Design Of Real Time Interactive Data Acquisition And Control System Using ARM9

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***Abstract*— A web server is a system which hosts a web site and provides services for any requesting clients. The general purpose web servers compose of an operating system, the web pages or the application and a huge amount of memory and sometimes a special hardware. The central function unit to get access on an embedded system via Web browser is the Web server. Digital acquisition is done by special ADC. The measured data are stored in external memory in which the memory acts as a data base during web server mode. The ARM processor directly supports the Ethernet service and RS232 communication. Hence the data has been stored and controlled by some other PCs or network via RS232 & Ethernet. ARM processor has internal I2C module. So it has the ability to communicate with any other peripherals. This system has LCD to display the information and measured parameters which makes the debugging and modification of the parameter easy. The Analog to digital interfacing module is independent with the embedded system, which is beneficial to the system maintenance and upgrade. As the embedded Ethernet interface makes the remote data exchange between the applications become very easy. Here we measure the remote signals and can control the remote devices through reliable protocols and communication network. The embedded web server is interfaced to the appliances and the sensors through the controller and it is via the embedded web server that we can control the appliances and monitor the sensors.**

***Index Terms*— Embedded ARM9 Processor, Real Time Linux Operating system (RTLinux RTOS), Embedded web server, Interactive data acquisition and control system (IDACS).**

I. INTRODUCTION

Data acquisition and processing plays an important role in the area of modern industries, and the performance requirements like the system precision and size vary according to different application areas. This system contains inbuilt data acquisition control system with online interaction. It makes the system more reliable and avoids more complication. It basis on the micro processor and Linux as the embedded operating system. Online Interactive Data Acquisition and Control system plays the major role in the rapid development of the fast popularization and control in the field of measurement and control systems. It has been designed with the help of many electrical, electronic and high voltage equipments; it makes the system more complicated and not reliable. This paper approaches a new system that contains inbuilt Data Acquisition and Control system (DACS) with on-line interaction. It makes the system more reliable and avoids more complication. It is the great demand in consumer applications and many industries. The design of very fast data acquisition in plasma discharge application was discussed in [1]. There are various digital DAC systems are available for the substitution of multisite job operation. A single worker can interact with the machine and collect various data from on- going work in a single work station. The simplest design of data acquisition system is detailed in [2], which is based on Linux Operating system [3]; it is the popular choice for many embedded real time applications and PC systems. The design of flexible and networked data acquisition architecture was approached in [4], where the software resources are stored in local memory to avoid the level of resource usage and increases system's efficiency. This system process the client based on dynamic manner by server response and it maintains separate data base with DAC controller. In [5] advanced traffic survey mechanism uses data collection process for post processing of vehicle's position. Signal conditioning is the major part of any data acquisition unit. High level integration architecture was discussed in [6]; it allows signals to be conditioned, simultaneously acquired according to the external clock and triggers processed and transferred data to real time servers. Signal measurement from astrophysical sources is described in [7]; where the shared memory and internet protocols are used for data handling and process from remote users. It was developed with Global Positioning System (GPS) and Environmental monitoring system. Similarly depends on industry and its location General Packet Radio Service (GPRS) also used for data transmission through on-line. But this paper doesn't use GPRS and GPS systems for data uploading into internet. It reduces the system complexity and effective for all kind of real time applications. Every real time embedded system should be run by real time operating systems. Even a small 8-bit microcontroller has the portability with RTOS is developed in [8]. In this paper Real time Linux Operating system is ported in ARM9 processor. This RTLinux RTOS is very effective for many embedded applications [9]. All processes are allocated with essential resources and associated with reliable scheduling algorithms and internet protocols followed by ARM processor. This miniaturized setup reduces the complexity & size of system.

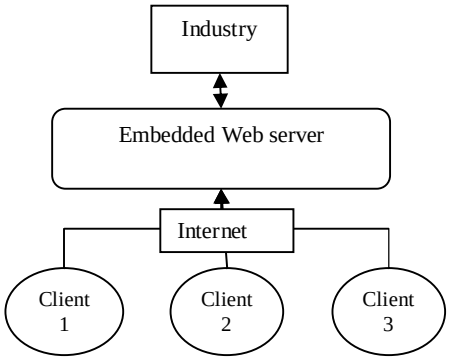

Fig.1 shows the overview of IDAC system.

ARM processor is the heart of this system, every client can access the industry directly through the embedded web server. IDACS shows Intelligent Data Acquisition and Control System. IDAC system contains ARM9 which is loaded with RTOS. It can handle DAC and Web server simultaneously as parallel tasks. And it can control the industry machineries by the control instruction sent by client via embedded web server. During signal measurements Analog to digital converter is very important, because almost every external source is giving analog signal only. While converting these analog to digital processor has to handle asynchronous interrupts. RTLinux can handle interrupts in an efficient way because RTLinux has preemptive kernel with required privilege levels, and during web server mode processor will handle client request and response to the particular client by sending web pages, client can interact the industry by giving instruction in web page on its own web browser. Generally web pages are designed using HTML language, so here we also use HTML language to build embedded web pages.

II. SYSTEM DESIGN

Hardware design, Software design and Porting are the entire important steps in whole system design.

A. Hardware design of the system

1) IDACS Design:

Generally ARM9 processor contains many devices like USB, SDRAM, LCD, Ethernet interface, etc. We use Ethernet in order to access embedded web server . The I/O channels are used to store and control the signals. Digital signals are stored using ADC.I/O channels selects many signals like electrical, nonelectrical signals. The temperature and light parameters are measures by using appropriate sensor. The output of the sensors is given to analog to digital converter (ADC). The analog signals obtained from sensors are converted in to digital format by using ADC. visitor counter application is implementing with the help of IR sensors. Here we are arranging two sets of IR to identify the in and out. The result is displayed on the LCD. IDACS design is the major part in hardware. ARM9 processor is a centre core of this system. The general hardware structure of the IDACS is shown in Fig 2. The online intelligent data acquisition and control system based on embedded ARM platform has high universality, each acquisition and control device equipped with 24-way acquisition/control channels and isolated from each other. Each I/O channel can select a variety of electrical and non electrical signals like current, voltage, resistance etc., Digital acquisition are done by special ADC. The measured data are stored in external memory in which the memory is act as a data base during web server mode. ARM processor directly supports the Ethernet service and RS232communication. Hence the data has been stored and controlled by some other PCs or network via RS232 & Ethernet. ARM processor has internal I2C module. So it has the ability to communicate with any other peripherals.

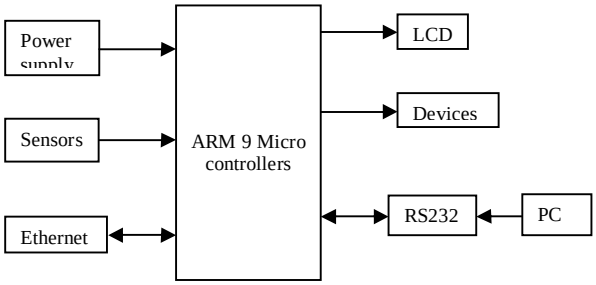

Figure 2. General Structure of the IDACS

I^2C is the wired communication protocol to communicate with other processor or peripherals thro two wired link. This system has 128*64 LCD to display the information and measured parameters which makes the debugging and modification of the parameter easy. The Analog to digital interfacing module is independent with the embedded system, which is beneficial to the system maintenance and upgrade. As the embedded Ethernet interface makes the remote data exchange between the applications become very easy.

2) Analog to Digital Converter:

Fig 2. uses 16bit ADC chip AD7715.This chip can convert the analog signal into digital and the converted digital data is send to ARM. It contains only five lines, which are DOUT – Data output, DRDY – Data ready, DIN – Data Input, CS – Chip select and SCLK – system Clock . Converted digital data will be sending out by DOUT pin of the chip. This ADC chip is driven by 2.4576MHz crystal. It contains separate Reference signals Ref+ and Ref- and separate Analog input channels AIN+ and AIN- . During communication with ARM processor this ADC chip should

be synchronized with the processor's clock.

B. Software design of the system

1) Real Time Linux:

RT-Linux implements a POSIX API for a threads manipulation. A thread is created by calling the pthread_create() function. The third parameter of pthread_create() is a function which contains the code executed by the thread. It is necessary to set thread priorities in RTLinux. Threads with higher priorities can preempt threads with lower priorities. RTCore is a POSIX 1003.13 PE51 type real-time kernel, something that looks like a multithreaded POSIX process with its own internal scheduler. RTCore can run a secondary operating system as a thread, using a small virtual machine to keep the secondary system from disabling interrupts. This is a peculiar model: a UNIX process with a UNIX operating system as a thread, but it provides a useful avenue to modularity. RTLinux is RTCore with Linux as the secondary kernel. RTCore with BSD UNIX as the secondary kernel. Real-time applications run as real-time threads and signal handlers either within the address space of RTCore or within the address spaces of processes belonging to the secondary kernel. Real-time threads are scheduled by the RTCore scheduler without reference to the process scheduler in the secondary operating system. The secondary operating system is the idle thread for the real- time system. The virtual machine virtualizes the interrupt controller so the secondary kernel can preserve internal synchronization without interfering with real-time processing. Performance is adequate to allow standard PC and single board computers to replace DSPs in many applications.

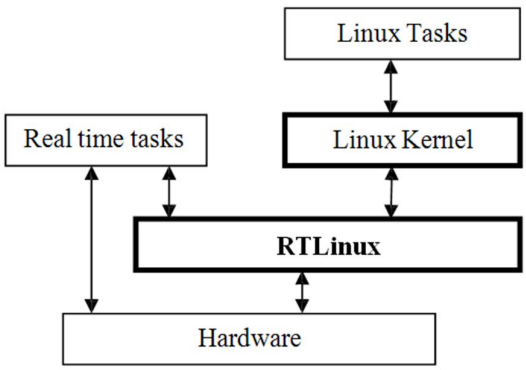

Fig.3: RTLinux Run time Model

Unlike Linux, RTLinux provides hard real-time capability. It has a hybrid kernel architecture with a small real-time kernel coexists with the Linux kernel running as the lowest priority task. This combination allows RTLinux to provide highly optimized, time-shared services in parallel with the real-time, predictable, and low-latency execution. Besides this unique feature, RTLinux is freely available to the public. As more development tools are geared towards RTLinux, it will become a dominant player in the embedded market. RTLinux is a typical dual-kernel, one is Linux kernel, which provides various features of general purpose OS, other one is RTLinux kernel, which support hard real time capability. Fig 4 illustrates the RTLinux architecture.

4. TCP/IP in RTLinux:

LWIP is an implementation of the TCP/IP stack "Use of the LWIP stack is to reduce memory usage and code size, making LWIP suitable for use in small clients with very limited resources such as embedded systems". Improvements achieved by LWIP in terms of processing speed and memory usage have been performed by means of violating the TCP/IP layers. Most TCP/IP implementations keep a strict division between the application layer and the lower protocol layers. As the barrier between the kernel and the application processes is not a strict protection, a more relaxed scheme for communication between the application and the lower layer protocols can be performed by means of shared memory.

III. RESULT

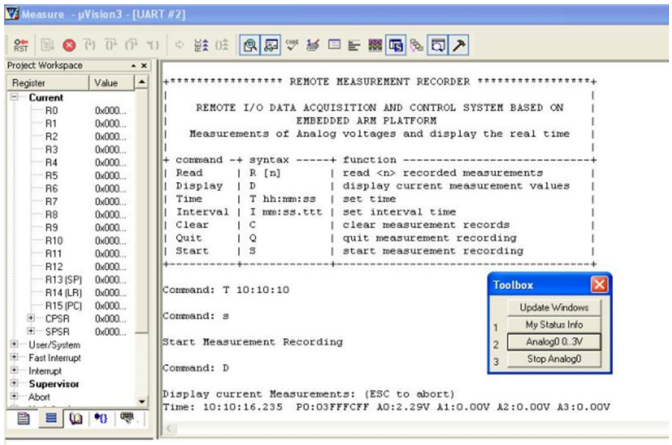

Fig.4 : Simulation result of ADC

Fig.5:ARM friendly board.

results show that the client can access the whole industry from any remote place via its own local browser. In industry the single ARM9 board acts as data acquisition and control system and as web server, so the system is compact with less complexity. This system replaces the traditional system for remote access and control by embedded web server with Real Time Linux operating system. And this system is adaptable with kernel level debugging. It can be done by GDB, DDD Linux debuggers.

IV. CONCLUSION

In the design of Data acquisition and control system every client can access the data from LAN via its web Browser. With the rapid development of the field of industrial process control and the wide range of applications of network, intelligence, digital distributed control System, it is necessary to make a higher demand of the data accuracy and reliability of the control system. This embedded ARM system can adapt to the strict requirements of the data acquisition and control system such as the function, reliability, cost, size, power consumption, and remote access and so on. This system operated by DACS mode to acquire the signals and control the devices remotely. Embedded web server mode is used to share the data with clients in online. Both modes are efficiently carried out by real time multi tasking operating system (RTLinux). This system can be widely applied to electric power, petroleum, chemical, metallurgy, steel, transportation, Electronic & Electrical industries, Automobiles and so on.

V. REFERNECES

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