A Web-Enabled Distributed Door Entry System

**Binaya Acharya (email:bacharya@eece.maine.edu),
Dr Bruce E. Segee (email:segee@eece.maine.edu)
Department of Electrical and Computer Engineering,
Instrumentation Research laboratory,
University of Maine.**

Abstract

This integrated security system that monitors and controls the access to a particular room/area was created as a demonstration of a typical distributed, web-enabled industrial application. It utilizes a bar code scanner, a data terminal, a PC at the door and another as a database and web server, a set of motion sensors, a PC camera and an electric door strike. These components communicate in a variety of ways including dedicated wires, RS-232, and TCP/IP networking. All authorized users are registered in a database. They can access the room by scanning their University identity card on the bar-code scanner. When a scan is made, the barcode is passed to the data terminal using a hardwired connection. The data terminal decodes the barcode and sends the information to the PC using RS-232. The PC queries the database using TCP/IP to determine if the door should be opened. If the user is in the database with the appropriate permissions, the PC instructs the data terminal to unlock the door. In this case, the scanner sets an output pin high to activate the door strike and unlock the door for four seconds. When a motion sensor trips, an interrupt occurs in the data terminal's program. The data terminal checks the other sensor to see if it's also tripped. If both are tripped, it sends a message to the PC via RS-232 to trigger a video capture. The database keeps record of all the authorizations, entries and the movies. The web front to the system creates a web page on demand giving information on recent entries. This page also contains click-able links for viewing movies associated with a particular entry.

1.Introduction

This project was inspired by an industrial application to monitor and automate a door entry. It is used as a demonstration for students at the University of a typical distributed web enabled industrial application. It uses a combination of off-the-shelf and custom-built components as well as software developed for this application. The primary components are as follows:

1. Bar code scanner
2. Data terminal,
3. PC at the door
4. Database and web server,
5. A set of motion sensors,
6. PC camera
7. Electric door strike

The basic operation of the system is as follows. When a bar code of a university ID, is read, a database is queried to determine if this ID belongs to a person authorized to open the door. If the value of the ID matches any of the IDs in the database then the data terminal enables the electric door strike for four seconds. When the user enters through the door and both the motion sensors are tripped, the local PC captures a movie for five seconds. These movies are stored with the database on the server. The web front end to the system retrieves the movies and the information on the entries on demand. Figure 1 summarizes the system.

Figure 1a. When the ID value is accepted by the system

Figure 1b. When the user enters through the door

2 Needs

The need was a simple and a robust distributed application to monitor and automate door entry. The system had to be inexpensive and able to be installed without obstructing the regular key lock system. The remote access to the database using a web front was desired to make it more effective in its mission. While security was a concern, monitoring of access to a facility was a primary motivation.

3. The Application

The door entry system can be divided into the sub systems described in the sections that follow.

3.1 The Bar Code Scanner System

The bar code system includes a barcode reader and a data terminal. The bar code scanner is programmed to read the size and format barcode found on a University of Maine student ID. When a user scans the bar code of his university ID, the scanner sends it to the data terminal. The data terminal formats the barcode information into a packet for the local PC. When the local PC receives the ID information, it performs a database query to determine if that person is authorized to open the door. If the entry is authorized, the PC informs the data terminal which will then unlock the door for four seconds using custom circuitry for the electric door strike as described in Section 3.3.

3.2 The motion sensors:

As the name suggests, the motion sensors detect motion in the area. These devices operate by means of passive infrared (PIR), that is when a warm body moves through the sensor's field of view a TTL signal is produced. When a user enters the door, a set of motion sensors is tripped because the sensors are very sensitive. Multiple sensors are used to reduce false trips. The program in the terminal then sends the message "BSPCALARM" to the PC. Upon receipt of this message, the local PC will capture a 5 second video and store it with the database on the server.

3.3 The Door strike circuit

The scanner cannot drive the door strike alone. The door strike requires 4-6V DC, 2 Amps. This could be supplied by a regular 5V power supply but we decided to use NiCad rechargeable batteries. When the solid-state relay is turned off, the door strike has no voltage or current flowing into it. There is a trickle of current (never more than 8 mA) flowing through the battery pack, recharging the batteries. When the solid-state relay is turned on, current from the batteries and the +12V source flow through the relay and into the door strike, opening it. Figure 2. shows the Door strike circuit.

Figure 2: Circuit diagram of the door strike system.

3.4 Network and Communication

The components of the system communicate to each other in a variety of ways including dedicated wires, RS-232, and TCP/IP networking.

3.5 The PC system:

The PC system includes a local PC by door to run the custom software and a remote machine used as a web and database server. The PC system keeps track of authorization, entries, and movies. The system is held together with the program “PhotoProto” that manages entry requests and movies. It also allows the addition of IDs to the database, changing the database, and changing movie directory. This program was written using Visual Basic. Figure 3. Shows some of the capabilities of the PhotoProto. The PhotoProto works according to the signal it receives from the data terminal through the serial port.

Figure 3a. The program is ready for taking movies

Figure 3b. Some of the features of the PhotoProto

The communication from the data terminal to the PC consists primarily of the two types of messages “BSPCALARM” and “SCPC”

1. **"BSPCALARM"** – this signal indicates that there is motion in the area. In response to that message the PC activates a QuickCam controlled by an Intrepid Control Systems to take a movie for the next 5 seconds. The movie is stored with a unique file name that encodes the date and time it was taken. The 'movie' table in the database is also updated with the time of the movie and its file name.
2. **"SCPC"(barcode ID)**- The content of the message is an ID that was scanned in. The ID is compared against all of the IDs in the database. If there is a match, the 'Entries' database is updated with who is entering and their time of entry. A message is then sent back to the data terminal, authorizing it to activate the door strike. If the ID is not in the database, a denial message is sent back to the data terminal.

All necessary data for the security system (authorized IDs, entry history, and available movies) are stored in a database. Although Microsoft Access database is currently being used, the type of database is irrelevant; the database could be ported to SQL Server, Oracle, or any other database types.

3.6 The Web Front -End

The web front end to the system allows remote access to monitor entry system. The web page was developed using Microsoft InterDev 6.0. The web page includes information about the system and the access to the database. An Active Server Page, “access.asp”, retrieves the entry and movie data. When entry data is requested, all entries for the specified time period are listed along with all movies that were taken in the minutes following the entry. When movie data is requested, all movies and their attributes for the specified time period are listed.

3.7 The Movie Cleanup Program:

Because of the size constraints, movies and entries need to be regularly cleaned. A cleanup program is written in Microsoft Visual Basic to remove the movies from the movie folder that are more than a week old.

4 Conclusions:

This web enabled door entry system is a simple yet a very robust system. It utilizes a set of inexpensive components. It can be easily installed in virtually any limited access facility. It has been running successfully for more than a year at our automation lab.

5.Bibliography

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BINAYA ACHARYA

Binaya Acharya is currently enrolled as an undergraduate student at the University of Maine as an Electrical Engineering major. He is employed in the Instrumentation Research Lab, Department of Electrical and Computer Engineering at the University of Maine as a Research Assistant.

BRUCE SEGEE

Bruce E. Segee is an Associate Professor of Electrical and Computer Engineering at the University of Maine. His research interests include Instrumentation, Automation, and Intelligent Systems. He is the Director of the Instrumentation Research Laboratory and a Member of the Intelligent Systems Group at the University of Maine. His work focuses on real-world deployable systems for use in manufacturing environments. Dr. Segee received his PhD from the Department of Electrical and Computer Engineering at University of New Hampshire in 1992.