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Design and Implementation of a Web-Based Inventory Control System Using a Small Medium Enterprise (SME) as a Case Study

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Abstract

In recent years, it has been observed that inventory data of most businesses are manually recorded into a spreadsheet and maintained with little or no technological innovation which has a lot of shortcomings in our modern world as it has shown to be challenging to successfully monitor inventories. In retail industries, inventory management poses a number of challenges. In order to meet client demand, companies must maintain inventory in warehouses. The goal of inventory management is to determine the right amount of inventory to meet demand while avoiding overstocks. In this research work, a Web-based Inventory Control System has been designed to improve on the shortcomings of the previous system. The Web-based system was created with tracking methods like QR codes and Barcodes in mind to track products as they travel from point of purchase to point of sale, between stores (in the case of emergency supplies from nearby stores), inside individual stores, and lastly directly to customers. On a daily basis, it also delivers precise up-to-date information to the corporate office on the inventory levels of the individual stores. It also allows specific users (for example, store managers, heads of operations, and so on) to access the system at any time from various locations to perform different functions. The inventory control system is a tremendous boost to the store managers and corporate office as it helps the store to find items that should be ordered first thereby spending less time on inventory management functions. It also helps the corporate office to efficiently monitor transactions that take place across multiple stores. As a result, customer service and customer satisfaction will surely increase, resulting in increased revenue for the company.

1. Introduction

The broad business problem is that a company's operational effectiveness is significantly impacted by high quantities of working capital spent in inventory. The fundamental issue is that some managers lack inventory management solutions. As a result, businesses must devise techniques for monitoring and sustaining their product inventory levels [1]. For this reason, some businesses employ a web-based inventory management system. A web-based system is one that runs on a web server and can be accessed by browsers from a variety of devices, including smartphones, tablets, laptops, and desktops. To show information to users, a web-based system employs a combination of server-side and client-side programs [2]. An Inventory Control System is a software program that

supports companies in managing their inventory. Data will be maintained in databases using web-based inventory control systems which help to organize entered data for fast recovery [3]. These web-based data management systems use a web browser for the coordination of information over the internet or company intranet [4]. This system covers the procurement, delivery, receipt, tracking, storage and warehousing, turnover and reorder [5]. Therefore, an inventory control system is essential in providing accurate information to all levels of the organization.

A complete inventory control system consists of a system for identifying every inventory item and its associated information, such as barcode labels or asset tags, hardware tools for reading barcode labels, such as handheld barcode scanners or smartphones with barcode scanning apps, inventory management software, which provides a central database and point of reference for all inventory, coupled with the ability to analyze data, generate reports, forecast future demand, and more, processes and policies for labeling, documentation, and reporting [6]. This should include an inventory management technique such as Just in Time, ABC Analysis, First-In First-Out (FIFO), Stock Review, or another proven methodology and finally people who are trained to follow these policies and processes [7].

Existing literature has focused on designing Inventory Management Systems using different approaches. The first designed an Inventory Management System utilizing Internet of Things (IOT) [8]. The system was designed using ultrasonic transducer and a processing device (like Raspberry Pi) connected to the internet. Due to the high level sophisticated equipment employed, workers found it hard to efficiently carry out their duties efficiently. Also, a Web based Inventory Control System using Cloud Architecture and Barcode Technology was designed for Zambia Air Force which utilizes the use of barcoding system to identify objects [9]. The drawback of this system is that it could only identify items at close proximity. In another work titled “Inventory Management Practices and Operational Performance of Selected Flour Mills Companies in Nigeria”, they made use of Microsoft excel spreadsheet to keep record of inventory related information [1]. Access to specific inventory data and information on demand was difficult.

This paper is about improving on some of the shortcomings as mentioned earlier.

1.2 System Technology

In this study, the utilization of the MERN stack alongside other tools was adopted for the backend and frontend. The MERN stack is a JavaScript stack that is used for easier and faster deployment of full-stack web applications. It is composed of four key technologies: MongoDB, Express, React and Node.js. These components provide an end-to-end framework which was designed to make the development process smoother and easier. The technique adopted in the implementation of the Inventory Control System began with the development of the backend architecture for processing, storing and transmitting the information. Backend is the server-side of the web application. It stores and arranges data, and also makes sure everything on the client-side of the web application works fine. It is the part of the web application that you cannot see and interact with. It is the portion of software that does not come in direct contact with the users. The parts and characteristics developed by backend designers are indirectly accessed by users through a front-end application. Activities, like writing APIs, creating libraries, and working with system components without user interfaces or even systems of scientific programming, are also included in the backend. The development of the backend was done using Node.js, a web framework for network applications, and MongoDB, a NoSQL database system. The frontend on the other hand is part of a website that the user interacts with directly. It is also referred to as the ‘client side’ of the application. It includes everything that users experience directly: text colors and styles, images, graphs and tables, buttons, colors, and navigation menu. Responsiveness and performance are two main objectives of the Front End. Frontend technologies or languages ensure that the web application is responsive i.e. it appears correctly on devices of all sizes no part of the website should behave abnormally irrespective of the

size of the screen. The client-side interface for the Inventory Control System was implemented using React, Bootstrap and CSS.

2. Methodology

The approach methodology and environment for the Inventory Control System are explained in this section. The web-based Inventory Control system was developed using the Waterfall Software development approach in which the system is divided into different parts and executed sequentially in order to achieve distinct highlighted goals. This section focuses on the functional and non-functional requirements of the system, use-case diagrams and specifications of each user of the system, and finally the class diagram showing the interconnection between system objects.

2.1 System Functional Requirements

Functional requirements specify the system's functions and services. The following are the functional requirements:

- Designated users should be able to login with their credentials and be routed to appropriate screens based on their access levels.
- Admin should be able to access inventory related information of all stores.
- Admin and Store Managers should be able to add new products and prices.
- Admin, Store Managers and Sales Representatives should be able to update products at threshold levels.
- The admin should be able to add new users and provide appropriate access to them.
- Admin and Store Managers should be able to view sales summary.
- Sales representatives should be able to checkout items from inventories.
- Sales representatives should be able to generate reports.
- Admin and Store Managers should be able to see orders

2.3 System Non-Functional Requirements

Non-functional requirements define how the system functions to the system limitations. It demonstrates the system quality. The non-functional requirements of the system are as follows. The system should be:

- Simple and user-friendly
- Efficient and accurate
- Secure access to authorized users
- Testable, Reliable and Scalable
- Cost-effective
- Robust so as to handle errors
- Secure privacy of users' information

2.2 Use-Case Diagrams

Use case diagram shows the interactions between a system and its environment (Sommerville, 2016). The use-case diagrams were used to gather the requirements of a system while depicting internal and external influences. It was also used to show the interaction between the requirements among the system's actors. The main actors in the Inventory Control System include the Admin (Corporate Management), Store Managers and Sales Representatives. The use case diagrams are as follows:

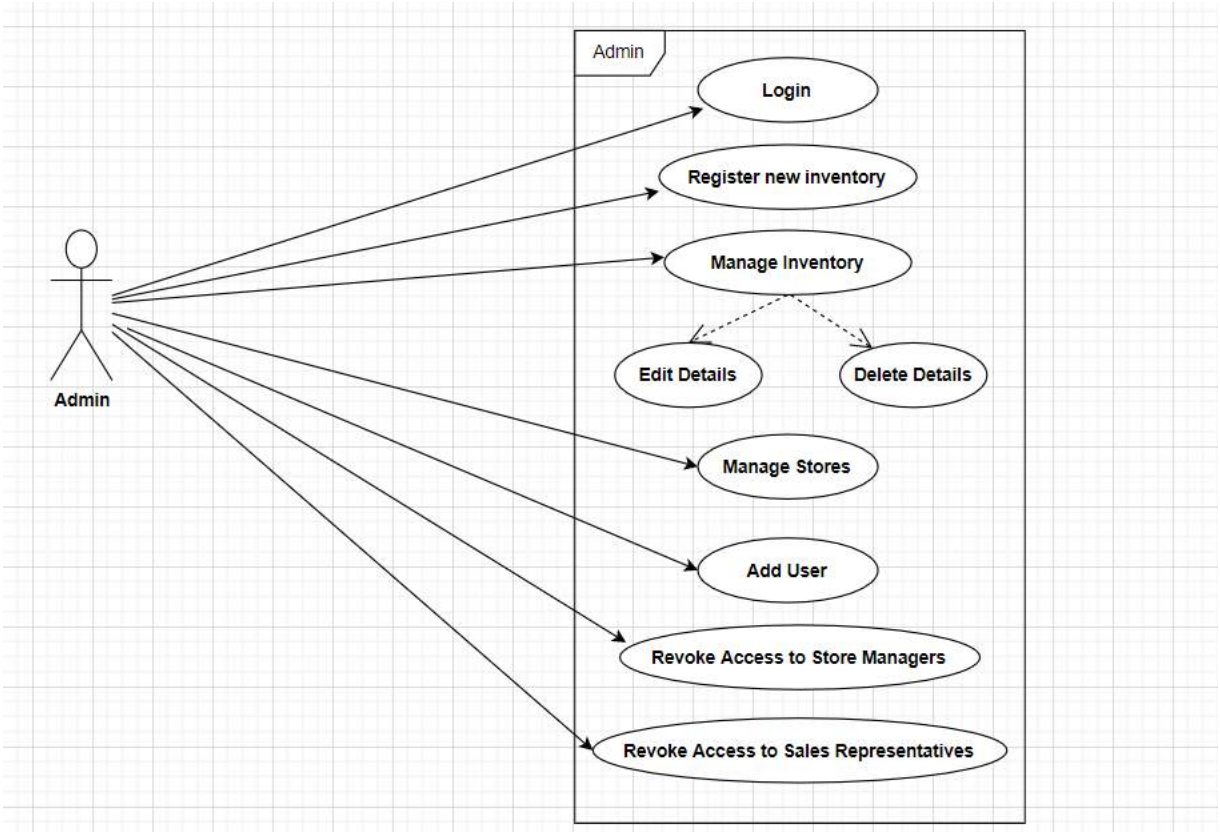

Figure 1 Admin Use-case Diagram

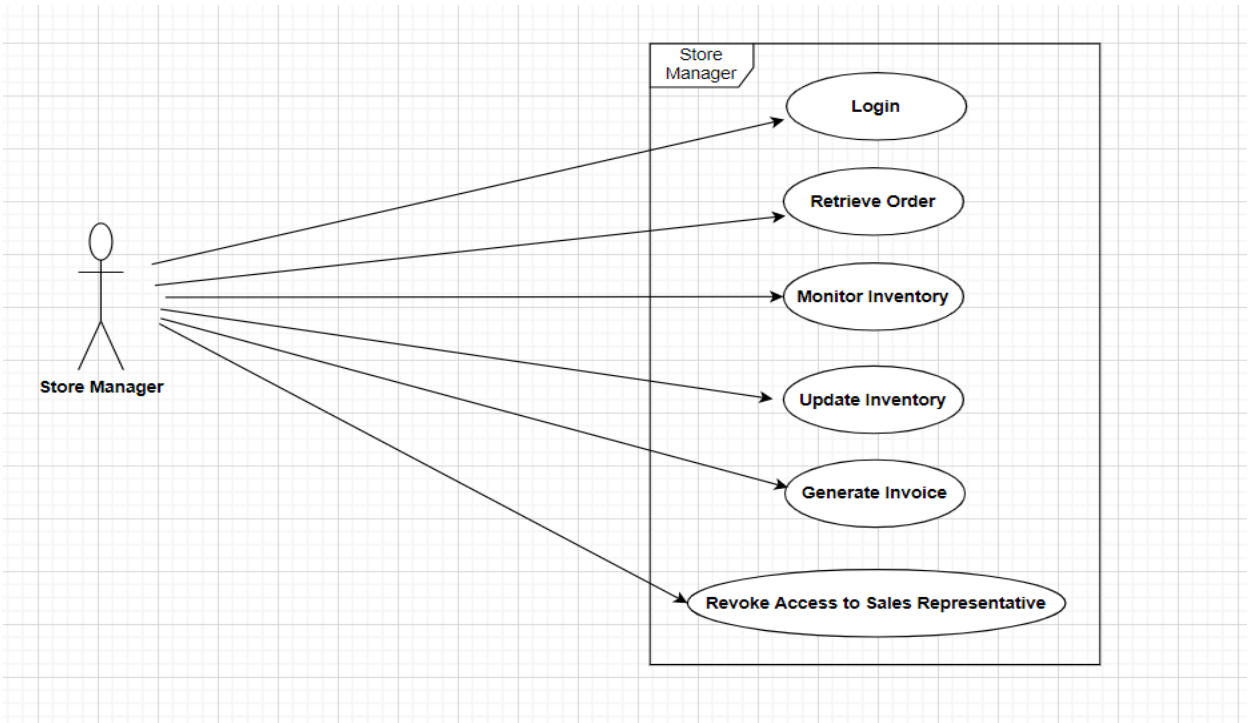

Figure 2 Store Manager Use-case diagram

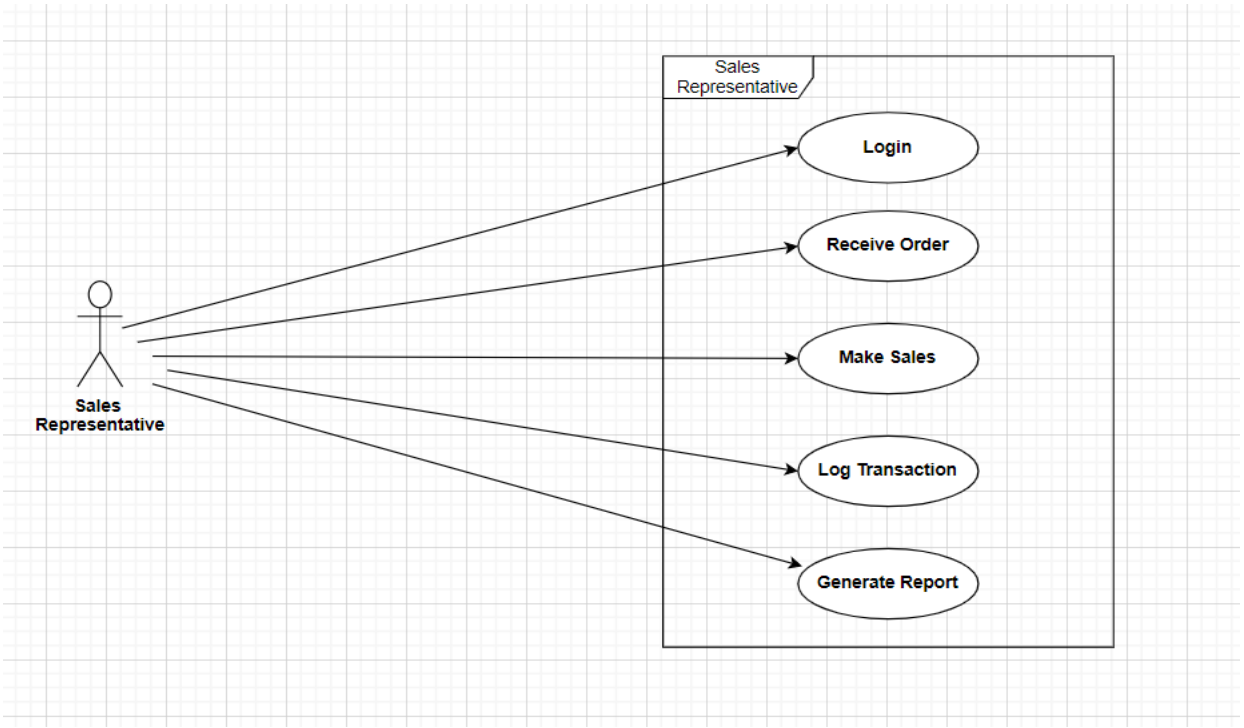

Figure 3 Sales Representative Use-case Diagram

2.3 Use-Case Specification

Table 1: Manage Stores

ACTORS	Corporate Office
DESCRIPTION	The corporate office (such as the CEO, Head of Operations, etc.) supervises operations and participates actively in the daily management of business in each company.
DATA	Sales Report, Inventories Records.
STIMULUS	1. Reorder request is made by individual Store Manager 2. Modification of Access rights of other levels.
RESPONSE	1. Corporate Office receives Reorder request 2. Corporate Office can generate real-time reports of individual stores. 3. Revokes access to Store Manager(s) and Sales Representatives(s).

Table 2: Monitors Inventories

ACTORS	Store Managers
DESCRIPTION	The Store Managers are the custodians of each individual store. They are to ensure that each store effectively performs
DATA	Material Inspection note, Products Received Note
STIMULUS	1. Reorder request is made by individual Store Manager and sent to the corporate office for approval. 2. Sends daily reports to Corporate Office.
RESPONSE	1. Corporate Office receives Reorder request and 2. Corporate Office can generate real-time reports of individual stores

Table 3: Makes Sales and Generates Reports

ACTORS	Sales Representatives
DESCRIPTION	The sales representative is the first line of engagement of the business to customers. They attend to customers demand and make sales appropriately
DATA	Purchase Order, Sales Report
STIMULUS	1. Reorder request is made by individual Store Manager 2. Account of daily sales by Store Manager
RESPONSE	Generates Sales reports daily

2.4. Class Diagrams

The object classes in the system, as well as the relationships between them, are depicted in class diagrams. The static view of the Inventory Control system was modeled using the class diagram. Through the usage of classes, it was utilized to outline the duties and collaboration of the system components.

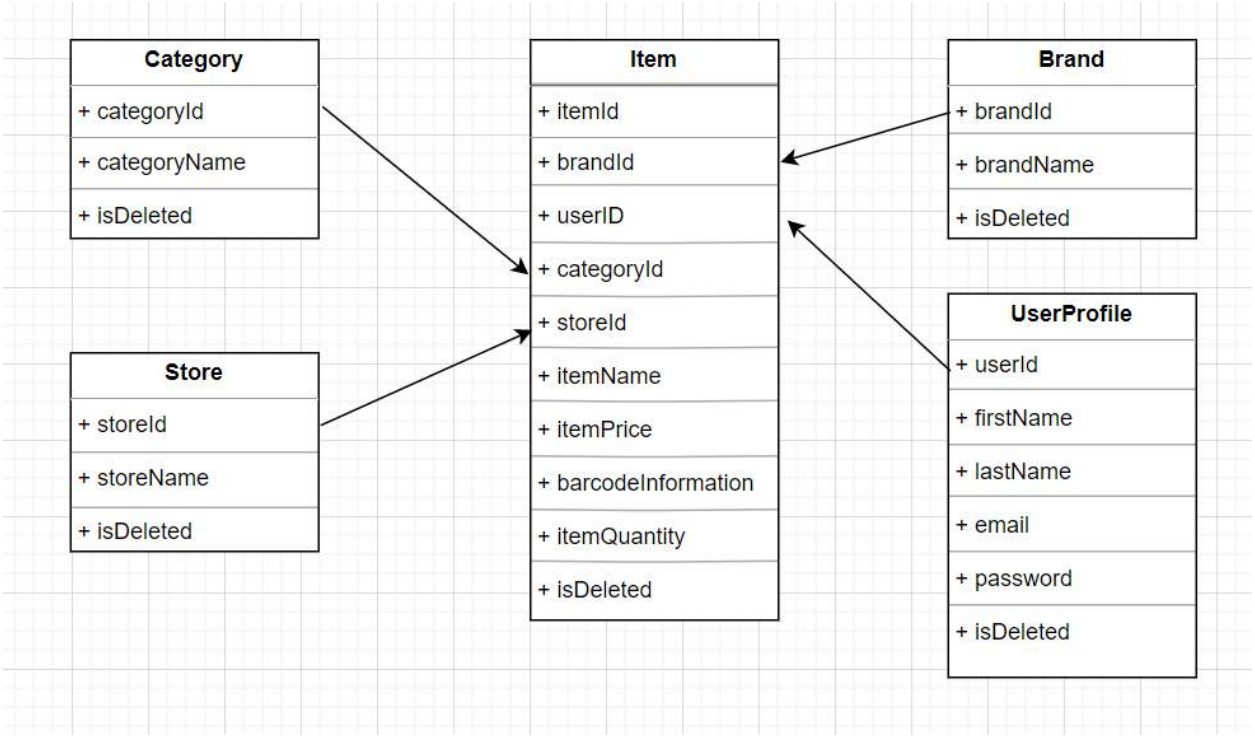

Figure 4 Class Diagram showing the Interconnection between system objects

3. Results and Discussion

The implementation process of this project was carried out using Visual studio IDE which is a streamlined code editor with support for development operations like debugging, task running, and version control. For the actual development of the software, HTML, CSS, bootstrap and MERN stack.

Figure 5 shows the runtime of the express server in the local machine during the development phase. This was quite useful in the development of the software as it helped log any error that occurred in our code for quick fix.

```
[nodemon] 2.0.7
[nodemon] to restart at any time, enter `rs`
[nodemon] watching path(s): *.*
[nodemon] watching extensions: js,mjs,json
[nodemon] starting `node server.js`
Server started on port 3000
PS C:\Users\USER\Desktop\Js Tut\angelayu\ics> nodemon server.js
[nodemon] 2.0.7
[nodemon] to restart at any time, enter `rs`
[nodemon] watching path(s): *.*
[nodemon] watching extensions: js,mjs,json
[nodemon] starting `node server.js`
Server started on port 3000
```

Figure 5 Node JS Express Server

Figure 6 shows a list of authorized users of the system. Here the admin is solely responsible for creating more users and specifying which actions they carry out.

Figure 6 User field showing lists of designated users

Figure 7 shows the dashbord of the system from the admin Point-of-View. Here he sees the status of every inventory of the system to determine the next course of action he should take.

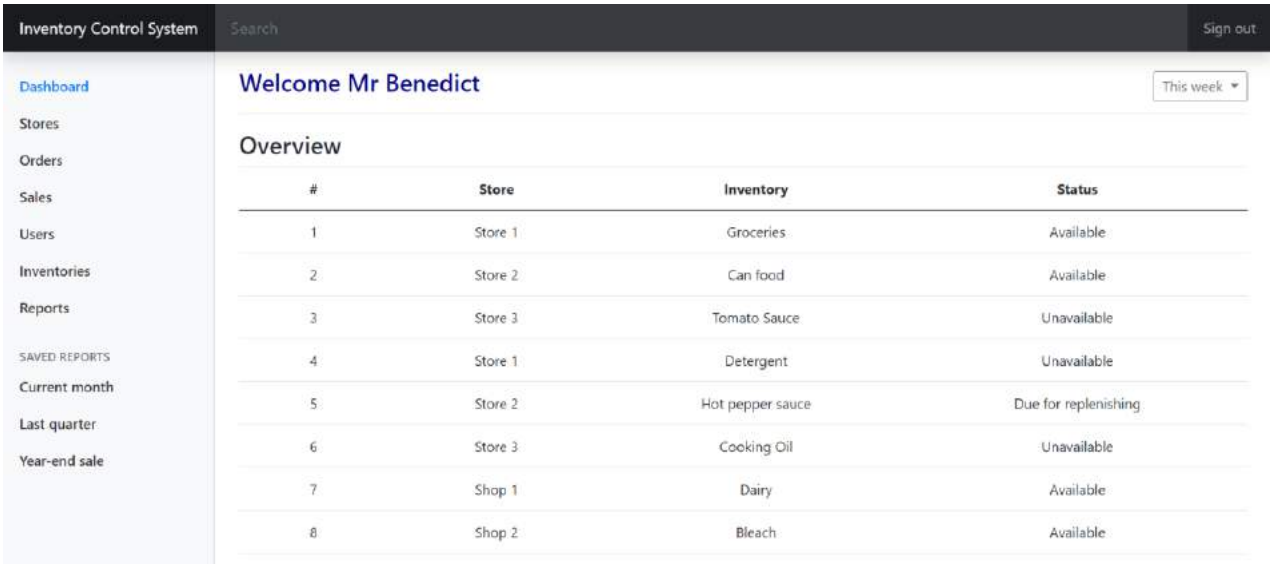

Figure 7 Overview of the dashboard from the admin point-of-view

Through the dashboard the admin can oversee the performance of individual stores and the business as a whole.

4. Conclusion

This paper has successfully presented an Inventory Control System using a Small Medium Enterprise as a case study. The Inventory Control System has a user-friendly interface that seamlessly displays information across all fields thereby allowing authorized users access information relevant to them. The inventory control system provides shop managers and business offices with a huge boost since the technology would help shops locate things that must be ordered first. They would therefore spend far less time on stock management responsibilities and spend more time managing everyday work of the shop. The corporate office will also help to manage transactions in individual stores smoothly. The store managers may also request the transfer of merchandise from neighboring stores to comply with urgently required

requirements. This would also boost customer service and customer satisfaction, which would increase company revenues.

Nomenclature

IDE	Integrated Development Environment
HTML	Hypertext Markup Language
SME	Small Medium Enterprise
IMS	Inventory Management System
CSS	Cascade Style Sheets

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