Information System for Small-scale Apparel Industries

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***Abstract*—Use of software based management systems for internal operations within firms has been a successful step in many organizations today to maximize their efficiency, accuracy and transparency, leading to their major business goal of profit maximization. In today's business world, huge amounts of capital are invested on buying and maintaining software based systems due to this reason. Yet, there are small scale industrial firms which could gain a higher performance by the introduction of IT solutions but are reluctant due to high expenses and complexity of these systems. This paper proposes on introducing such a management system for a specific Batik garment factory— Lekha Batik Garment Factory Management System (LB-GMS) which took into account the problem of creating simple and efficient management systems for small-scale firms.**

Keywords—network application; Java RMI; SMS gateway; management; batik; garment industry;

I. INTRODUCTION

Apparel industry, being one of the oldest industries in the world can be considered as a main income source to countries like Sri Lanka. Batik arts, a specific traditional branch of this industry has been prevailing in many Asian countries. Today, there exists batik garment production firms with more than 100 employees, where support of more efficient management systems would cause high efficiency. However, today software systems target only the large-scale apparel industries.

This solution targets a rural traditional batik garment factory where the tasks are carried out by almost 100 employees. The firm is a leading batik garment supplier which covers island wide sales and is popular due to the high product quality. The client's utmost requirement was to have a management system to automate the manual book keeping processes and to have a distributed system in order to co-relate the tasks carried out at the firm.

The production process uses different kinds of clothes and dyes as major raw materials and the store manager keeps records on these raw material purchases and usages in order to calculate the available current stocks. Then, the production takes place under several steps and in brief can be shown as cutting, sewing the basic garment structure, dyeing, washing, drying, sewing to complete the garment and at last finishing the product. It outputs about 40 different types of garments. Sales occur at another department in the firm. The firm sells their garments only to a specific set of customers and the prices are not unique across all customers. The customers consist whole-sellers from different areas in the country. Employees are assigned to production processes as well as for other tasks like store management, sales and office tasks. An employee can be an interior or exterior person where interior people do their tasks within the premises and external people take stocks of garment pieces to their homes and cover the task. External employees are assigned only for waxing and sewing. Any employee who does waxing or sewing are paid based on the garment pieces they have covered. Other employees are paid based on their attendance and overtime hours.

This batik garment factory currently uses manual record keeping and traditional methods in its administration. The factory lacks an accurate system for calculating income-expense summaries. These factors have affected the client in deciding for using a software based management system. A typical garment factory management system does not support much flexibility to suit this kind of firm as the firm structure, processes and the social environment deviates much from a typical firm. So, it is worth to introduce a software application suitable for rural traditional industrial firm considering these deviations. While fulfilling the user requirements, a major concern was given to preserve the non-functional requirements including usability, reliability, supportability, performance and security. The system includes subsystems for employee salary management, stocks management, production process management, sales management and decision making reports development.

II. RELATED WORK

Currently, the apparel industry is one of the main areas IT solutions are introduced specifically and many software companies in Sri Lanka as well as in the world target this industry [3]. The manual documentation in apparel industry is a highly data redundant process and has a higher probability of making errors in calculations. This led to the idea of producing ERP systems for this industry [2]. In 1960s, an open loop MRP (Material Requirement Planning) system was introduced as a result. It included automated functions like Purchase Orders, Work Orders and Rescheduling Notices based on a Planned Order. In 1970s, this system was developed as a closed loop ERP where capacity requirements are checked before purchasing and selling items. In 1990s, introduction of client-server applications make it possible to access a server within different departments of the organization. Now, with

integration of cloud computing, the ERP systems are highly flexible and advanced [5].

Fast React which is considered as one of the robust apparel management software producers, presents their clients with a vast range of software products [4]. Vision, Evolve and Align being the major 3 products of them, serves different levels of functionalities. Vision is a software product which targets the operations from design to delivery. Evolve is a planning tool for manufacturers to achieve effective capacity management and improve competitiveness. This causes to profit maximization as reducing costs and increasing revenue can be achieved by better planning. Align targets textile and other raw material producers who also need to plan quickly, accurately and effectively. These 3 products are independent from each other and quite robust in applications. But, the domain they assume is fashion designing companies which always consider market requirements and innovate new products. The traditional small scale industries deviate in this point as they comprise traditional procedures and garments which are not much compatible with modern fashion design. As well, the complexity of these systems doesn't match with the employees and officers at small scale industries to get on with the IT applications directly from manual documentation. Elastic which is another garment factory management system developed by Elastic suite, is much simpler than the above mentioned product [6]. This covers the functionalities including a Digital/Custom Catalogue Builder, Online Order Entry with live ATS and ERP integration. But, this system lacks of tracking the supplier details and recoding details on production and importantly employee management procedure within the factory.

Through analysis of the currently prevailing systems, it is obvious that the market lacks cheaper apparel management software specifically for traditional small scale industries like batik industry. But, the tasks carrying out at these firms too need to be aligned with the modern technology to increase efficiency, transparency as well as the accuracy. This leads to automation of many tasks reducing the data redundancy.

III. SYSTEM DESIGN

A. *System Requirements*

Based on the processes at the firm, LB-GMS consists 5 main sub systems as Employee management, Stocks management, Production process management, Sales management and Office tasks automation.

Figure 1, the use case diagram depicts functional requirements which were captured in the requirement gathering process. The users of the system includes owner, officer, sales manager, store keeper and supervisors excluding the normal employees. System must be able to keep records of all employees, their assigned tasks, their attendance and completed work as well as the salary payment history. In the context of a traditional rural industry, the system must be capable of automating the salary calculation, but at the end, giving the chance to the owner to add or deduct payments based on other circumstances.

Stocks including clothes and dyes management is important to identify trends in usage and adjust purchases of raw material based on them. Use cases relevant to store keeper keep tracks of them. Production process is documented based on which clothes are used in which garment production as well as to keep daily coverage of each step in production. Supervisors are handling these processes. The owner is able to identify poorly occurring steps based on these. Having the database on customers, their orders and issuing them a proper bills is necessary for sales management. This too helps in identifying trends of customers and periods of the year where production needs to be increased. The total summary of these must be visible to owner as different business reports.

Non-functional requirements of the system considered the nature of users and their novelty to use IT applications. All above functionalities are allowed based on a 3 level user hierarchy. User authentication and secured passwords ensures the security of the system. As the system is separated from the World Wide Web, the system needs to be protected against insiders only.

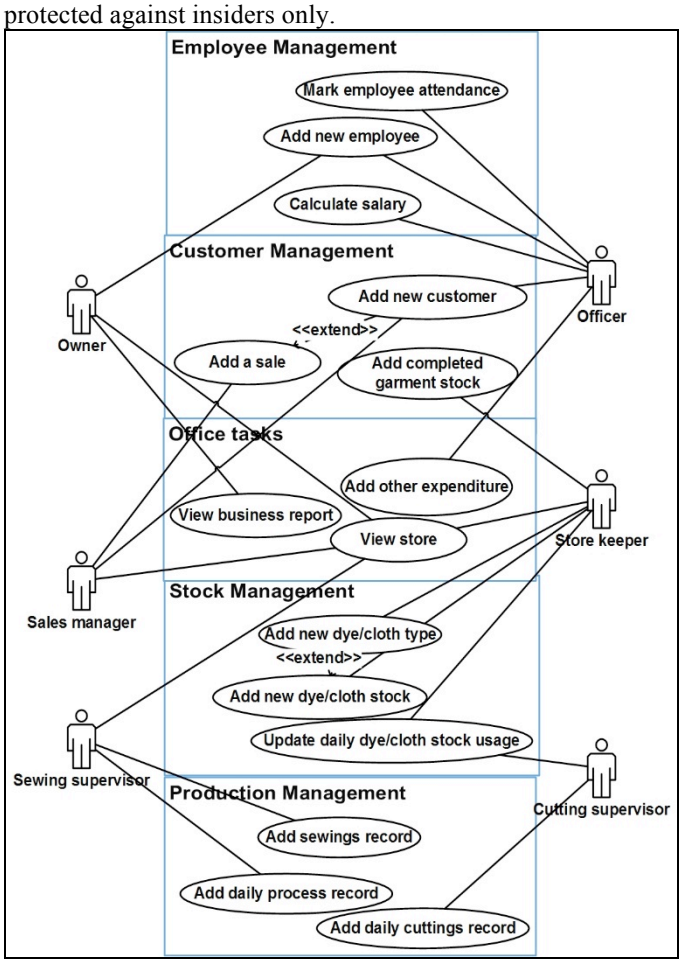

Fig. 21. Use case diagram.

User levels in system access are 1) Super User- Owner, 2) Managing level-Office Clerk and 3) Supervisors of departments. In order to achieve usability, the system is created with many auto completion buttons where possible and easy to identify words, phrases and icons. The system must not lag making the user arrogant and must comply with the GUI standards. In order to achieve reliability, validations for all the fields are activated and users are guaranteed to inform on failure or success of each function. The database can be backup and restored allowing the reliability on data.

B. *System Design*

The system design can be overviewed by 4+1 view model of architecture. The basic architectural model used for the system is the three tier architecture including presentation, logic and data tiers. The Presentation Tier contains all of the user interfaces to interact with the users. The Logic Tier handles all of the Business logic and control the user interactions with the database, the Data tier consists of the database, providing the persistency of information.

The use-case view as discussed in the above section is an introduction on functional requirements of the system. Logical view for this system can be shown by the class diagram as shown in Figure 2. The system mainly interacts between the employees, garments and raw materials. Main raw materials are cloth and dye and the employees are of two types which are significant in calculating the salary.

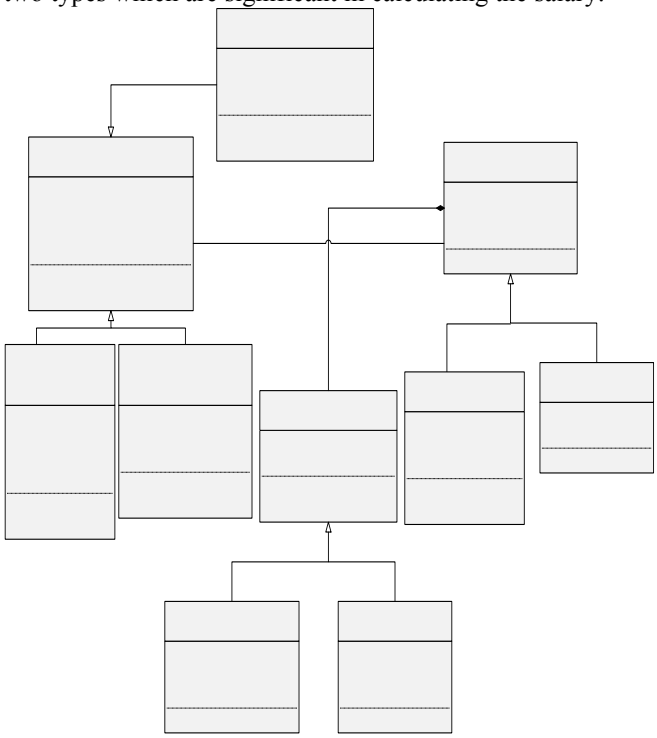

Fig. 2. Class diagram.

The process view for the system can be represented as activity diagrams and sequence diagrams for main functional requirement for the system. In this specific use case in Figure 3, when a customer order a set of garments, the sales person needs to check if the customer is already registered in system and if not, add as a new customer.

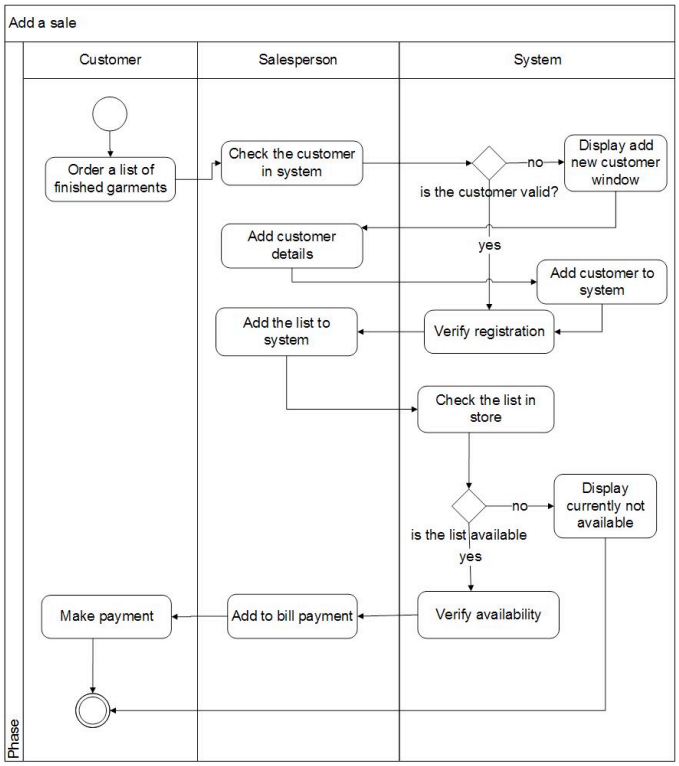

Fig. 3. Activity diagram for add a sale use case.

Then, check the store if the asked garments are available to complete the order. The sequence diagram for this is shown in Figure 4. This describes how the process specified in the activity diagram must take place with different users and subsystems of the system. This shows that the officer is a direct user of the system and customer can not directly interfere with the process.

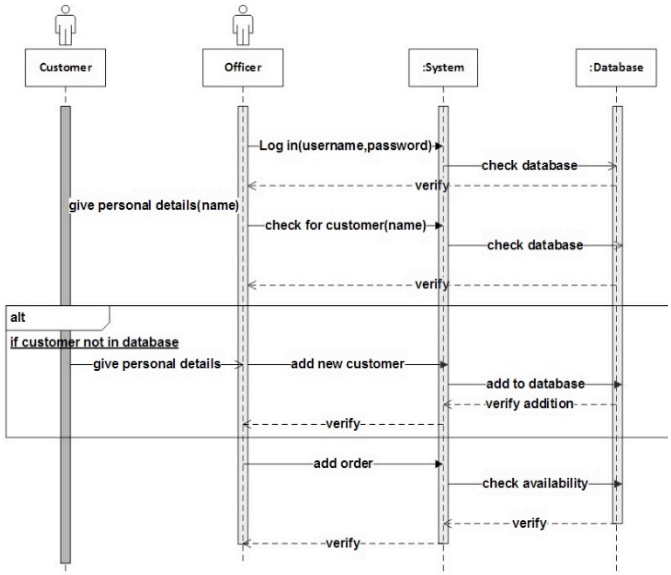

Fig. 4. Sequence diagram for add a sale use case

C. *Database Design*

The data view of the system is described through the ER diagram represented by Figure 5. As same as in the class diagram, the ER diagram too is developed considering the garment, employee, customer and raw material as main components.

Raw materials include clothes, dyes, threads and waxes. These are purchased as stocks. The stock entity stores information on these purchases. Daily usage of dyes, threads and waxes are stored in daily material usage table while for usage of clothes, another table called daily cloth usage is used. This is because the system needs to record for which type of garment clothes were used. So, the daily cloth usage entity is a relational entity between garment and raw material entities. For each garment, under the production process, how much are in each phase of production is recorded in daily coverage table. The customer table is to keep information on registered customers and the order is another relational entity between a customer and a garment. One order includes one customer and a set of garments. Employee entity is divided into 2 sub entities as employee with a salary and employee with a wage. For the employee with a salary, the system needs to consider how much of garments they have sewn or waxed. This is acquired through the piece coverage entity which is an optional relationship entity between employee and garment as it only relates to employee with salary. For other employees, no of days and the overtime hours they have worked is recorded to pay salary.

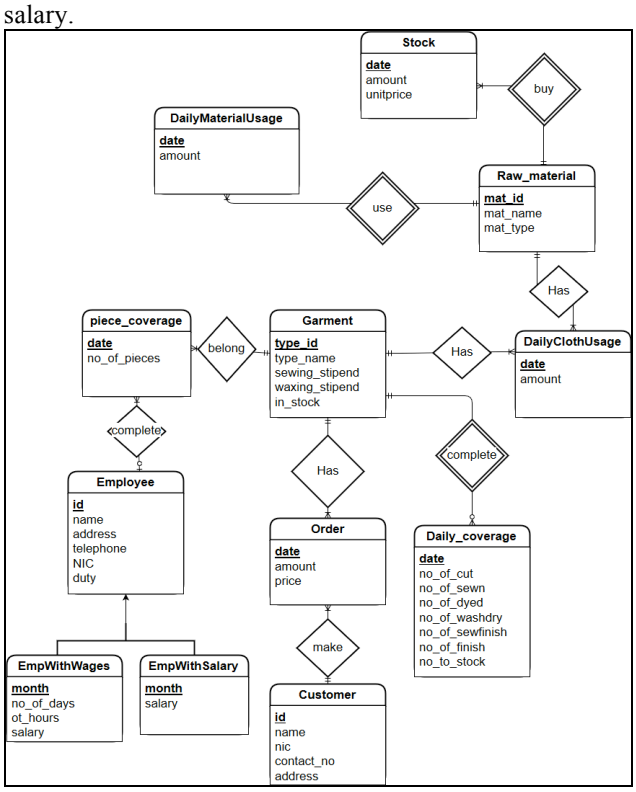

Fig. 5. ER diagram.

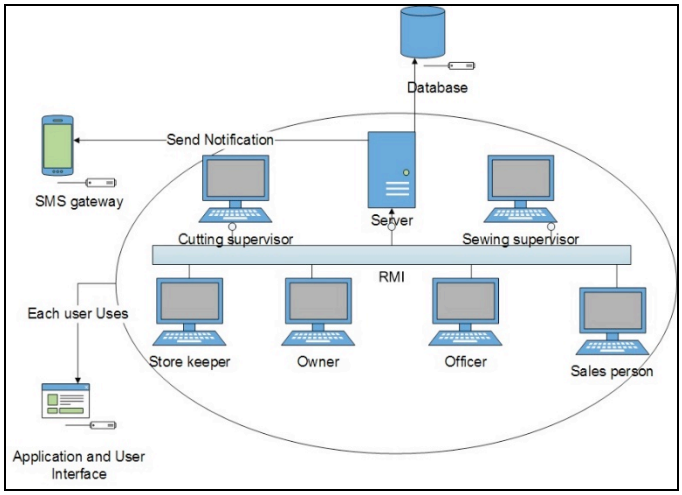

Fig. 6. Deployment.

IV. SYSTEM IMPLEMENTATION

A. *Implementation Procedure*

The system was developed as a Java RMI based application to provide the local area network for the factory as shown in Figure 6. The standard structure for RMI was used and project was developed as 3 java projects for client, server and the interface. The common interface between the client and the server comprises of model classes and controller interfaces. Both client and server use these in their implementations. Redistributable jar of interface is used by both server and client. Client calls these functions through controller interfaces as needed. Java swing was the main library behind the user interfaces. Database implementation was using MySQL14.14.

Within the factory, a local network is to be created with 1 server that manages the database for all clients. The departments will have a separate client machine to enter and search for relevant data by each section.

As depicted in Figure 7, to enhance the business reports, the bar charts and pie-charts showing a pictorial view of success are added to the system using an open source library, jasper reports [8]. It is used to print the bills for customer orders. The stocks available, garments production every year and income-expense summary reports are too visualized using this library giving the ability of printing too.

The notification sending occurs through an SMS gateway called 'OzekiNG', a service running in background. This uses a GSM Modem with a local service provider's sim [1]. The SMS rates are charged through that connection. Once the OzekiNG is configured with the service provider's information, the application can call SMS gateway via the java library for OzekiNG to send the notifications to a set of mobile numbers. Mobile numbers saved with employee details at persistence layer are used.

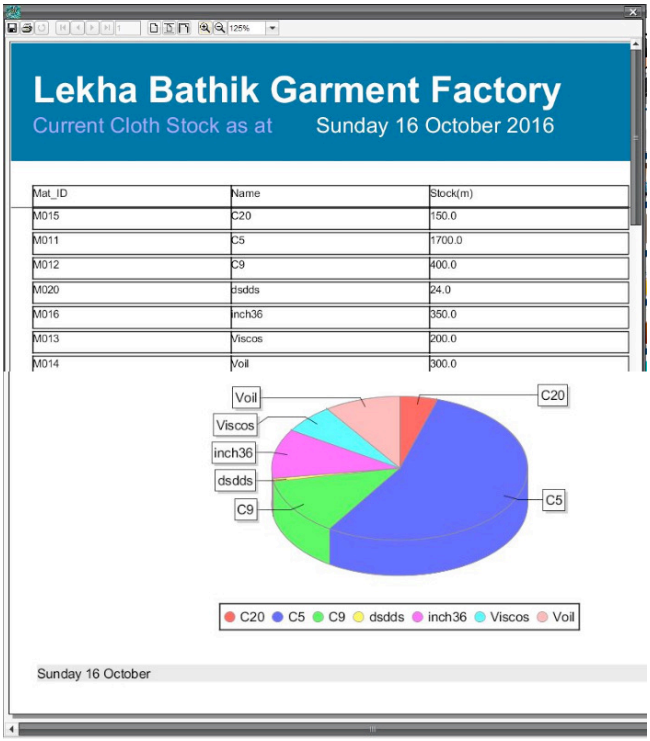

Fig. 7. Reporting.

B. *Resources used*

The requirement gathering phase identified different resources to implement the system. Existing data of manual documentation including basic types of clothes and waxes, the

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intialize month to user_selected_month
intialize year  to user_selected_year
set monthly_expenses_list for year,month
initialize expense_sum to zero

while monthly_expenses_list is not empty
add expense_value to expenses_sum
end while

add material_buying_expense to expenses_sum

set monthly_income_list for year,month
initialize income_sum to zero

while monthly_income_list is not empty
add income_value to income_sum
end while

add sales_income(month,year) to income_sum

set profit to income_sum minus expense_sum
```

Fig. 8. Pseudocode for profit calculation.

set of garments that the firm produces as outputs, sewing and waxing stipends for different garments, samples of employees and customers were used to create the prototype database. They were important in identifying the mechanisms to automate the documentation process as well. As an example, income-expense summary calculation was based on the pseudocode in Figure 8..

The short video on Vimeo about the firm [7] and the factory visit was much more than a material to decide on the implementation process.

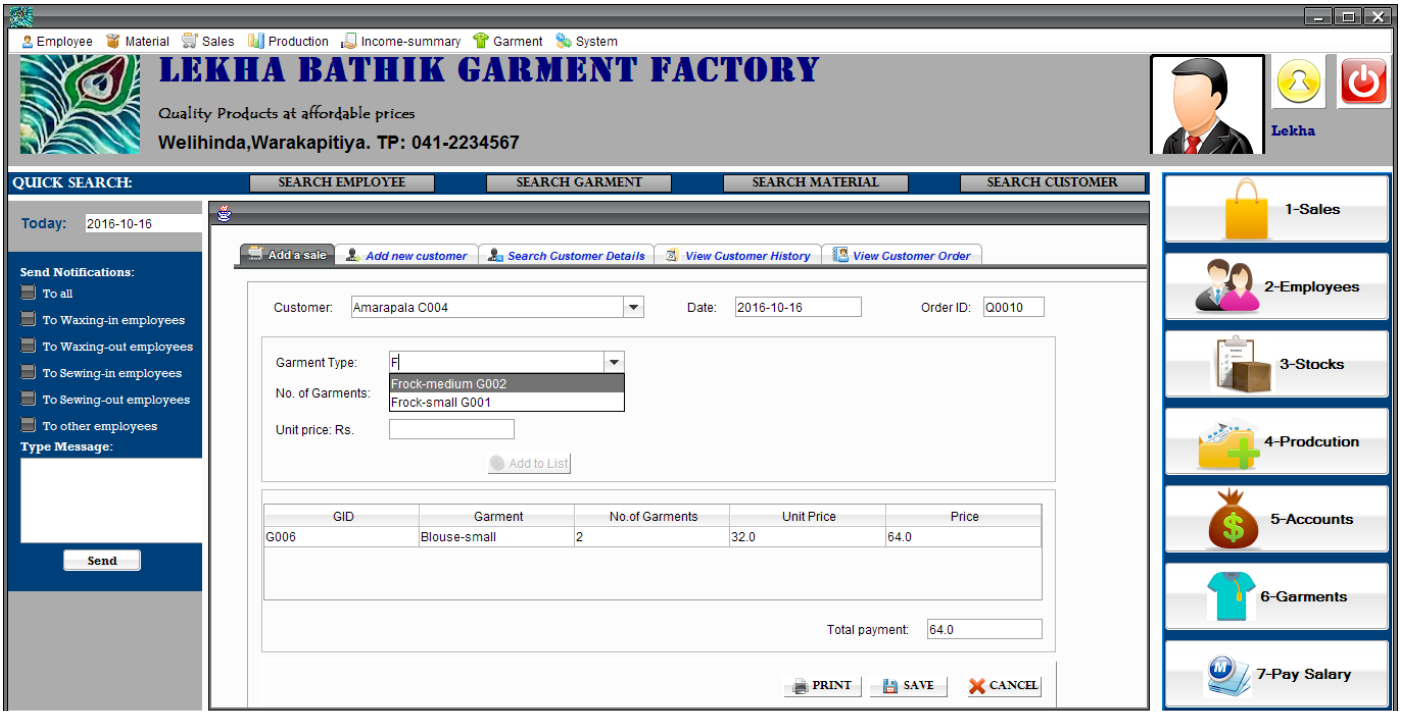

Fig. 9. Main user interface preview

C. *Main User Interfaces*

All the mentioned functional requirements are implemented as graphical user interfaces interwoven with each other using java swing. The server consists of a simple graphical user interface to start the server and show that the server is running.

Considering the client application, the main window preview is shown in Figure 9. The system login is simple, but robust with encrypted passwords LB-GMS itself is simple to traverse and what the user search for can be quickly identified in the main dashboard. Lack of an advanced English knowledge will not be an issue to use this system unlike in the commercial management systems available. The possibilities of the user to enter erroneous information is always avoided using validated fields, combo boxes and check boxes.

Usability is increased by auto filling combo boxes, user tool tips and easy access tool bar as well as the menu bar.

The right menu gives quick access to the different sections and this preview shows that the owner owns full-control over the system which is restricted to other users while SMS facility enables to send messages to groups specified as in Figure 10.

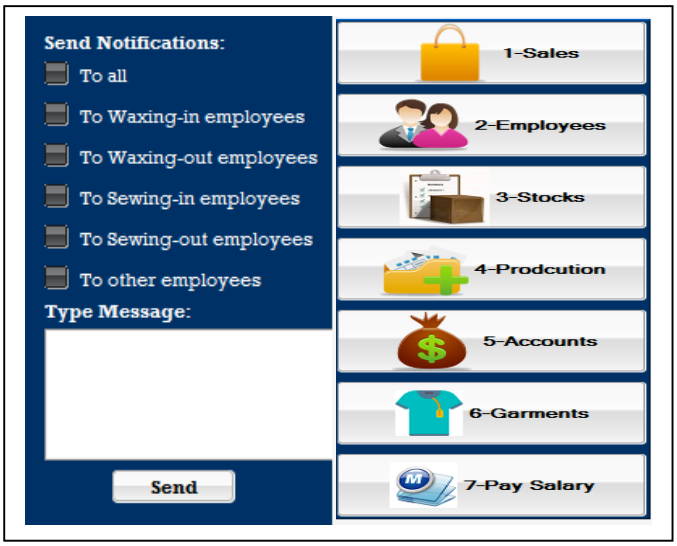

Fig. 10. Notification panel and quick-access bar

V. EVALUATION

Testing of the system covered different aspects of testing including unit testing, integration testing, user acceptance testing. The major goal of these tests were to verify that the system assures the user requirements and gives a favourable level of service to the user. The testing targeted software, hardware, database and other supported products to the system development. Unit testing used JUnit library while user acceptance test was done to the system by giving the opportunity to the client to play with the system under construction. This helps in identifying the places where user requirements are deviated as well as to know whether the user interfaces are comfortable to be used by the client.

VI. CONCLUSION AND FUTURE WORK

This software system can be guaranteed as a management system that suits the specific client targeted as well as a solution to small scale traditional garment factories. This can be a good alternative for expensive and complex management systems available at online market. This software management system is a simple and comprehensive system for a traditional small scale garment factory firm usually of an employee capacity about 100.

As a start-up project, this project could be extended in many branches. The sales management system could be developed further to track advance payments, debts etc. for each customer. The system can be automated to remind the customers on their payments using a notification system. Expanding the sales management as a separate web based application could be an advantage to widen the customer basis and to ease of the customers. Employee management system too can be improved with automated finger print systems for marking attendance. The business statement development could be developed to the industry standards so that it is helpful for legal purposes as well as for each stakeholder of the firm to know about financial status and performance of the organization.

VII. ACKNOWLEDGEMENTS

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