

# Teaching Research Based on Embedded Linux System Development and Application

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**Abstract**—In recent years, embedded Linux has become the darling of embedded operating systems due to its own powerful advantages and rapid development of Linux, as well as its advantages in kernel volume, tailoring, stability, and price. More and more people use embedded Linux system development research, it can be said that this has become the trend of The Times. This study first introduces the definition of embedded systems and the advantages of Linux embedded systems and then presents the hardware structure of embedded home gateway. Through the understanding of the Linux operating system, the working principle of the Linux system is analyzed, and the design of the Linux network device driver is simply studied.

**Keywords**— Embedded Linux System, Network, Hardware structure.

## I. INTRODUCTION

Recently, with the development of computer technology, an embedded system has become an important part of the computer field. Embedded devices can almost be said to be ubiquitous. There are many such devices around our lives, such as mobile phones, TV sets, etc., some big machines, such as cars, etc., or some security systems with high confidentiality [1]. Due to the high real-time performance of Linux, strong adaptability, and the use of a very wide range, at the same time with a small functional perfect kernel and other unique advantages [2]. Because these advantages of embedded Linux endowed the industry with new vitality and hope, arousing the strong interest of the enthusiasts concerned. The Embedded Linux operating system is one of the most important parts of the embedded system. It connects both hardware and software and combines hardware and software. It should not only be able to be used in some specific applications but also be adaptable in terms of cost, safety, reliability, and size [3].

Embedded system is mainly in the application, it depends on computer technology because it can achieve the software and hardware cutting, so it is more practical for some of the functional, safe and reliable performance of the higher special computer. In the embedded system, the operating system and application software are in the computer hardware, that is to realize the combination of software and hardware [4]. An embedded system has many advantages, such as the amount of software code required to develop an embedded system is very small, the embedded system response speed is very fast, and so on. Because of its advantages, the embedded operating system is generally used in real-time and multi-task processing systems. In the early embedded computers, because there was no popularization or general use at that time, the

characteristics of the embedded computers at that time were more specific, and the software could not use general software but had to be specially written and developed. In the early days of microprocessors, in order to improve the temporal and spatial efficiency of embedded software, assembly language was used to write the code. But in recent years, with the rapid development of microelectronics technology, embedded systems no longer strictly pursue the space-time efficiency of software.

## II. EMBEDDED LINUX SYSTEM

The advantages of Linux are very obvious, its source code is open, the kernel is very robust, and many Linux systems are free for use, which is a kind of welfare for many professionals, and it is this powerful advantage that Linux has become one of the most influential mainstream operating systems in today's society [5]. And the Linux operating system plays a very important role in Internet servers. Linux is a general-purpose operating system, and its best application domain is the server domain. Although its design principles conflict with embedded systems, it is found that these problems can be solved after the study of its core structure [6].

Linux as an embedded operating system is a very big advantage, and this advantage is far more than other embedded operating systems [7]. The advantages of an embedded Linux system can be described as follows:

### (1) Efficient network communication performance

The Linux kernel is very simple and practical in the design of the network protocol stack. It has realized a relatively complete network protocol set. In the high-level network protocol, Linux not only supports some basic protocols but also can directly use SLIP and PLIP protocols, so that the serial port and parallel cable can be directly connected. In addition, Linux fully supports the TCP/IP protocol, which is generally supported in networking systems.

### (2) Robust and stable

The embedded Linux system is very robust, stable, and also very safe, Linux after continuous development and optimization, thus derived from the embedded Linux, there is no doubt that it will inherit these advantages of Linux. Embedded systems to a certain extent will be more robust, stable, and have security requirements, so many people before the existence of the first implementation, and then found the error to correct the idea in embedded development is not. The reason why we choose Linux as the embedded operating

system is the advantages of the Linux system and apply them to the embedded system.

Linux is easy to maintain, and users can centrally update the operating system and all installed software. Each distribution has its software management center, providing regular updates that are both secure and efficient.

### (3) *Open source code and free*

Linux is known to be open source, and this is probably a big reason for the current popularity of Linux. It is the open-source nature of Linux that has led to the rapid development of Linux in recent years. Because the code in Linux is open to the public, many professionals can modify it with greater freedom. At the same time, it is easy to communicate with others when encountering problems, which promotes its development. In addition, some software and programs developed with Linux are open to the outside world, which are valuable resources for developing embedded systems. Under the premise of completely open kernel code, users in different fields and at different levels can easily transform the kernel according to their own application needs, and design and develop embedded systems to meet their own needs at a low cost.

### (4) *Support for multiple platforms*

Embedded Linux is currently supported on many hardware platforms and is an embedded operating system that runs on many different devices. Need to invest a lot of money and time during development, it is often a lot of research and development team, but Linux embedded system just can try our best to avoid this restriction, and Linux on time management, adopt a unified model for management, on the hardware platform of the changes will not affect the upper application, namely, the management can be effectively reduced.

### (5) *High availability and security*

Linux is very stable and not prone to crashes. Linux can run as fast as it did when first installed for several years. Windows, on the other hand, can be slow after six months. Linux has a long uptime and no need to reboot after each update or fix. As a result, Linux runs the most servers on the Internet.

Installing Linux is a great way to prevent viruses from pouring in. In Linux, the program cannot change system Settings and configurations unless the user logs in as root. Therefore, the permissions of downloaded files/malware will be limited. That is unless you are in power user status, you cannot even install software, and viruses/malware cannot be installed automatically. And because Linux is open-source, developers around the world can view the source code, which means most of the bugs have already been dug out.

### (6) *Easy to maintain*

Traditionally, Linux was only for geeks, but now Linux is a user-friendly operating system with a nice graphical user interface (GUI). It has almost all the features of Windows, and the GUI has evolved to the point where it meets the needs

of most users. Some people think Linux isn't good enough for gamers, but there are several games available on Linux.

### (7) *Free and super customization*

Embedded Linux is completely free, and it has a powerful suite of free software, from educational software to audio/video editing. Many companies can use the software for free, greatly reducing the cost budget. Linux is so flexible that users can customize the system to their needs. It offers a large selection of wallpapers, desktop ICONS, and panels, with more than half a dozen desktop environments to choose from. For other tasks, from GUI interfaces and file managers to DVD burning, there are different options available for the specific software. The system administrators can enjoy a powerful command-line write shell scripts to automate routine maintenance and a variety of other tasks. Therefore, you name it, Linux pretty much does it.

## III. APPLICATION FIELDS

As the core of digital products, an embedded system has been put into use in many industries, automobile, instruments, communication, and other fields have great application value, in addition, although the current operating system has been called a part of the embedded system the control logic is still a single program [8-11]. At present, the application of the embedded systems is quite extensive, and the application demand is quite market, which has great research value in the research prospect and has the potential for further research and development. The application of embedded system mainly includes the following aspects:

### (1) *Industrial field*

In the tide of industrialization, the embedded technology is also in a very important role, the effective application of embedded technology in industry field, for industrial development in the direction of fully automated also played a very important role, including automatic numerical control equipment, such as smart meters, modern technology, and embedded technology is to improve residents' quality of life [12]. The key technical support to promote national economic development. The typical application of embedded technology in the industrial field is a robot, and with the continuous development of artificial intelligence, it can be expected that one-day robots will completely replace artificial, in order to achieve a significant reduction in the cost of industrial production, embedded technology is of great significance. In addition, for the very popular intelligent mechanical equipment, the application of embedded technology which also has the very vital significance, the data processing technology, remote sensing technology, and embedded technology of organic combination, can largely promote the industrial level of human ascension, which in turn can greatly promote the progress of human society.

As a whole, the application of embedded technology in the industrial field mainly focuses on improving the level of industrial production automation, promoting the development of artificial intelligence technology, and then improving the overall strength of the industry.

## (2) Consumer electronics

In addition to the military, industrial and communication fields, embedded technology has been widely used in the field of electronic consumption. In recent years, with the rapid popularization of the Internet and the rapid development of information technology, it has provided a very important technical foundation for the development of e-commerce, and then in recent years, the electronic consumption industry has developed rapidly [13].

In the field of consumer electronics, mobile storage and smart home appliances are derived from embedded technology based on the full application. Many new electronic products have appeared in our daily life and are playing an increasingly important role in our daily life. Among them, intelligent home appliances, network equipment, and other products have gradually evolved into indispensable products in people's life. Under the background of the rapid development of the 3C industry, the application of embedded technology in the field of electronic consumption has inherent technological advantages, and in the future design of intelligent home appliances, it can realize more in-depth human-computer interaction based on embedded technology. Through such intelligent design, can let all the equipment in a family and embedded technology are connected, then can realize the curtain device, lamp device, and other devices with the change of time, the change the season and make the corresponding adjustment. Home automation adjustment, while bringing consumers a better consumption experience, can also effectively realize the reduction of energy consumption, visible embedded technology in the field of electronic consumption application of the important significance.

## (3) Communication field

The application of embedded technology in the field of communication plays a very important role in improving the transmission of communication data. Compared with the traditional computer technology used in the field of communication, embedded technology can provide more support [14]. Under normal circumstances, an ordinary embedded computer can realize the effective control of various components of the computer under the action of the microprocessors. Such as network card, digital camera, printer, Modem E, sound card, floppy drive, scanner, USB hub, monitor, mouse, hard disk, keyboard, display card, and other parts can be effectively controlled based on the embedded computer.

In addition, relying on the extensive application of embedded technology in the communication industry, it can also provide various advanced equipment and instruments for related industries and is widely used in communication, consumption, instrumentation, process control, and other fields, promoting the development of social and economic development toward a more advanced field. At the same time, to meet the consumer demand for different products of science and technology, the choice of means of communication for humans to provide more choices, enhances communication convenience, safety, and speed, to ensure that all kinds of communication information can be accurately and quickly to

complete the transfer operation.

In general, the Embedded Linux operating system of embedded and information home appliances supports all the computing functions, but the kernel needs to be customized and tailored according to the actual application, so as to provide drivers for special hardware and develop applications on this basis.

## IV. CONCLUSION

In this paper, make full use of the current embedded Linux system technology, effectively improve the application level and scope of embedded technology in intelligent products, and effectively improve the cost performance of embedded technology, based on the development of embedded technology to drive the rapid development of computer technology.

Therefore, the embedded Linux system technology performs special functions, under the control of internal computer equipment or system, with strong timeliness, low power consumption, high thin, low resource utilization, easy control, high specificity, and many other advantages, the current in the field of industry, communication and consumer electronics fields such as the many fields have a wide range of applications. The future market demand for embedded technology will continue to increase.

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