

A Study on System Development Process based on Embedded System

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Abstract. Embedded systems are suitable for application system with strict requirements on the functionality, reliability, cost, size and power consumption. Also embedded Linux has been widely used to its numerous characteristics, such as open-source, small size, fast speed, and excellent network performance. Therefore, embedded Linux gets more attention and has more application in industrial monitoring field. In this paper, we propose system development process based on embedded system. Using this system development process can increase the reusability of development process and time.

Keywords: Development Process, Embedded System, Host/Target

1 Introduction

In recent years, methods to collect data from around also have been presented. In addition, by the fast performance, optimization and miniaturization technology of hardware, sensors that collect environmental information from around have been miniaturized. And there are a lot of monitoring programs using sensor. To collect and analyze data sent from various sensors, PC server is used previously. But recently, embedded systems are usually used. Due to high performance and optimization techniques, now embedded systems can also run many programs that work on server. Though there are many advantages, system development on embedded systems are more difficult than on a PC. In this paper, we present system development process based on embedded system.

2 Related Work

Embedded systems are resource constrained and have power limitations [1]. So, embedded systems need slim and real-time operating system. Because of the numerous economic and technical benefits, embedded systems usually adopt embedded Linux as operating system. Linux can be made to run on almost any CPU

board. So, embedded Linux may be the best choice for a particular embedded system. In other words, embedded Linux system simply designates an embedded system based on the Linux kernel and does not imply the use of any specific library or user tools with this kernel [2]. Wireless sensor networks provide sensing information and process this information. Wireless sensor networks compose of many sensing nodes [3]. Sensor node consists of one or more microcontrollers, CPUs or DSP chips and has multiple types of memory, a RF transceiver and a power source such as battery. Also sensor nodes accommodate various sensors and actuators.

3 System Development Process

In the development of embedded systems, application development is performed by the host and application execution takes place on the target. In addition, to collect and analyze in real time data sent from various sensors, a monitoring program is developed through interworking between embedded systems and wireless sensor network. In this paper, we present system development process for monitoring system based on embedded system. In general, monitoring system includes collecting, storing and processing of environmental data gathered with many sensor nodes. The overall architecture of embedded system and sensor node interworking system is shown in Figure 1. In this paper, embedded Linux is installed to embedded system and sensor node uses microprocessor, RF Chip, sensor board and so on.

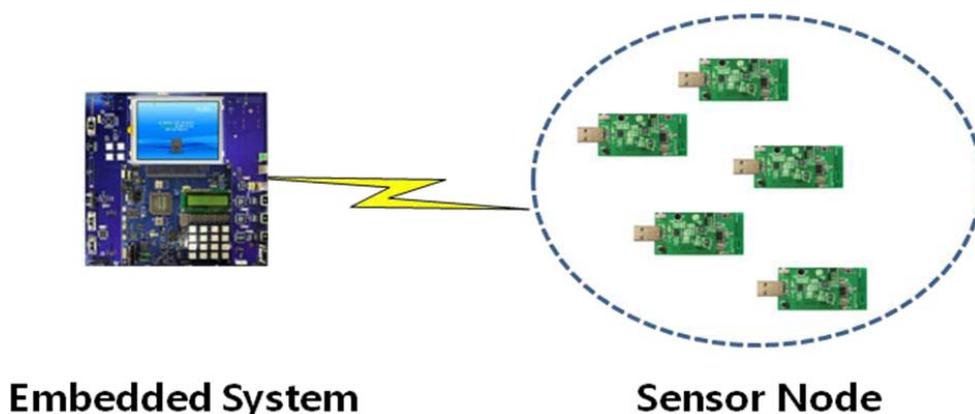


Fig. 1. Architecture of embedded system and sensor node interworking system

We analyzed a lot of use cases about monitoring system based on embedded Linux [4][5]. As mentioned before, system development process for the monitoring system is based on development and runtime environment. The overall environment consists of host, target and wireless sensor networks. In the host, Linux as operating system, tool-chain as cross-compiler and TinyOS for wireless sensor node is installed. In the target, boot-loader for booting, kernel and file system as embedded Linux, DBMS for environmental data management and monitoring program as an application is installed. In wireless sensor nodes, sensing program as application is installed. System development process for monitoring system based on embedded system mainly

consists of three parts, such as host, embedded system and sensor node. System development process can be represented as follows:

1) Install OS: Install operating systems for development environment. These are Linux and TinyOS. In Linux, porting of kernel and file system for embedded system is processed.

2) Tool chain: Tool chain as cross compiler tool is used to generate executables for embedded system.

3) Modify Makefile: To transplant monitoring program to set up embedded system, modify some part of Makefile.

4) Install monitoring program: Compile monitoring program using a modified Makefile and then install monitoring program which consists of three modules, such as collection, analysis, storage.

5) Install sensor program: Compile sensor program and then install sensor program which consists of sensing and transmission module.

6) Install DBMS: Install embedded DBMS for environmental data management.

4 Conclusion

The development of embedded systems is done by separating the host and target. Monitoring program is developed through interworking between embedded systems and wireless sensor network. In this paper, we present system development process for monitoring system based on embedded system. Using the proposed system development process promotes the reuse of development process and modules and can reduce development time and errors.

References

1. Kyung-Seok Hyun, Myung-Eui Lee, "Implementation of Digital Photo Frame using Embedded Linux System", Journal of the Korea Academia-Industrial cooperation Society, Vol.7, No.5, pp.901--906, October (2006)
2. Fang Ruomin, Chen Guoding : Building development platform of wind power monitoring system based on embedded Linux, Electronic Component & Device Applications, Vol.11 No.5, pp.40--42, May (2009)
3. Dae-Woo Choi : Implementation of a Testbed for Wireless Sensor Network, Journal of the Korea Academia-Industrial cooperation Society, Vol.12, No.1, pp.445--450 (2011)
4. Jie Cao, Lei Yin, Hong Zhao : Design and Development of Embedded Multimedia Terminal, Distributed Computing and Applications to Business Engineering and Science (DCABES), Ninth International Symposium, pp.289-292, August 10-12 (2010)
5. Jiang Linying, Zhu Zhiliang, Li Hailong, Guo Zhenhua : Embedded Laboratory Environment Monitor System, Information Engineering, ICIE '09. WASE International Conference, pp.197--201, July 10-11 (2009)