Embedded Data Acquisition System Using an Internet Based FTP Server

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Abstract—In this paper we are presenting the internet based data acquisition system which will be comparatively low in cost and can be flexible to serve for different applications by connecting different modules. Key module in the system is embedded board which communicates via GPRS which eases it’s accessibility from any place in the world through a web server built into the board. Using FTP server removes the need of server maintenance. With this new approach we will be able to reduce large data operating cost.

Keywords—Data acquisition, Embedded system, FTP Server, Interaction, Internet, Real-time.

I. INTRODUCTION

Data acquisition systems with remote accessibility are getting popular in industry and consumer applications [1]. Internet has become the faster way for integrated multimedia such as voice, video, graphics or data communications. It may absorb within its standards and protocols other well-established technologies, such as telephony, facsimile, messaging, data and entertainment technologies. Its fastest growing service, the World Wide Web, has created a true information revolution and is daily pushing the limits of current technologies to cope with its growth [2].

The Internet Protocol (IP) continues to dominate as a standard for global communications, and other Internet standards are quickly emerging to offer quality of service on the Internet. The wide spread popularity, acceptance and usage of these technologies has presented an opportunity to research and development engineers as well as information technology service providers to develop and provide value added services.

Several systems using Bluetooth, Infrared (IR), Zigbee used for wireless communication has the limitation of range, also, real time applications for image transfer present today are not interactive in nature, as Image contain large amount of information that requires much storage space, large transmission bandwidth and long transmission times [2].

The traditional data acquisition system transmits Images through GPRS connection. The requested image can be transmitted to the client via central server. Using central server to transmit the acquired Image has some disadvantages. First the server act as a relay, no direct bidirectional communication between client and embedded system can be established. In addition it requires server software and maintenance which increases operational cost of the system. Therefore central server shown in Fig. 1 has to be eliminated for a real time system.

Fig.1. Traditional Embedded Data Acquisition System [4]

Interactive Internet-based systems provide a way to monitor and adjust using standard web browsers and a PC. The target systems can be monitored and controlled independent from the location and the platform since standard web browsers can be used on the client side [8].

A typical data-acquisition system is made up of three components connected to each other via the Internet, as shown in Fig. 1. The data-acquisition system needs to transmit the acquired information to the requesting clients.
The clients also need to send commands. If necessary, this is implemented through a server, and then, an enormous amount of data transfer time would be consumed. Thus, alternative methods need to be explored.

The next section is to know the basics of data acquisition system and how our proposed system can be flexible. In this system a General Packet Radio Service (GPRS) board and a Silicon Camera are connected to the embedded board to form the complete system for the proposed solution. Features of all the components are presented at high level. The last section of paper will narrate the conclusion.

II. What IS Data-Acquisition System?

Data acquisition systems are a way to monitor and control the established system remotely using the web browser and a computer. The target systems will be monitored and controlled remotely from the control room as we are using standard web browsers on the client side.

Traditional data-acquisition system is having three components connected to each other through Internet, as shown in Fig. 1 [6]. The data-acquisition system captures the information and sends it to the requesting clients. These clients send the specific request or acknowledging commands to form the connection with server and start the data sharing. When there is need of huge data sharing, such systems are implemented through a server which consumes huge amount of data transfer time. This motivates us to identify the alternative method to form the fast, cost effective and reliable data acquisition system.

A. Interaction between the Client and the Embedded Device – Direct link bypassing the server

Cellular mobile communication is the main purpose of developing GPRS and GSM [6]. GPRS connection is adopted in numerous mobile remote control/access systems. GPRS with unlimited duration of connectivity is charged only for the data package transfers. It is a less costly solution only for the optimized data transfers. The GPRS Key Parameters are as mentioned in Table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Bandwidth</td>
<td>200 kHz</td>
</tr>
<tr>
<td>Modulation type</td>
<td>GMSK</td>
</tr>
<tr>
<td>Data handling</td>
<td>Packet data</td>
</tr>
<tr>
<td>Max data rate</td>
<td>172 kbps</td>
</tr>
</tbody>
</table>

Requested data is transmitted to the client via central server after the GPRS connection has been established. There are some limitations of using a central server to transmit fetched data. First one is that client interface framework is needed for this central server. Time delays occur for an additional data transfer before making the data available for the client. No direct communication can be established in between the client and server due to the server in between. Due to this the system becomes unsuitable for the real time control applications. The main motive behind designing the real-time system is to get the in time response for to the queries sent by Client. Real-time systems are expected to be fast enough and reliable. Correctness of the real-time system depends upon the correctness of the logical results as well as that of the delivery time [9]. In this method it becomes costly for the data transfer when the number of clients increases to access the data transfer via GPRS.

Direct communication enables access to only relevant information in the embedded system. Direct communication eliminates the need of central sever and as only requested data is transferred it reduces the amount of unwanted data that gets transferred if the server is in between.

The proposed system uniquely reduces the cost occurring from frequently requested data and eliminates the need for a well-established server. The system uses a dummy (FTP) server for static information, thus optimizing the transfer of large data. The user can directly log in and access the data from anywhere in the world through a web server built into embedded device in real time. This system eliminates the need to maintain an additional server in order to minimize the operational cost while operating with large amount of data like Image.

We should make the IP address of the embedded module available at client. Static and Dynamic IP can be used to form this communication. Using static IP is a simple method where we hard code the IP address. Dynamic IP is assigned through Dynamic Host Control Protocol Server while forming the connection between client and server. In our application we are using the Static IP.

In the proposed system our program code on the embedded device needs to have the IP address updated on the FTP server manually. Our code is designed to fetch the IP address of the system which we do hardcode and then it forms the link between server and the system.

B. How is Data Managed in the System?

To send all the captured pictures like images through internet at less management cost the Internet server is used.
If the huge data or big images has to be sent, the embedded module is set in such a way that it sends the image only once through GPRS and stores it on FTP server. This way we eliminate the frequent transfer of the large data through GPRS. This reduces the transfer cost especially when more than one clients requests for same data or there are multiple requests for the same data at a time as shown in Fig. 2.

![Fig. 2. Data Managed with Multiple Clients](image)

In this system user interface is provided by the FTP server site FileGenie as shown in Fig. 3. Code has been created in such a way that it will continuously capture the images and will send it to FileGenie server. This FileGenie UI establishes a direct connection with the embedded system which stores the images into the RAM.

![Fig. 3. User Interface](image)

C. What will be the Hardware and software requirement?

The embedded board used is the ARM controller board LPC 2148. ARM board COM port 0 is used to connect SIM 900 and COM port 1 is used to connect the camera module. ARM board is having the controller LPC 2148 which is programmed with the code developed to run the system.

One of the serial ports is used in the application design stage for debugging purposes, and this port is designed to host more devices with a multiplexer unit.

The other serial ports used by the modules1 are used to test the system functionality. The acquisition units on the device can be varied with no limitation on their functionality and can be added by using appropriate interfaces.

Programming has been done in C language and the compiler used is Keil Microvision IDE. Philips Flash utility has been used to load the program to the ARM board.

III. Sample Application

Surveillance application for monitoring the traffic rule violation is developed using internet based data acquisition system, using SIM 900, ARM board and μCAM modules. ARM board has been used as a master server whereas user PC is used as a client. ARM board is loaded with the driver program. The piece of program to run the system is developed in C language, which will integrate and initiate the hardware modules. After integrating the hardware modules the preliminary testing has been performed to check the power on by checking the LCD display on ARM board and LED on SIM 900.

On power ON, SIM 900 which is a GPRS module has been switched ON and the initial portion of the code activates the GPRS connection. Also, on the power ON, Camera module is also started and it starts capturing the images. While this is happening, portion of the code accesses the FTP server and the IP address of this server is fetched. At this stage of the system development, we have to copy this IP address in the code as we are developing the static IP address system. Now the system got the IP address of the target FTP server where we expect the captured images to be stored. FTP server we are using is the FTP server site FileGenie which serves 20MB of free space once you are registered to this site. On the client PC, registered user has to login to see the captured images. The flowchart is shown as Fig. 4.

The camera acquires bulk image data; therefore, it is a good module to demonstrate the effectiveness of the system. It compresses and transfers the image from the camera to the serial port. The communication with the camera is established over an RS232 communication protocol using an asynchronous package transfer method [6]. Before taking a snapshot, the camera is synchronized by sending an appropriate number of synch data packages.

After the synchronization, both the embedded board and the camera wait until they receive an acknowledgement from the other side before sending another request or data. Here, the bottleneck is the camera; hence, the speed of data transfer can further be improved by using a camera with a faster sampling rate. The client initiates the camera control script, which eventually takes a snapshot.
The embedded board receives the data from the camera port then stores them into the FTP of filegenie.com through GPRS.

![System Flowchart]

At Master server side, GPRS has been activated to form the connection between the ARM board and the FTP server. Once the image has been captured from the camera, it has been temporarily stored in the RAM of ARM board and then it will be transferred to the IP address of the FTP server.

The monitoring Server is located at the monitoring firm service provider center(s) (e.g., security firm or civil defense). The filegenie is the web site where data can be saved by signing in to that site. Instead of installing FTP on a separate PC, or to have a separate web site the image data is sent to FTP of filegenie. So www.filegenie.com works as a monitoring server. For prototype model it provides 20 MB data to be saved freely. As VGA camera is used the size of the image is between 1 to 2 KB hence total no. of images that can be saved is 1000. Hence it is sufficient to take data for five days. Then data can be saved and deleted from filegenie to take new data.

FileGenie also provides the data storage capacity of 7000MB which are used to save data up to 30 days. That is the reason why this system is optimal. The need for static IP can also be removed at the server and client side.

<table>
<thead>
<tr>
<th># of clients at the same time</th>
<th>Total Time (sec) to receive Image</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTP Server</td>
</tr>
<tr>
<td>1</td>
<td>9.2</td>
</tr>
<tr>
<td>2</td>
<td>9.2</td>
</tr>
<tr>
<td>3</td>
<td>9.2</td>
</tr>
</tbody>
</table>

The Table II shows the performance difference between systems using FTP server and that using normal server.

The program has been designed in such a way that it will continuously capture the images of the object and will send them to FileGenie server. Further work can be done for triggering the Camera once an object moves and sensor senses it.

IV. CONCLUSION

In this way, we have studied, designed and developed low-cost, Internet-based data acquisition system. Surveillance application is developed using FTP server based data acquisition system which provides server as well as user interface. The application possibilities can be extended by attaching several modules with appropriate interfaces. This system is capable of bidirectional communication with optimal cost which is an important factor in real-time system applications. For normal data acquisition system, the operational cost is more but with use of this system we have reduced the data transfer and storage cost by using the FTP server on internet. This makes these kind systems more suitable for high data transfer with low cost. This system is designed for static IPs whereas it can be easily modified to support dynamic IPs. This gives the flexibility depending on the requirement.

The system can be enhanced further by using different sensors to make it a more effective surveillance system suitable for traffic control which can provide more detailed information.
REFERENCES


