Implementation of a Data Driven Transaction Processing System for the AUN's Restaurant, Yola – Nigeria

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ABSTRACT
As a matter of fact, the need for information technology as a mechanism for promoting business processes has become necessary, business establishments need computer management information systems (MIS) in order to move on in the center of competition. The use MIS in the restaurant business can deliver economic value. The American University of Nigeria's (AUN's) restaurant has a barrier to duplication of data in the computer files within the business processes which causes discrepancies, that results to waste of storage space on the existing system due to non-database application used, it is difficult to collect customer's weekly or monthly transactions because data could not be shared easily within the business processes. Although, the most commonly use of system in restaurant business is the point-of sale system (POS) terminals. Hence, in this paper the researchers have developed a Data Driver Transaction processing system (DD-TPS) for the AUN's restaurant with integrated modules for POS, payroll management, credit card and inventory control. It is obvious that much have to be invested in purchasing an information system in order to manage business processes within an organization.

Keywords
Data Driven, Transaction Processing, AUN

1. INTRODUCTION
Online Transaction Processing (OLTP) system's main drive is to capture information about the daily economic activities of an organization's unit and departments. One might argue that the purpose of OLTP system is to get data into computers [23]. OLTP systems are useful for addressing the operational data needs of an organization and designed for day-to-day operations like payroll and accounting systems [15]. Today's online transaction processing increasingly requires support for transactions that span a network. For this reason, new OLTP software uses client/server processing and brokering software that allows transactions to run on different computer platforms in a network [4]. Today it is widely recognized that most organizations need information systems to survive and succeed in the competitive business environment. Information system can help companies extend their business range to far-away locations, offer new products and services, reform organization structure and work flows, and perhaps significantly change the way they operate the business. The restaurant industry is naturally no exception to this trend.

A restaurant business magazine in the US once conducted a study on information systems for the restaurant industry. They observed that the primary uses of computers in this industry were accounts receivable, employee salaries, menu analyses, inventory control, food service control, employee work schedules, creating and processing tables or documents, kitchen production, and printing menus. According to their statistical analysis, large-scale restaurants and, in particular, restaurants in tourist hotels are almost completely dependent on computers to process these affairs [8]. Long ago, using cash registers to manage cash was common in the restaurant industry. Today, cash registers have been replaced by POS terminals. Although new POS computers system are still cash based, management can obtain additional information such as monitoring of items sold, materials used, and employee work efficiency. They can even calculate wages and the amount of tips due. The main computer, linked to the POS terminals by Internet connection, provides information such as accounting records and food purchases to obtain desired values [17].

However, there still exists the problem of managing restaurants manually especially in developing countries. Automation of the restaurant industry is an inevitable development; via restaurant information systems, overall management performance can be enhanced. Computerization of procedures can also increase productivity, as operation costs can be more efficient and thus reduced. The AUN's restaurant has barrier of duplication of data in the computer files for each within the organization also causes serious inconsistency in the data. This results to waste of storage space on the system**,** due to File – Base Approach Processing system (Non database application) used, it is difficult to collect customer's weekly or monthly transaction because each transaction is not indexed in the flat file used and data could not be shared among different application because there is no central database for all the applications. Therefore, the aim of this paper is to develop a DD-TPS with integrated modules for POS, payroll management, credit card and inventory controls for use at the AUN's restaurant.

2. LITERATURE REVIEW
Ellison and Mann [12] classified clerical processes as the use of IT to replace manual processes such as purchasing, inventory control, production, sales, marketing, menu planning, employee scheduling, payroll, and financial reporting. They defined the integrated administrative processes as IT linkages between and among processes within the food service operation as well as to external departments including reservation systems linked with food service production, point of sales and production scheduling, equipment interfaces, purchasing linked with suppliers, nutrient analysis, internal and external e-mail, and transfer of operating data via intranet systems to corporate offices. They also defined tactical processes as Internet use of information systems for market information, marketing and purchasing analysis, supply chain management, data warehousing and /or mining, and the use of systems for forecasting. The transaction between the waiter and the restaurant departments and also between waiter and the cashier will be systematic. The use of technology is diverse in the foodservice industry: from minimal to extensive. Survey research in hospitality has shown that most restaurant companies score highest in their usage in the clerical arena; integrated usage is lower; and

tactical usage is lowest [24]; [12]. These findings support the notion that most restaurants use technology as a data processing tool to process sales and accounting data; integration with other processes such as ordering from vendors is limited; and strategic use of systems is underutilized. According to Oronsky and Chathoth as cited by [5], recent trends of information technology in the restaurant industry are customer feedback systems (e.g., customer relationship management (CRM), social media activity integrated into CRM platform, and real-time, web-based reporting), repeat business management applications (e.g., e- reservation systems, POS integration into online ordering), marketing management systems (e.g., POS software and handheld terminals), operational restaurant systems (e.g., wireless credit card authorization or mobile POS and revenue management system, accounting/financial software, and integrated cost control software or inventory management tools), human resources management systems (e.g., labour management systems, labour screening and recruitment systems, and company intranet), and Back of House management systems (e.g., kitchen technologies, kitchen management systems, kitchen displays, and kitchen printers). Chien, *et al*. [9] cited by [13] steered that self-governing restaurants in Iowa (n=144), and stated comparable results to those of [12]. They found that the most highly utilized software packages were office products (word processing and spreadsheets) and accounting packages (over 80%). Less than half of the independents used POS systems, time and attendance systems, and recipe costing. Even fewer operators used more advanced applications such as employee scheduling (28.9%) or food production forecasting (21.1%).

Information technology can enable managers to make tactical, operational, and strategic decisions. A foodservice management consultant reported, all stages of the restaurant production and service chain must act in concert to deliver quality products at the right prices to the right guests at the right times. Restaurant technology can monitor and coordinate these activities in timely and focused manner. Failure to do so can result in excess inventory, poor food and service quality, underutilized capacity, and excess costs. The most common use of systems is the use of POS. POS applications eliminate arithmetic errors, improve guest check control, increase average guest check, reduce labor costs, improve reaction to trends, reduce credit card expenses, and reduce undercharges. Theorize that these applications improve profitability. Firms that do not fully utilize the applications available to them are losing opportunities to increase their profitability as shown in Figure 1.

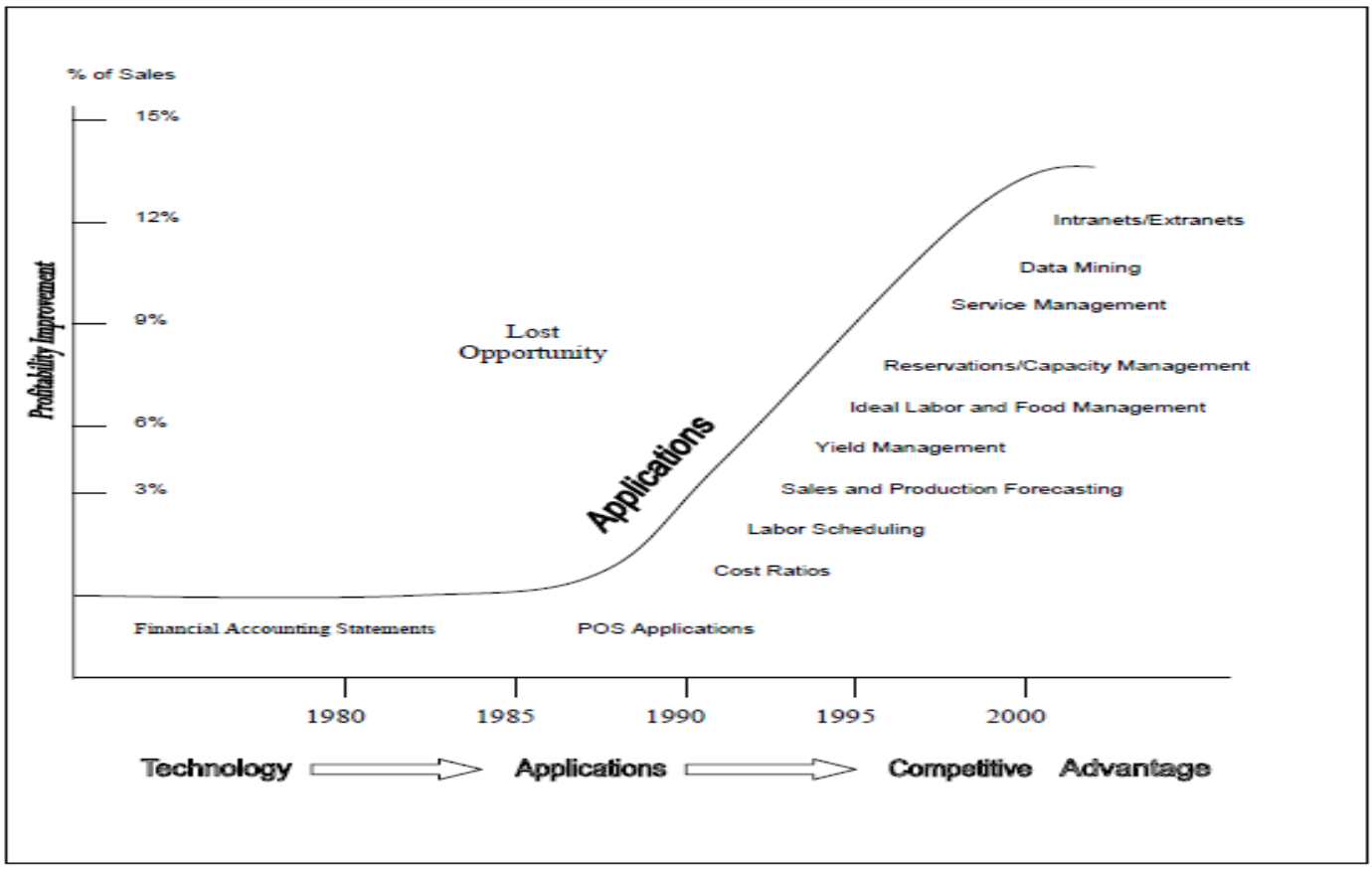

Figure 1: Evolution of Restaurant Technology [7]; cited by [13].

There are many technology used in the restaurant industry. However, a review of literature established that there have not been studies on restaurant technology as much as on other fields in the hospitality industry [14] cited by [5]. [20] Has developed a Restaurant Ordering System using mobile application, it makes the ordering system more efficiency and can help the manager to avoid human error and enhance the business development. In this system, the ordering transaction is a step by step model to make the transaction more systematic and the system can guide the staff to avoid any order mistakes. Besides the efficiency service, by using this system it can gave a better quality service to customer and it will attract more customers to the restaurant to get this quality of services. This system is using mobile application to take orders. The customer's orders will be sent to the kitchen through the mobile device. The waiters don't have to go to the

kitchen or bar department to give the order because the order lists will be display to the department's screen [20].

According to [2] the applications used in restaurants are classified into two: we have applications that are used in Front of House (FOH) operations and the ones that are in Back of House (BOH) operations. The FOH operations are done by taking orders and delivering food to guests and completing with payment process (2). There are numerous technology applications that are used in the restaurant business processes. Most of the important technologies that are used in Front of House are: point of sale systems (POS), POS integrated modules, POS integrated payment applications and some emerging technologies used in FOH [5]. POS system is "a network of cashiers and server terminals that typically handles food and beverage orders, transmission of orders to the kitchen and bar, guest-check settlement, timekeeping, and interactive charge posting to guest folios" [7]. The core system for FOH & BOH processes is the POS application [2]. POS systems date back to the early 1980s. They make it possible to update prices, change menu items, and track sales data through POS systems, all in a simple and quick way [3]. A POS system has mainly two components, which are POS hardware and POS software [16] cited by [5].The POS hardware systems are installed on computers and provide the capability of connecting any piece of equipment or device to the POS such as: touch screen terminal, integrated credit card swipe device and table side ordering devices such as handheld terminals [6]. [16] argued that the POS hardware is worthless itself and cannot work for the purpose of the restaurants, so there should be some POS applications installed into POS hardware to instruct to what to do, how to do it and when to do it.

Advancement in POS technology results in user-friendly POS hardware such as touch 24 screen terminals which are very informative and easy to use [11]. The eZee Burrp is another restaurant application that uses the POS system which was fully integrated and spontaneous Restaurant/Bar POS Software, the system is suitable to manage restaurant, bar, quick service restaurant, delivery, and take away outlets. It is a simple approach system that is capable of supporting all languages, easy to use, and comprises rock-solid security [20]. A touchscreen terminal is made of a flat screen and microprocessor to control it [16]. It is a flexible device providing ease to data entry and meal selections, and eliminating incomplete orders [16]. Additionally, [3] state that touch screen terminals decrease the number of staff working on the front line and decrease customers' wait time. Moreover, advanced touch screen terminals reduce the burden of employee training and increase employee effectiveness and efficiency [11]. In 2012, 81% of the bill payments in fine dining restaurants were processed through credit, debit and/or pre-paid cards [21]. Therefore, an integrated credit card swipe device is now an inseparable part of the advanced POS systems [16]. This is an integrated device to the main POS system, made of magnetic stripe readers, which are used for credit card authorization and printing receipts to be signed [6]. According to [19] integrating credit card payment into POS has increased the efficiency of the employee. Another piece of user-friendly POS hardware is the handhelds POS terminal, which is also known as mobile POS device or tableside ordering device. A handheld POS terminal is a portable device which has all the capability of the main functions of a pre-check POS system, as well as integrated tableside ordering and payment devices [16].

Although the handheld terminals date back to the late 1970s [6] updated versions are still commonly used and are increasing in popularity in the restaurant industry [18]. However, a passionately debated conversation about the advantages and disadvantages is still on-going even into the present [5]. Even though most of the literatures reviewed in this paper, which most researchers developed systems for use in the restaurant business processes, most of which are based on the use of POS. In this paper, the researchers have developed a DD-TPS with integrated modules for POS, payroll management, credit card and inventory controls.

3. METHODOLOGY

According to [1] the system methodology in operations research has generated widespread discussion in academic and practitioner circles. System methodology and design in operations research is pitching its tent towards system design and methodology in information system. There is various method of developing a Data-Driven Transaction Processing System (DD-TPS) application for an organization. The development of the restaurant system/application involves having a complete understanding of its design architecture. The design has two phases (Front-end and Backend).

3.1 System Design and Analysis

The Logical Model of DD-TPS: Having investigated the business profile of AUN's restaurant which describes overall functions, processes and functions of the business, the researcher's uses these facts as basic input requirements for the development of the logical models. In this study the logical model of the System shows what the system must do regardless of how it will be implemented. The modeling tool used to represent the external behavior of the system is Data Flow Diagram (DFD). We graphically describe the movement of data through the DD-TPS System at various stages which helps Users, Managers, and Non-technical users to understand the design of the proposed DD-TPS. The DFD applied in this study is hierarchical, with a single top level. The Context Diagram in Figure 2 shows the highest level represented as a single process called context diagram. Also each of the entity such as POS, Payroll, ATM Card payment, and Inventory is indicated in context diagram.

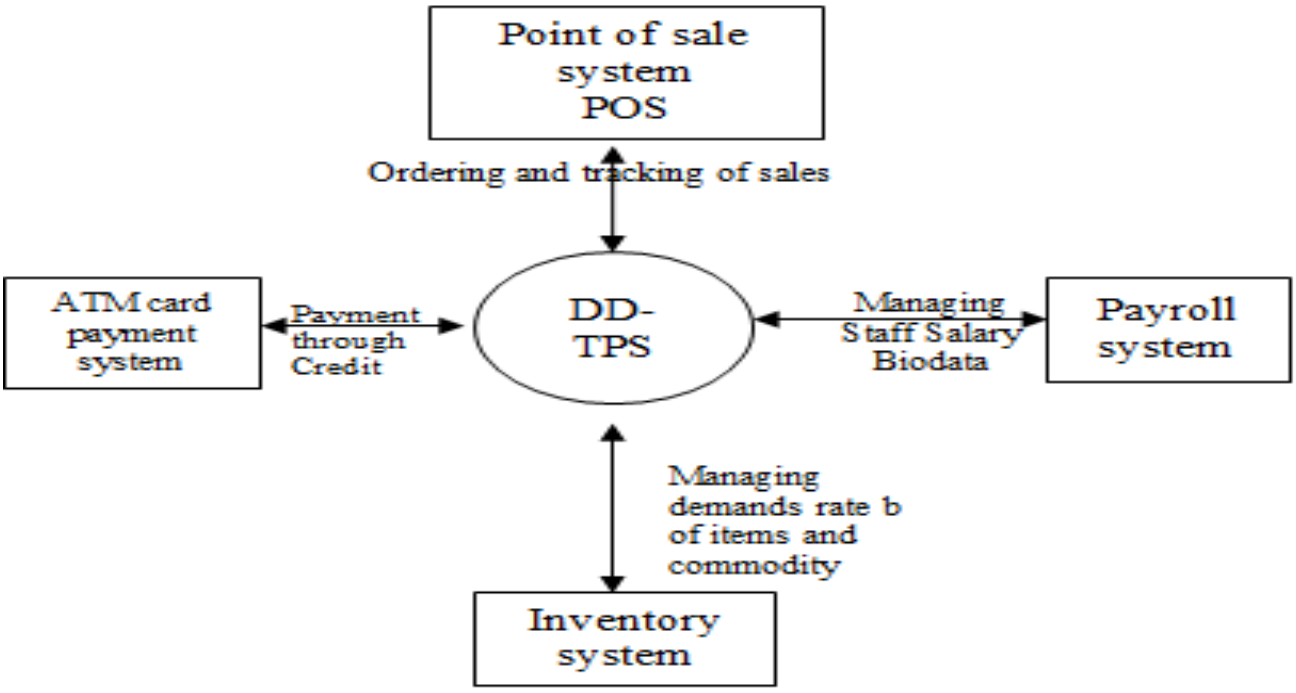

Figure 2: Context Diagram for DD-TPS

Levels Zero Diagrams: Each of the entity (POS, Payroll, ATM Card payment, and Inventory) indicated in context diagram in Figure 2 is further decomposes into level zero as shown in Figure 3.

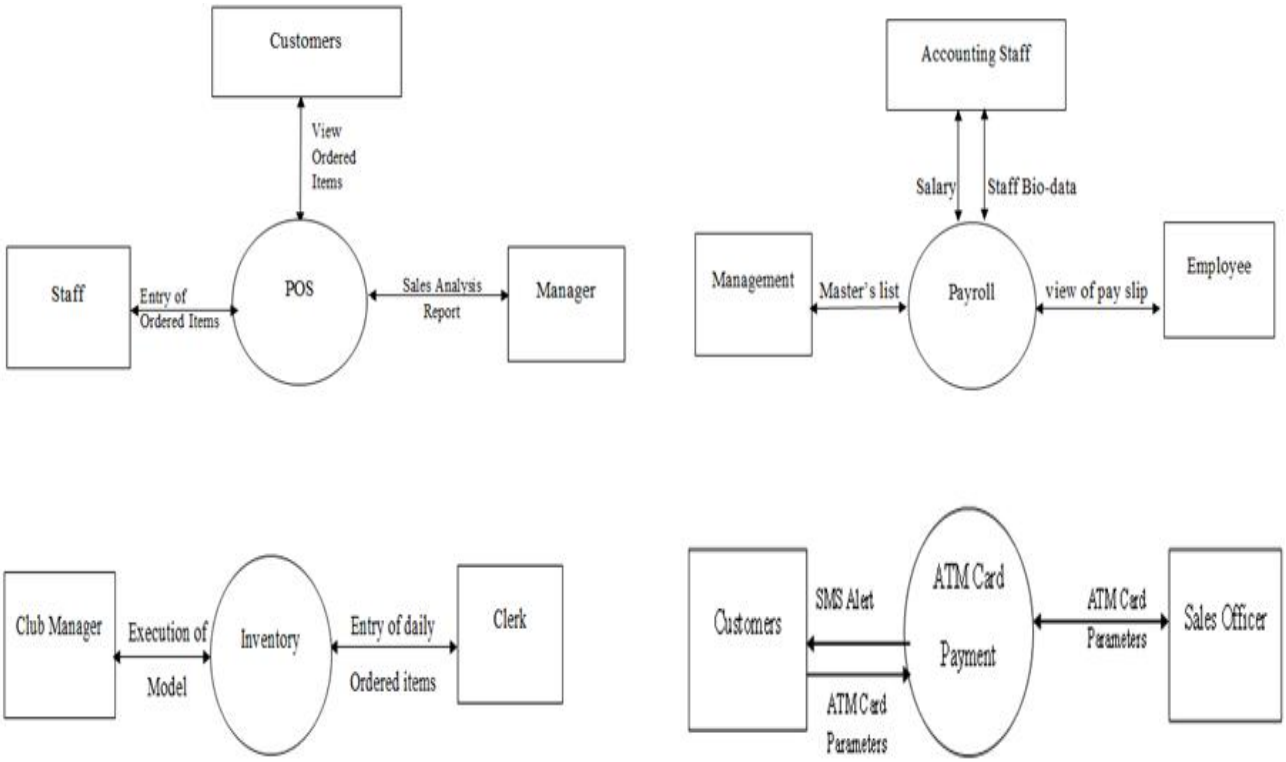

Figure 3: Levels Zero Diagrams for POS, Payroll, ATM Card payment, and Inventory.

The researchers have used the eclectic blend of Newsvendor models from operations research and data flow diagram from information system. A combination of mathematical model and pictorial or graphical models was also utilized to represent the system. The adopted inventory models (Newsvendor model) is used to build an inventory module of the system, while data flow diagram was used to represent the system at various stages of development which can help users,

managers and non-technical users to understand the design of the system. It shows how data moves through the system but not the program logic or processing steps.

Database Design for the System: This is the graphical model that depicts the relationship among the table that store user's information within the database. The constructed DD-TPS is a database-driven application with SMS (Short Messaging Services) alert components. The back –end (Database) is created with SQL. Figure 4 is the structure and relationship between the tables used for Payroll System.

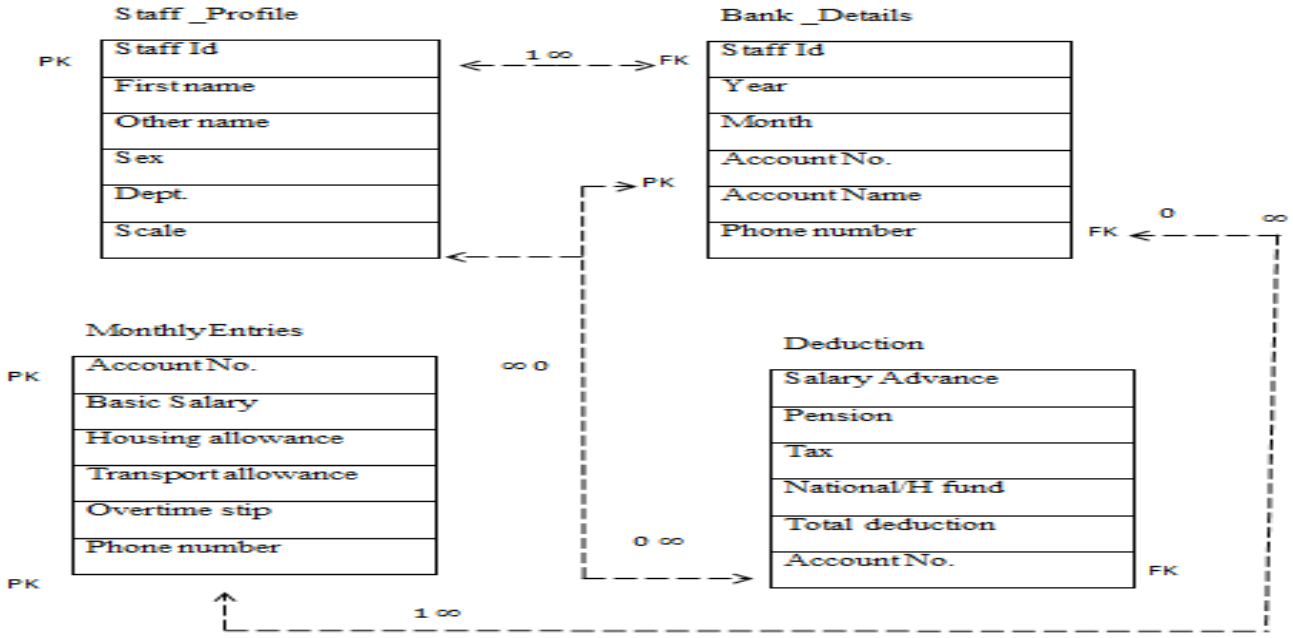

Figure 4: Entity Diagram for the Payroll System.

Figure 5 is the database structure for POS and E- Payment System. All these work together managing data and information coming from the users' interface. The tables are normalized to prevent data redundancy and provide better integrity to the data.

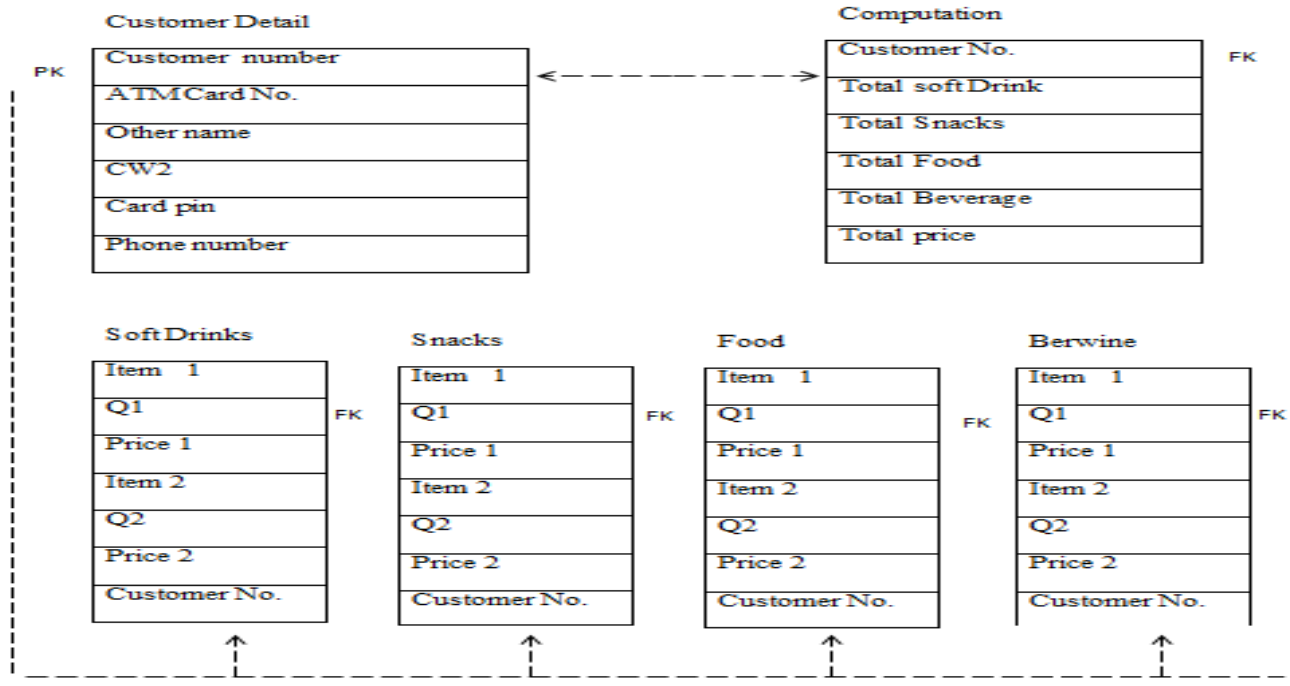

Figure 5: Point of Sale SMS-alert System Table.

Interface Design (input/output): The front-end is the user interface design consisting of windows forms, back-end which contains the database of the application, comprises tables for storing input data and stored procedures for implementation. The interface design comprises of both input and output designs of the system. The system input is designed to receive

data from the user or administrators. The system output present information to the user either as a single query or in report format. The system output varies from search results, query reports, login authentication message, exception messages, etc. The system output is the most important component of a working system because the interactivity of the system depends on its output. This is the main reason why the output of an information system determines the effectiveness and efficiency of the system.

3.2 System Requirements

The development tools used for the system are:

- Visual Studio 2008 (VB.NET): This tool is used for front-end coding and component building.
- Reporting Tools (Crystal Report 11v): A reporting engine used to generate report from the dataset for users' need.
- MS-SQL Server: An enterprise database engine used to store all data from the front – end.

The minimum requirement for running this information system called DD-TPS is as follows:

Software requirement: Operating System such as any window version OS like window 7, 8, and window server 2003, 2008, 2012, Web browser (Google chrome, internet explorer and Mozilla) Visual-Studio 2008, SQL Server 2008 and Crystal Report 10v.

Hardware requirement: Processor of 1.7 GHz clock speed, RAM (Random Access Memory) of 1 Gigabyte, Hard drive size of 20 Gigabyte free space, Four Client system (monitor and system unit) and Printer HP. Please use a 9-point Times Roman font, or other Roman font with serifs, as close as possible in appearance to Times Roman in which these guidelines have been set. The goal is to have a 9-point text, as you see here. Please use sans-serif or non-proportional fonts only for special purposes, such as distinguishing source code text. If Times Roman is not available, try the font named Computer Modern Roman. On a Macintosh, use the font named Times. Right margins should be justified, not ragged.

3.3 System Development Process

According to [22] the goal of a system developer is to deliver the best possible information system, at the lowest possible cost, in the shortest possible time. Due to the fact that information system affect people throughout the organization, the researcher used the team-oriented approach called Rapid Application Development (RAD) as the most appropriate approach to be used for the development of the system. RAD provides a fast-track approach to a full spectrum of system development tasks including planning, design, construction, and implementation. Also it speeds up information systems development and produces a functioning information system with reduced cost and increase the probability of success.

3.4 Proposed System Architecture

A client-server design style is used in this study. In this design, the database server processes individual SQL commands, the transaction server handles a set of SQL commands; the object server exchanges object messages with clients and a web server sends and receives internet based communication. A 3 – tier architecture is used with additional security layer called data access layer. The proposed DD-TPS is a type of information system that integrates four different modules together on a single platform i.e. Model- driven Inventory System, Payroll – System, POS and ATM Card Payment Transaction.

The reason for adding Data Access Layer to the adopted 3 – tier architecture is to provide security for the confidential data and information of the organization. We assume that TDE (Transparent Data Encryption) that came with MS-SQL Server to encrypt the entire database can be decrypted by any data base administrator. In order to prevent the records in the database being hacked by intruders we introduce Data Access Layer with encryption algorithms to transform the incoming and processed data (Information) into Cipher-text. The client/server design (see Figure 6) style is adopted and modify with the inclusion of data access layer to execute the proposed DD-TPS. It has four different layers with various specific functions performed by each of the layer:

i. User services: This is the visible or external layer where users (Staff, Management Staff, and Supervisors) can interact with the system. It is also called presentation logic. It is a user interface which handles data entry, data query, report generation etc. Each of the modules (POS, Payroll, ATM Card Payment, and Inventory) integrated into this system DD-TPS has its own user interface which allows various users to enter their data for processing. It is a graphic user interface, characterized with the following features: Mouse click event, Pop-up menu, Confirmation dialog box for execution of commands and Tool tips message. In this design, the user interface only runs on the client's side.

ii. Business Services: This is the middle layer or business logic or business logic server or application logic. Any form of request made by users from the user interface will be handled in this layer and the request passed to the server for processing. Some requests will either be passed to the Data Access Layer to be encrypted or to the database server to be stored. This is the power house of all the layers where programming codes reside. There is a link among the data access layer and database server in order to enhance thorough communication from the front-end and back -end.

iii. Data Access Layer: This layer is purposefully introduced to secure incoming data before getting to the database server. There is a need to provide enough security for the users' ATM card passwords, staff payroll slip, inventory detail etc. An encryption algorithm is executed on every confidential data that is passed to this layer, and decryption of Cipher- text information into plain text is also performed in this layer.

Data services: This layer is called database server which stores the data and provides data access and database management function to all the organization's information: The database server in this layer processes SQL statements used in manipulating, processing and managing data. Database components like tables, triggers, store procedures, and user-defined functions created for this system stored in this layer.

SMS Alert Components: This component sits on the database having its interface at the front-end of ATM card payment module and Payroll module. On every transaction in any of the modules the DD-TPS push the short message service alert via internet connectivity to the SMSC to the client's mobile phones. The push SMS technology is adopted for this system, which allows short message service to be sent in form of alert and never allows responses from the users. So it is one directional flow of message. In summary, the major reason for using the three – tier architecture for the development of DD-TPS is simply because of the following facts:

- Enhancement of overall performance of the DD-TPS by reducing the data server work load.
- It provides easy maintenance of each layer because the DD-TPS is developed on each layer with specific components.

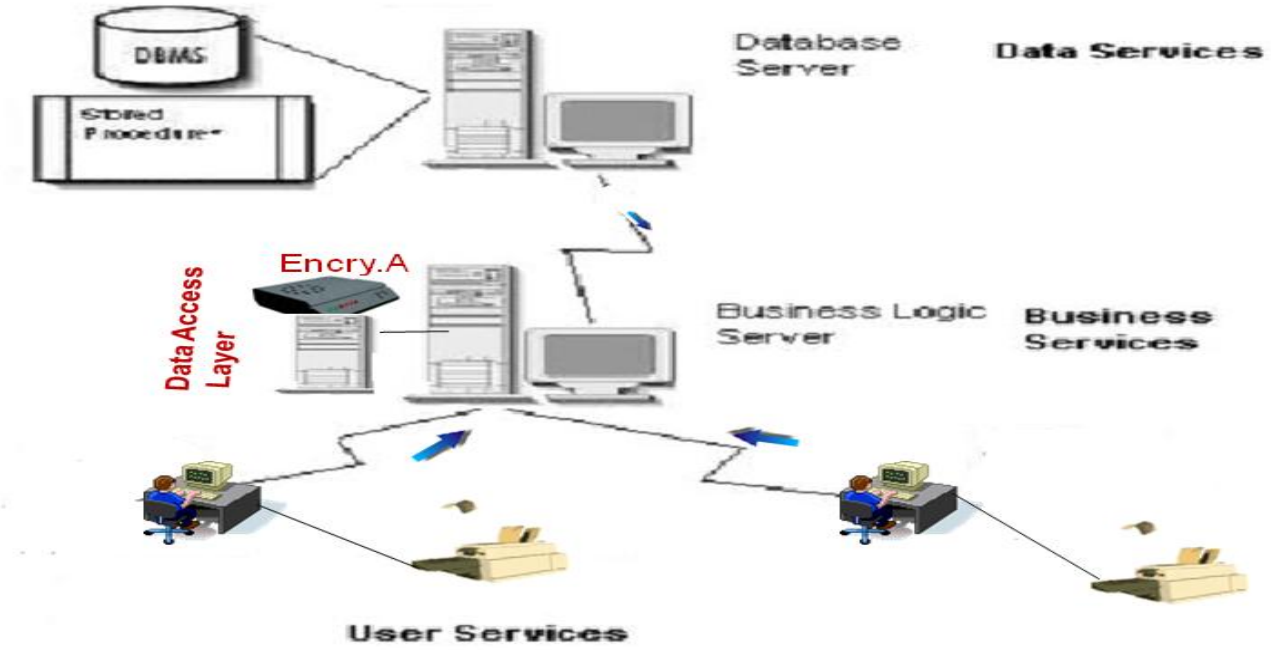

Figure 6: The proposed 3 Tier Client/Server Architecture for DD-TPS.

3.5 The Proposed System Interfaces

The first set of input to the system is a pair of Username and Password. After the pair has been entered, the system authenticates the user by validating the username and password. This is done by calling the login stored procedure which in turn checks the database by verifying if both the Username and Password supplied exist in the database. If true, the system authenticates the user else, the user is denied access as can be seen in Figure 7. The other inputs to the system are only carried out after the user has been granted access to the system.

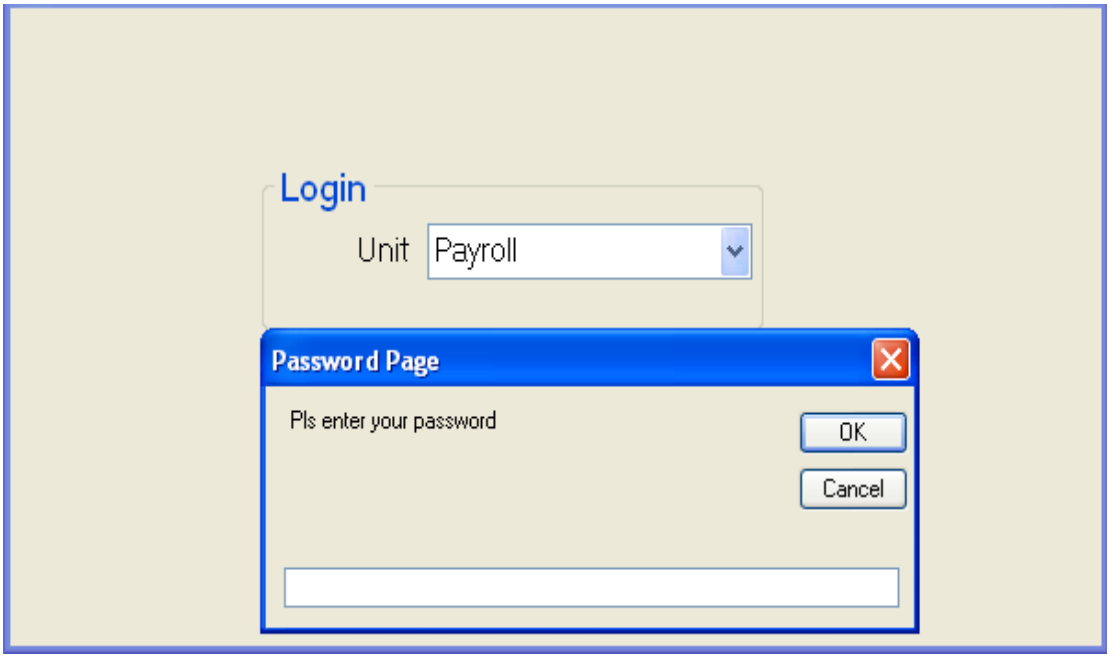

Figure 7: Log-in Page for Password Authentication.

The interface in Figure 8 provides a platform for entering employees' profiles and monthly salaries. The interface has the following features:

i. Submit button: On clicking the button, it saves each employee's salary detail and profile in a database and clears the screen for the next entry.

ii. Search button: On clicking the button after the staff identification number is provided, the details about that particular employee is displayed on the screen.

iii. Delete: On clicking the button, it requests for the staff identification number of the employee's record to be deleted with confirmation dialog box. It deletes the record permanently.

iv. Display: It helps to display all records from the database

v. Update: This button helps to modify employee's details.

Print: It is used to print employee's pay slip.

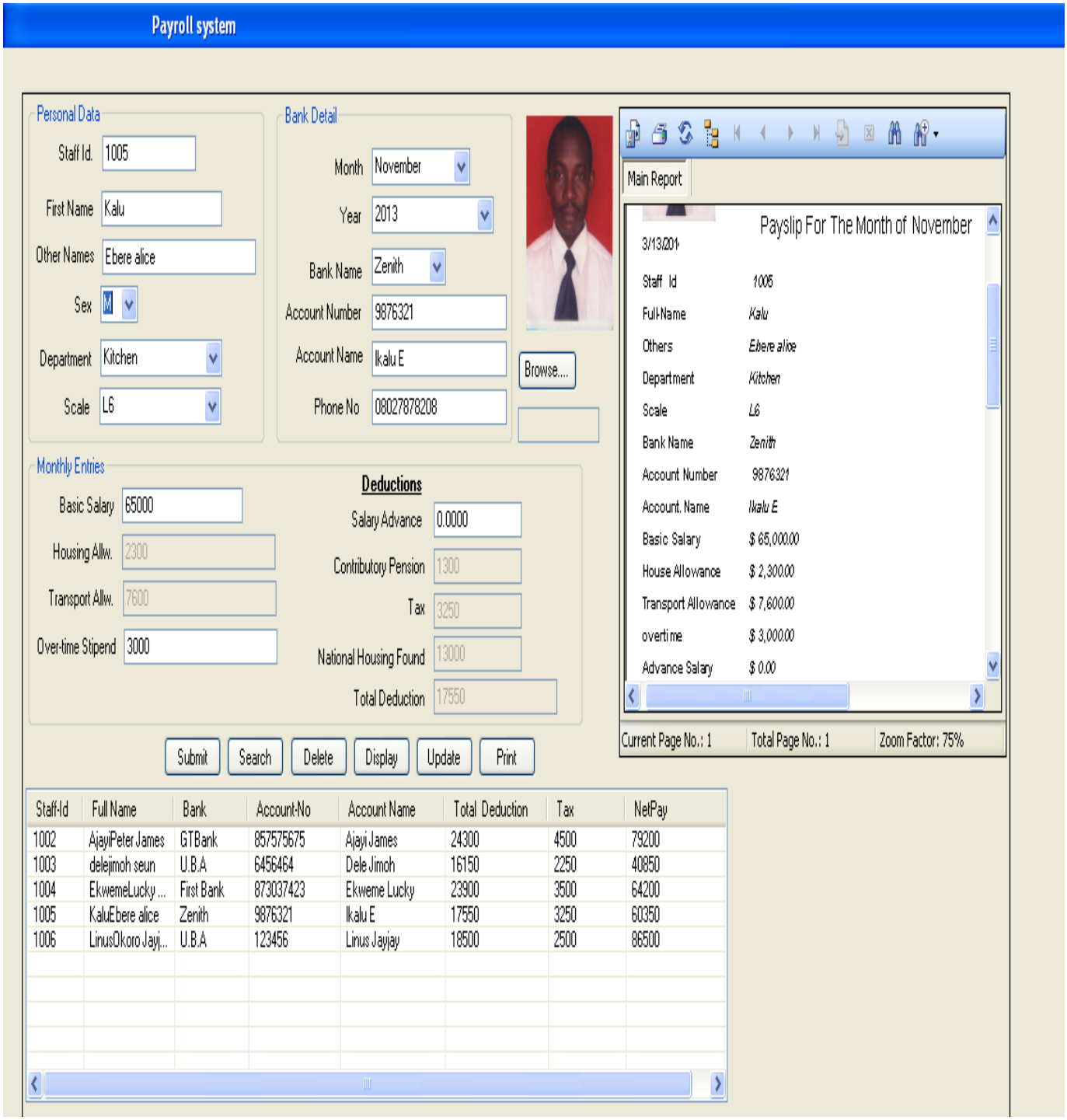

Figure 8: Users' Interface for Payroll System.

The interface for placing order for customers and payments are either carried out through cash or E-payment. SMS alert is sent to the customers' hand phone immediately transaction is done via E-payment system as can be seen in Figure 9.

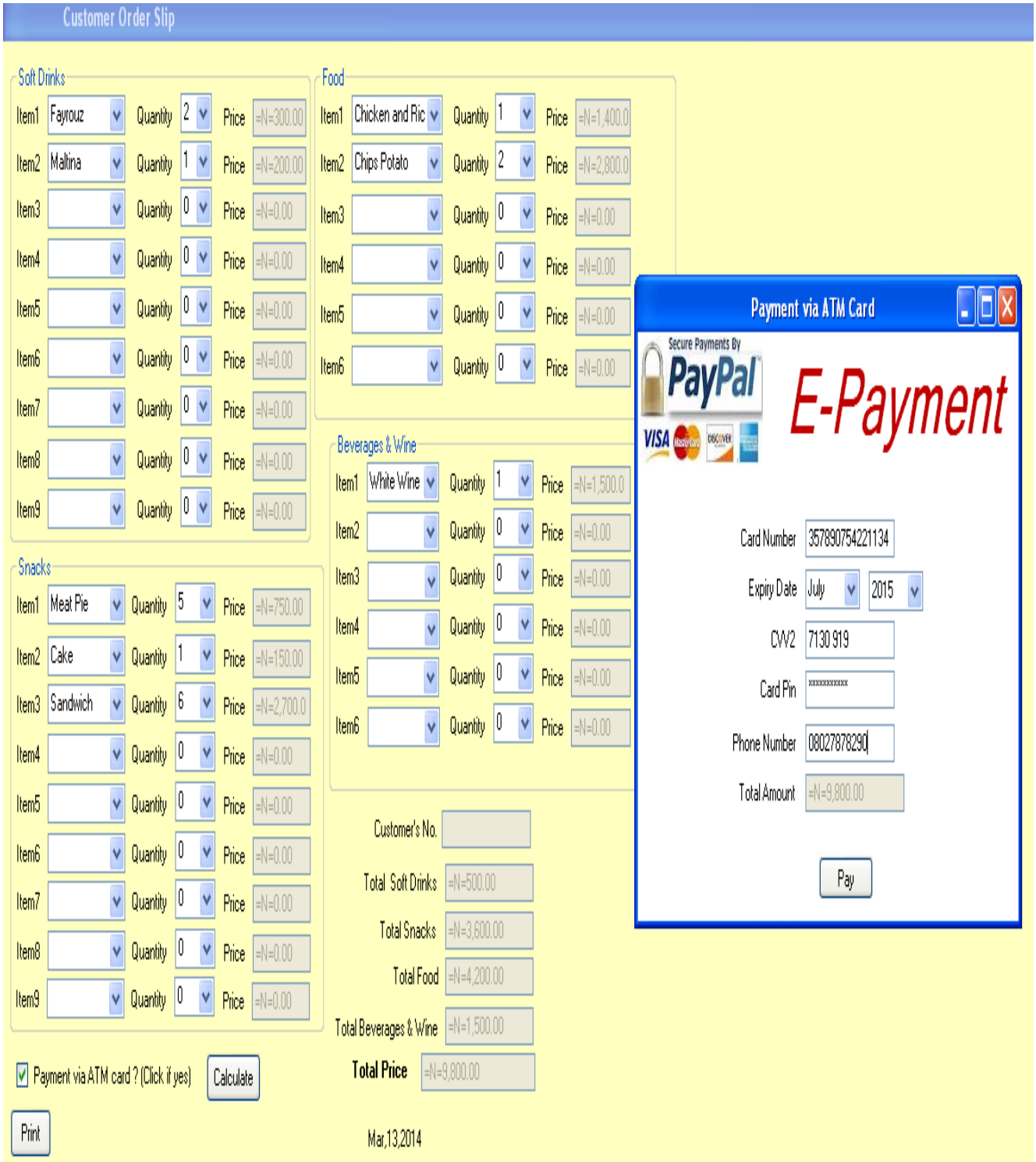

Figure 9: Users' Interface for Point of Sale and E-payment.

Figure 10 shows the interface where values for selling price and cost price are entered by the users. The computations of critical Ratio and Z value are carried out by the system. The system also display statistical table for further computation of optimum inventory policy for each meal item (M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12).

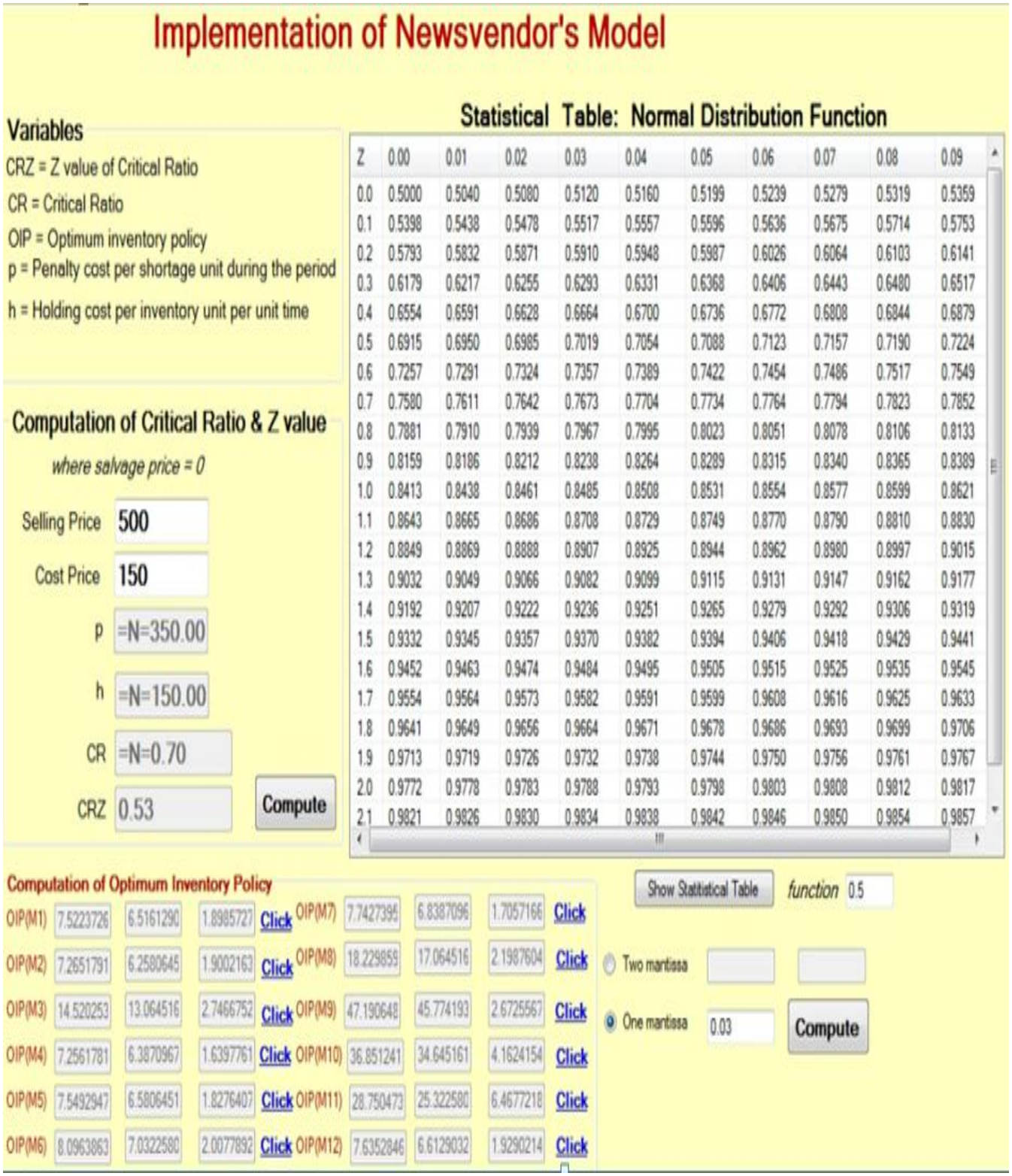

Figure 10: Users' Interface for Newsvendor Model Implementation.

Figure 11: is the interface for capturing total quantities of each meal (M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, and M11and M12) ordered by customers on daily basis. The computation of mean, standard deviation and V% are carried out on clicking Compute link on the interface.

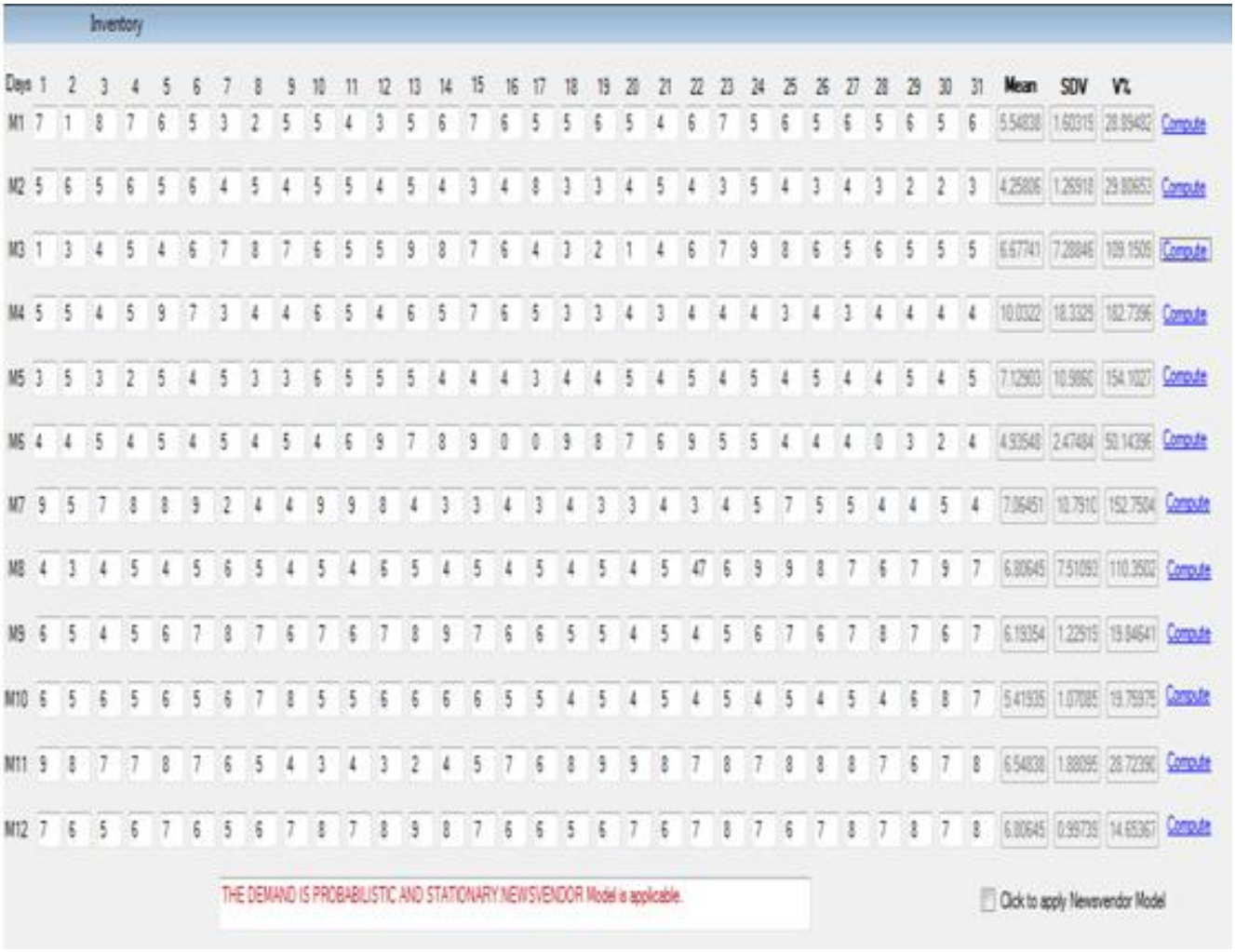

Figure 11: Users' Interface for Newsvendor Model Implementation.

From the computed results the Optimum Inventory Policy (OIP) is as follows:

(OIP) 1: shows that to maximize the profit to order 8 types of meal 1 instead of 6 type of meal 1.

(OIP) 2: show that instead of preparing 6 type of meal 2, we need to make it 7 type of meal 2.

(OIP) 3: shows that instead of doing 12 type of meal 3 we can do actually 16 of it.

(OIP) 4: shows that instead of doing 6 of meal 4 we can do 7 of meal 4.

(OIP) 5: shows that there is no need of increasing the number of meal.

(OIP) 6: shows that we can do 9 of meal 6 instead of 7 of meal 6.

(OIP) 7: we can do 8 of meal 7 instead of 6 of meal 7.

(OIP) 8: there is no need either to increase or decrease the number of meal.

4. CONCLUSSION

In this paper, the researchers have developed a Data-Driven Information System that is used as a stand-alone system to POS for ordering and tracking sales, modules that determine the level of menu items the organization must maintain to ensure smooth operations and also computerization of employee payroll management. On the basis of our findings during the course of the study, it is obvious that much have been invested in purchasing an information system in order to manage business processes within an organization. The researchers have successfully proposed for a DD-TPS that integrates four different modules into a single platform which minimizes the cost of buying four different modules for AUN's Restaurant. The DD-TPS is a system developed with the following modules: POS module, Inventory module and payroll module and was successfully implemented to minimize the cost of buying four different systems. The DD-TPS modeled with DFD was developed and implemented as a replacement for the manual method adopted by the AUN's restaurant. The proposed DD-TPS has four different modules which include: POS, model-driven inventory system, Payroll system and E-payment system. The four modules are sharing the same database on same server for better maintenance and functionality.

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