

# Design and Implementation of Embedded Web Server and DACS with ARM9 using Linux

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**Abstract-** This paper presents implementation of embedded web server based on ARM9 Processor. The embedded web server design includes a complete web server with TCP/IP support and Ethernet interface. Through the Ethernet we could acquire the different real-time information, and based on the information, we could draft corresponding options and we can also implement control through Internet. In this paper we will be using SAMSUNG Mini2440 32 bit ARM Processor with Linux OS porting. For this purpose we will be using Friendly ARM9 board which is having an inbuilt Ethernet controller. Finally the application is developed and ported into an ARM9 processor using embedded 'C' language. Web pages are written by hyper text markup language (HTML); this system is used for real time applications such as Data Acquisition and control System (DACS).

**Index Terms-** ARM9, Embedded web server, Linux Operating System, HTML (Hyper Text Markup Language), DACS

## I. INTRODUCTION

In recent years, embedded systems have become a centrally important aspect in a wide variety of applications, such as studying environmental phenomena, mapping and managing large-scale systems, aiding security, data services and other fields. Embedded controllers are said to have a market share of 98% or more of the global processor market, implying that less than 2% of all processors are employed in traditional computers. In this project the main task was to design an embedded web server system which would be able to serve the purpose of data acquisition and also act as a web server. So our approach to develop this system initiated with the extensive study of ARM, data acquisition systems and web servers. This provided us with the necessities for the desired system. According to these requirements from all available resources, most appropriate set of elements were chosen and the final design was created and to implement this design various hardware and software tools were used.[6]

An embedded system is a device that has computer intelligence and is dedicated to performing a single task, or a group of related tasks. Embedded systems often perform monitoring and control functions such as gathering and reporting sensor readings or controlling motors and switches.[5] Data Acquisition and Control System (DACS) is meant for acquiring data from sensors and as most of the physical sensors available provide analog data, these systems also perform analog to digital conversion.

### A. Embedded Web Server:

The web server concept gives us the flexibility of monitoring and controlling the electronic devices from every nook and corner of the world. This can also be used as security system and has wide range of applications. Nowadays, monitoring and controlling systems or electronic devices through pc are very common. In this technology pc it act as a server. The electronic devices which are going to monitor and control are connected to pc. They are bit more cost and cannot work continuously for a long time. The hardware architecture is very complex. The development of this system not only brings more difficulties but also increase maintenance of client software. With the rapid development of technology the embedded systems plays a major role and go through into the areas of people's life. A new technology known as web technology used to monitor and control the systems or electronic devices through web page. Web-based technology is the more popular technology in the world for sharing or browsing data.

A web server is a system which hosts websites and provides services for any requesting clients. The general purpose web server composes of an operating system, web pages or web applications and a huge amount of memory and sometimes a special hardware. The embedded web server is the combination of embedded device and Internet technology, which provides a flexible remote device monitoring and management function based on Internet browser and it has become an advanced development trend of embedded technology. [5]

### B. Data Acquisition and Control System:

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software. Compared to traditional measurement systems, PC-based DAQ systems exploit the processing power, productivity, display, and connectivity capabilities of industry-standard computers providing a more powerful, flexible, and cost-effective measurement solution.

Data acquisition systems (abbreviated with the acronym DAS or DAQ) typically convert analog waveforms into digital values for processing. The components of data acquisition systems include:

- Sensors that convert physical parameters to electrical signals.
- Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values.

- Analog-to-digital converters, which convert conditioned sensor signals to digital values.

## II. SYSTEM ARCHITECTURE

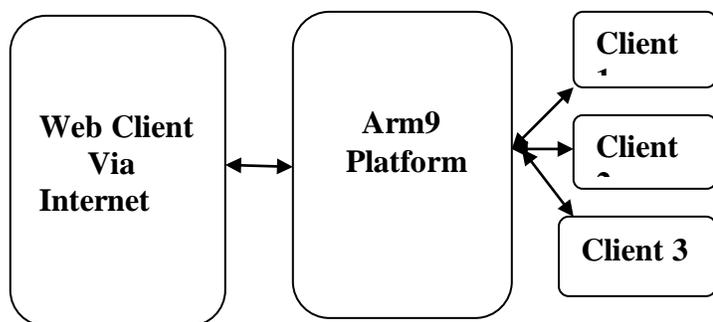


Figure 1 System Architecture

The entire system uses B/S (Browser/Server) mode for its low development cost, flexibility, easy maintenance and upgrade. Compared with C/S (Client/Server) system, B/S system does not require development of client programs so that developers can concentrate on the development of the Server and this mode is simple to use, convenient to maintain, and easy to extend. The client PC is connected to the Internet through a browser and then gets access to the embedded Web server. Through this way, remote login and operation are realized. Fig. 1 shows the proposed concept of Data Acquisition and Control Systems (DACS) with embedded web server. It contains Linux OS portable ARM processor. The real time operating system manages all the tasks such as measuring signals, conversion of signals, data base updation, sending HTML pages and connecting/communicating with new users etc. The Linux OS manages all the required tasks in parallel and in small amounts of time. Web based management user interfaces using embedded web server have many advantages: ubiquity, user-friendly, low-development cost and high maintainability.

## III. SYSTEM DESIGN

### A. HARDWARE DESCRIPTION

Samsung's S3C2440A is designed to provide hand-held devices and general applications with low-power, and high-performance micro-controller solution in small die size. The ARM processor is a Reduced Instruction Set Computer (RISC). The S3C2440 is a 32 bit microcontroller that internally integrates ARM920T of the ARM Company [9]. ARM920T implements 5-stage pipeline architecture and separate 16KB Instruction cache and 16KB Data cache which are used for faster performance. The S3C2440 have some integrated on-chip functions such as LCD controller, RAM controller, 3 paths UART, 4 paths DMA, 4 path with PWM of Timer, parallel I/O port, 8 channels of 10-bit ADC, the interface of touch screen, I2C interface, two USB interface controllers, two channels SPI, the main frequency of S3C2440 up to

400MHz [4]. Figure 2 shows MINI2440 On-board peripherals layout. [2]

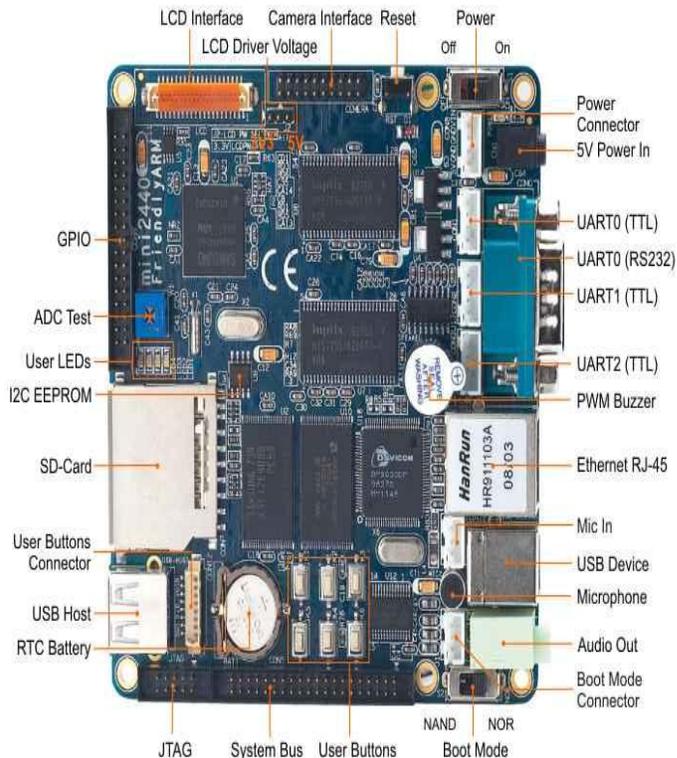


Figure 2 MINI2440 on-board peripherals layout

### B. SOFTWARE DESCRIPTION

The figure shows the software approach. Software development process based OS includes: The establishment of cross-compiler, the creation of root files system, the transplant of Boot loader, the porting of embedded Linux, and the development of embedded Web server. The application used here is embedded web server for monitoring and controlling systems based on ARM9 with its .app code which is combined with Linux platform .ARM Linux gcc is the cross compiler used in ARM9 which will help to compile. source code .C into .bin file. This GCC compiler contains editor, linker, and compiler to generate three different files. Boot loader vivi is used here. The application code .C file will be developed by a user. This application code .C file is used as a task in Linux Platform. The ARM GCC compiler can compile the source code .C file and application code .C file together at a time and generates the file consists of .obj files and .bin files. By using linker the .obj files are linked and send it to compiler to generate .elf file, .bin file and .obj file. In these three different files .bin file is used to dump on ARM9 kit by using DNW tool.

The function of Boot loader is to initialize the hardware devices and establish memory mapping tables. Thus it establish appropriate hardware and software environment, provides interface to send commands to target board and prepare for the final call to the operating system kernel. Linux is used a operating system because Linux system is having a hierarchical structure and completely opens its kernel source. Linux can port

to a wide range of hardware platforms, and can run in most of the architecture. Linux has a comprehensive set of editing, debugging and other development tools, graphical interface, a powerful network supporting and rich applications. In addition, the kernel can be reduced by configuring it. [4]

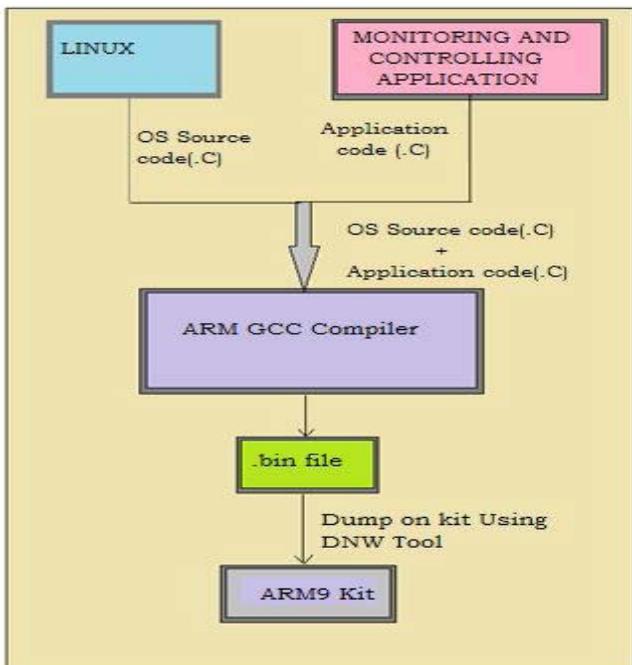
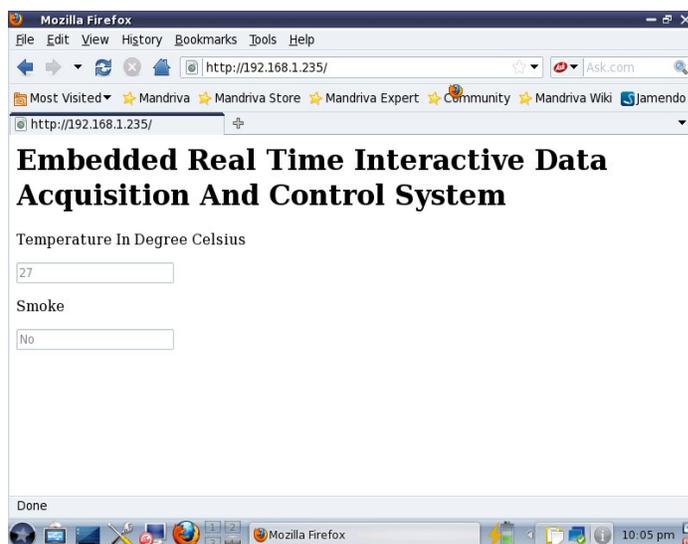


Figure 3 Software Approach

#### IV.RESULTS

As mentioned earlier the application of Arm9 processor based an embedded web server for real time monitor and control of devices through internet has to be developed on Samsung S3C2440A board. The proposed approach tests the operation successfully and produces the required result. The data from devices which we have to control is stored in the data base of web server through TCP/IP protocols can be retrieve through the web browser by using internet facility.

```
ashish: minicom
File Edit View Scrollback Bookmarks Settings Help
Try to bring eth0 interface up.....eth0: link down
Done
Please press Enter to activate this console. eth0: link up, 100Mbps, full-duplex
[root@FriendlyARM ~]# cd www
[root@FriendlyARM /www]# rm -rf index.html
[root@FriendlyARM /www]# ls
12[-1?]  led-result.template  mini2440.png
4[4     ]  leds.cgi             web.cgi
images   leds.html           webcam.html
[root@FriendlyARM /www]# cd
[root@FriendlyARM ~]# cd udisk/
[root@FriendlyARM /udisk]# cp index.html /www
[root@FriendlyARM /udisk]# cd
[root@FriendlyARM ~]# ls
12[-1?]  dev      lib      opt      tmp      verp
4[4     ]  etc      linuxrc  proc     txen     web
adc-test  hello    lost+found  root    udisk    web.cgi
armcomtest  home    ls        sbin    usr      www
bin       index.html  mnt      sys     var      www
[root@FriendlyARM ~]# ./web
Enter data for Temp is:
23
```



#### IV. CONCLUSION

In this paper the system EWS (Embedded Web Server) replaces the pc web server. The embedded web server can be used with industrial equipments, medical instruments, educational institutions, offices and in many other places. The system has low cost, portability and is easy to upgrade and maintain. The user can monitor and control the devices through web technology. The overall cost advantage of the system in terms of the components used makes it an attractive choice for data-acquisition applications.

With the deepening of the Internet application field, embedded Internet technology will get more extensive application and development, the design of the embedded Web server will also play an active function and role.

REFERENCES

- [1] Vaishali Patil, Avichal Kapur, “ Real Time Embedded Web Server Based LED’s Control using ARM Processor and Ethernet” International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 2, March -April 2013, pp.1346-1349.
- [2] Ali Ziya Alkar, *Member, IEEE*, and Mehmet Atif Karaca , “An Internet-Based Interactive Embedded Data-Acquisition System for Real-Time Applications” IEEE Transactions on Instrumentation and Measurement, VOL. 58, NO. 3, MARCH 2009.
- [3] Ch. Sravani, N.V.Narayana Rao “Developing Touch Screen based Data Transmission Using S3C2440 Processor,” International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 2, Issue 1,Jan-Feb 2012, pp. 863-869.
- [4] Nakul Padhye and Preet Jain, “Implementation of ARM Embedded Web Server For DAS Using RASPBERRY Pi”, VSRD International Journal of Electrical, Electronics & Communication Engineering, Vol. 3 No. 4 April 2013.
- [5] Soumya Sunny P, Roopa .M, “Data Acquisition and Control System Using Embedded Web Server, International Journal of Engineering Trends and Technology- Volume 3 Issue 3- 2012.
- [6] G.Sunil Kumar, T.Swapna, “Design an Embedded Web Server for Monitoring and Controlling Systems or Devices”, International Journal of Engineering Trends and Technology (IJETT) – Volume X Issue Y- Month 2013.
- [7] P. Stephen Nischay, S. Latha , “Design of DACS(Data Acquisition and Control System)using Linux International Journal of Emerging Technology and Advanced Engineering Website: [www.ijetae.com](http://www.ijetae.com) (ISSN 2250-2459, Volume 2, Issue 11, November 2012).
- [8] V.Billy, Rakesh Roy, Sanket Dessai, and S. G.Shiva Prasad Yadav, “Design and Development of ARM Processor Based Web Server” International Journal of Recent Trends in Engineering, Vol. 1, No. 4, May 2009.
- [9] M.Manoj Kumar, G.Srinivasa Raju, “Design and Implementation of the Lab Remote Monitoring and Controlling System Based on Embedded Web Technology” International Journal of Scientific and Research Publications, Volume 3, Issue 3, March 2013 1 ISSN 2250-3153.
- [10] Indu Hariyale, Vina Gulhane, “Development of an Embedded Web Server System for Controlling and Monitoring of Remote Devices Based on ARM and Win CE” International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-1, Issue-2, June 2012.

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