Monroe Mechanical Back-To-Front Database Solution

By

Tyler Woebkenberg

Submitted to
the Faculty of the Computer Science Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Computer Science Technology

University of Cincinnati
College of Applied Science

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Acknowledgements/Dedication

I would like to give special thanks to Ez Housh and Monroe Mechanical for providing the vision of the project and an opportunity to complete it. Ez, specifically, provided a drive to complete the project while taking the time to explain the direction of the project and the company with amazing patience and clarity. I would also like to extend special thanks to Paul Simmons who consults with Monroe and develops all of their back-end filepro databases. Paul provided the most helpful input and support to the project while remaining flexible with his work on the back-end databases. Paul also joined me in training for filepro in December so that together, we could learn more about filepro. I would like to thank Sandy Stamper, the controller for Monroe Mechanical, who was an integral part in developing the methods of billing the national company, Family Christian Stores. Without her help and instruction on accounting practices, we would have continued to use a flawed system of billing and possibly ruined our relationship with Family Christian Stores. Thanks to my academic advisor, Russ McMahon, who took not only an academic interest in me but a personal interest as well considering our love of running. He was a support and encouragement in all areas and provided the needed direction to complete this project and all documentation. Finally, thanks to my family most of all and my friends who have stood by me and supported me in my many years of college. I’m almost to the end and without their love and support, I would not have made it this far.
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Abstract

*Monroe Mechanical Back-to-Front Database Solution* (Back-to-Front) is a web-enabled database solution that allows Monroe Mechanical (Monroe) to centrally manage national heating, ventilation, and air conditioning (HVAC) service jobs for corporate customers. This system is designed to replace the previous system in use by many corporate customers of paper invoices, faxes, and mail. Monroe currently dispatches and invoices all of its HVAC service work in its back-end database system. The Back-to-Front system took advantage of these same features used within Monroe and applied them to corporate service work. Monroe allowed outside service companies access to the back-end service work information and allowed them to invoice service work performed on behalf of Monroe. The paper explains this problem many national companies face with HVAC service work and Monroe’s solution to fix it, including the design of the system and what software tools were used to produce the system. In addition to that, it explains the five unique users of the Back-to-Front system who access it on a regular basis.
Introduction

Monroe Mechanical is a service company that has been in business since 1954. It relies heavily on the service dispatch data to determine where the workers in the field will be and what they will be doing. The current owner and president of the company is Ez Housh. He consistently adopts new technology to improve the flow of this information to the company’s workers in the field.

Mr. Housh saw the need to be able to deliver real-time dispatch information to workers in the field without direct access to our back-end databases. This system was first developed for the service technicians of Monroe and it was called ServiceTech Direct. The system used Handspring Visors and a batch synchronization method to update information daily.

When I began at Monroe Mechanical in January 2002, I started working on an enhancement to the ServiceTech Direct project that wirelessly delivered the company’s back-end, database information to service technicians in the field. The enhancement was able to accomplish this by using a Web-enabled, front-end database, FileMaker Pro. The enhancement still used the Handspring Visors but attached Handspring Visorphones to these devices and then the service technicians had access to the Web-enabled data in the new databases.
At the beginning of 2003, Monroe Mechanical acquired a national service account, Family Christian Stores. Monroe is responsible for dispatching all service calls for Family Christian Stores east of the Mississippi River. Service companies across the country were hired by Monroe Mechanical to perform out-of-state service. The service companies needed a way to access the dispatch information and invoice Monroe Mechanical for the work they performed. This was accomplished by making a slight enhancement to ServiceTech Direct.
1. **Statement of Problem**

Monroe Mechanical (Monroe) acquired a national service account, Family Christian Stores. Monroe is responsible for dispatching all service calls for Family Christian Stores east of the Mississippi River. Service companies across the country were hired by Monroe to perform out-of-state service. The service companies needed a way to access the dispatch information and invoice Monroe for the work they performed.

2. **Description of the Solution**

Monroe was able to fulfill this need with a national company in a way that is efficient and easy for the national company, the outside HVAC service companies, and Monroe. They were able to setup an online system that provided service work information to service companies and the ability for those companies to invoice Monroe for the work that is done. The national company has the ability to access the online system to review and approve invoices from the service work. The national company is then billed out of this system. This online system links in with Monroe’s back-end databases so that Monroe employees do not need to access multiple systems to dispatch service work for multiple clients.
2.1 User Profile

2.1.1 Service Employee

The service employee is an employee of Monroe Mechanical. Most tasks this user will complete will be done in the text-based interface of filepro. This user will be responsible for dispatching service jobs to the service companies. This user can also view and update the work orders and can search information about the site or units at a site. The service employee should have a basic level of computer competency. This user should be comfortable with inputting information into a text-based interface. E-mail skills and word processing skills are also required for a service employee.

2.1.2 Preferred Service Provider (PSP)

The PSP is an outside service company who does work on behalf of Monroe based on need and the service jobs dispatched to them by the service employees. The PSP is also responsible for invoicing Monroe for the work done using the online system and updating all site and unit information. A PSP should have a basic level of computer competency including the ability to navigate to a Web page and enter information into the Web page. The PSP would also be expected to be comfortable with e-mail and word processing.
2.1.3 National Company / Corporate User

The corporate user will be responsible for reviewing all submitted invoices for service that has been performed. The corporate user would then need to approve these invoices for payment. This user can also view statistical information or historical invoice information. A moderate level of computer competency would be required for a corporate user. On top of Web browsing, e-mail, and word processing, the corporate user would need to be comfortable with spreadsheets and graphical data.

2.1.4 Service Manager

The service manager is an employee of Monroe Mechanical. A service manager has all the abilities as a service employee as well as the ability to manage all usernames and passwords for the system. A service manager is also responsible for reviewing all invoices received from the PSPs and invoicing the national company for all work performed. The service manager would also have access to statistical information about service jobs. A medium to high level of computer competency is required for a service manager. A service manager would have to be comfortable setting up users and assigning passwords and privileges to users. This user would also need to have the same abilities as a corporate user in order to view graphical data and spreadsheets.
2.1.5 System Administrator

A system administrator is a user with full control over the system. On top of having all the privileges as the other users, a system administrator has the ability to modify the Web pages used in the system and maintains all databases used for the system. A system administrator could develop new Web pages or databases for the system if the need arose. He would also be responsible for monitoring the system to ensure it is working properly and no sensitive information is being lost by faulty security or systems. A high level of computer competency is required for this user due to the high level of control the user has over the system. The system administrator must be comfortable developing HTML Web pages and filepro databases for use in the system along with all the basic functions of e-mail, word processing, and spreadsheets.
2.2 Design Protocols

2.2.1 Project Design

Figure 1. Data Flow Diagram of System
2.2.2 Data Objects

- **Work Order**
  The work order contains important information the Service Employee must use to communicate to the PSP what service needs to be performed. A work order will be issued for each service job that must be completed by the PSP.

- **Invoice**
  The invoice is based off the work order and, in many ways, is more important than the work order. The invoice indicates what work was done with respect to a particular work order, how much time the work required, and how much the job will cost with labor and material costs.

- **Site**
  The site is information about the locations at which the PSPs will perform service. It includes address and contact information about each location.

- **Unit**
  Every site has HVAC equipment to service. Each piece of equipment is designated as a unit. Each unit is barcoded and the unit information is collected for history and warranty purposes.
2.2.3 Processes

2.2.3.1 Ordered Processes

1. Create Work Order

   The Service Employee completes this process. It involves generating a work order based on service information from sites around the country.

2. Access Work Order

   The PSP completes this process. It involves the PSP simply calling up this information from an authenticated Web page. The PSP may only view work orders that are assigned to it.

3. Enter Unit Information

   The PSP also completes this process by gathering the serviced unit information from the field and submitting online after accessing the work order.

4. Submit Invoice

   This is the final process in the PSP’s ordered processes. After the PSP has performed the work according to the work order and submitted the unit information, they submit all invoice information related to the job.

5. View Invoice for Approval (Service Manager)

   The Service Manager would now enter the system after the PSP submits the invoice. The Service Manager reviews this information to ensure it is accurate with respect to the job and the type of work done.
6. Approve Invoice (Service Manager)

After the Service Manager has reviewed all invoice information and verified its accuracy, he can approve the invoice for payment to the PSP.

7. View Invoice for Approval (Corporate User)

When the Service Manager approves an invoice, the Corporate User is notified and then begins a similar process to the Service Manager. The Corporate User reviews the invoices that have been submitted for payment to ensure they are within the allowed price range and scope of work. A Corporate User may only view invoices for its stores.

8. Approve Invoice (Corporate)

If the invoices are within the allowed pricing and scope of work, the Corporate User can approve the invoices for payment using this process.
2.2.3.2 Unordered Processes

1. Enter Site Information

   The Service Employee is also responsible for entering the site information.

   The site information is important because it includes the details about the job sites the PSPs will visit to complete the work.

2. View Work Order Information

   The Service Employee has the ability with this process to view the information that has been entered for a particular work order.

3. View Unit & Site Information

   These are two processes that can be performed by both the Service Employee and the PSP. It allows both users to view the information about a particular unit or site. A Service Employee may view any unit or site information. The PSP is limited to viewing only those units or sites for which they are responsible.
2.2.4 Database Design

2.2.4.1 Database Tables

As anyone can see, this project requires an elaborate database layout and design. Some of the important databases are discussed below.

2.2.4.1.1 Work Order Table

The work order table contains important information about a particular service job such as date, store number, and problem description. From this table, service work can be dispatched in a work order form and tracked using the work order number. From the work order, you are able to determine what national company the work order is attached to as well as what Preferred Service Provider is assigned to perform the work.
2.2.4.1.2 Invoice Table

The invoice table works in conjunction with the work order table. When a service provider performs service work based on a work order, they bill Monroe Mechanical based on an invoice. Monroe Mechanical, in turn, uses this invoice to bill the national company to which the work order is assigned. The Invoice table references the Invoice Parts and Invoice Units table to keep track of material billed against an invoice and track service history, respectively.

2.2.4.1.3 Corporate & PSP Tables

The Corporate and PSP Tables both serve a similar function. They are both responsible for keeping track of the information regarding a particular national company or Preferred Service Provider, respectively. This contains all contact information, all billing information, and all necessary financial information about a national company or service provider.

2.2.4.1.4 Site & Unit Tables

The Site and Unit tables both work with the invoice database and provide history records for sites regarding their HVAC units and jobs performed at the site. From these tables, Monroe Mechanical employees can determine what has happened at a particular worksite quickly without having to look through 1000’s of work orders and invoices.
2.2.5 Interface Design

The system interfaces were designed with simplicity in mind. Since Monroe is a service company, many Monroe employees have valuable input with regard to what is useful information to display. When designing interfaces, there are three groups to consider: Monroe, PSP, and Corporate. The Monroe group includes Service Employees and Service Managers.
2.2.5.1 Monroe

Much of Monroe’s work is done in a text-based terminal session linked directly into the back-end database. Many of the screens the Monroe users see will resemble the figure below.

![Monroe Service Dispatcher](image)

*Figure 3. Sample Monroe Interface Design*
2.2.5.2 Preferred Service Provider (PSP)

Users in the PSP group will always access the database information through a web interface. These users will have an interface that resembles the following figure.

![Sample PSP Interface Design](image)

Figure 4. Sample PSP Interface Design
2.2.5.3 Corporate

A user in the Corporate group will have access very similar to a user in the PSP group. A Corporate user will only have access to the database information through a web interface similar to below.

![Sample Corporate Interface Design](image)

**Figure 5.** Sample Corporate Interface Design
3. Objectives

- A Web-based HVAC Service Dispatch Application
- A back-end database that will allow for dispatch and invoicing of HVAC service jobs on a national scale. The database will be developed in filepro.
- A front-end web application that allows for efficient access to service information and invoicing. The front-end will be developed using HTML. Scripts in the back-end database will dynamically create the content of these pages.
- Authentication for five levels of users:
  - Service Employees
  - Preferred Service Providers
  - Service Managers
  - Corporate Users
  - System Administrators.
- Ability for authenticated users to:
  - Create work orders for needed service work
  - View work orders created
  - Enter unit information
  - View work order, site, and unit information
  - Enter invoice information
  - View invoice information
  - Approve invoices for payment
- Invoice reporting as requested by Monroe and Corporate Users.
4. Design and Development

4.1 Budget

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</tr>
<tr>
<td>PII 450MHz UNIX Server</td>
<td>3500</td>
</tr>
<tr>
<td>G4 500MHz Mac Laptop</td>
<td>2500</td>
</tr>
<tr>
<td>filepro plus development version 5</td>
<td>8800</td>
</tr>
<tr>
<td>fpcgi</td>
<td>1000</td>
</tr>
<tr>
<td>filepro for Windows demo</td>
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</tr>
<tr>
<td>Terminal application for Macintosh</td>
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</tr>
<tr>
<td>Taco HTML Editor</td>
<td>0</td>
</tr>
<tr>
<td>Adobe Photoshop version 7 for Macintosh</td>
<td>649</td>
</tr>
<tr>
<td>Adobe Illustrator version 10 for Macintosh</td>
<td>499</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$18948</strong></td>
</tr>
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</table>

*Figure 6. Budget*
Figure 7. Timeline
4.3 Software

The filepro database version 5 will be needed since the current system uses that. The filepro demo for Windows will be used for development. The Terminal application will be used to access the filepro demo for Windows. fpweb is a Web addition to filepro that allows users to access the back-office data in filepro from the Web. An HTML editor named Taco HTML Editor will be used to code all Web pages. Adobe Photoshop and Adobe Illustrator will be used for graphic work.

All web pages will be hosted on the UNIX server so a hosting service or program will not be required. All hardware and software requirements for this project are owned by Monroe Mechanical and are detailed below. The following page includes my proposed budget and timeline for the project.
4.4 Hardware

A Pentium III 450 MHz CPU with 350 Mb of RAM will host a demo version of filepro 5 for development and training. The machine is running Windows XP and has a 12 Gb hard drive.

The database filepro is running on a UNIX machine running a PII 450 MHz CPU with 128 Mb of RAM and a 15 GB hard drive. The operating system is SCO UNIX. Based on the average processing load of the current machine, I do not see a need to upgrade the machine except in the case of adding an extreme amount of users to the system.

Development will be done on a Macintosh G4 laptop running 500 MHz with 512 Mb of RAM and a 30 Gb internal hard drive and 60 Gb external hard drive. The OS is Mac OS 10.2.8.
5. Proof of Design

The next section shows in detail how deliverables of the project were fulfilled.

5.1 A Web-based HVAC Service Dispatch Application

This application has been developed and is currently in use by Monroe Mechanical. All types of users have access to the system and are able to carry out their business functions within the service dispatch process. To date, over 600 invoices have been generated electronically on the online system.

5.2 A back-end database that will allow for dispatch and invoicing of HVAC service jobs on a national scale.

The existing databases used prior to the Monroe Mechanical Back-To-Front Database Solution were modified to work with this new application. They now allow for a Monroe Service Employee to generate a work order for service work that can be performed by Monroe locally or by a Preferred Service Provider nationally. The databases are filepro databases.

5.3 A front-end application that allows for efficient access to service information and invoicing.

The Preferred Service Provider can now access work orders related to it and invoice that work order online using the Back-To-Front Solution. The front-end application runs on HTML webpages generated by back-end processing and display back-end data from the filepro databases.
5.4 Authentication for five levels of users

5.4.1 Monroe Service Employees

A Monroe Service Employee must enter a correct username and password combination in order to access the back-end database and generate work orders. The back-end server handles user authentication for this user.

5.4.2 Preferred Service Provider (PSP)

A Preferred Service Provider must enter a correct username and password combination in order to access the online application to access work orders and generate electronic invoices. The front-end application handles authentication for this user.

5.4.3 Monroe Service Managers

A Monroe Service Manager must enter a correct username and password and have the correct privileges in order to view submitted invoices and approve them based on information provided from the PSP. The back-end server handles user authentication for this user.

5.4.4 Corporate Users

A Corporate User must enter a correct username and password combination and have the correct privileges in order to view approved Monroe invoices, approve invoices for payment and view previously approved invoices. The front-end application handles authentication for this user.
5.4.5 System Administrators

A System Administrator has multiple username and password combinations in order to administer the various databases associated with the application as well as the servers on which the application and databases are housed. This user authenticates through a variety of methods in order to access the back-end data, databases, back-end processing, and front-end layout and design.

5.5 Ability for authenticated users to do the following.

5.5.1 Create work orders for needed service work

A Monroe Service Employee has the ability to generate work orders using the back-end filepro database.

5.5.2 View work orders created

A Preferred Service Provider can view the created work orders using the online system that reads from the back-end database.

5.5.3 Enter unit information

A Preferred Service Provider can enter unit information for a jobsite based on the equipment that was serviced.

5.5.4 View work order, site, and unit information

A Preferred Service Provider can view the work order information for any un billed job, any site information for which they are responsible, and any unit information for which they are responsible.

5.5.5 Enter invoice information

A Preferred Service Provider can generate an online, electronic invoice based on a work order for a service job.
5.5.6 View invoice information.

A Monroe Service Manager can view the invoice submitted online by PSPs in the back-end database system.

5.5.7 Approve invoices for payment.

A Monroe Service Manager and Corporate User can both approve invoices submitted online by PSPs. A Monroe Service Manager uses the back-end database to approve invoices from the PSPs. A Corporate User uses the online system to approve invoices after a Monroe Service Manager has approved them.

5.6 Invoice reporting as requested by Monroe Service Managers and Corporate Users.

An immediate online report of all invoices submitted, pending approval, and approved invoices is available to Monroe Service Managers. Corporate Users have the ability to immediately view all approved invoices. Any further invoice reporting would have to be generated from the accounting system.
6. Conclusions and Recommendations

Overall, this project proved to be a wonderful real world problem and solution that was a great capstone experience for my education here at University of Cincinnati. It was completed in response to Monroe Mechanical’s need to centrally manage national service dispatch for a national company. The system was developed almost exclusively using HTML and the back-end processing of the filepro databases that Monroe uses on a daily basis to perform its business tasks. The project required that I learn some more advanced HTML techniques and most importantly, learn to develop in filepro. The HTML was easy enough to learn, but I struggled most with the filepro databases and development. filepro is a legacy database that is more than 25 years old so many newer database concepts and protocols did not work with it. Monroe provided the money for me to attend two different filepro training sessions at which I was able to gain valuable knowledge of filepro databases and the development environment.

Even before I was able to begin working with filepro for development, I had to spend a lot of time configuring the server to work with filepro on the Internet. The server had a Netscape Web Server running which served as its webpage host. filepro requires that the server host webpages with an Apache Web Server rather than the provided Netscape. It took over a month to find an installable Apache Web Server and get it up and running so that filepro could begin to display web content.

Even with all this development done, money spent and knowledge gained, I reached the end of this time and was convinced that filepro would not be the solution for Monroe in the future. Monroe Mechanical has many advanced data needs well beyond the scope of this project that prompted me to further discuss the idea of moving much of
the back-end database work to a newer database. Beyond that one major thing, filepro is a very useful and powerful enough database that enables Monroe Mechanical to centrally manage service heating and dispatch for their local service jobs and for national accounts.

I am currently in the process of investigating other database options for Monroe while finishing up my final coops.