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By:

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THEME

Configuration and Implementation of uClinux on Hardware Platform

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TABLE OF CONTENTS:

- **Introduction:**

An embedded system is a special-purpose computer system that is designed to perform very small sets of designated activities. Embedded systems date back as early as the late 1960s where they used to control electromechanical telephone switches. The first recognizable embedded system was the Apollo guidance computer developed by Charles Draper and his team. Later they found their way into the military, medical sciences, and the aerospace and automobile industries.

Embedded systems, which are widely used in consumer electronic appliances, are characterized by a rapidly increasing complexity and shorter product cycles. The designers are under more and more pressure to reduce design cycles usually in the presence of continuously changing specifications. This explosive growth in the embedded systems market has been fueled by rapid prototyping technologies. The ability to quickly program microprocessor memories in-circuit and reconfigure field programmable digital hardware is critical to embedded systems engineers who must meet ever shortening development cycles.

Today they are widely used to serve various purposes; some examples are the following.

- Network equipment such as firewall, router, switch, and so on.
- Consumer equipment such as MP3 players, cell phones, PDAs, digital cameras, camcorders, home entertainment systems, and so on.
- Household appliances such as microwaves, washing machines, televisions, and so on.
- Mission-critical systems such as satellites and flight control.

In the early days effectively no operating system was used in embedded systems. There was in-house development of all the software that directly drives the hardware with almost no or very minimal multitasking and user interaction in place. But with the passage of time, more complex embedded systems started emerging and along with that a growing list of features that an embedded system should support.

All of these requirements mandated use of an operating system in embedded systems that should at least provide multitasking/multithreading, process and memory management, inter process communication, timers, and so on. So the companies started enhancing their in-house developed software so that they could have a minimal

but a full featured operating system running on their embedded platform. Various firms started efforts to provide an operating system aimed at embedded systems.

Today we have a multitude of embedded operating systems. Apart from company in-house developed operating systems we have Wind River's VxWorks®, Microsoft® Windows® CE, QNX® Neutrino®, Accelerated Technology®'s Nucleus™, Red Hat®'seCos™, Sun Microsystems ChorusOS™, LynuxWorks™'s LynxOS®, and embedded Linux as primary embedded operating systems.

The objective of this project is the implementation of embedded Linux system on based arm7tdmi processor at91 Atmel platform.

For this work we will use gnu development tools to compile uClinux and build our system and our platform based on 2.6.x kernel of linux.

This project presents on four chapters in first chapter we will talk about the uClinux and we will compare between Linux and uClinux, also we will speak about architecture of uClinux and kernel source code in the final we will speak about gnu toolchain gcc and binutils components , they are important for our work .

In second chapter we will describe the development platform card, in our case it is the Atmel AT91SAM7SE-EK based on arm7tdmi processor. It's architecture is then given .in the third chapter we will configure and compile uClinux for getting image of our Atmel AT91SAM7SE-EK board. And in the final chapter we will speak about how we can transfer our system and its application to our platform and execute it in xip (Execute in Place).

This project finishes with general conclusion about our work and prospects for future work.

- **Conclusion:**

The embedded systems are very important in our life, they cover many fields in our life like Network equipment, Consumer equipment, Household appliances and Mission critical.

This work presents an implementation of embedded Linux system on hardware a platform. For this work we chose uClinux as OS for our embedded system because it is open source project, free for use and widely used in the embedded world. It can support new drivers and user applications.

To compiling and building our system, we needed a cross-compiler for ARM target because our platform is based on arm7tdmi processor. So we installed this compiler in our Linux operating system and we chose Linux as operating system because the uClinux is the popular variant of mainstream Linux, specially designed for deeply embedded microprocessors without the memory management unit.

Before building our embedded system, we had to configure it. Essential configurations were done by choosing the right product (Atmel in our case) and vendor at91 .we chose the library uClib for our system because we needed it when we write our applications in language c and add it to uClinux.in configuration we chose the 2.6x kernel because it supports Atmel at91 platform. In addition, it is very light, modern and the most of platforms and their embedded system in uClinux and their architectures works with it. We configured the kernel by choosing arm7tdmi processor and specified the memories addresses and sizes like they are indicated in the technical sheet for the hardware platform.

For file systems options, the romfs(read-only) acts as the root file system which is necessary ,whereas the ext2 is read-writable but it consumes significant memory space. You can determine to select ext2 or not or even other file systems according to your memory size and your application.

After that we compiled and build uClinux and then we got our system binary image.

To verify that our system work, we had to simulate it using Skyeye simulator. This simulator was before that configured for our hardware platform. The results were good and we saw our system worked on skyeye.

After, we linked the PC with our platform for transferring and testing our system and the application. For that we used SAM-BA 2.11 produced by the company itself.

Prospects:

- Our system is open source project, so it let us to add on it new drivers or platforms.
- We can transfer and lunch our system on a hardware platform in order to manage or lunch a customized task or an user application.

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- **ملخص**

ان هذا العمل حول تطبيق نظام متضمن من اجل لوحة ذاكرة شركة اتمل يستند على معالج ارم7ت د م ي. لهذا العمل نستعمل نظام التشغيل يوسي لينكس. وقد استخدمنا سلسلة ادوات الجنو من اجل تأليف نظام التشغيل يوسي لينكس .وقد قمنا بتشكيل يوسي لينكس من اجل خلق النظام المتضمن .ومن اجل بناء النظام استخدمنا المجمع الخاص بالأنظمة المتضمنة . ومن اجل التأكد من ان نظامنا يشتغل استخدمنا برنامج نظام محاكاة. ان هذا العمل مصدر مفتوح نقدر علي تطويره بالمستقبل.

الكلمات المفتاحية:

يوسي لينكس ,لينكس, الأنظمة المتضمنة,الجنو،شركة اتمل

- **Abstract:**

This work about implementation an embedded Linux system for a platform Atmel bases on a processor arm7tdmi. For this objective we use operating system uClinux .we use GNU toolchain for compiling uClinux specially GCC and binutils components. We configure uClinux for create our embedded system .for building our system we use arm cross compiler .when we get our system we simulate it with special simulator. This work is open source we can develop it.

Key words: embedded system, uClinux, GNU toolchain, arm cross compiler, Atmel, arm7tdmi.