AC 2010-277: ANDROID BASED MOBILE ORDER MANAGEMENT SYSTEM

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Android Based Mobile Order Management System

Abstract

Currently, some businesses' employees engaging in outside sales use specialized tablet computers, and particularly use them to place orders. Unfortunately, this approach has a number of shortcomings; the tablet computers can be very costly to upgrade and maintain and usually have a short battery life. Wireless is an emerging communication technology frontier that offers the possibility of instant mobile communications. Given advances in mobile computing technology, the role of hand-held devices seems certain to grow exponentially as more computing power and communications capability is included. It is in the best interest of business and information managers to take advantage of mobile technology to transform overall business strategies, operational efficiency, and information availability. It is essential to streamline business processes with mobile devices to maintain competitiveness and increase responsiveness in today's market. In this paper we argue that there is an enormous potential benefit for these businesses from use of mobile devices like smart phones to assist in recording sales orders and synchronizing with existing software, anywhere at any time. The Smartphone device chosen for this purpose is based on the open source Android platform. The key factors in choosing Android are its capacitive touch-screen, embedded database file system, total cost, and much more. This paper describes an application that is designed based on a client-server model, with central database serving as a repository of data relating to customers and product information. Another important feature of this application is its network connectivity needed to pull real-time data from a backend server. In addition, it is possible to use the application in an off-line mode. The mobile application developed presents a mobile application solution for the main entry point allowing the sales force to capture customer orders in the field on a handheld device that can communicate with the laptop and then submit the orders to the business system via the Internet.

Introduction

Currently, some businesses' employees engaging in outside sales use specialized tablet computers, and particularly use them to place orders. Unfortunately, this approach has a number of shortcomings; the tablet computers can be very costly to upgrade and maintain and usually have a short battery life. Wireless is an emerging communication technology frontier that offers the possibility of instant mobile communications. Using mobile technologies improves business processes to create unique and sustainable competitive advantages and thus intangible assets for business and information managers. Given advances in mobile computing technology, the role of hand-held devices seems certain to grow exponentially as more computing power and communications capability is included. It is in the best interest of business and information managers to take advantage of mobile technology to transform overall business strategies, operational efficiency, and information availability. It is essential to streamline business processes with mobile devices to maintain competitiveness and increase responsiveness in today's market. As digital technology advances and the Internet become much more powerful, businesses must seek to explore these opportunities in order to maximize revenue and deliver a better employee and customer experience by utilizing mobile technology.

Wireless is one of the emerging communication technology frontiers, offering the possibility of instant mobile communications. Given the advances in mobile computing technology, the role for hand-held devices seems certain to grow exponentially as more computing power and

communications capability can be included. As digital technology advances and the Internet becomes much more powerful, the client seeks to explore these opportunities in order to maximize revenue and deliver a better employee and customer experience by utilizing mobile technology. It is widely discussed and studied by business and information managers that by using mobile technologies to improve business processes unique and sustainable competitive advantages can be created. With today's small, lightweight and inexpensive mobile devices, mobile solutions have become pertinent for a wide-ranging usage, to enable the employees to have the flexibility to process customers' orders more efficiently and effectively. To remain competitive and to become more responsive in today's market, it is essential to streamline business processes with mobile devices. The work reported in this paper was undertaken by Oupraxay [4] as a capstone project to satisfy his graduation requirements. In the following sections we present implementation; analysis and system workflow, class diagram and design of the final products.

Motivation

Mobile Order Management System (MOMS) is developed for a business that currently provides specialized tablet computers to the sales representatives to carry around and use in the field to create new orders, look up customer and parts information, and other related activities. The problem with this model is that the tablet computers can be very costly to upgrade and maintain. For example, a single tablet computer may cost up to $3000 excluding maintenance overhead, such as replacing new battery or hardware components. In addition, the single most important issue the sales force is facing with using the tablet computers is the laptop's short battery life. It has become impractical to use on a full-day working basis without recharging or replacing the battery every two hours. Therefore, there is an enormous potential benefit for the client if today's smart phone can assist them in recording sales orders and synchronizing with existing software from tablet computers anywhere at any time.

MOMS is developed to serve as the main entry point allowing the sales force to capture customer orders in the field on a handheld device that can communicate with the laptop and then submit the orders to the business system via the Internet. The common features of the system: Look up customer data, Look up parts data, Look up customer history, Create, Edit, Delete orders, Synchronize for new data, Transmit new orders, Change quantity and Change price. The system is also capable to synchronize with the existing backend database system to update its local database. The local datasets containing customers, parts, and history attributes can be embedded and used by the mobile devices for offline processing. The ability to update datasets with existing clients' order processing system provides a beneficial flexibility for salespeople to enter orders anywhere at any time with or without Internet access.

The mobile platforms recently released include iPhone and Android; they show advancement in hardware as well as software in comparison to the devices that were introduced in the past. Android was first released in 2008 and called G1 (HTC) and is developed by Open Handset Alliance (OHA) [3, 8], .Oliver in [2] provides an extensive survey and evaluation of current mobile platforms such as, Blackberry, iPhone, Symbian and Android. He concludes that these platforms do not satisfy the needs of today's researchers. However, people have used Android platform to develop agent based, peer-to-peer mobile applications with JADE [7] and a lightweight distributed implementation of IMS LD [9]. In order to avoid any legal complications we also worked with Android platform because it is open source and vendor independent. However, other key factors in choosing Android are its capacitive touch-screen, embedded database file system, total cost, and

much more. MOMS is designed with a repository of data as a central database that is related to the product and customer information. The whole designed is based on client server model. The most important feature of the system is its network connectivity needed to pull real-time data from backend server. In addition, we can also use the application in an off-line mode. However, in order for this option to work we have to provide a local of the database to each SmartPhone, assuming the database contains the most up to date information regarding products, customers, history, etc. This information requires to be synchronized with the central database daily as and when the internet access becomes available. Newly created orders are transmitted to the server only after they are saved to the local database. After new orders have been sent to the server successfully, the status of existing orders is updated in the local database. Orders can also be converted to HTML or PDF format to present to the customer. MOMS uses an open source Eclipse and Android SDK as a development framework. It provides nice templates and emulator to deploy and test the application. The programming language being used is based purely on object-oriented Java programming language. The modularity of the object-oriented approach and the richness of Android platform makes MOMS more robust in terms of flexibility, scalability, maintainability, performance, reliability, and reusability. Fortunately, the database system, Sqlite, is already supported by the Android out of the box. Thus, it makes system integration much easier.

Implementation

The main objective of this work is to present a user friendly mobile application that will empower salespeople working in the field outside their office space. The application equips them with all the necessary functions to properly and efficiently manage customers' orders, as well as provide a means for around-the-clock communication to increase business production. Li in [5] states that reducing a customer's waiting time will lead to minimizing the sum of production time for all the customer order that were handled before handling the current customer's order. MOMS is capable of achieving this goal. The technology used is based on open source software for flexibility and scalability to allow for future growth. We assume that end-users have a limited familiarization with the basic touch screen phone so the application operation emphasize the simplicity of Graphical User Interface (GUI) and finger-friendly touch screen which require essentially no prior mobile knowledge beyond what is normally required for basic mobile usage.

The motivation for implementation of MOMS is also based on the latest scalable open source mobile technologies for minimizing costs and maximizing Return-Of-Investment (ROI). The Android platform is a powerful open source operating system (OS) that fits well for today's mobile devices, such as, smart phone usage. It offers many benefits such as large application programming interface (API), customizable application and installation, lightweight components and libraries, database management, and network communication. The development process is completely based on open source technology and development tools such as Eclipse, Android platform, and Java programming language. Thus, there will be little cost associated with development tools and software components required by the system.

Typical client application can be either web clients or desktop clients. Desktop client applications access corporate backend data services through a TCP/IP based network communication. On the other hand, web-based applications are developed based on Service-Oriented Architecture (SOA). MOMS is developed based on Java Eclipse development environment, and other similar application database management. In the test environment, an Android simulator is used. The mobile application is capable of storing and processing a medium or large database. This capacity

is deemed sufficient to support the client's order processing requirements. The considerations for MOMS development in the context of mobile technology include the infrastructure and architecture requirements to support the sales order processing workflow. The application's data synchronization is required between desktop application and MOMS. With the development of Android software components, in particular the embedded database component, MOMS is able to synchronize its database system with the existing desktop database application to update the database, generate new orders, and transmit them over the Internet. This will increase the flexibility, security and performance of the database by transferring the database of 50,000 or more records to the mobile device without using the mobile data network. In addition, an important issue that needs to be taken into consideration is that the majority of mobile client applications are driven by interaction with existing application infrastructure or desktop clients for security reasons. The primary interaction in this model is between the mobile and desktop application that enable the communication with the backend enterprise data. MOMS rely on "synchronizing" data by communicating with any existing Order Entry application residing on the desktop.

The idea of mobile computing was brought to light in the research community by the introduction of first commercially available Personal Digital Assistant (PDA), although the device itself failed to gain lot of consumer attention. The new smart phones possess lot of memory and processing power as well as improved connectivity. Although, the Android SDK also includes a smart handset emulator however the only device available is called HTC Dream also more popularly known as G1 by T-Mobile. The specifications for such a device include 192 MB RAM, screen with a resolution of 480 x 320 and MSM7201 chipset with a frequency of 528MHz [1].The OHA [3] is a group of handset manufacturers and a flurry of new products is expected in the near future with lot of improvement in performance [6]. The implementation of MOMS was completed and successfully tested using a commercially available smart phone (G1) from T-Mobile. However, the main issue during the design and implementation was the simplicity and ease of use in managing and entering orders using one hand or finger on a small touch-screen. Unlike laptops, using mobile touch-screen without hectic feedback can generate lots of errors. In order for MOMS to offer multiple ways of handling virtual touch-screen data input, the Android platform capability for voice recognition processing can easily be integrated into the system and allows users to have the ability to use voice recognition to interact with the device. This involves many architectural changes in the default virtual keyboard system provided by the operating system. The software the PC used to communicate and synchronize data with BEMOE has also been removed. To keep the users' data current, the initial specification requires that users have their mobile phone connected to laptop via USB connector to perform data synchronization. With an unlimited wireless data plan, the users should have the ability to use the Internet to connect to the backend server to perform data updates in real-time. As a result, MOMS "Sync" feature has been developed and included in the final product. Finally, one additional feature is having the ability not only to generate and view pick slip in real-time, but also to create a PDF and send it as an attachment to the customers, this feature is very useful since it allows the customers to view the price in detail before deciding to finalize their purchase.

Data Flow

The MOMS provides complete tools required in order for end-users to perform and manage order processing. It is designed with simplicity as a key characteristic. User training requirements are minimized by using modern and consistent GUI components and layout such as list view and drop-down boxes for transaction processing to simplify and enhance the user experience and reduce

potential frustration. In order to ensure user friendly interface design as well as simple and smooth screen transition the process of entering and managing orders is intuitive and simple to use for the system to be effective. Each screen flows logically from one phase to another. The transition of data is carefully managed and maintained. Initially, the user is presented with main screen and tab menu. From the main screen, user can view Customer, Parts, History, and Orders windows. These four initial tabs consist of important information allowing users to perform tasks effectively. The users have the ability to select items from different tabs during entering orders. The figure #1 provides data flow of MOMS for basics transition screen. The figure #2 provides the processes required for creating or managing orders. Users must select a customer, and then select a part number from Parts or History tab window to add to the Order window. Figure #3 shows UML use case diagram that describes the most generic conceptual modeling of the system.

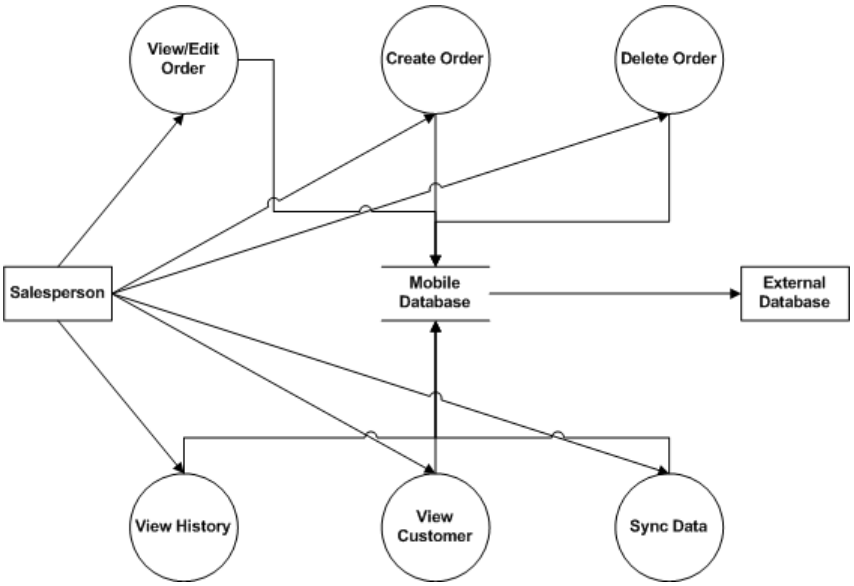

Figure 1: Data Flow Diagram

Architecture and Design

MOMS consists of three application tiers: The Business Logic Tier, the Presentation Tier, and finally the Data Tier. The Presentation Tier is a universally accessible industry standard Graphical User Interface (GUI) compliant application that allows users to create, edit and view order processing information. On the user presentation tier is a physical mobile screen, to add, delete and modify the customer's orders among other things with simplicity and ease of use. The Business Logic Tier is responsible for controlling the connection between the two tiers namely presentation tier and the data tier. This is where all the different conditions in regards to connecting to local and external database are going to be defined. In other words it is the service and controller of the data flow. The Data Tier is the storage location for the order processing data. BEMOE is going to implement this tier in the industry standard Structured Query Language (SQL) database. This tier can only be accessed by the application users through the Business logic and Application Programming Interface (API).

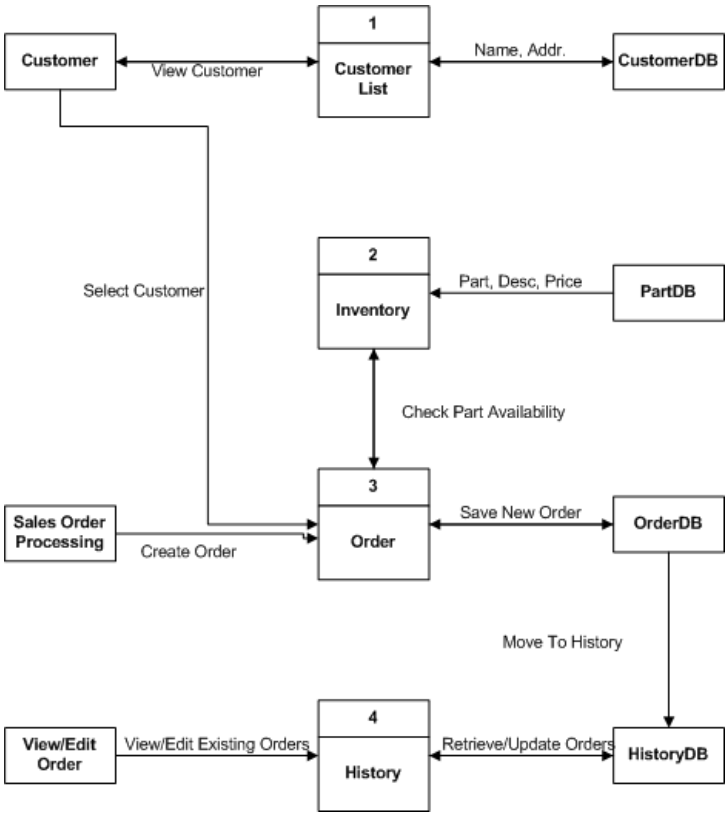

Figure 2: State Transition Flow Diagram

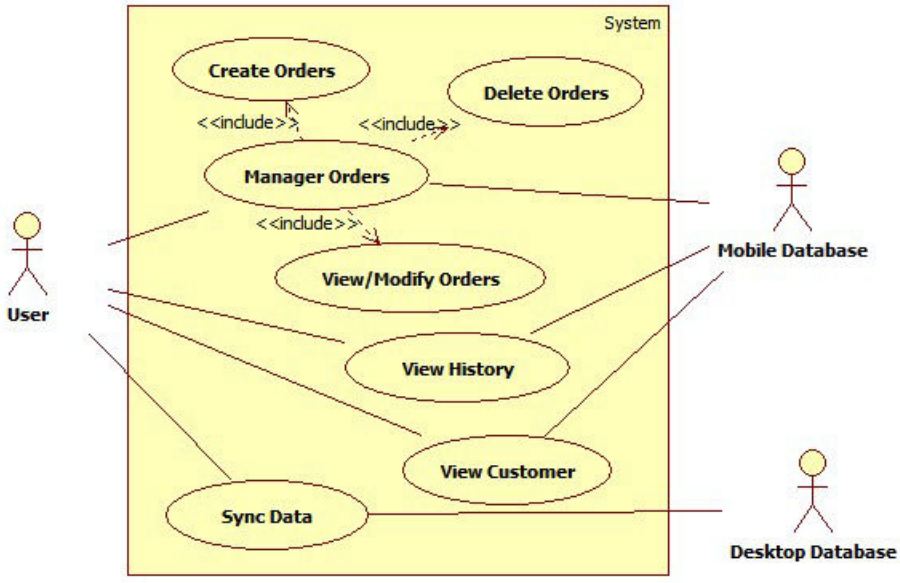

Figure 3: BOMOE Use Case Diagram

For mobile application the user interface becomes very important because of the small user screen in terms of screen input, and processing power, MOMS is straightforward and paying attention to user's tasks, in particular for data input. The application consists of four main screen tabs,

Customer, Parts, History, and Orders. Each of these tabs provides easy selection and context switching. Customer tab provides the list view of customers. The user should be able to select a customer to create a new sale orders as shown in figure #4. The part tab provides the list view of parts. The user should be able to select part number to add to order details, as shown in figure #5. The history tab provides the list view of customer's history. The user should be able to select part number from the history to add to order details as shown in figure #6. Order tab provides the list view of orders. The user should be able to select order to view order details as shown in figure #7.

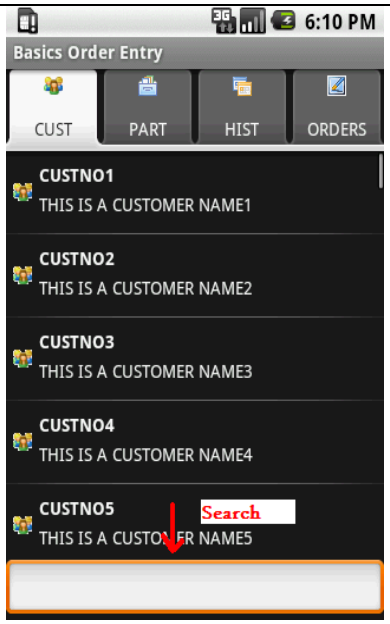

Figure 4: Customer View Screen

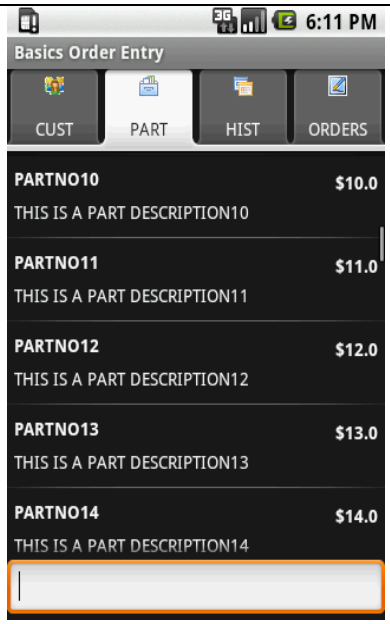

Figure 5: Part View Screen

Figure 6: History View Screen

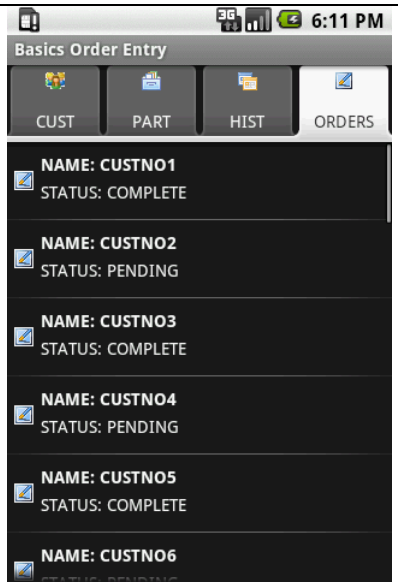

Figure 7: Order View Screen

Functionality

The functional interaction and user interface are perhaps the most vital components of MOMS. If the interface is inadequately designed, the user's capability to utilize the computation power of a mobile application may be stalled. There are three vital principles that lead to the design of efficient user interfaces of our system: (1) minimize the user's need for data input, (2) put the user in control, and (3) make the interface steady and reliable throughout the OS. We conducted an exploratory user study to assess the design, appeal, and functionality of the system and address potential issues arise during the testing phase. Once the prototype is created, it is being evaluated by the end-users immediately to determine whether it meets their specific needs.

The usability evaluation cycle involves multiple phases. The prototype is evaluated by the user, who provides the designer with direct comments about the efficacy of the interface. Design modifications are made based on user input, and the next level prototype is created. The evaluation cycle continues until no further modifications to the interface design are necessary. The following figures highlight some the final user interface design for MOMS and all screens use the default theme to match with the rest of the operating system. All screen layout and font size are well designed so it makes it easy to read and pleasant to look at.

The customer's screen and profile provide easy access to all customer information as shown in figure 8.

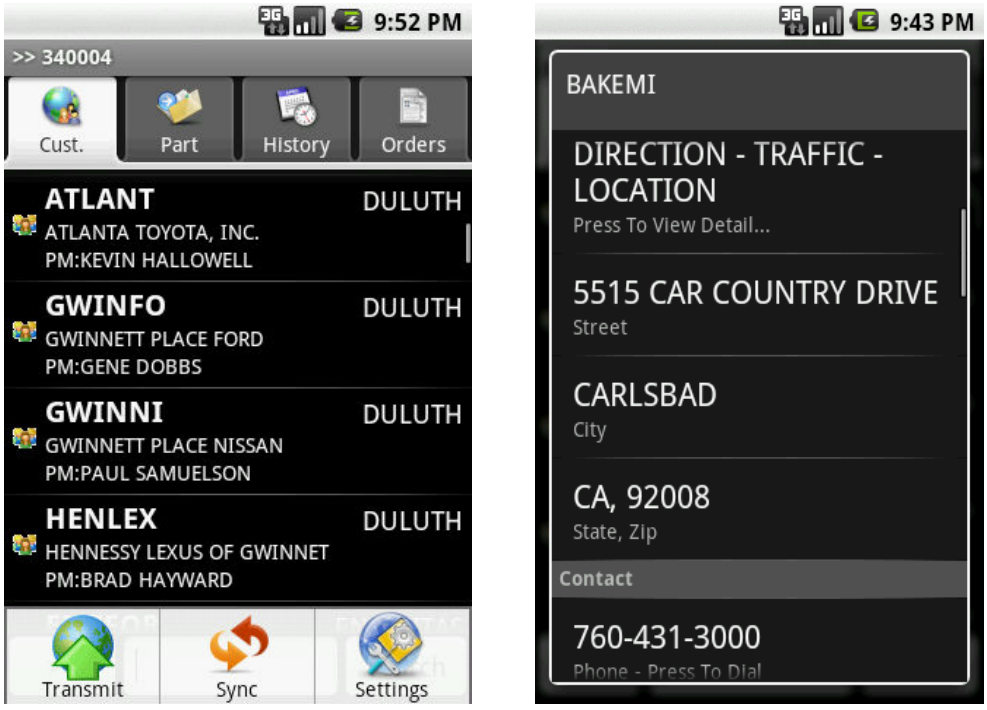

Figure 8: Customer List & Profile

The following figure 9 shows parts, history, and add on line item screens.

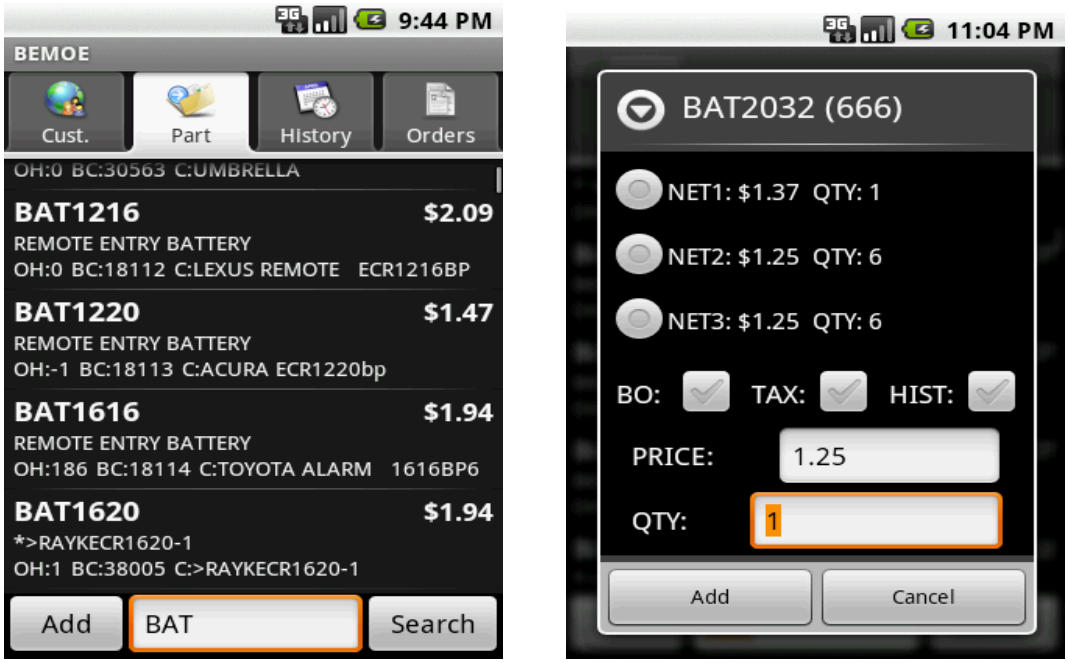

Figure 9: Part & Add-on Line Item

The following figures show order entry screens, detail about the orders , items and pickup slip.

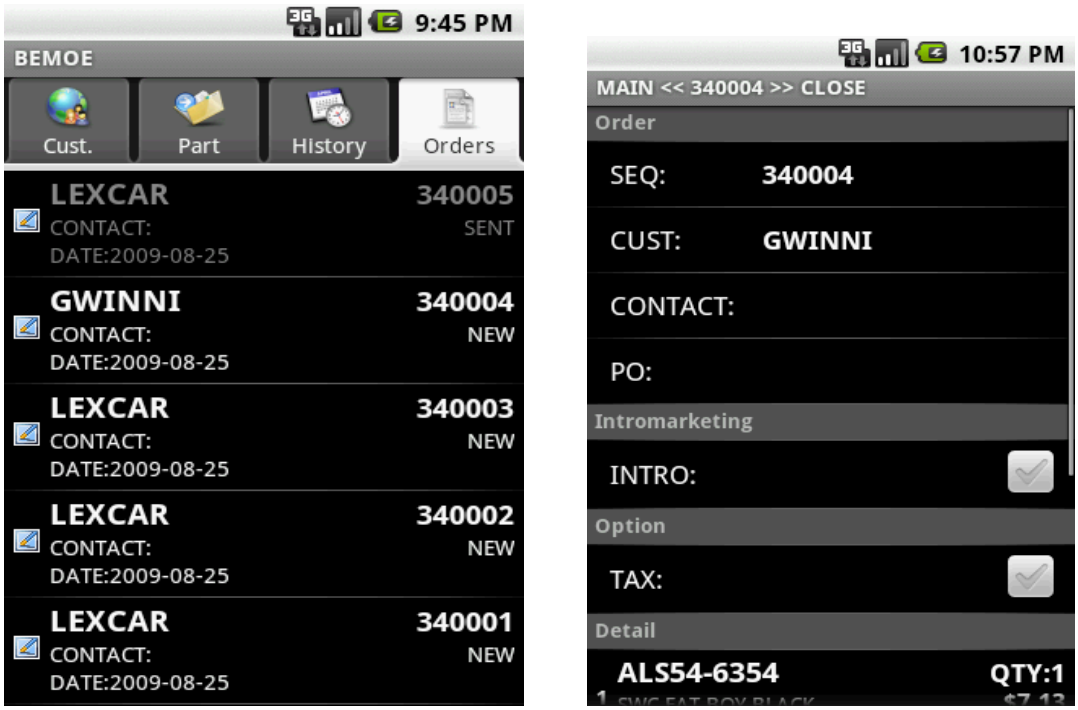

Figure 10: Orders & Detail Line Item

Figure 11: Order Detail & Pick Slip

The following shows system preference screen.

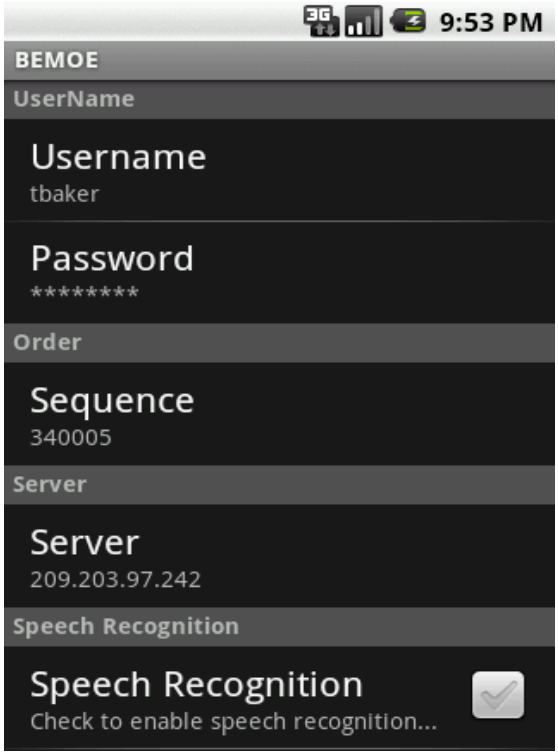

Figure 12: Options Screen

Limitation

After undergoing intensive testing for quality assurance, there is one minor issue that cannot be resolved because of the operating system's limitation – the memory space needed to copy external database file into the Smartphone. The actual database file required to download from the server is about 6-8MB depending on the customer's sales history. However, the system can only buffer up to 10MB of free heaps; as a result, the system is forced to close after download is finished. This problem occurs only when MOMS has been running for a very long period of time, therefore the system needs to be closed completely before synchronization can be performed.

Conclusion

In this paper we argue that there is an enormous potential benefit for these businesses from use of mobile devices like smart phones to assist in recording sales orders and synchronizing with existing software, anywhere at any time. The Smartphone device chosen for this purpose is based on the open source Android platform. The key factors in choosing Android are its capacitive touch-screen, embedded database file system, total cost, and much more. This paper describes an application that is designed with a repository of data as a central database that is related to the product and customer information. The whole designed is based on client server model. Another important feature of this application is its network connectivity needed to pull real-time data from a backend server. In addition, an off-line use of the application is also possible. However, in order for this option to work we have to provide a local of the database to each SmartPhone, assuming the database contains the most up to date information regarding products, customers, history, etc. This information requires to be synchronized with the central database daily as and when the internet access becomes available. Newly created orders are transmitted to the server only after they are saved to the local database. After new orders have been sent to the server successfully, the status of existing orders is updated in the local database. Orders can also be converted to HTML or PDF format to present to the customer with additional functionality such as; Look up customer data, Look up parts data, Look up customer history Create, edit, delete modify orders, upload new data, and transmit new orders.. The mobile application developed presents a mobile application solution for the main entry point allowing the sales force to capture customer orders in the field on a handheld device that can communicate with the laptop and then submit the orders to the business system via the Internet.

As of now, MOMS is a complete and functional product that can be used to replace an existing desktop or laptop order entry system. It incorporates service-based pluggable architecture and componentized modules for maximum reusability. Thus, the overall quality and integrity of the system is flexible for future changes.

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