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1. Product Concept

This section describes the purpose, use, and intended user audience for the Supply Fetch product. The Supply Fetch product is a voice controlled system used in an office supply room that allows a user to verbally state the item they seek and the corresponding drawer with that item is indicated through a lighting system.

1.1 Purpose and Use
The purpose of Supply Fetch is to provide a more efficient method of searching for office supply items versus the traditional method (manually looking at labels and searching through various drawers). This product basically fulfills the problem of “show me the item I am looking for” in a timely and efficient manner.

1.2 Intended Audience
The Supply Fetch system would appeal to any individual, group, organization, or company that routinely uses an office supply room to acquire certain office supplies. Our immediate audience, that we plan to demonstrate our device for, is any UTA staff and faculty member that utilizes the office supply room on the 6th floor of the Engineering Research Building (ERB) at the University of Texas at Arlington.

![Figure 1-1 Product Concept](image-url)
2. Product Description and Functional Overview

This section provides the reader with an overview of the Supply Fetch product. The primary operational aspects of the product, from the perspective of end users, maintainers and administrators, are defined here. The key features and functions found in the product, as well as critical user interactions and user interfaces are described in detail.

2.1 Features and Functions

The Supply Fetch system will indicate the location of the drawer (with an LED) containing the item verbally stated by the user.

The product has four main components: the microphone, interface component, indication controller, and the indicators. The interface component will be in the form of a graphical user interface (GUI) that handles voice to text processing and database utilization for mapping items to drawers.

Supply Fetch does not monitor or handle any type of inventory (e.g. system will not notify user when the supply of pencils has been exhausted). Refer to the previous section’s graphic Figure 1-1 for a visual representation of the finished system.

2.2 External Inputs and Outputs

The overall functionality of the Supply Fetch system is very straightforward; the user states the item they desire, the interface component processes the audio input, the corresponding word is searched for within the internal database, and if a positive match is found the main component sends a signal to the corresponding indicators which are then turned ON to emit light, indicating the correct drawer to the user.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>A high quality microphone that captures vocal input from the user</td>
<td>Accepts audio <strong>input</strong> from the user speaking the item’s name</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Outputs</strong> the audio data to the interface component</td>
</tr>
<tr>
<td>Interface Component</td>
<td>Small computer, possibly touch-screen tablet, that processes audio input</td>
<td>Accepts <strong>input</strong> from the microphone</td>
</tr>
<tr>
<td></td>
<td>from microphone and communicates with indication system</td>
<td><strong>Outputs</strong> by communicating to the corresponding indicator</td>
</tr>
<tr>
<td>Indication System</td>
<td>Small series of devices for each drawer composed of a receiver, LED, and</td>
<td>Accepts <strong>input</strong> from the interface component</td>
</tr>
<tr>
<td></td>
<td>battery if necessary</td>
<td><strong>Outputs</strong> LED light to indicate the correct drawer to the user</td>
</tr>
</tbody>
</table>

Table 2-1 Description of External Inputs and Outputs
Figure 2-1 Preliminary Data Flow of the Supply Fetch System
2.3 Product Interfaces

The user will be able to interact with the interface component’s GUI by utilizing a series of simple buttons. The main screen should have a minimal amount of buttons for simplification. Below is a mock-up of the possible GUI for the interface component as well as a graphic of the indicator on each drawer handle. These are not final designs.

![Mock-up of possible GUI for interface component](image)

Figure 2-2 Sample Screen Shots and Component Graphics
3. Customer Requirements

This section covers the requirements the customer has specified as being important. The customer is the EOS team sponsor Dr. Darin Brezeale. The requirements in this section cannot be changed without approval from the customer and other stakeholders affected.

3.1 Size of Supply Fetch

3.1.1 Description: The Supply Fetch system should be noninvasive and should not interfere with regular office room activities as a result of its size.

3.1.2 Source: Dr. Darin Brezeale

3.1.3 Constraints: Shelf workspace

3.1.4 Standards: All Senior Design projects must fit within a cubic yard.

3.1.5 Priority: 1 - Critical

3.2 Simple User Interface

3.2.1 Description: The user interface should be simple and easy to use. It should also provide fast and seamless functionality and activate the microphone for voice to text processing with at most a single button.

3.2.2 Source: Dr. Darin Brezeale

3.2.3 Constraints: One user at a time

3.2.4 Standards: None

3.2.5 Priority: 1 - Critical

3.3 Prepping of the System

3.3.1 Description: The average user should not need to “prep” or “train” the Supply Fetch system beforehand, like dictation software.

3.3.2 Source: Dr. Darin Brezeale

3.3.3 Constraints: None

3.3.4 Standards: None

3.3.5 Priority: 1 - Critical
3.4 Speech Processing System
   3.4.1 Description: The Supply Fetch system will use a microphone to capture the user’s voice for voice to text processing.

   3.4.2 Source: Dr. Darin Brezeale

   3.4.3 Constraints: The microphone will pick up audio within at least 6 feet.

   3.4.4 Standards: None

   3.4.5 Priority: 1 - Critical

3.5 System Should Find Item Requested by User
   3.5.1 Description: The Supply Fetch system should indicate to the user the correct location of the item they requested.

   3.5.2 Source: Dr. Darin Brezeale

   3.5.3 Constraints: None

   3.5.4 Standards: None

   3.5.5 Priority: 1 - Critical
4. Packaging Requirements
The Supply Fetch system will be designed for easy setup, maintenance, and use. The system will only require attaching four devices together and the software will come already installed. The following are packaging requirements for the Supply Fetch system that describe system contents, setup, and operating requirements.

4.1 Product Will Include One Interface Device
4.1.1 Description: The Supply Fetch system will include a device with a screen and controls that will allow a user to activate the voice processing and mapping items. Interface software will come preinstalled.

4.1.2 Source: Easy Office Solutions

4.1.3 Constraints: This device will require a wall socket for power.

4.1.4 Standards: None

4.1.5 Priority: 2 - High

4.2 Product Will Include One Microphone
4.2.1 Description: The Supply Fetch system will include a microphone that will capture the user’s voice. This component will attach to the interface device.

4.2.2 Source: Dr. Darin Brezeale

4.2.3 Constraints: This device may require its own wall socket for power.

4.2.4 Standards: None

4.2.5 Priority: 2 - High
4.3 Product Will Include One Indicator Controller Device

4.3.1 Description: The Supply Fetch system will include a device that communicates with the tags to indicate the correct drawer. The controller device will be attached to the interface component.

4.3.2 Source: Easy Office Solutions

4.3.3 Constraints: The controller will support up to 44 indicators because the CSE supply room has a total of 44 drawers.

4.3.4 Standards: It will need to conform to FCC standards if implemented wirelessly.

4.3.5 Priority: 3 - Moderate

4.4 Product Will Include the Necessary Indicator Devices

4.4.1 Description: The Supply Fetch system will include the necessary indicator devices that act as tags to indicate where items are. These devices will each contain a LED light.

4.4.2 Source: Easy Office Solutions

4.4.3 Constraints: 44 drawers maximum will be supported.

4.4.4 Standards: The devices will need to conform to FCC standards if implemented wirelessly.

4.4.5 Priority: 3 - Moderate
5. Performance Requirements

The following section outlines the performance requirements that the Supply Fetch system should meet. These requirements are based on the aspects of both speech processing and item finding procedures so that issues like response time and voice processing are handled appropriately.

5.1 Accented Speech

5.1.1 Description: The Supply Fetch system should process accordingly for various user accents.

5.1.2 Source: Easy Office Solutions

5.1.3 Constraints: The quality of the speech processing libraries.

5.1.4 Standards: English

5.1.5 Priority: 3 - Moderate

5.2 Singular vs. Plural Item Request

5.2.1 Description: The Supply Fetch system should accommodate for referencing an office supply in singular, plural, and other common names (i.e. “pen” or “pens” or “ballpoints”).

5.2.2 Source: Easy Office Solutions

5.2.3 Constraints: The quality of the speech processing libraries.

5.2.4 Standards: English

5.2.5 Priority: 3 - Moderate

5.3 Background Noise Reduction

5.3.1 Description: The Supply Fetch system should decipher between the user’s voice and background noise.

5.3.2 Source: Easy Office Solutions

5.3.3 Constraints: The mechanism used for capturing voice (i.e. microphone capabilities).

5.3.4 Standards: None

5.3.5 Priority: 3 - Moderate
5.4 Voice Detection Wait Time
   5.4.1 Description: The Supply Fetch system should remain in an active listening state for a limited amount of time after the item search is activated.
   
   5.4.2 Source: Easy Office Solutions
   
   5.4.3 Constraints: The system cannot listen for an extended period amount of time.
   
   5.4.4 Standards: None
   
   5.4.5 Priority: 2 - High

5.5 Location Revealing Response Time
   5.5.1 Description: The Supply Fetch system should reveal the location of the item within a reasonable amount of time.
   
   5.5.2 Source: Easy Office Solutions
   
   5.5.3 Constraints: Takes no longer than 15 seconds.
   
   5.5.4 Standards: None
   
   5.5.5 Priority: 2 - High

5.6 Indication Method Hold Time
   5.6.1 Description: The Supply Fetch system indicators should flash for a reasonable amount of time once the item has been found.
   
   5.6.2 Source: Easy Office Solutions
   
   5.6.3 Constraints: Flashes no longer than 15 seconds.
   
   5.6.4 Standards: None
   
   5.6.5 Priority: 2 - High
5.7 Item Request Failure

5.7.1 Description: The Supply Fetch system should provide an alternative input method (e.g. GUI keyboard input, dropdown choices etc.) if the system continuously fails at identifying an item.

5.7.2 Source: Easy Office Solutions

5.7.3 Constraints: None

5.7.4 Standards: None

5.7.5 Priority: 2 - High
6. Safety Requirements

This section highlights the safety requirements from the perspective of the user, software, hardware, and environment of the embedded system. The system will need to comply with safety procedures when interaction occurs between administrative access, drawer opening/closing, hardware edges, wiring, and on/off switches of the product.

6.1 Non-Hazardous Equipment

6.1.1 Description: The Supply Fetch system should not interfere with the regular space or drawer use in such a way that it becomes hazardous to users (i.e. should not expose wire that is not properly insulated or hardware objects with rough edges or texture that can cause damage to either the user or drawer).

6.1.2 Source: Easy Office Solutions

6.1.3 Constraints: Wires and hardware

6.1.4 Standards: None

6.1.5 Priority: 1 - Critical

6.2 Administrator Interface to Control Inventory & Settings

6.2.1 Description: The Supply Fetch system should only allow an administrator to make customizations, change settings and add or remove tags/items from the system.

6.2.2 Source: Easy Office Solutions

6.2.3 Constraints: Log-in requirement

6.2.4 Standards: None

6.2.5 Priority: 2 - High
7. Maintenance and Support Requirements

The following section states the maintenance and support that will be provided for the delivered product. Documentation troubleshooting, startup, and source code will be provided for quick customizations and referencing; however, any major support will most likely have to come from the supplier.

7.1 Start-Up Guide

7.1.1 Description: The Supply Fetch system should include a guide that will provide the user with basic instructions on product startup along with tips for troubleshooting.

7.1.2 Source: Easy Office Solutions

7.1.3 Constraints: None

7.1.4 Standards: English

7.1.5 Priority: 2 - High

7.2 Testing

7.2.1 Description: The Supply Fetch system should be tested for performance and correct output delivery in its practice and final environment. Testing, for example, may consist of having the CSE department staff members participate in item request scenarios.

7.2.2 Source: Easy Office Solutions

7.2.3 Constraints: Access to CSE staff supply room

7.2.4 Standards: None

7.2.5 Priority: 1 - Critical
7.3  Maintenance and Support

7.3.1  Description: Team EOS will not be committed to providing maintenance after May 2013 unless members voluntarily decide to enhance/fix the system functionality when needed.

7.3.2  Source: Easy Office Solutions

7.3.3  Constraints: None

7.3.4  Standards: None

7.3.5  Priority: 1 - Critical

7.4  Source Code and Documentation

7.4.1  Description: The Supply Fetch system should include all source code used throughout the project and necessary deliverables for future reference.

7.4.2  Source: Easy Office Solutions

7.4.3  Constraints: None

7.4.4  Standards: English

7.4.5  Priority: 1 - Critical

7.5  Testing Feature for the Indicators

7.5.1  Description: The Supply Fetch System should include a feature that allows the user to test if the indicators are functioning properly. (e.g. Activating this feature would power every LED on so the user could discover if any LEDs are not functional.)

7.5.2  Source: Easy Office Solutions

7.5.3  Constraints: None

7.5.4  Standards: None

7.5.5  Priority: 2 - High
8. Other Requirements

The section below covers other necessary requirements not stated in the previous sections of the SRS. Since the project involves communication to multiple devices, it should be stated that the system can only work at its best if every drawer has its own indication device for pairing.

8.1 Environment Deployment

8.1.1 Description: The system should be able to be adapted and deployed to other shelves with drawers that are often found in offices and stores.

8.1.2 Source: Easy Office Solutions

8.1.3 Constraints: Need to have sufficient amount of indicators for the drawers.

8.1.4 Standards: None

8.1.5 Priority: 1 - Critical

8.2 Item Frequency Tracker

8.2.1 Requirement Description: The system should provide Business Intelligence information to users or administrators; track the frequency of items requested.

8.2.2 Source: Easy Office Solutions

8.2.3 Constraint: Request history will be tracked for a particular range of time.

8.2.4 Standards: None

8.2.5 Priority: 5 - Future

8.3 On/Off Indication

8.3.1 Description: The Supply Fetch system should have on/off states that appear obvious to the user during time of interaction.

8.3.2 Source: Easy Office Solutions

8.3.3 Constraints: None

8.3.4 Standards: Switch/Button

8.3.5 Priority: 2 - High
8.4 On/Off Voice Detection
   8.4.1 Description: The Supply Fetch system should indicate that it is waiting to receive voice input from the user for processing the item request.
   8.4.2 Source: Easy Office Solutions
   8.4.3 Constraints: None
   8.4.4 Standards: None
   8.4.5 Priority: 2 – High

8.5 Power Supply
   8.5.1 Description: The Supply Fetch system should accommodate for powering components that need to be attached.
   8.5.2 Source: Easy Office Solutions
   8.5.3 Constraints: If wireless, battery life expectancy.
   8.5.4 Standards: None
   8.5.5 Priority: 1 - Critical
9. Acceptance Criteria

This section of the document discusses the criteria that are required for the Supply Fetch to be a completed product. Specifically this section is about what our customer (Dr. Darin Brezeale) requires of the Supply Fetch product when it is a fully completed.

9.1 Verify the system will find the item requested by the user

9.1.1 Requirement(s) addressed

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<th>Requirement</th>
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<td>System Should Find Item Requested by User</td>
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<td>5.1</td>
<td>Accented Speech</td>
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<td>5.2</td>
<td>Singular vs. Plural Item Request</td>
</tr>
<tr>
<td>5.3</td>
<td>Background Noise Reduction</td>
</tr>
<tr>
<td>5.7</td>
<td>Item Request Failure</td>
</tr>
</tbody>
</table>

9.1.2 Verification Procedure

The sponsor, EOS members, and other users will test the system to verify that it works correctly. If the system has an error in deciphering a voice command given during this test, it should allow error correction procedures to pass this criterion.

9.2 Verify the device is a useable end product for the CSE department

9.2.1 Requirement(s) addressed

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
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<tbody>
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</tr>
<tr>
<td>4</td>
<td>Package Requirements</td>
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<td>6.2</td>
<td>Administrator Interface</td>
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<tr>
<td>7.1</td>
<td>Start-Up Guide</td>
</tr>
<tr>
<td>7.2</td>
<td>Testing</td>
</tr>
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<td>7.4</td>
<td>Source Code and Documentation</td>
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<td>Environment Deployment</td>
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<td>8.3</td>
<td>On/Off Indication</td>
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<tr>
<td>8.4</td>
<td>On/Off Voice Detection</td>
</tr>
<tr>
<td>8.5</td>
<td>Power Supply</td>
</tr>
</tbody>
</table>
9.2.2 Verification Procedure
Customer will make sure that the indicator units are easy to replace and that the device can be easily placed into the supply room. The Supply Fetch should also pass the acceptance criteria 9.1 above to verify it can be used. The customer will also verify that the system provides a simple, easy to use interface, and that proper documentation of system is provided.

9.3 Verify the device does not impede activity in supply room

9.3.1 Requirement(s) addressed

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Size of Supply Fetch</td>
</tr>
</tbody>
</table>

9.3.2 Verification Procedure
Customer will verify that the system can be picked up and easily moved. The customer will also verify that the lights and the system will not be an impediment to activity in the supply room.
10. Use Cases

The following section describes the many different ways a user will interact with the Supply Fetch system. Each use case details the steps the user will take to use and maintain the system.

10.1 Setup Supply Fetch

10.1.1 Scenario: An administrator attaches the microphone and indicator controller to the interface and adds indicators to the drawers.

10.1.2 Actor(s): Administrator

![Diagram of Setup Supply Fetch](image)

**Figure 10-1 Use Case: Setup Supply Fetch**
10.2 Find item

10.2.1 Scenario: A user activates the item search, speaks the name of the item the user wants to find, and sees the drawer indicator flash if the item was found.

10.2.2 Actor(s): User

Figure 10-2 Use Case: Find Item
10.3 Add item to database

10.3.1 Scenario: An administrator uses the interface to add an item to the item database and associate it with a tag.

10.3.2 Actor(s): Administrator
10.4 Delete item from database

10.4.1 Scenario: An administrator uses the interface to remove an item from the item database and its association with a tag.

10.4.2 Actor(s): Administrator

---

**Figure 10-4 Use Case: Delete Item from Database**
10.5 Add tag to database

10.5.1 Scenario: An administrator uses the interface to add a tag to the tag database.

10.5.2 Actor(s): Administrator

Figure 10-5 Use Case: Add Tag to Database
10.6 Delete tag from database

10.6.1 Scenario: An administrator uses the interface to remove a tag from the tag database.

10.6.2 Actor(s): Administrator

Figure 10-6 Use Case: Delete Tag from Database
11. Feasibility Assessment

This section of the SRS looks at the feasibility of the Supply Fetch Device. It will look at how possible the whole of the device is depending on its independent components. The feasibility section covers the topics of scope analysis, research, technical analysis, cost analysis, resource analysis, and schedule analysis. The basic summary of this section is that it shows finishing the project by the end of the spring 2013 semester is indeed feasible.

11.1 Scope Analysis

The scope of work for all of our requirements is reasonable, and prototyping of these by the deadline appears feasible. This assessment is based on each of the team member’s set of skills and experience and the research we have done together about voice analysis technologies. We expect that most of the work scope will be the voice detection and drawer indication requirements. After looking at many different options for speech to text, we feel that using voice processing equipment with an attached SDK can help us meet the voice detection requirement.

Although we have already decided on using lights to notify a user what drawer an item is in, we are still researching ways to wirelessly activate those lights. To manage our scope better, any changes proposed after defining our final requirements will most likely not be taken into consideration unless they are strongly thought to be necessary in which case the proposal will take an audit process as well as an impact analysis to determine whether the project still maintains feasibility and constraint satisfaction. In our analysis we will particularly think about how the proposed change will affect customers, costs, trade-offs, and the priority of the proposed change.

11.2 Research

With regards to research, we have begun to place much emphasis on the two largest aspects of the project: the speech to text functionality and the indication system of the Supply Fetch system.

One of the largest components is the speech to text system that will be used to identify an item request. Fortunately, based on the research we have completed as of today, there appears to be a substantial amount of tools and source code for being able to add speech to text capabilities to any kind of project. Because most methods of voice to text hold their own advantages and disadvantages, it will become crucial that we compare each option so that we can choose one that we feel are comfortable with and is also able to satisfy our requirements. We also are aware that a previous semester team, Beta Homes, had tried to include voice recognition to their system but were unsuccessful with the implementation.
This finding in Beta Homes, has brought us to consider future risks that we may face which is why concentration on research for effective voice detection is being completed upfront. Some of the possible solutions for speech to text implementation include Google voice search form, voice recognition for Arduino, voice actions for Android, and the Kinect for Windows speech recognition.

The other largest component of the system is the method of locating the item efficiently. We feel that compared to the speech to text, this aspect of the project may require the most critical analysis since we hope to implement the indication process wirelessly. Our current research approach for finding wireless communication information consists of web searching and using peers for suggestions. We also hope to schedule some time with several professors that specialize in hardware who can point us to the correct resources and technology. Some of the possible solutions for wirelessly controlling LED’s include Arduino Xbee, infrared, and radio frequency technology.

11.3 Technical Analysis
Our Supply Fetch System will consist of 4 major components: a microphone, an interface component, an indicator controller, and indicators for the drawers.

Our microphone will accept user voice input so that our interface component can process the audio accordingly and convert the request to text so that it is checked against the database of the interface unit. For speech processing, we will depend on pre-existing speech to text libraries of the voice/microphone equipment.

The user will interact with the GUI of the interface component to activate voice search and manage the database that maps items to indicators.

Our indicator controller accepts commands from the interface component so that it can signal the correct indicator for the item which is connected wired or wirelessly.

The hardware design for the method of indication has been recently discussed for feasibility among other students and professors who are knowledgeable about wireless communication. Recently, we discussed the feasibility of using Sensor Network Technology in order to wirelessly have communication between one unit and many indicating devices. This wireless indicator unit attached to each drawer would need to have a wireless receiver, a microcontroller, LED, and battery attached.

With regards to technical skills, each member has the necessary basic experience to implement the various hardware and software components of the Supply Fetch system.
11.4 Cost Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
<th>Low-End Unit Cost</th>
<th>Extended Low-End Cost</th>
<th>High-End Unit Cost</th>
<th>Extended High-End Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>1</td>
<td>$20.00</td>
<td>$20.00</td>
<td>$150.00</td>
<td>$150.00</td>
</tr>
<tr>
<td>Laptop or Tablet</td>
<td>1</td>
<td>$200.00</td>
<td>$200.00</td>
<td>$400.00</td>
<td>$400.00</td>
</tr>
<tr>
<td>LED</td>
<td>44</td>
<td>$0.05</td>
<td>$2.20</td>
<td>$0.20</td>
<td>$8.80</td>
</tr>
<tr>
<td>Wireless Receiver</td>
<td>44</td>
<td>$3.00</td>
<td>$132.00</td>
<td>$10.00</td>
<td>$440.00</td>
</tr>
<tr>
<td>Wireless Emitter</td>
<td>1</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$25.00</td>
<td>$25.00</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>44</td>
<td>$1.00</td>
<td>$44.00</td>
<td>$6.00</td>
<td>$264.00</td>
</tr>
<tr>
<td>Battery</td>
<td>44</td>
<td>$0.05</td>
<td>$2.20</td>
<td>$0.20</td>
<td>$8.80</td>
</tr>
<tr>
<td>Wires</td>
<td>1 roll</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td>Misc. – Resistors, Capacitors, etc.</td>
<td>1</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$20.00</td>
<td>$20.00</td>
</tr>
<tr>
<td>Shipping</td>
<td></td>
<td>$30.00</td>
<td>$30.00</td>
<td>$50.00</td>
<td>$50.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$442.40</strong></td>
<td><strong>$1371.60</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 11-1 Preliminary Component Cost Estimates

11.5 Resource Analysis

The EOS group is made up of two Computer Engineering students, a Computer Science student, and a Software Engineering student. For programming languages we all have a good understanding of Java, C/C++. This is good because right now we feel that C# is the language of choice for some aspects of the project, and having a good understanding of these languages will help us to learn C# at a faster pace. The Computer Engineering students have a knowledge of microcontrollers, wiring, and circuitry; which should help with creating the hardware for the wireless lights. As for the wireless aspect of the lights, one member of our group has an understanding of using C with some network programming, and two of our members are currently in a networks class. This all together should help us in approaching how to set up the wireless feature.

As for the voice to text, our group has an understanding of some web programming (mostly html and php), and we also have the capability of learning C# with .NET quickly. The web programming skills would be necessary if we decided to use speech to text software that depended on the internet. C# and .NET would be necessary if we decided to use the .NET speech API’s for cross platform capabilities and ease of use. As for databases, we all have a good general knowledge of MySQL because we have all completed a database course. Because of the content of the database and the necessary transactions needed to access items, we estimate the database will result in a straight forward implementation. As for the possible GUI interface, the Software Engineering student has interface development
experience, and the Computer Science member has touched on the basic aspects for creating user interfaces; thus, implementation can be seen as feasible.

As a final note, we believe that we possess the experience to complete the components of this project, besides the lack of knowledge in C# and .NET. We feel that we can easily recover from this issue using our knowledge of Java’s similar syntax/concepts and the Nedderman Hall Library resources, to quickly pick up C# and .NET. In conclusion, it is feasible for us to complete this project by the Spring of 2013 with the current knowledge Easy Office Solutions contains.

11.6 Schedule Analysis
Estimating the size and schedule for a project is always a difficult and tedious task. Our team followed the following process for estimating various aspects of the Supply Fetch project.

- Estimate the size of the product (number of lines of code or function points)
- Estimate the effort (man-months)
- Estimate the schedule (calendar months)

11.6.1 Size Estimation
Our team decided to use function-point estimation instead of SLOC (source lines of code) estimation because we believe it is more accurate to use functionality aspects of the project (individual functions) rather than guessing on the amount of code we will produce.

<table>
<thead>
<tr>
<th>Program Characteristic</th>
<th>Low Complexity</th>
<th>Medium Complexity</th>
<th>High Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>x 3</td>
<td>x 4</td>
<td>x 6</td>
</tr>
<tr>
<td>Outputs</td>
<td>x 4</td>
<td>x 5</td>
<td>x 7</td>
</tr>
<tr>
<td>Inquiries</td>
<td>x 3</td>
<td>x 4</td>
<td>x 6</td>
</tr>
<tr>
<td>Logical Internal Files</td>
<td>x 7</td>
<td>x 10</td>
<td>x 15</td>
</tr>
<tr>
<td>External Interface Files</td>
<td>x 5</td>
<td>x 7</td>
<td>x 10</td>
</tr>
</tbody>
</table>

Table 11-2 Function-Point Complexity Ratings

- **Inputs**
  - *Activate the Supply Fetch Program* button (low)
  - *Administrator* button (low)
  - *Update Database* button (medium)
  - Voice input to the microphone (high)
  - Audio data from microphone inputted to major component (high)

- **Outputs**
  - LED turning “ON” to indicate correct drawer (high)
  - “Database was successfully/unsuccessfully updated” message (medium)
  - Audio data outputted from microphone to major component (high)
- **Inquiries**
  - Database search for the spoken item’s name and corresponding LED (high)

- **Logical Internal Files**
  - Database of item names and drawer (LED) locations (high)
  - Audio data from microphone processed by the major component (high)

- **External Interface Files**
  - Audio data acquired by the microphone (medium)

The sum of all the function-points’ complexity ratings is the unadjusted function-point total. However, there are fourteen value adjustment factors that must be taken into consideration. They are each ranked on a scale of 0 to 5 depending on the complexity and importance. They are then summed together and scaled to a range of 0.65 to 1.35. This is known as the influence multiplier and it is multiplied with the unadjusted function-point total to give us the adjusted function-point total. This adjusted result is far more accurate than the unadjusted total.

**Value Adjustment Factors**

1. Data communications (3)
2. Distributed data processing (1)
3. Performance (5)
4. Heavily used configuration (3)
5. Transaction rate (5)
6. On-Line data entry (0)
7. End-User efficiency (5)
8. On-Line update (0)
9. Complex processing (2)
10. Reusability (5)
11. Installation ease (4)
12. Operational ease (2)
13. Multiple sites (3)
14. Facilitate change (2)

40 total adjustment factors (scaled 0.65-1.35) \( \Rightarrow \frac{65 + 40}{100} \times \frac{105}{100} = 1.05 \)

<table>
<thead>
<tr>
<th>Program Characteristic</th>
<th>Low Complexity</th>
<th>Medium Complexity</th>
<th>High Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td>2 x 3 = 6</td>
<td>1 x 4 = 4</td>
<td>2 x 6 = 12</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td>0 x 4 = 0</td>
<td>1 x 5 = 5</td>
<td>2 x 7 = 14</td>
</tr>
<tr>
<td><strong>Inquiries</strong></td>
<td>0 x 3 = 0</td>
<td>0 x 4 = 0</td>
<td>1 x 6 = 6</td>
</tr>
<tr>
<td><strong>Logical Internal Files</strong></td>
<td>0 x 7 = 0</td>
<td>0 x 10 = 0</td>
<td>2 x 15 = 30</td>
</tr>
<tr>
<td><strong>External Interface Files</strong></td>
<td>0 x 5 = 0</td>
<td>1 x 7 = 7</td>
<td>0 x 10 = 0</td>
</tr>
<tr>
<td><strong>Unadjusted Function-Point Total</strong></td>
<td></td>
<td></td>
<td>84</td>
</tr>
<tr>
<td><strong>Influence Multiplier</strong></td>
<td></td>
<td></td>
<td>1.05</td>
</tr>
<tr>
<td><strong>Adjusted Function-Point Total</strong></td>
<td></td>
<td></td>
<td>88.2</td>
</tr>
</tbody>
</table>

Table 11-3 Function-Point Totals
11.6.2 Effort and Schedule Estimation

We used McConnell’s Table 8-7 to calculate the effort and approximate schedule by using Jones’s First Order Estimation. We also used the common “rule of thumb” equation to calculate the estimated amount of calendar months required to complete the project.

\[
\text{Calendar Months} = 3.0 \times \text{Man Months}^{1/3}
\]

\[
\text{Man Months} = \frac{\text{Calendar Months}^3}{9}
\]

<table>
<thead>
<tr>
<th></th>
<th>Best in Class</th>
<th>Average</th>
<th>Worst in Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate Power</td>
<td>0.39</td>
<td>0.42</td>
<td>0.45</td>
</tr>
<tr>
<td>Adjusted Function-Point Total raised to Appropriate Power</td>
<td>88.2^{0.39}</td>
<td>88.2^{0.42}</td>
<td>88.2^{0.45}</td>
</tr>
<tr>
<td>Calendar Months</td>
<td>5.738</td>
<td>6.563</td>
<td>7.507</td>
</tr>
<tr>
<td>Man-Months</td>
<td>6.997</td>
<td>10.469</td>
<td>15.669</td>
</tr>
<tr>
<td>Calendar Months with 4 Team Members</td>
<td>1.749</td>
<td>2.617</td>
<td>3.917</td>
</tr>
</tbody>
</table>

Table 11-4 Effort and Schedule Estimation for the Supply Fetch Project

Based off the calculations above, with a team consisting of four members, the worst case scenario for completing the Supply Fetch project would be 4 months while the best case scenario would take just under 2 months.

11.6.3 COCOMO Model Estimation

Our team also used the COCOMO® 81 Intermediate Model Implementation to estimate the effort and schedule of the Supply Fetch project to provide another overall estimate and to provide a comparison to the schedule calculated above.

Note: Embedded mode - project must operate within a strongly coupled complex of hardware, software, regulations, and operational procedures, such as real-time systems.

The online calculator can be found at the following address: 
http://sunset.usc.edu/research/COCOMOII/cocomo81_pgm/cocomo81.html
SLOC: **1000** (rough estimate)

### Product Attributes
- Required Reliability: **Very High**
- Database Size: **Medium**
- Product Complexity: **Very High**

### Computer Attributes
- Execution Time Constraint: **Very High**
- Main Storage Constraint: **Medium**
- Virtual Machine Volatility: **Very Low**
- Computer Turnaround Time: **Medium**

### Personnel Attributes
- Analyst Capability: **Medium**
- Applications Experience: **High**
- Programmer Capability: **High**
- Virtual Machine Experience: **Very Low**
- Programming Language Experience: **High**

### Project Attributes
- Modern Programming Practices: **High**
- Use of Software Tools: **High**
- Required Development Schedule: **Extremely High**

---

#### Results
- **Effort** = 4.72 man-months
- **Schedule** = 4.11 calendar months

Based off the COCOMO calculations above, the Supply Fetch project would take a little over 4 months to complete which is close to our previous worst case calculation of 3.9 months.

In conclusion for Schedule Feasibility, we believe that our team of four committed members will be able to fully complete the Supply Fetch project in the allotted time over the course of the spring 2013 semester (January – May).
12. Future Items

This section reiterates the requirements from previous sections that were given a future priority (priority 5). Since they were given such a low priority, they will only be implemented if all other requirements are fully implemented and there is a sufficient amount of remaining time for these low priority items. If the following requirements are not implemented it will not affect the acceptance criteria for the Supply Fetch product.

12.1 Other Requirement 8.2 Item Frequency Tracker

8.2.1 Requirement Description: The system should provide Business Intelligence information to users or administrators; track the frequency of items requested.

8.2.2 Constraint: Schedule: adding this functionality to the system would require additional time and man-hours that our strict schedule does not permit.