

# Design of On-line Interactive Data Acquisition and Control System for Embedded Applications

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**Abstract - In various Internet applications based on the client/server architecture, it is better to use embedded WEB server other than PC server for decreasing volume, cost and power consumption. The paper introduces the design of the WEB server based on the ARM9 processor and analyzes hardware configuration and software implementation with the growing popularity of Internet. 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. It allows the user to interface real time applications like, Industrial automations and data acquisition etc.,. Data acquisition plays an important role in real-time controls and online supervisions. In this paper we will be using S3C2440 32 bit ARM Processor with Linux porting. For this purpose we will be using Friendly ARM board which is having an inbuilt DM9000 Ethernet controller. In this Paper we are implementing a WEB server. 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, Mission critical applications.**

**Keywords - Linux Operating system ,Embedded ARM9 Processor, Embedded web server.**

## I.INTRODUCTION

The system contains inbuilt data acquisition control system with online interaction. It makes the system more reliable and avoids more complication. It

basis on the microprocessor and Linux as the embedded operating system.

The ARM board acts as acquisition, control unit and embedded web server. In this paper we are implementing data monitoring and control, visitor counter application, server application and devices ON / OFF control. Here we are implementing data monitoring and control action for two sensors.

Temperature sensor and is LDR. For both sensors one set point is assigned. If temperature value below the set point heater will ON, and if temperature value above the set point cooler will ON. For LDR also we are arranging one set point.

If light intensity is less then street light is ON or intensity is more street light will OFF. At the same time 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. For data acquisition we are going to implement the web server concept.

User can access the hardware in two ways i.e. PAN or LAN. In the application program we are assigning one specific IP address for our hardware. The sensors statuses are displayed in web page whenever user is giving request from any one of the system with in the LAN. From the

web page user can control (ON / OFF) the devices. Hence, results show that the client can

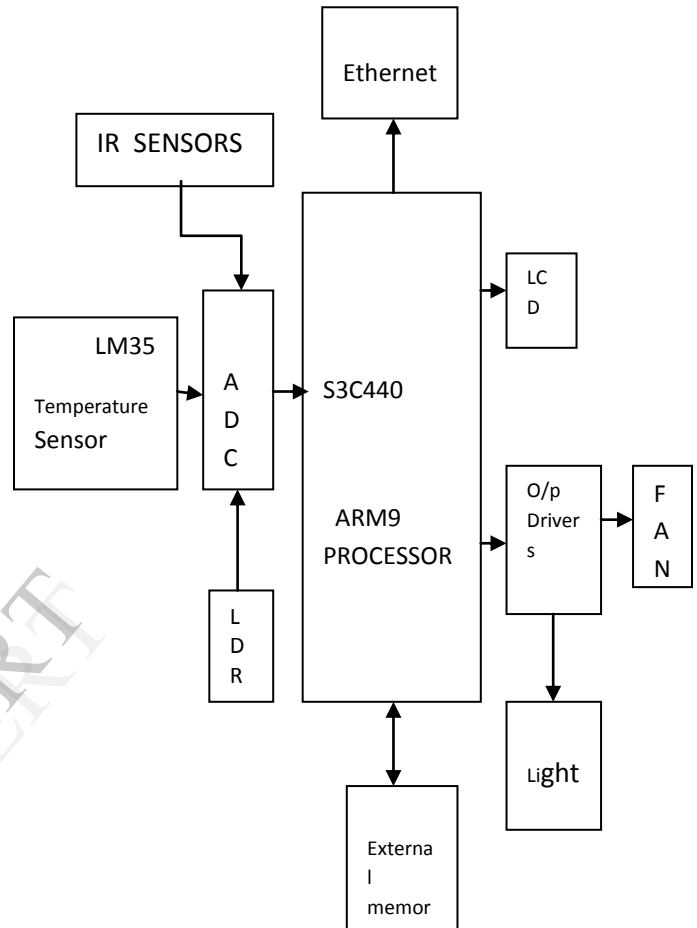
## II. DESIGN OF THE SYSTEM

Hardware design, Software design and Porting the web server application are the important steps in system design.

### A .Hardware design of system:

The implementation of proposed work applies S3C2410s32-bit ARM microprocessor which takes ARM920T as its core. This microprocessor has rich resources, including Clock, USB, SDRAM, Nand Flash, LCD, Ethernet Interface, JTAG, Power, ADC etc. These modules can help achieve Ethernet services. The client PC is connected to the Ethernet through a browser and then gets access to the embedded Web server. The acquisition and control device equipped with 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 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.



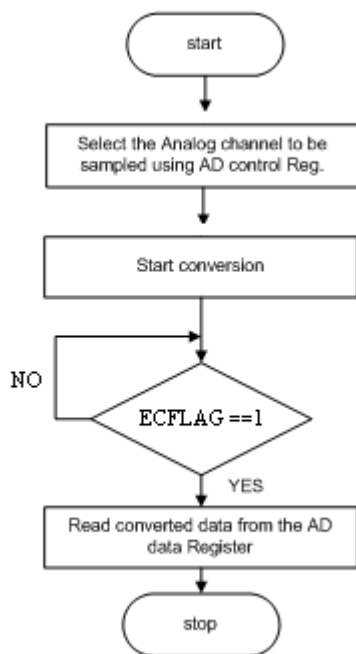
For data acquisition we are going to implement the web server concept. User can access the hardware in two ways i.e. PAN or LAN. In the application program we are assigning one specific IP address for our hardware. The sensors statuses

Fig 1.Block diagram

are displayed in web page whenever user is giving request from any one of the system with in the LAN.

## 2. Analog to digital converter:

The analog to digital converter (ADC) of the S3C2440A is a 8-channel ADC. It converts the analog input signal into digital codes at a maximum conversion rate of 500KSPS with 2.5 MHz A/D converter clock. The S3C2440A supports Touch Screen Interface, which consists of a touch screen panel, four external transistors, an external voltage source, AIN[7] and AIN[5]. Touch Screen Interface controls and selects control signals (nYPON, YMON, nXPON and XMON) and analog pads (AIN[7], AIN[5]). The ADC channels are used for connecting sensors. The sensors that we are employing are temperature and Light and IR sensors.



## B. Software design of the system:

### 1. Linux:

Software development process based on embedded OS includes: Establishment of cross compiler, the transplanted of Boot loader, transplanted of embedded Linux and root file system. Later the embedded application is ported onto the system. To begin with, system cross-compiler environment using arm-linux-gcc- 4.3.3 is established. Supervivi Bootloader is used as Bootloader. For compiling the kernel on the ARM9 board cross compiler tools are used to generate executables for embedded system.

### 2) porting Linux to ARM9Board:

To configure the kernel 2.6.29 according to requirements and its compilation to obtain the required zImage.

#### 1. Cross-build environment:

The arm-linux-gcc cross compiler is employed to generate the executables for the Master system. The following steps are done to install it. The arm-linux-gcc-4.3.2.tar.gz tar file is copied into a directory.

```
# tar xvzf arm-linux-gcc-4.3.2.tar.gz -C
```

The installed compiler path is added to the system environment variable: PATH. It is done by editing the .bashrc file as follows.

```
# vim / root /.bashrc
```

At the end of the file the following line is added  
export PATH = \$ PATH: / usr/local/arm/4.3.2/bin

#### 2.The Transplantation of Linux Kernel:

```
# cd /opt/Friendly ARM/mini2440
```

```
#cd /Linux-2.6.29.
```

```
# cp config_mini2440_n45 .Config
# make menuconfig
```

```
# make zImage
```

**3. Downloading kernel image to Mini2440:**

```
#ftp 192.168.2.151
```

```
Name: plg
```

```
Password: plg
```

```
ftp>put server.c
```

```
#minicom
```

**3. Implementation of Web server:**

Initialization of the web server such as creating an environment variable, binding a port, listening a port, entering the loop and waiting for connection request from a client. When there is a connection request from a client , web server is responsible for receiving request and saving related information. After receiving the request,Boa analyzes the request and it process it accordingly.

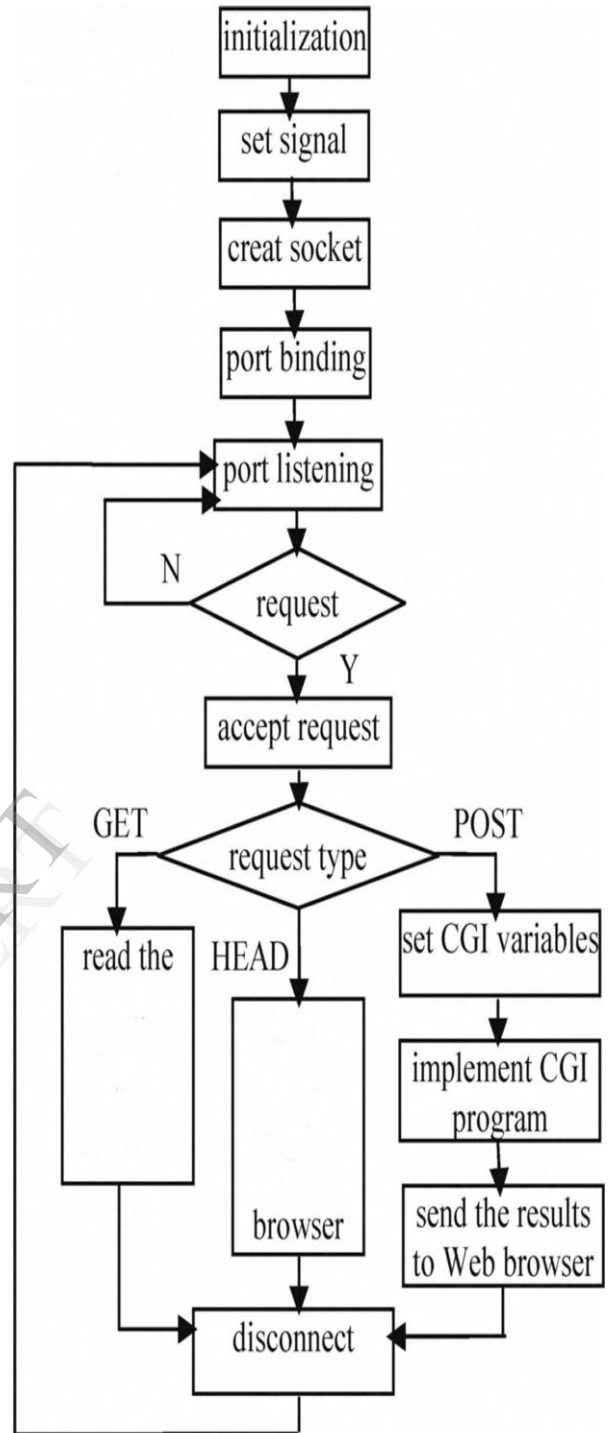


Fig 4&5 shows the results of ARM web server based on Ethernet controller.

Figure 8. Host System and Hardware Target board

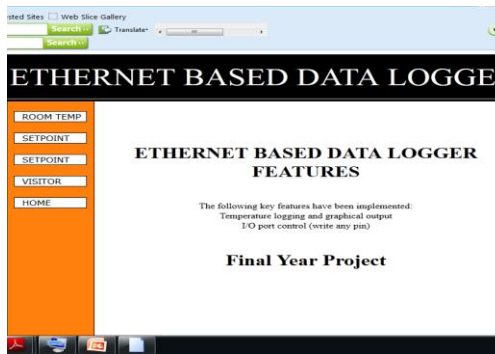


Fig 4. Web page requested by client

Fig 3. Web server flowchart

### III. RESULTS AND DISCUSSIONS

The web page is designed using HTML language. It is requested by the client to the server. Then the webserver processes these request & response for client request with webpage. Now the client can access the data monitoring and control devices through LAN.

Fig.5 host system and target board

Hence results show the client can access the whole system from LAN via browser. In industries the single ARM acts as data acquisition and control system and as web server, so it compact with less complexity. This system replaces the traditional system for data access and control by embedded web server with Linux operating system.

## IV. CONCLUSIONS

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 field of Industrial process control and wide range of applications of network ,intelligence it is necessary to make a higher demand of data accuracy and reliability of the control system. This embedded ARM system can adapt to the strict requirements of data acquisition and control system such as reliability, cost, power consumption and size. Embedded web server mode is used to share the data with clients in online. The modes of server are efficiently carried out by multi tasking operating system . This system can be widely used in electric, petroleum, electrical Industries, Automobiles, ATM networks and so on.

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