

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Project report on

Barcoding of Inventory System for FIFO Adherence

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IN

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CERTIFICATE

This is to certify that the Senior Design project entitled “Barcoding of Inventory system for FIFO adherence” is a bonafied work carried out by the student team Rajesh Rathod 01FE19BCS282, Amit Terdal - 01FE19BCS261, Yashasvi A R - 01FE19BCS017, Sneha H - 01FE20BCS405, in partial fulfillment of the completion of 6th semester B.E. course during the year 2021 – 2022. The project report has been approved as it satisfies the academic requirement with respect to the project work prescribed for the above said course.

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# ABSTRACT

In today's modern world, every company has its own set of aims in order to stand out in the corporate world. In line with it, this project automates the process of barcoding of boxes and notifying the location of items by the use of a web application. The traditional approach used for this was manual. The manufactured parts had to be stored in boxes containing different layers. Parts manufactured first had to be sold first. The process of identifying the location of parts to be sold based on manufacturing date was also manual. This is prone to errors as it may lead to expiry of certain products if FIFO was not implemented correctly. Here we try to address this by providing a web application. This application automates this process using barcodes. The QR Code system is used in various inventory management systems to track items, read their product number and display prices. The QR Code required for this project is generated considering various important fields. The application development process consists of four phases namely Requirement Analysis and Database Design , Development, Testing and Deployment. The application is built on MVC architecture. This application is able to generate QR Code and retrieve location from where the product needs to be sold, hence reducing human efforts.

Keywords : QR Code generation, FIFO, Inventory Management System.

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# Chapter 1

## INTRODUCTION

With the growing demands from the industrialized world, it is clear that industries must share equal responsibility in order to meet them all. The expansion of the quantity and types of needs necessitates the organization's use of broader and novel techniques. The numerous approaches used in industries for development and production work have improved over the last several decades, but there are still a few issues to be concerned about.

Despite having more advanced and efficient tools and machines, as well as a larger workforce, industries require a more efficient and proven technique to handle all of the processes that help the industry maintain its position and popularity in the sector to which it belongs. First In-First-Out (FIFO) adherence for dispatching manufactured goods and perishable products is one among them. The industry currently has manual searching of goods to export them sequentially. In simplified words we can say that the goods that are packed and stored first will be going out first. Distinct labels are attached to all the products. These labels contain the information about the product such as batch number, Packed date, and Expiry date(if it is a perishable item). The goods here are stored in the racks/rows which are given a unique location-id. These locations are filled one by one as the items are labeled and packed. The process of searching the item based on its location id is done manually. In order to automate this process, a web portal that stores the information of the parts, generates the QR code for each item, checks for the availability of the parts and notifies the location of the part where it is stored is developed.

### 1.1 Motivation

Despite technological advancements, there are still some practical things that must be followed in order to preserve discipline in every area, beginning with fundamental planning and ending with deployment. The packaging of manufactured parts and productions at Spicer India are done manually. The QR coding of boxes is not automated. Each box has a fixed number of layers, and each layer can accommodate a certain number of parts. The products manufactured first are stored in lower layers and also must be sold first. Tracking of boxes, that is, the box number and layer number to be filled next and the box number and layer number to be sold next is being done manually.

This requires lot of human effort and is prone to errors. One of the key motivators for the present project has been the increase in requirements and their timely fulfilment, as well as efficiency.

The boxes can be missed and products can expire even before they are sold if there is a small error. This leads to wastage of manufactured parts and contributes to losses in the industry. Hence there is a need to automate this entire process. By automating the process of barcode generation, maximum efficiency and minimum loss can be ensured. Since the web application and barcode will give exact details of where to store the manufactured part, the layer that is empty, it helps in easier functioning of industry. The application can also give the location from where the parts need to be used to sell first and this makes sure no products are wasted. Hence the motivation of this project is to reduce human effort in this entire process and increase efficiency of working which will finally benefit the industry.

## 1.2 Literature Review

### 1.2.1 Market Survey

In this section we discuss similar available applications for Storing and Dispatching of Manufactured goods and Perishable goods that are already existing in the market. In the survey for a particular application we look for features such as mode of availability of the application, cost of the application (paid or free), open source or not and some important functionalities promised by the application. From an online survey we came across applications that are available for resource management or dispatching. Below we describe the inventory system that is in accordance with our project.

An inventory management system (or inventory system) is the process by which you track your goods throughout your entire supply chain, from purchasing to production to end sales.[1] It enables us to govern how we should approach inventory management of business.

A system to accurately track and control the stock is a must to any venture. So, this inventory system tells us the number of components that we need to create or assemble our products. If there is no one such inventory system then one shall end up with either excess stock or shortage of stock or the stock may be miss-handled.

To be more specific, we here make use of the Perpetual inventory system. Perpetual inventory is a system that involves tracking stock levels as goods are received, produced, sold, or returned to the store.[1] This inventory system ensures to deliver the most up-to-date inventory figures, with less dependence on stock takes for accuracy.

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In accordance to it, we here by develop a web-portal to track the items which are stored and exported in FIFO format and create a database for the same.

### 1.2.2 Framework Survey

Here we discuss about the frameworks that are available and suitable for development of this application. In this survey for the framework we look for advantages and important functionalities provided by each framework. For a particular framework we even look for availability and response from the community for the issues raised during development. The selection of the framework is done considering certain factors such as usability, security, availability. Below we discuss some popular frameworks suitable for development of our application i.e., workload and skill level based automated scheduling of operator to machine.

MEAN (MongoDB, ExpressJs, Angular, NodeJs): MEAN is considered simple framework for front end and backend development. MEAN is open source and free framework. [2]This software is built using JavaScript and is very important in the creation of dynamic stack frameworks and websites. MEAN supports two-way data flow which helps in synchronization of views and model. As Angular in MEAN is a complete framework which increases the productivity of the application developing. [3]The main drawback of this framework is that it is not flexible. MEAN stack helps in reducing the development time to a greater extent. MEAN stack has the collaboration of collection of a NoSQL database called MongoDB and JavaScript based frameworks Express JS, Angular JS and Node JS. The code written in development of web application in MEAN runs on chrome-based java script engine. Hence this reduces the memory requirement and improves the response time.

MERN (MongoDB, ExpressJs, ReactJs, NodeJs): MERN is a popular framework and has support for various libraries. This framework is also used largely for applications with front-end and back-end. This is highly flexible unlike MEAN. One of the important features of this framework is that it supports 3rd party packages. MERN has no readily available templates. As react has no templates and is a part of MERN most developer prefer to use react since there is no need to practice and learn the templating language. Another advantage is same code can be run on both server and browser.

Django: Django is an open-source framework for backend web applications based on Python []

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Django framework is simple to use. It is highly flexible boundaries that support rapid development. It is considered as reliable framework that can be scaled easily. This works on MVT (Model, View, Template) architecture. Some features of Django are it provides effective database for development. Django is well known for its security with admin privileges.

Django has great community support and rich ecosystem. The main goals of Django framework are simplicity, flexibility, reliability, and scalability.

Considering these advantages of Django over other frameworks we choose Django for the development of workload and skill level based automated scheduling of operator to machine application.

### 1.3 Problem Statement

To design and develop a web-portal to track the items which are stored and exported in FIFO format and create a database for the same.

### 1.4 Objectives

- To generate a QR code for the products.
- To track the items in the boxes.
- To rewrite the QR code of the previous box which was not completely filled.
- To track the location of the box in the rack.
- To create a database to store all the information.
- To store the manufactured product in a container based on FIFO.
- To update admin about the location of the earliest manufactured production on the basis of partname.

### 1.5 Scope and Constraints

- The application can be improved by optimizing its performance.
- New web-pages can be appended to existing websites based on the increasing requirements of the industry.

- A corresponding mobile application can be developed that can scan the QR code generated to get the detailed information of the respective item.

## Chapter 2

# REQUIREMENT ANALYSIS

Requirement analysis lays out a detailed overview of the model or the system we develop. It also deals with clearly specifying its parameters and goals. Once the product is ready, it should be able to satisfy all requirements of the customer. Functional requirements deal with the main functionalities and features expected from the system. Non-functional requirements deal with functionalities relating system's performance, security, and reliability.

### 2.1 Functional Requirements

Functional requirements define a system or its component along with the main functionality of the system that defines the system as a whole unit. Below are the functional requirements of the system.

- Admin shall be able to add new products to the database.
- Admin shall be able to add the manufactured products into the database User shall be able to view the list of available products.
- Admin shall be able to generate and retrieve the QR code of the productions.
- Admin shall be able to search for the availability of the productions.
- Admin shall be able to get location-id of the searched production which was added first to the database.
- Application shall be able to provide an admin authentication to the database.
- Application shall be able to allow the admin to perform modifications to the database.

### 2.2 Non Functional Requirements

In this section we discuss about non-functional requirements which describes the features of the application behaviour. Non-functional requirements deal with the performance attributes of the system. It justifies how the system should exist in terms of its usability, performance, reliability, maintainability, etc. Below are the Non-functional requirements of the system.

- Application should be user friendly (Usability).

- Application response time should be less than 5 seconds (Performance).
- 

## 2.3 Hardware Requirements

This section gives information about the Hardware Requirements and is related to the devices on which the web application is compatible. Just to run the website, minimal hardware requirements are employed. Below are the Hardware requirements of the system.

- PC with minimum i3 Processor
- Minimum 4GB RAM.

## 2.4 Software Requirements

This section gives information about the Software Requirements for the project that is related to the operating systems on which the web application is compatible.

- Windows(greater than 7)/Ubuntu OS.
- Browser support(any).

## Chapter 3

# SYSTEM DESIGN

The system design describes the overall architectural view of the proposed system. The system is designed in such a way that the user can access the application using the web browser. The system design gives a visualization of the proposed system and its components that make up the principal architecture.

### 3.1 Architectural Framework/System Design

The architectural framework combines and stores the system architecture of an enterprise into different suitable views.

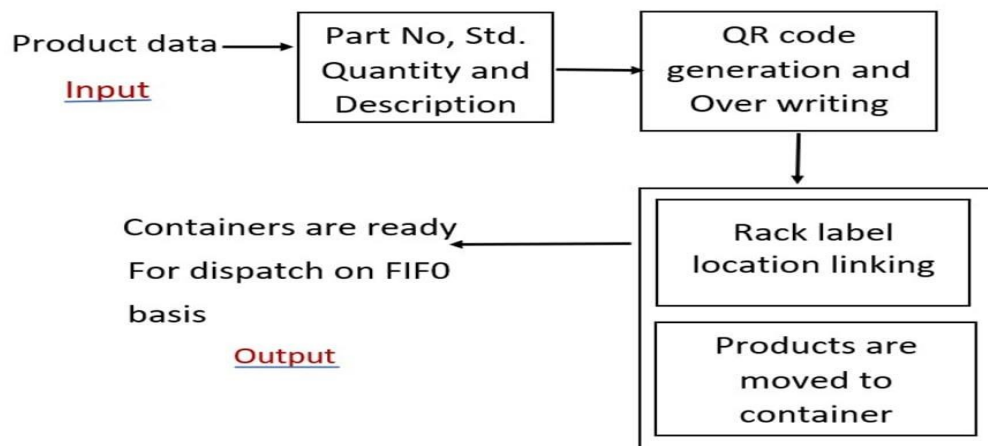


Figure 3.1: Process pipeline

To carry out any complex task effectively and efficiently, the general approach is to divide the whole bunch of tasks into several smaller subcategories which are generally called 'modules'. Each module, thus created has its own specific goals that have to be achieved in its coverage area for the whole system to function effectively.

The system design is driven by two modules which are Barcode Generation and Portal Development.

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The input to the system is the data of the products that needs to be stored in the database. This data is provided by the industry. The data is pre-processed before giving it as an input to the system. The pre-processing of the data involves removal of unnecessary fields of from the data provided by the industry as explained in Data pre-processing field.

### 3.1.1 QR-code Generation

This module is carried out with the help of a library that is installed by getting additional dependencies to the framework. [4] This library provides a simple way to create QR code using only the Python standard lib. With the help of this library QR code can be generated in image format. QR code generator takes the field as input and generates QR code that are unique.[4]

### 3.1.2 Portal Development

As said earlier, the web-application is built on Django framework that encourages rapid development. This framework enables us to have models. A model is the single, definitive source of information about our data [5]. Each model can have different essential fields and behaviors of the data that we want to store. In other words, we can say that each model will map to a single database table.

In Django, each model is a python class that subclasses from `django.db.models.Model` [6] and each attribute of the model represents a database field. With these, Django provides us an automatically-generated database-access API. This also helps in retrieving/fetching data from the created databases through various queries.



### 3.2 Interaction Model: Use Case Diagram

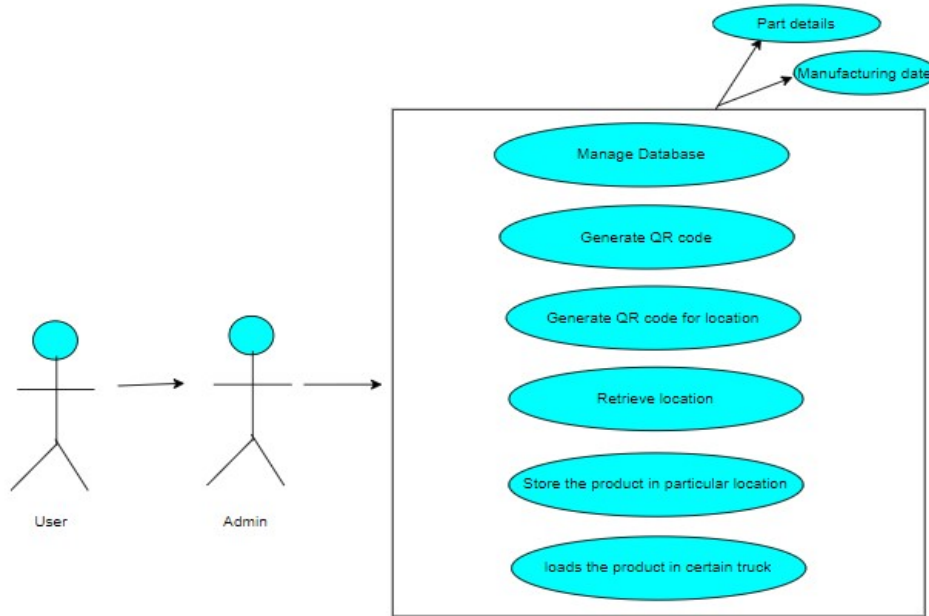


Figure 3.2: Use Case diagram

Use case diagram is used for representing the interactions between the components of the system. The operations that can be performed by an actor that is admin in the case of dispatching manufactured goods and perishable goods are represented using use cases. The admin here is the external agent who interacts with the application and performs certain operations. For example, an admin can login to the inventory system directly using simple authentication. An admin has the authority to add new products and/or manufactured products to the database. At the same time, an admin can also delete new products and/or manufactured products from the database.

When a new manufactured product is added to the database, the barcode for the product gets automatically generated which are dependent on fields of the product as explained in Barcode Generation module. In accordance to it, we can say that there is also interaction among the components of the system itself.

The figure 2.1 shows the use case diagram for the interaction of the admin with the webapplication system as well as interaction among different components within the system. The use case diagram consists of use cases such as admin login, management of database, generation of QR code, generation of QR code for location, retrieval of location of parts, Storing the product in particular location, loading the product in certain truck and retrieval of part details.

# Chapter 4

## IMPLEMENTATION

This chapter gives a brief description about implementation details of the system by describing each component with its code skeleton in terms of algorithm.

### 4.1 Requirement Analysis and Data Pre-processing

Requirement analysis and data pre-processing is the first phase of the application development. This section is divided into Requirement Analysis and Data pre-processing based on the operations. The requirement analysis phase consists of requirement engineering process during the application development. Data pre-processing consists of pre-processing the raw data using pre-processing techniques such as extraction, selection and handling incompleteness.

#### 4.1.1 Requirement Analysis

In this module the requirements for our problem statement were collected and analysed from the discussion with the client. This is a dynamic phase where the requirements are being added while developing the application. Initially the development started with initial understanding of the problem and data. Later on, the requirements are being added during requirement and review meeting. Every time the expected requirements are being developed in given time and in next meeting the things are updated to the clients. Once the client reviews the previous requirements the new requirements and improvements are suggested. This continues till the completion phase. Some of the important requirements and their summary from all the review meetings are listed below.

- To create the database to store the products information.
- To import the data from excel file to the database.
- To enable the client to add new products and new productions.
- To generate the QR code for new productions automatically.
- To generate the QR code for location.
- To rewrite the QR code for newly generated products.
- To assign the product box to a particular container based on FIFO.
- To provide CRUD operations for admin after simple authentication of admin.
- To enable the user to search for the availability and location of the first produced item.

### 4.1.2 Data Pre-processing

Given the dataset(explained in 5.1), models (as explained earlier in portal development module) are been created.

The provided dataset can be split into three models *Products*, *Productions* and *Locations*. The Products Model consists all the parts that the company offers to its clients and is capable of manufacturing. It consists of the partname which is alphanumeric and unique to each part, this acts as a primary key to the model. Other than the part name its description is also stored which tells us about the part. The standard box quantity of that particular part is aslo stored in this model.

For example, part named 2-28-1697 is a tube yolk and has a standard box quantity of 810. The location model stores the names of all the existing physical locations in the manufacturing unit also the staus of it being empty or occupied is stored. The location names are alphanumeric and each occupy one box of manufactured products. The Production model keeps an record of all the productions that are stored in the manufacturing unit. It stores import data like the part name of the productions, date of production, location of where the particular production is stored and the quantity produced. It also the a unique barcode which is made by combining all the above data to identify the production and its details uniquely.

## 4.2 Design

### 4.2.1 Client-Server Design

To set up the server we store the pre-processed data to the database .This database will be further accessed by the client. To set up the client we design the user interface using the web. Thereby providing the access of the server to clients to interact.

## Chapter 5

# RESULTS AND DISCUSSIONS

The entire project is implemented using Django Framework for backend and Microsoft Powerapps for frontend as per the industry requirement.

### 5.1 Dataset Description

In this section we discuss about the data set details with their attributes in detail.

The data was provided by the industry. The raw-data consisted of part details in excel sheets. This data consisted of three fields for each product which are Part number, Description and Standard quantity.

Part Nos	Description	Std Qty
10078623	TUBE YOKE	-
10122970	TUBE YOKE	-
10131911	ARMED TUBE YOKE FORGING	-
2-28-1697	TUBE YOKE	810
2-28-367	TUBE YOKE	990
10047308	FLANGE YOKE	-
10047306	#N/A	490
10026551	TUBE YOKE	495
10042072	TUBE YOKE	495
10094186	#N/A	768
10083455	END YOKE - FLANGED ASSEMBLY	448
10048907	ARMED TUBE YOKE	768
35666-3	#N/A	-
6-2-25	FULL RND FLANGE YOKE	100
AUSKU-1263	3 ARM TUBE FLNAGE	250
6-28-347	TUBE YOKE	200
6-40-521	TUBE SHAFT	144
INSKU-100474	TUBE FLANGE 105PCD -AUSKU-	250
170-2-19	FLANGE YOKE	100
6.5-2-15	FLANGE YOKE	-
2-40-1031	TUBE SHAFT	-
4-28-417	TUBE YOKE	400
13449	PIN - ROLL	-
6-40-541	TUBE SHAFT	144
90-2-15	FLANGE YOKE	100

Figure 5.1: Dataset snapshot

## 5.2 Results

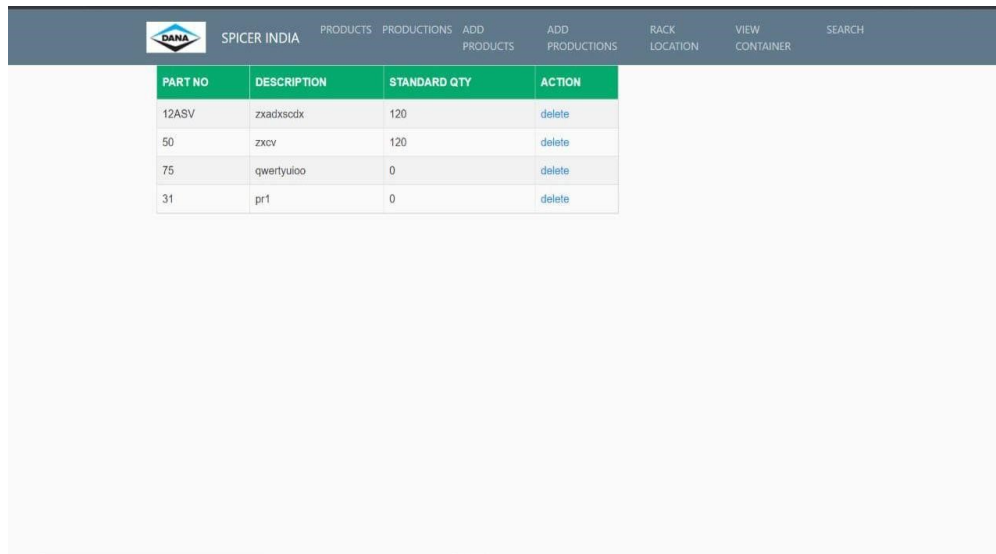
The portal can be operated by admin

The figure 5.2 shows the main dashboard of the website that appears on opening the website. This web-page gives an overview of the industry and also simple description of the products that are handled by the industry.



Figure 5.2: Dashboard of the website

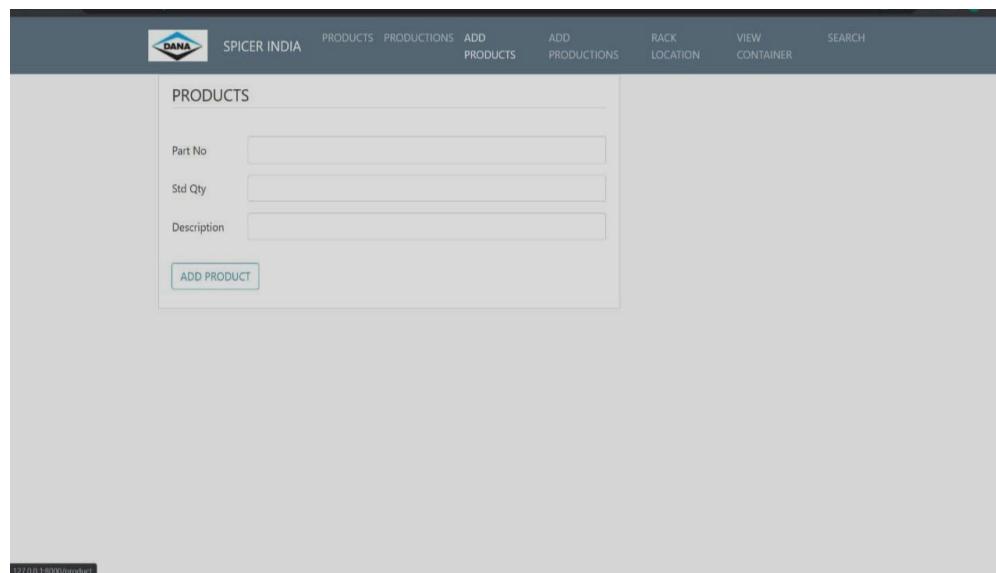
As an addition to the objectives mentioned, the website also enables the user to view the available products. The list of the products is imported to the website from the csv file that contains information of the items. Figure 5.3 shows the pictorial representation of the webpage that displays the table of items. This table can be viewed under "PRODUCT" section of the navigation bar of website.



PART NO	DESCRIPTION	STANDARD QTY	ACTION
12ASV	zxadxscdx	120	<a href="#">delete</a>
50	zxcv	120	<a href="#">delete</a>
75	qwertyuloo	0	<a href="#">delete</a>
31	pr1	0	<a href="#">delete</a>

Figure 5.3: Table of products

The website can not only display the items that are imported from the ready csv file, but can also provide facility to add new products. Figure 5.4 represents the form that allows an user to enter additional products to the table present in Figure 5.3. We can add new products to the table under "ADD PRODUCTS" section of the navigation bar of website.



PRODUCTS

Part No

Std Qty

Description

Figure 5.4: Form to add new products

Along with the provision to add new products, we can also add new productions from the industry. QR code get automatically generated when a new production is added by the use of the form as shown in Figure 5.5.

Figure 5.5 shows the form through which the website enables an user to add new productions and generate QR code for the same. We can add new productions and generate QR code under the section "ADD PRODUCTIONS" of the navigation bar of website.

The screenshot shows a web application interface for 'SPICER INDIA'. The navigation bar includes links for PRODUCTS, PRODUCTIONS, ADD PRODUCTS, ADD PRODUCTIONS, RACK LOCATION, VIEW CONTAINER, and SEARCH. The 'ADD PRODUCTIONS' section is active, displaying a form with the following fields:

- Part ID: 28 (dropdown menu)
- Qty: (text input)
- MFD: dd-mm-yyyy (date picker)
- Location: (text input)
- ADD PRODUCTION (button)

The URL in the browser is 127.0.0.1:8000/production.

Figure 5.5: Form to add manufactured products

The QR code images of the productions added to the database gets generated and can be viewed under "PRODUCTIONS" section of the navigation bar of website.

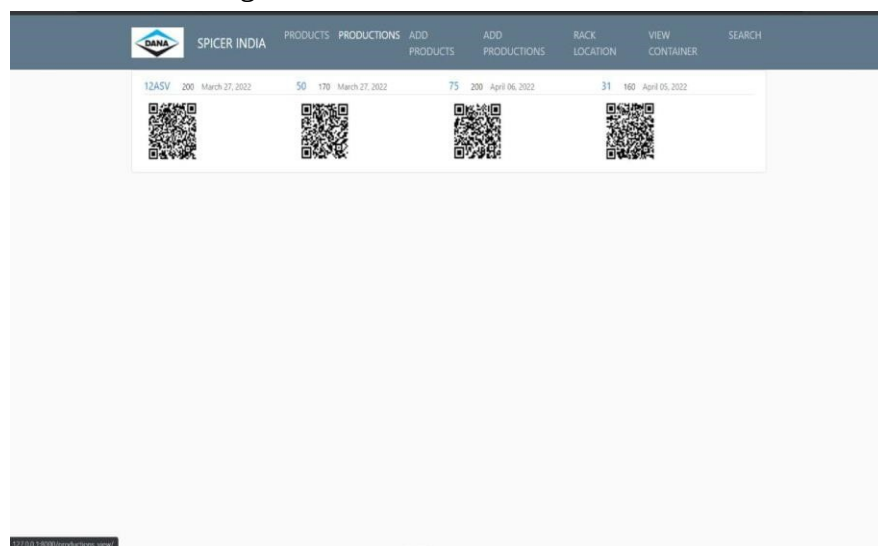


Figure 5.6: Packaged production details

In order to export the stored items, availability of the item and its location needs to be known. This operation can be performed under "SEARCH" section of the navigation bar of the website. Figure 5.7 shows the SEARCH section that enables the user to check from the dropdown list, the availability of items. Figure 5.8 shows the location of the selected product adhering to FIFO.

The screenshot shows a web application interface for 'SPICER INDIA'. The navigation bar includes links for PRODUCTS, PRODUCTIONS, ADD PRODUCTS, ADD PRODUCTIONS, and SEARCH. The 'SEARCH' link is highlighted. Below the navigation bar, the main heading is 'SEARCH FOR LOCATION'. There is a dropdown menu labeled 'OBJECTS ON PAGE' and a blue button labeled 'select'.

Figure 5.7: Form to search the availability of the products along with its location

The screenshot shows the 'LOCATION RESULTS' page in the SPICER INDIA web application. The navigation bar includes links for PRODUCTS, PRODUCTIONS, ADD PRODUCTS, ADD PRODUCTIONS, RACK LOCATION, VIEW CONTAINER, and SEARCH. The 'SEARCH' link is highlighted. Below the navigation bar, the main heading is 'LOCATION RESULTS'. The results display the following information:

- PRODUCT NAME : AS\_123
- MANUFACTURED DATE : April 7, 2022
- QUANTITY : 150
- LOCATION : D21

Figure 5.8: Results of the product search

The data of the items can be separately handled by the admin. This can be done by simple authentication webpage provided by Django framework. Figure 5.9 shows the image of admin login.



The website provides special provision to the admin to directly login to homepage of the spicer portal. Once the admin enter the homepage they have the access to operate all the product processes.

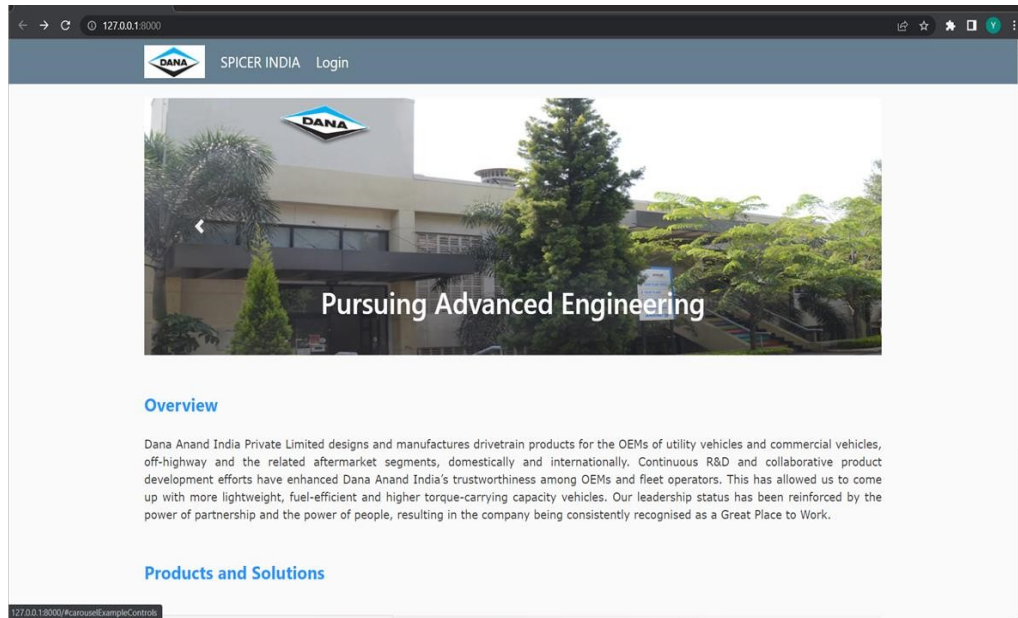


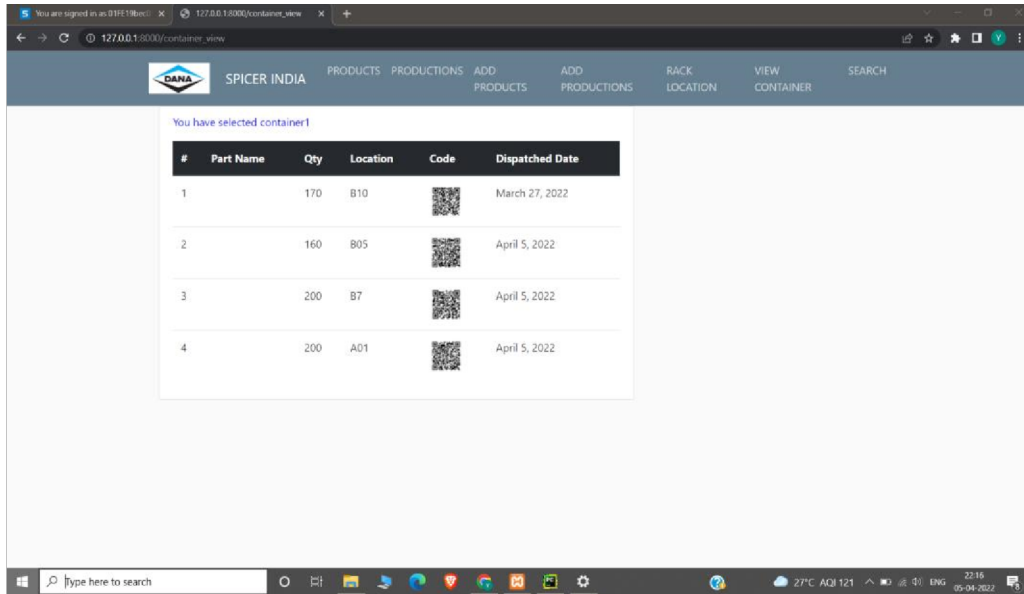
Figure 5.9: Admin login facility

The “RACK LOCATION” section of the page provides all the details regarding the filled rack locations along with the part name, filled quantity of the package, corresponding package QR-code and an option to move the package into a container as shown in Figure 5.10.

#	Part Name	Qty	Location	Code	Action
1	12ASV	200	A01		Moved
2	50	170	B10		Moved
3	75	200	B7		Moved
4	31	160	B05		Moved

Figure 5.10: Rack Location

The “VIEW CONTAINER” option of the page Figure 5.11 shows the container details. It gives the details of the packages moved to the containers along with their corresponding QR-code. The maximum capacity of each container is 32 packaged boxes.







#	Part Name	Qty	Location	Code	Dispatched Date
1		170	B10		March 27, 2022
2		160	B05		April 5, 2022
3		200	B7		April 5, 2022
4		200	A01		April 5, 2022

Figure 5.11

## Chapter 6

# CONCLUSION AND FUTURE SCOPE OF THE WORK

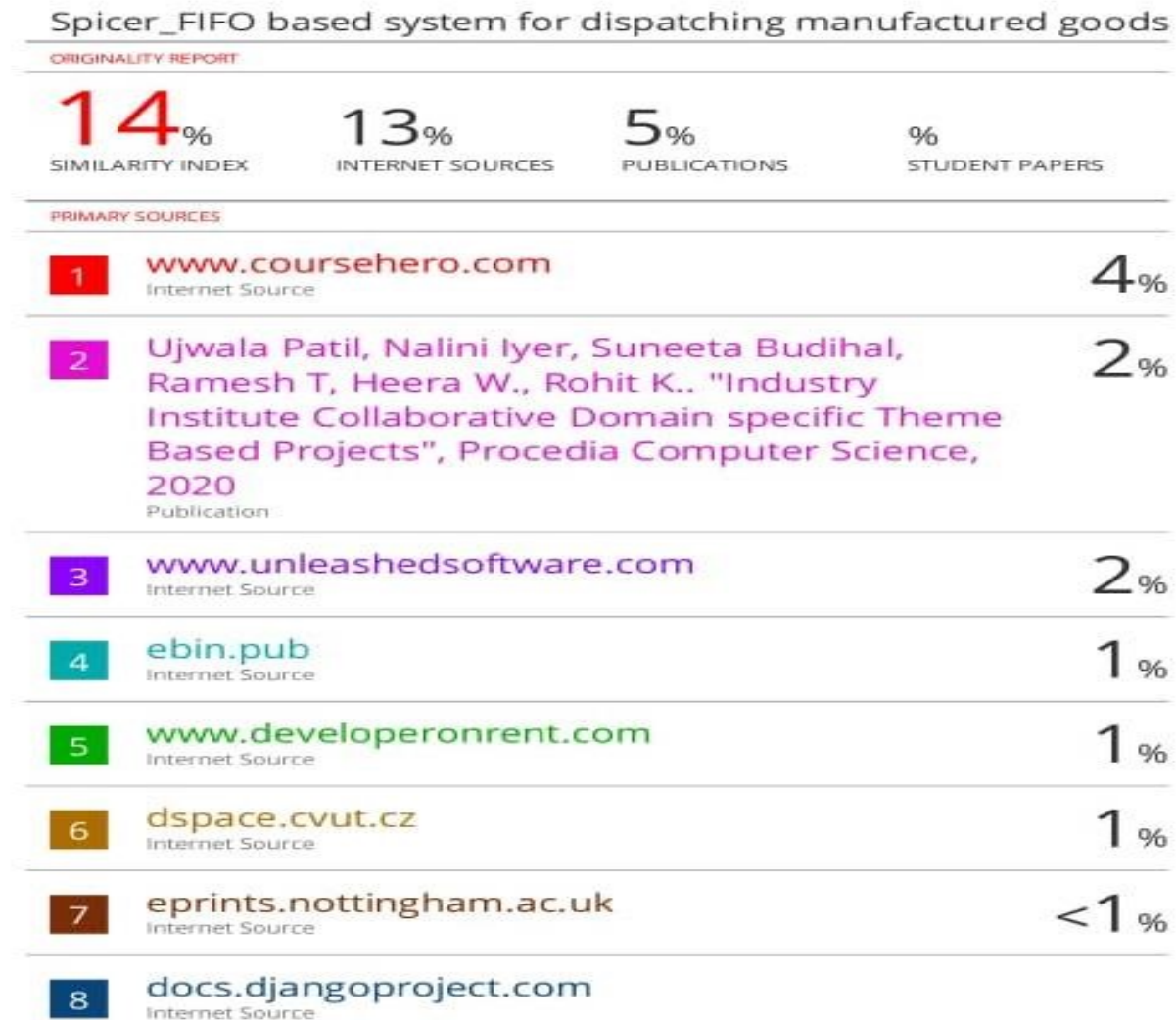
The website developed helps the industry in easier management of their products. It is developed using python django framework. For each product a unique QR code is generated based on part number, manufacturing date and location. To retrieve location from where the part is to be taken, it is done using first come first serve concept (FIFO). The backend of website has multiple models which stores all the data required. The website is developed which successfully generates QR code and retrieves location of part based on manufacturing date. This web application hence reduces human effort through the use of QR code for information storage and retrieval.

The application can be improved by optimising the performance. New pages can be added to existing website to manage different sections of industry. A corresponding mobile application can be developed to read information from QR code and display the contents.

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