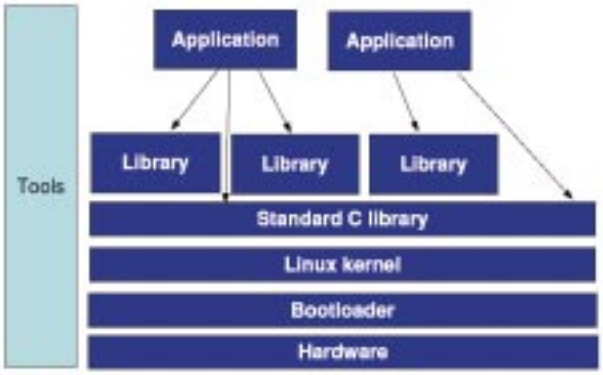
The basic block diagram is as mentioned below. The unit consist of the ARM9 processor based Single Board Computer. This single board computer is having embedded Linux preloaded. SBC9302 is based on Cirrus Logic EP9302 processor, which has ARM920T core. Although stand-alone (no OS) applications can be run on SBC9302, it is primarily intended to run Linux based applications.



1.3 SINGLE BOARD COMPUTER (SBC)

Single board computers are most commonly used in industrial situations where they are used in rack mount format for process control or embedded within other devices to provide control and interfacing.

Because of the very high levels of integration, reduced component counts and reduced connector counts, SBCs are often smaller, lighter, more power efficient and more reliable than comparable multi-board computers.



Feature of the selected single-board computers (SBC):-

Hardware: EP9302

SBC9302 is based on Cirrus Logic EP9302 processor, which has ARM920T core.

1. 200 MHz (184 MHz for industrial) ARM9 CPU (EP9302)
2. On-board 8 MB Flash, 32 MB SDRAM
3. Optionally, upto 16 MB Flash and upto 64 MB SDRAM
4. 2 UARTs with option for RS232 / RS422 / RS485 / TTL (3.3V level)
5. RJ45 Ethernet LAN interface
6. 2 USB Host interface ports
7. 1 USB device interface port
8. PC/104 expansion bus
9. Channel 12 bit ADC
10. Upto 23 GPIO (3.3 Volts TTL)
11. RTC with battery-backup
12. SD-Card interface
13. Standard 20 pin JTAG interface
14. Wall type power supply included
15. One serial cable and one USB cable included.
16. Small size - (90 x 95 mm)

1.4 BLOCK DIAGRAM

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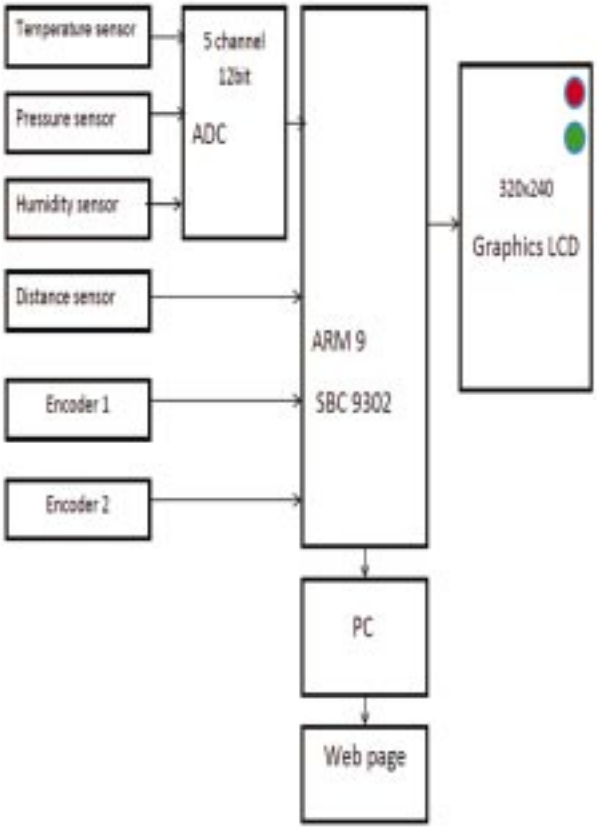
The precise data coming from all four sensors are displayed on 320 X 240 Graphics LCD in different graphical format. Before displaying data on GLCD all sensed parameters are first set to Upper and Lower Limit by two encoders.

These two encoders set the upper and lower limit by two Knobs respectively. Output parameter fluctuate number of pulses which are directly dependant on the knob position. GLCD also shows indication of over and under measurement status after doing respective calculation.

Following are the essential for embedded Linux setup:

1. Embedded system development board (like ARM9 board)
2. Host PC
3. Serial cable
4. Ethernet cross cable
5. Embedded Linux kernel running in board.



Serial connection is used to bring up shell in host pc. Ethernet connection is used for downloading kernel and debugging. Host terminal must have following tools:

1. IDE
2. GCC tool chain for Embedded Linux.
3. TFTP (Trivial File Transport Protocol) server,

This is for downloading of modules. Linux is free to download, user is free to modify source code, user is free to distribute its modified code to everyone. But, as in order to use it professionally, we still need following,

- Integration
- Development of Board
- Support Package (BSP)
- Maintenance
- Support

All above things are not free of cost but user has to pay for the same.

Linux is one of the favorites Operating System for Embedded development.

A] Benefit of using Embedded Linux

1. Vendor independent

Using Linux means you are no longer depend on particular vendor for supply of tools. In Linux everything is available from open source community. Even service model of all Linux vendors is almost same they used to provide Linux kernel, libraries etc. So, user can easily switch from one vendor to another. And even if user wants to go without vendor, everything is freely available. But in that case of the work of integration, BSP development has to be done by use itself.

2. Easy availability of used tools

In embedded Linux so many development tools and utilities are easily available. User can download them and use them freely. So this result in fast development time for embedded system products.

3. Various hardware supports

Linux community is very active. They regularly add support of new hardware. Linux is used in various research laboratories and universities worldwide, so

Linux is always up to date with latest hardware support.

4. Low cost development

By using Linux in embedded system product, we can development low cost products. Linux development tools are free and easily available. Linux is royalty free. There is no need to pay royalty for making any number of products.

B] Development Tools

Development tools are important. They save development and debug time. But most importantly, they make developers more happy and productive by automating many routine, boring, and time-consuming tasks. It's painful to see programmers spend a significant percentage of their valuable time on such routine tasks as downloading their code to the embedded target. This situation is not uncommon even with traditional embedded systems, but it's far worse with embedded Linux, where the lack of good development tools is evident.

Commercial tools

Embedded Linux integrated development environment (IDE) software suites are usually available from the same companies that sell embedded Linux. Wind River, MontaVista, TimeSys, LynuxWorks, and a dozen other vendors come to mind.

However, these are open source tools and can be downloaded from Internet. Important tools required are:

1. **gcc compiler**: This is native compiler - i.e. runs on Linux computer and generates executables for Linux computer. This is generally part of the Linux installation on the computer.
2. **arm-elf-gcc**: This is cross compiler - i.e. runs in Linux computer and generates executables for standalone ARM targets. This is is useful for generating executable file of boot-loader. Boot-loader is a standalone application, since it starts before Linux. This can be downloaded from Internet.
3. **arm-linux-gcc**: This is cross compiler – i.e. runs in Linux computer and generates executables for ARM Linux targets. This is useful for generating Linux applications to run on SBC9302 board. This can be downloaded from Internet.
4. **make**: This is Linux standard make utility, useful for building complex projects. This is generally part of the Linux installation on the computer.
5. **Minicom**: This is a serial terminal utility – similar to HyperTerminal of Windows. This can be part of Linux OS installed on the computer.
6. **TFTP**: Stands for Trivial File Transfer Protocol – it is a useful tool for transferring files over Ethernet LAN. This can be also part of Linux OS installed on the computer.
7. Many useful make files, configuration files and some shell scripts can be also considered part of the development tool.

1.6 FUTURE EXPANSION

- The GUI on GLCD will transmitted through network and displayed on demand through webpage.
- Includes serial interface and remote access with unit.

1.7 References

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