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# Implementing µCos II Kernel Based RTOS Using ARM7 TDMI (LPC2148) Based Controller

**Barigela Kalpana**
M.Tech(ES),
Raja Mahendra College of Engineering,
Hyderabad.

**B.Gajan, M.Tech**
Assistant Professor,
Raja Mahendra College of Engineering,
Hyderabad.

## ABSTRACT:

A real-time operating system (RTOS) is key to many embedded systems today and, provides a software platform upon which to build applications. Not all embedded systems, however, are designed with an RTOS. Many embedded systems, however, with moderate-to-large software applications require some form of scheduling, and these systems require an RTOS.In this project we are going to perform multitasking simultaneously. We going to perform tasks like LED blinking, LCD message display, serial communication (UART0 and UART1), buzzer simultaneously using Micro C/OS – II kernel based RTOS.

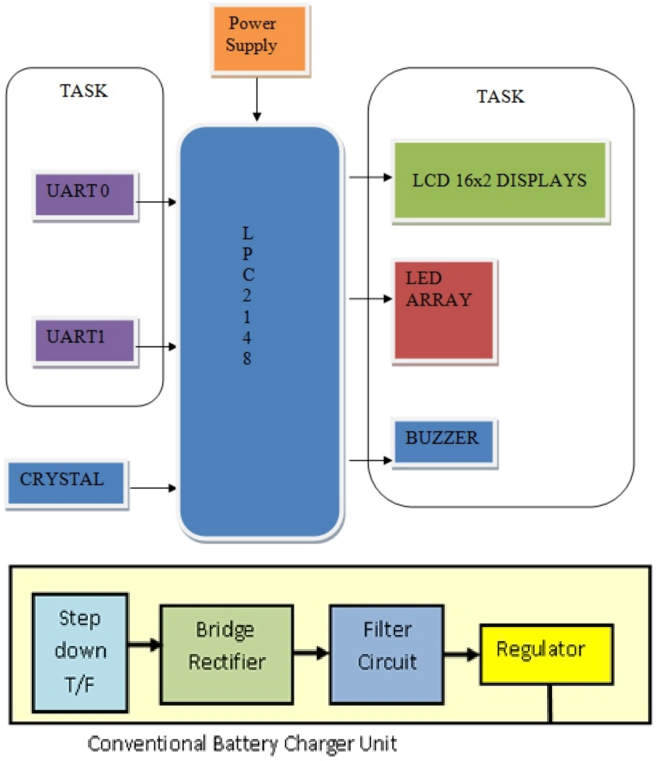
## LPC2148 Controller:

The LPC2148 are based on a 16/32 bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT,PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. With a wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

## Power supply:

This project uses two power supplies, one is regulated 5V for modules and other one is 3.3V for microcontroller. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full Wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

## BLOCK DIAGRAM:




## SERIAL COMMUNICATION:

The main requirements for serial communication are:
1. Microcontroller
2. PC
3. RS 232 cable
4. MAX 232 IC
5. HyperTerminal

When the pins P3.0 and P3.1 of microcontroller are set, UART which is inbuilt in the microcontroller will be enabled to start the serial communication.

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## Architectural overview:

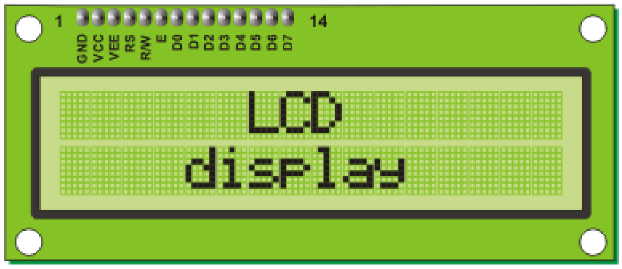
The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of microprogrammed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

• The standard 32-bit ARM set.
• A 16-bit Thumb set.

## LPC2148 CONTROLLER
## General description:

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

## LIQUID CRYSTAL DISPLAY:




A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each . It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

| Command | RS | RW | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Execution Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Clear display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1.64mS |
| Cursor home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | 1.64mS |
| Entry mode set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | 40uS |
| Display on/off control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | U | B | 40uS |
| Cursor/Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | D/C | R/L | x | x | 40uS |
| Function set | 0 | 0 | 0 | 0 | 1 | DL | N | F | x | x | 40uS |
| Set CGRAM address | 0 | 0 | 0 | 1 | CGRAM address | | | | | | 40uS |
| Set DDRAM address | 0 | 0 | 1 | DDRAM address | | | | | | | 40uS |
| Read "BUSY" flag (BF) | 0 | 1 | BF | DDRAM address | | | | | | | - |
| Write to CGRAM or DDRAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 40uS |
| Read from CGRAM or DDRAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 40uS |

## IMPLEMENTATION
## 9.1. Software Required:

The software required for this project to develop is as following

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### 9.1.1 Windows XP:

This is an Operating System (OS) on which all the software applications required for our project are going to be run. This OS is flexible to any user to operate and easy to understood. Accessing the soft wares and using them is very convenient to user.

### 9.1.2 Orcad:

OrCAD is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly to create electronic prints for manufacturing of printed circuit boards, by electronic design engineers and electronic technicians to manufacture electronic schematics.

### 9.1.3 Keil Micro vision 3 IDE:

The µVision development platform is easy-to-use and it helps you quickly create embedded programs that work. The µVision IDE (Integrated Development Environment) from Keil combines project management, source code editing, program debugging, and complete simulation in one powerful environment. Code written in 'EMBEDDED C'

### Software Development Cycle:

When you use the Keil µVision3, the project development cycle is roughly the same as it is for any other software development project.

1.Create a project, select the target chip from the device database, and configure the tool settings.

2.Create source files in C or assembly.

3.Build your application with the project manager.

4.Correct errors in source files.

5.Test the linked application.

The following block diagram illustrates the complete µVision3/ARM software development cycle. Each component is described below

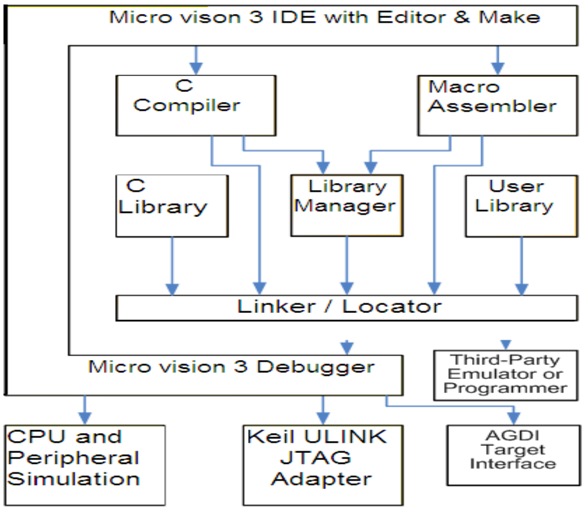


Fig 7.2 Software Development cycle in keil Software

### 7.1.4 Flash Magic Software: How to Download Hex File into MCU of Board

The method to download Hex File into Flash Memory of MCU in Board is to use Program Flash Magic that is connected with MCU through Serial Port of computer PC. This program can be downloaded free without any charge from website http://www.flashmagictool.com/

### Conclusion:

The project is been designed and implemented with Atmel LPC2148 MCU in embedded system domain. Experimental work has been carried out carefully. Here we have designed a simple, low-cost controller based implementing uc/os - ii kernel based rtos using ARM7 TDMI (lpc2148) based controller.

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