Design of ARM Based Data Acquisition & Control Using Wireless Network

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Abstract— Design of ARM based data Acquisition & Control using Wireless Network is proposed. This system is an intelligent for data monitoring and control using Wireless Network. Proposed system designed based on ARM Processor with RTOS, GSM, GPS, and Sensors. An ARM processor with embedded system can be used for diverse industrial applications involved with a real-time monitoring and control. RTOS can be ported to ARM hardware, and system can deal with much more complicated tasks. Embedded system designed provides a generic design with all kind of data acquisition and control. System is used as an embedded web server with all data back up in SD Card. By typing the IP Address of the LAN on the browser the administrator and user get webpage on screen contains all the current status & Location of the Vehicle on Google Maps. With the help of GSM Network Immediate notification is given to the administrator and location of vehicle on Google Maps with real time Auto Update.

Keywords- *ARM-TDMI, µc/OS-II, GSM,, Ethernet, Memory Card, Data Acquisition, Data Monitoring, GPS*

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I. INTRODUCTION

In this modern, fast moving and insecure world, it is necessity to be aware of one's safety. In Industries, systems are becoming very complex Industrial system needs to test the site equipment's and environmental conditions to track the state of system in real time [5]. This system requires design, which has to be flexible and adaptable, for that microcontroller based systems can be used. These systems are more reliable and provide high performance to the system.

Reduced Instruction Set Computer (RISC) is used in The ARM architecture. This makes the instruction set and related decode mechanism much simpler than those of micro programmed Complex Instruction Set Computers. Results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline mechanism is employed so that all parts of the processing and memory systems can operate continuously With the help of pipelining while one instruction is being executed, and decoded, and a third instruction fetched from memory ARM based embedded system will be more functional, reliable, cost effective, less in size ,and low power consumption. Microcontroller has limitation of low speed and poor memory, so it execute simple control tasks. Main two components of RTOS are "Real-Time" and "Operating System".

Real-Time gives a desired response or reaction to an event on the instant of its evolution. The desired response depicts the logical correctness of the result produced. System operates in a strict time constraint. Operating System (OS) is a system program, which is an interface between hardware and application programs. Features of OS are enables its primary role of managing the hardware resources to meet the demands of application programs. RTOS supports real-time applications for embedded systems by providing logically correct result within the deadline required. Capabilities define its deterministic timing behavior and limited resource utilization nature. Industrial application requires multiple tasks to be executed. Monitoring and Controlling the industrial system, processing of data, storing of the data and transmission of the data with polling technique require more time so use of multi-tasking is involved. When ARM processor combined with RTOS with timing constraint can be realized for the data acquisition and transmission of data. For e.g. transmission of data using Ethernet or RS-485 which requires industries standards like modbus protocol and it will have timing constraint [2]

II. METHODOLOGY

A.Praposed Architecture

Industrial system require Monitoring & Control Memory Card is required which we will contain entire log details. The desktop computer industries require Web server so Ethernet control is required. Embedded system uses FLASH and MMC memories for program running and data storage. RTC data is written on MMC for data log. As far as the control and acquisition system concerned, the Analog to Digital Converter (ADC) is essential components. The ADCs are used for data acquisition.

The LCD controller can be programmed to support different requirements on the screen. The IP address of the system is burned in EEPROM. The Ethernet controller will read the IP address when reset. Ethernet module is interfaced to serial peripheral interface of controller. Message can be send with help of GSM which is interfaced as it provides a wireless communication i.e. message can be sent to particular individual instantly. The GPS receiver module interfaced with UART1 of ARM processor provides location information. All this information is send it to a monitoring station (receiver side) by GSM module wirelessly that is interfaced with UART0 of ARM processor. Also the same information is given TCP/IP Network.

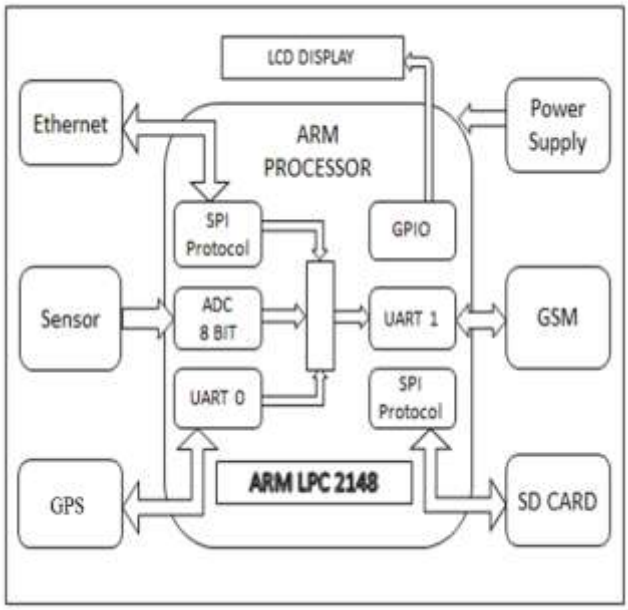

Figure 1: Block diagram of Proposed Architecture

B.GPS Module

GPS Receiver MT3318 Module is based on the MediaTek MTK MT3318 chipset. It consist of patch antenna from Cirocomm. It can receive signal from 51 satellites simultaneously.

Figure 2: GPS Module [15]

This GPS receiver gives data output in standard NMEA format with baud rate of 9600 bps. Receiver consist of onboard battery for memory backup for quicker acquisition of GPS satellites. Module can be interfaced with the 5V TTL / CMOS logic. This GPS module is very easy to interface and requires only Transmit, Receive through the serial port of the microcontroller.

C.GSM Module

GSM module is a plug and play GSM Modem with a simple to interface serial interface. It used to send SMS, calls, and other GSM operations by controlling it through simple AT commands from micro controllers and computers. SIM300 module used for all operation, It comes with RS 232 interface which can be used to easily interface the modem to micro controllers and computers.

Figure 3: GSM Module [16]

D. Ethernet Module

The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI). It is designed to serve as an Ethernet network interface for any controller equipped with SPI. Module also provides packet filtering schemes to limit incoming packets. Module also provides DMA for fast data throughput and hardware assisted checksum calculation. Communication with the host controller is implemented via an interrupt pin and the SPI. Two dedicated pins are used for LED link and network processing indication. With the ENC28J60 two pulse transformers and a few passive components are all that are required to connect a microcontroller to an Ethernet network.

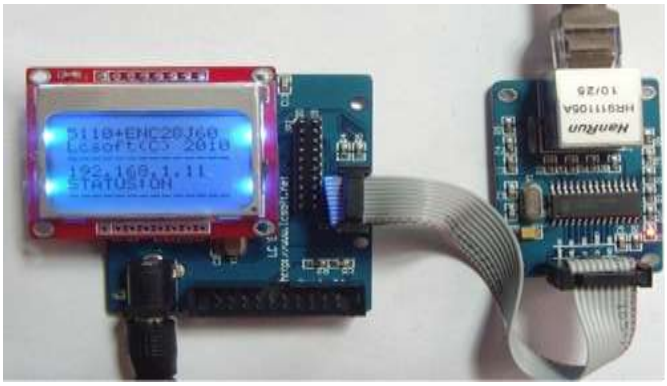

Figure 4: Ethernet Module [17]

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E.Hardware Clk Rate.

MODULE	ON-CHIP PROTOCOL	CLK RATE
GSM	UART 1	9600BPS
GPS	UART 0	9600BPS
MEMORY CARD	SPI 0	62.5KHz
ETHERNET (ENC28J60)	SPI 0	2MHz
TEMP SENSOR	ADC 0	1MHz

Figure 5: Hardware Clock rate

III. RTOS

RTOS/ µC/OS II (pronounced "Micro C O S 2") stands for Micro-Controller Operating System Version 2.

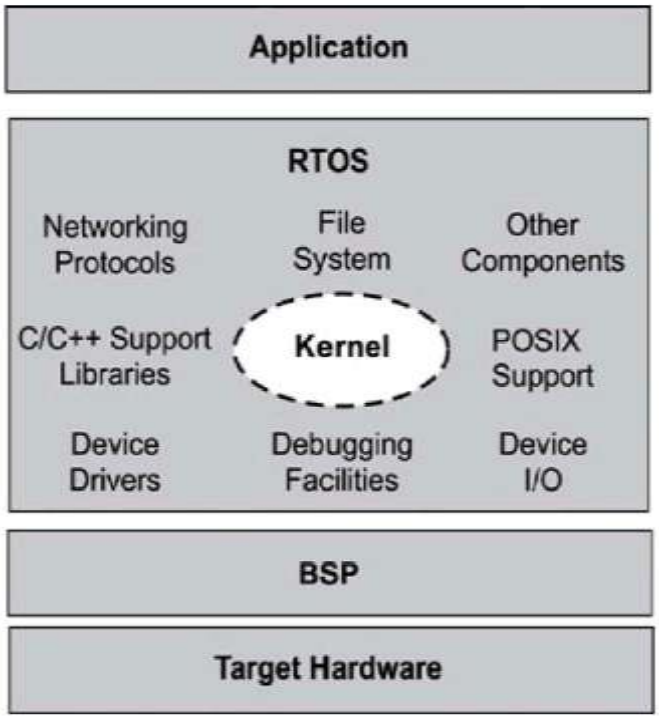

Figure 6: Hardware & µC/OS-II Interface[18]

IV. IMPLEMENTATION

The heart of the system is a real-time kernel that uses preemptive scheduling to achieve multitasking on hardware platform. The previous sections dealt with µCOS_II porting to the application. This section deals with the implementation of hardware and software. The Task may vary depending on the application.

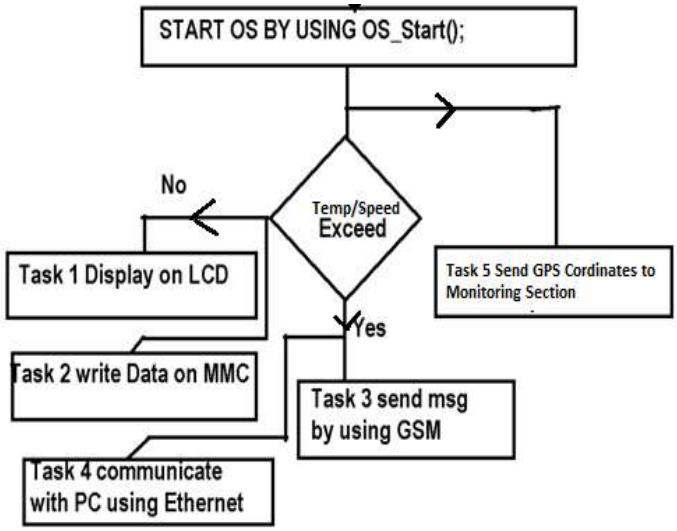

Figure 7: Flow chart of Hardware & µCOS II Implementation

Imparting of µC/OS-II we can perform simple tasks like Temperature sensor (i.e., ADC), 16x2 LCD (i.e., degree to Fahrenheit), UART (i.e., sending message through GSM), Ethernet (i.e. to communicate with desktop PC) MMC (i.e., memory card for data backup), & GPS (i.e. to send real time Coordinates wireless nodes).

V. SOFTWARE

Keil IDE is a windows operating system software program that runs on a PC to develop applications for ARM microcontroller and digital signal controller.IDE provides a single integrated environment to develop code for embedded microcontroller.

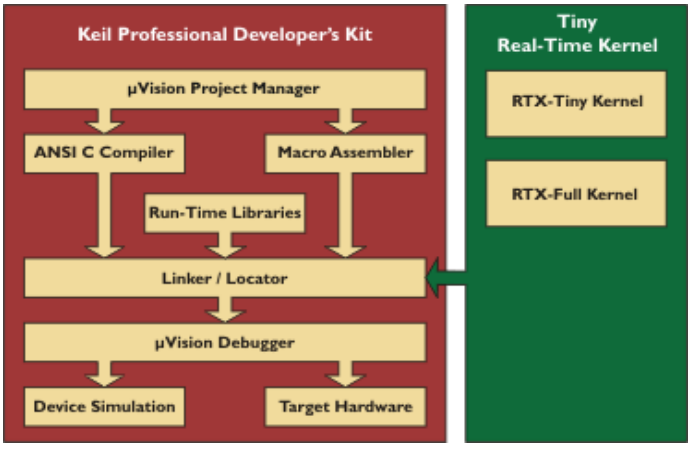

Figure 8: Interfacing flow of Keil compiler [19]

Keil µVision4 IDE (Integrated Development Environment) is a Windows based front end for the C Compiler and assembler. KeilµVision4 is used for writing embedded C programs. Embedded C is a high level language. Standard libraries are modified or enhanced to address the peculiarities of an embedded target processor.

VI. CONCLUSION

Design of ARM based data Acquisition & Control using Wireless Network is proposed necessary mighty functions to developing fast and efficient an application. System perform real-time controls like standard electrical interface. High precision data acquisition can be achieved by the embedded system. Using the Ethernet port of the embedded system, networked Monitoring and control can be achieved through an industrial Ethernet LAN. The Embedded System provide a platform for diverse control and acquisition applications and factory automations. The system is able to deal with Multi-Tasks this enhances the reliability of the control and acquisition system and reduces the risks. In addition system uses the GPS and GSM Module for long distance communication and MMC card for data backup that provides an alternative interface for conventional control and acquisition applications. Our technology choice for both wireless data communication and fast wired communication and control the device using web server by centralized monitoring system with Google Maps Thus, the embedded system is compact system and reduces the cost that is useful for industrial applications. As system is generic solution it becomes easy to provide machine to machine communication and entire embedded. This design can be used widely in remote data acquisition and control and tracking system in industry.

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