

Data Acquisition System (DAS) Based On ARM Embedded Web Server

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ABSTRACT

In this paper we present Internet based Data Acquisition system. It deals with the monitoring and acquisition of physical parameters in the real time necessary in Industrial Automation. This is achieved using the main core of the system which is an embedded hardware, running a $\mu\text{C}/\text{OS-II}$ a popular choice of operating system for embedded applications. The $\mu\text{C}/\text{OS-II}$ was successfully ported on the ARM & the web server application is configured with the operating system ($\mu\text{C}/\text{OS-II}$). The embedded device communicates through General Packet Radio Service (GPRS), which makes it accessible from anywhere in the world through a web server built into the embedded device. In addition, GPRS provides a real-time data transfer allowing interaction. The proposed system eliminates the need for the server software and maintenance. A novel approach is introduced to minimize the operational costs while operating with a large amount of data. The system is demonstrated to work for online as well as offline. When online, queried data is directly available at the client side. Here is an inbuilt offline system with 8-bit co-processor technique so one can get the data on personal computer without any internet connection, for personal reference. It can be also used for the analysis like system failure.

Keywords – ARM11, Embedded Web Server, $\mu\text{C}/\text{OS-II}$, GPRS

I. INTRODUCTION

DATA-ACQUISITION systems are in great demand in industry and consumer applications. In some applications, human beings have been replaced by unmanned devices that will acquire data and relay the data back to the base. There are data-acquisition and control devices that will be a substitute for a supervisor in a multisite job operation. A single person can monitor and even interact with the ongoing work from a single base station. An acquisition unit designed to collect data in their simplest form is detailed in [2]. Nowadays in industrial sector the whole control and management is done through the web server. This was the major revolution that took place and out lifted the methods of control system

As described in [4], a web server is a computer that delivers web pages to other computers in the network. Every web server has a unique IP address and possibly a domain name. Any computer can work as web server by installing server software. The embedded web server is a high performance embedded web server, allows users to monitor and control their embedded applications using any standard browser without the need of server software. The embedded web server can communicate with the web browser through TCP/IP. The user can use a web browser and typing URL of website into that browser user having authentication can examine the web

pages. This web server does not need dedicated high configuration computer.

As described in [5], an embedded web server is an ARM processor that contains an internet software suite as well as application code for monitoring and controlling machines/systems. Embedded web servers are integral part of an embedded network.

General web servers, which were developed for general purpose computers such as NT servers or Unix and Linux workstations, typically require megabytes of memory, a fast processor, a preemptive multitasking operating system and other resources. A Web server can be embedded in a device to provide remote access to the device from a Web browser if the resource requirements of the Web server are reduced. The end result of this reduction is typically a portable set of code that can run on embedded systems with limited computing resources. The embedded system can be utilized to serve the embedded web documents including static and dynamic information about Embedded systems, to Web browsers. This type of web server is called an Embedded Web Server [8].

In this paper LPC2917-1 ARM-9 processor is used with $\mu\text{C}/\text{OS-II}$ which is free RTOS for real time Data Acquisition. Operating System ($\mu\text{C}/\text{OS-II}$) is successfully ported on ARM9.

Here is GPRS based portable low-cost data-acquisition system, which can establish a reliable

bidirectional connection for data acquisition. The system uniquely reduces the Costs occurring from frequently requested data and eliminates the need for a well-established server. The system uses a dummy server for static information, thus optimizing the transfer of large data. The user can directly log in and interact with the embedded device in real time without the need to maintain an additional server. The system is modularly built, allowing different modules to be added. Fig.1.1 shows the architecture of embedded web server system, in which remote clients like mobiles, PC's etc. can communicate to the embedded board through internet.

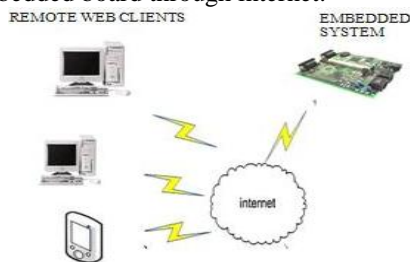


Fig.1.1 Embedded web server System

In section II online system is introduced with algorithm. In Section III, we will introduce the details of the offline system along with algorithm. In Section IV details of data acquisition sensors connected to the embedded system are demonstrated along with their specifications. Section V presents the conclusion

II. ONLINE MODE

Fig.2.1 shows the DAS with sever in online mode. In this mode, when internet connection is available, the data taken from the sensor will be directly uploaded in the dummy server by the embedded board. This queried data will be served to the clients available worldwide. This is achieved with the help of GPRS module SIM300.

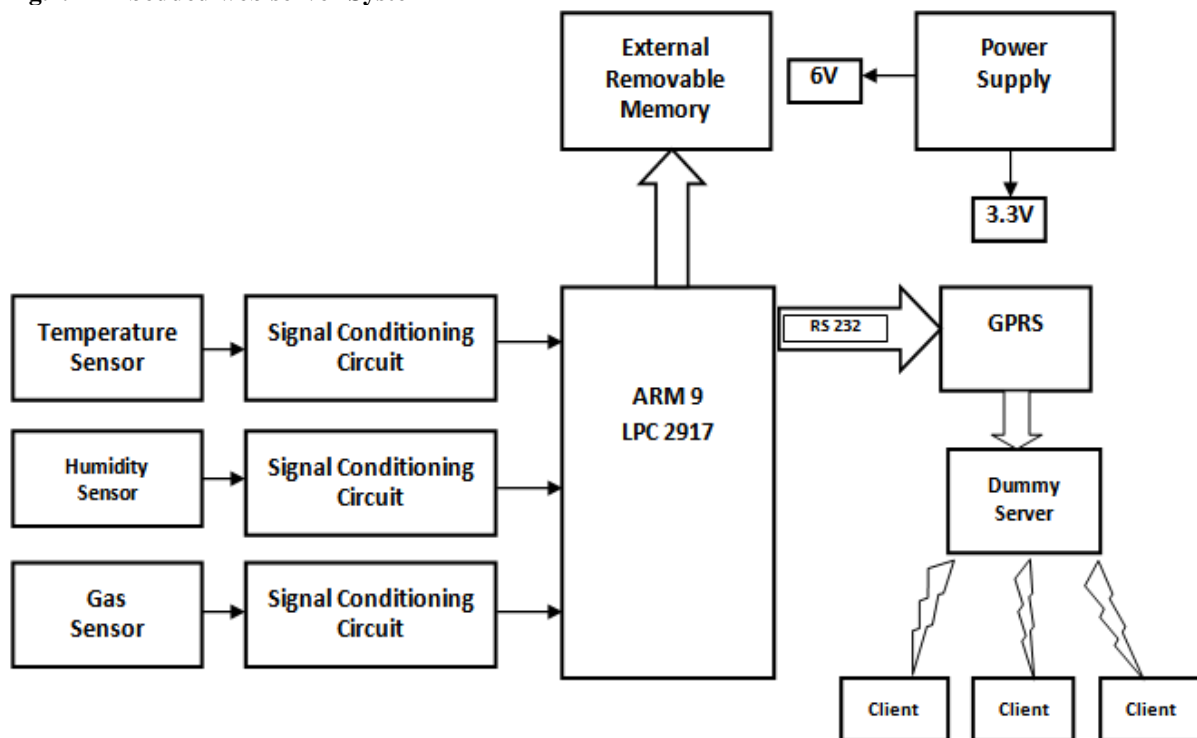


Fig.2.1 Online System

LPC2917-1 (ARM-9) Processor is used as a heart of the embedded web server.

Algorithm of ONLINE Hardware:

1. Start
2. Read the sensor output (one by one for all predefined channels)
3. Analog to Digital conversion.
4. Convert to appropriate values in case of gas unit, temperature unit and moisture unit.
5. Convert total data as a packet format of message.
6. Upload to IP link through defined communication protocol for embedded web server.
7. Stop

Algorithm of ONLINE Software:

1. Start.
2. Get the packed group messages through access point.
3. Convert them to read values of data for end user operations
4. Update the data to web page through a protocol and algorithm.
5. Operations as per request from clients.
6. Give the specific output.

Fig.3.1 shows, Embedded Web Server with Offline mode. Here we have designed offline system inbuilt with 8-bit co-processor technique so one can get the data on personal computer without any internet connection, for personal reference. It can be also used for the analysis like system failure Fig.3.2 shows Data management in the system.

Algorithm of OFFLINE Hardware:

1. Start
2. Read the sensor output (one by one for all predefined channels)
3. ADC conversation
4. Convert to appropriate values in case of gas unit, temperature unit and moisture unit
5. Write total data in external memory through a specified algorithm.
6. Stop

Algorithm of OFFLINE Software:

1. Start.
2. Read total data in external memory through a specified algorithm with help of 8 bit microcontroller.

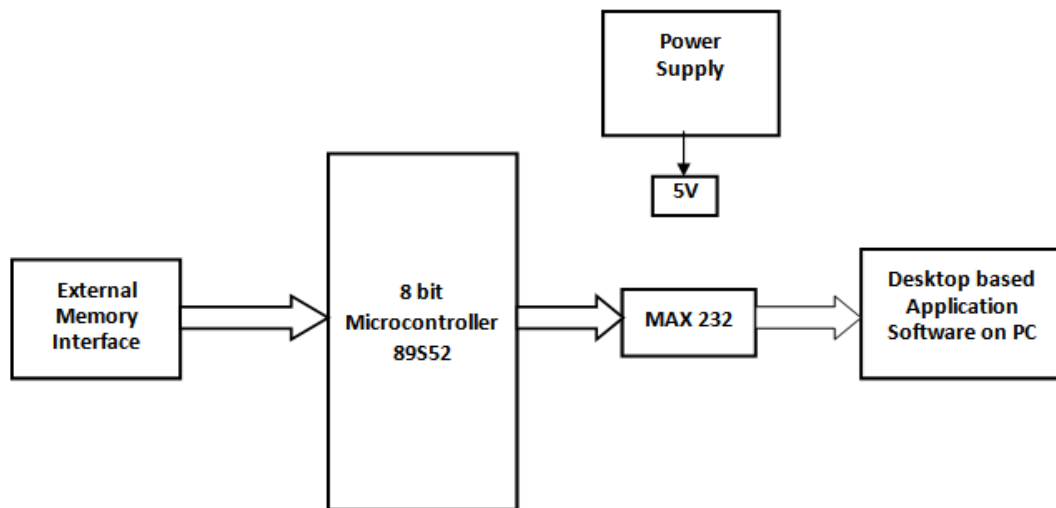


Fig.3.1. Offline mode

3. Update the data to desktop application through a protocol and algorithm.
4. Operation as per request from windows user.
5. Give the specific output.
6. Stop

Fig.4. gives the data management in the system, where bulky data is transferred through dummy (FTP) server. Clients can directly interact with the server by putting query.

viii) Offline front end: VB 6.0

Sensors used –

1. Humidity sensor Module SY-HS-22
2. LM -35 Precision Centigrade Temperature Sensor
3. MQ-6 gas sensor

The system is basically used in industries where manual observation is not possible.

III. Components, Software and Sensors used in the system –

- i) Processor - ARM-9 : LPC2917-1
- ii) GPRS Module: SIM300
- iii) Development IDE: Keil
- iv) RTOS: μ C/OS-II
- v) PCB Design: Orcad 9.0
- vi) Online front end: ASP.net
- vii) Backend: Sql server 2008

IV. Conclusion

This system eliminates the need for central server. A novel approach introduced minimizes the operational costs while operating with a large amount of data. The system is demonstrated to work for online as well as offline. This system has advantages in terms of allowing direct communication and reducing overhead, which can be vitally important for some real-time applications. The operational costs

have been reduced by relinquishing the storage of large data to an FTP server on the Internet. A remote user only requires a common internet browser to get the information of real time data.

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