DR. MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY

Inventory Management System for Retailers

DONE BY

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1. INTRODUCTION

1.1 Project Overview

The Inventory Management system stores item information for the Sales Order Management, Procurement, and manufacturing systems. It also stores sales and purchasing costs and quantities available by location and places holds on locations. We update the general ledger inventory account balances with any change in inventory valuation, count variances, or movement. The Procurement system retrieves item costs for purchase orders from the Inventory Management system. The system stores the products and the stored data gets updated once the values are changed in the database especially when the customers buy products the count may decrease or increase through which the updated values finally get reflected in the user page.

1.2 Purpose

Retailers may get huge volume of data when it comes handling the stock all alone though the manual method where each and every product has its tag id, batch number, manufacturing date, expiry date and composition individually. Hence a software application that entirely manages the inventory of the retailers becomes an ease free environment that clearly manages the stocks and keeps it up-to-date.

2. LITERATURE SURVEY

2.1 Existing Problem

I. Inventory management for retail companies

2021 Second International Conference on Information Systems and Software Technologies (ICI2ST), March 2021

Authors: Rodrigo Arcentales-Carrion, University of Cuenca; Mario Pena,University of Cuenca

The correct management of inventories has become a fundamental pillar for achieving success in enterprises. In this context, this article aims to analyze and present an extensive literature concerning inventory management, containingmultiple definitions and fundamental concepts for the retail sector. A systematicliterature review was carried out to determine the main trends and indicators of inventory management in Small and Medium-sized Enterprises (SMEs). This research covers five years, between 2015 and 2019, focusing specifically on the retail sector. The primary outcomes of this study are the leading inventory management systems and models, the Key Performance Indicators (KPIs) for their correct management, and the benefits and challenges for choosing oradopting an efficient inventory control and management system. Findings indicate that SMEs do not invest resources in sophisticated systems; instead, a simple Enterprise Resource Planning (ERP) system or even programs such as Excel or manual inventories are mainly used. technologies have been developed over time for inventory management, going from basic manual reporting to an integrated information system (IS), which can help to "decide how and whereorders should be fulfilled to improve service levels while decreasing total costs".Moreover, these new functionalities can collaborate in the most effective handling of materials and better manage the cycle of purchase - reception - allocation in production.

II. A Case Study of Inventory Management System for an InternationalLifestyle Product Retailer in Bolivia

Second South American International Conference on Industrial Engineering andOperations ManagementAt: Sao Paulo, Brazil, April 2021
Authors: Boris Herbas Torrico, Universidad Católica Boliviana San Pablo Cochabamba; Sebastián Alem Oyola Universidad Católica Boliviana San PabloCochabamba

Developing countries are characterized by trade imbalances with developed countries due to process inefficiencies, bureaucracy, and communication problems. This leads to longer lead times and supply uncertainty. Consequently, firms attempt to overcome the supply uncertainty by carrying unnecessary amounts of buffer stocks. The paper analyzed the inventory management system of an international lifestyle product retailer in Bolivia and found that, as the literature predicted, the firm showed no use of basic inventory control techniques. Particularly, it did not make data-driven decisions, lacked aneffective inventory management system, or knew which products had higher consumer demand, and thus worked under a high level of supply uncertainty andinventory management illiteracy. Therefore, to reduce supply uncertainty, we developed a new inventory management system based on two strategies:

(a) strategies to reduce demand uncertainty; and (b) strategies to reduce process uncertainty. Specifically, the paper implemented triple exponential smoothing for product demand forecasting, ABC segmentation to identify the most important products in the firm's portfolio, the newsvendor model to determine optimal inventory levels, powers-of-two policies, to optimize reorder times, and Turnover Based Metrics to arrange SKUs in the warehouse. Overall, the results suggest the significance of taking into account the country in which any firm operates.

III. Research paper on Inventory management system

Authors: Punam Khobragade, Roshni Selokar, Rina Maraskolhe,Prof.Manjusha Talmale;
G.N.I.T, Kalmeshwar Road, Nagpur, Maharashtra,India
The motivation of this paper is to create better understanding in redefiningrequirement of retailer for paper publication. Generating backup data is a criticalprocess in a project for our shopkeeper. This work can be categorized as time consuming job and need high accuracy when placing the proper materials with itsquantity. Moreover, the project scalability itself will increase the risk so is the processing time hence can make us loose the control when there is a lot of revision, like drop and insert, that being made. Since this is the first time we createthe automation, there are so many requirements that might not defined properly. The purpose of this paper is to review and redefine the automation's requirementsfrom basic like: What are their requirements? How can we fulfill the Shopkeeper's requirements? What is our limitation to fulfill those requirements?The proposed solution is the requirements from the shopkeeper to create backupinventory within limited time and in high accuracy makes us to come up with automation solution by using desktop. At this time, we think that this is the basedsolution.

IV. Inventory Management using Machine Learning

Authors: Praveen K B, Pradyumna Kumar, Prateek J, Pragathi G, Prof.

Madhuri J; Computer Science & Engineering Bangalore Institute of TechnologyBengaluru, India
This paper tells the plan of using artificial intelligence into inventory management. The transitioning from the traditional ways of managing inventory,which is the direct result of the availability of the huge amounts of real-time datathat are now routinely generated on the internet and through the interconnected world of enterprise software systems and smart products. Managers need to makeeffective use of this newly available data, by redesigning their inventory management process, to stay in the competition against several other E- commerce businesses. Optimum inventory should be maintained by all organization so that under inventory can be eliminated which disrupt the financialfigures. Careful evaluation of internal and external factors through better planningcan improve the status of inventory. Demand forecasting is a systematic processof anticipating the demand of a product or service offered by the organization inthe future under a set of unpredictable and competitive forces. In this paper XGBoost

regression model is used to perform demand predictions. XGBoost is amachine learning algorithm which uses decision trees. In prediction problems thathave the data unstructured Neural networks outperform other prediction algorithms, but in our case the data is structured and tabulated, and decision tree algorithms are considered best for structured.

2.2 References

I.   Inventory management for retail companies

2021 Second International Conference on Information Systems and Software Technologies (ICI2ST), March 2021

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III.   Research paper on Inventory management system

International Research Journal of Engineering and Technology (IRJET)Volume: 05 Issue: 04, Apr-2018

Authors: Punam Khobragade, Roshni Selokar, Rina Maraskolhe,Prof.Manjusha Talmale; G.N.I.T, Kalmeshwar Road, Nagpur, Maharashtra,India

IV   Inventory Management using Machine Learning

International Journal of Engineering Research & Technology (IJERT),Volume 09, Issue 06 (June 2020)
Authors: Praveen K B, Pradyumna Kumar, Prateek J, Pragathi G, Prof.
Madhuri J; Computer Science & Engineering Bangalore Institute of TechnologyBengaluru, India

2.3 Problem Statement Definition

Retail inventory management is the process of ensuring you carry merchandise that shoppers want, with neither too little nor too much on hand. By managing inventory, retailers meet customer demand without running out of stock or carrying excess supply.

In practice, effective retail inventory management results in lower costs and a better understanding of sales patterns. Retail inventory management tools and methods give retailers more information on which to run their businesses. Applications have been developed to help retailers track and manage stocks related to their own products. The System will ask retailers to create their accounts by providing essential details. Retailers can access their accounts by logging into the application.

Once retailers successfully log in to the application they can update their inventory details, also users will be able to add new stock by submitting essential details related to the stock. They can view details of the current inventory. The System will automatically send an email alert to the retailers if there is no stock found in their accounts. So that they can order new stock.

3   IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.
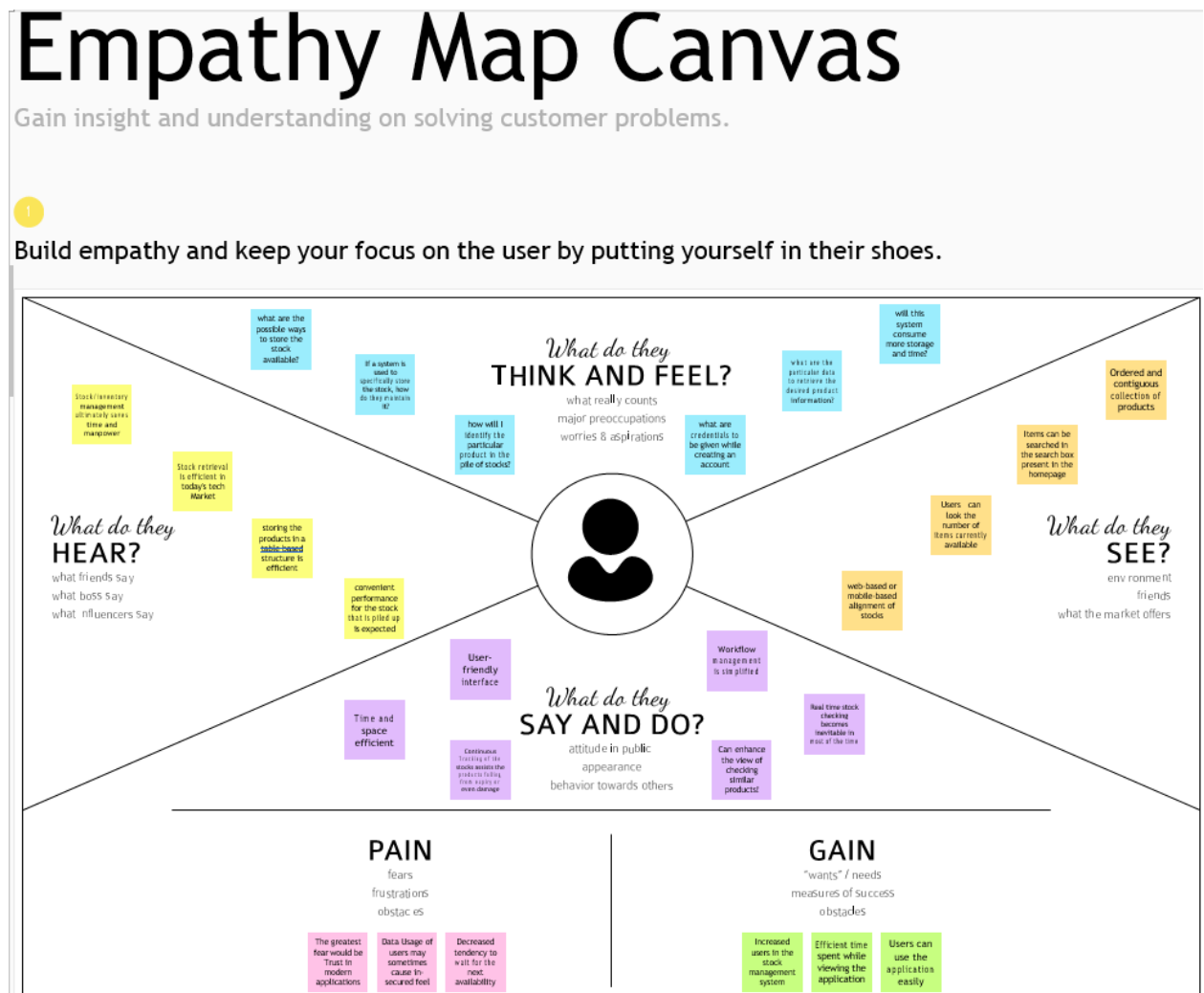
3.2 Ideation & Brainstorming

Ideation and Brainstorming are performed to generate ideas and solutions. Brainstorming is a group activity unlike ideation.

2

Brainstorm

◢ Write down any ideas that come to mind that address your problem statement.

⏱ 10 minutes

Aravind

Interaction with retailers to know about the ongoing methodology followed	know about immediate actions that perceives the mindset of the shop owners	A quantitative analytical approach can be done
Stocks can be put in a huge data table to maintain the veracity	Can check for the availability of the stocks by the retailers itself	A separate account can be created for each of the retailers

Naveen

An user friendly application can be created	Retailers can enter the count of the products at each stage after the item has been sold	Retailers being the ultimate users can use the system for their reference
Manual maintenance of the stocks can be avoided	Maintaining a separate file that manages the inventory along with additional details can be excluded	can handle the user privacy if the whole system is digitalized

Ravindran balaji

Use Python flask for backend of the web application	User-privacy should be prioritized	Can keep track of the inventory in an efficient way
keen monitoring of the stocks can be done	Send grid option can be utilized to send the messages	A report can be generated whenever the stock is high or too low

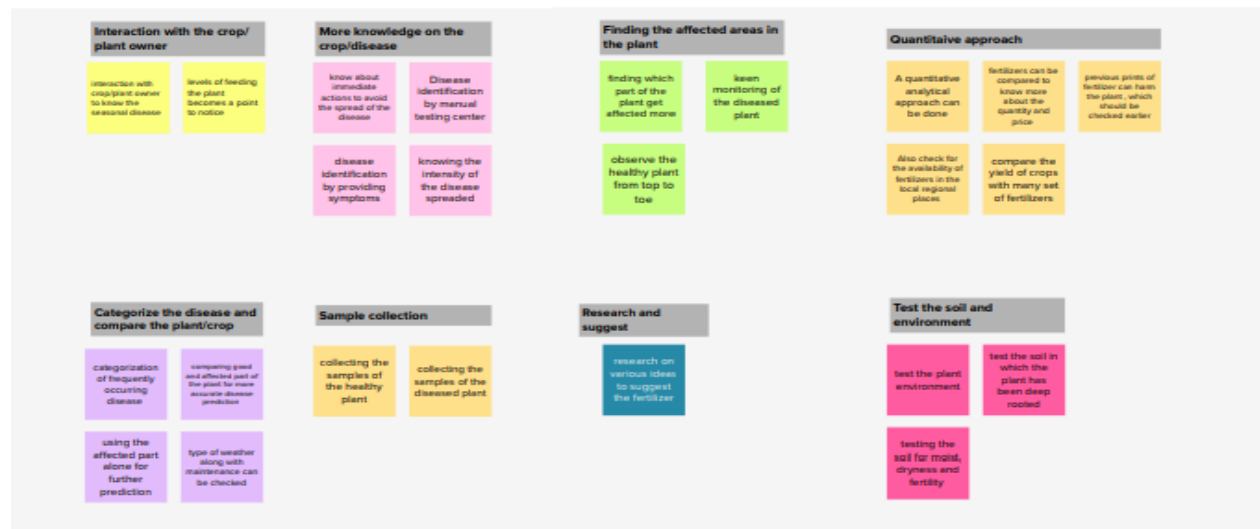**Vetriselvan**

IBM cloud can be used for cost effective storage	Best service can be provided in the digitalized platform	Emails can be sent when the stocks are not available
System should not lag while utilization	The platform must be a reliable one for customer usage	The system should be an interface that is very secured in maintaining the user details

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

⏱ 20 minutes

Interaction with the crop/plant owner

interaction with crop/plant owner to know the seasonal disease	levels of feeding the plant becomes a point to notice

More knowledge on the crop/disease

know about immediate actions to avoid the spread of the disease	Disease identification by manual testing center
disease identification by providing symptoms	knowing the intensity of the disease spreaded

Finding the affected areas in the plant

finding which part of the plant get affected more	keen monitoring of the diseased plant
observe the healthy plant from top to toe	

Quantitaive approach

A quantitative analytical approach can be done	fertilizers can be compared to know more about the quantity and price	previous prints of fertilizer can harm the plant , which should be checked earlier
Also check for the availability of fertilizers in the local regional places	compare the yield of crops with many set of fertilizers	

Categorize the disease and compare the plant/crop

categorization of frequently occurring disease	comparing good and affected part of the plant for more accurate disease prediction
using the affected part alone for further prediction	type of weather along with maintenance can be checked

Sample collection

collecting the samples of the healthy plant	collecting the samples of the diseased plant

Research and suggest

research on various ideas to suggest the fertilizer

Test the soil and environment

test the plant environment	test the soil in which the plant has been deep rooted
testing the soil for moist, dryness and fertility	

using the affected part alone for further prediction

test the plant environment

Also check for the availability of fertilizers in the local regional places

interaction with cropplant owner to know the seasonal disease

knowing the intensity of the disease spreaded

type of weather along with maintenance can be checked

finding which part of the plant get affected more

know about immediate actions to avoid the spread of the disease

test the soil in which the plant has been deep rooted

comparing good and affected part of the plant for more accurate disease prediction

research on various ideas to suggest the fertilizer

disease identification by providing symptoms

keen monitoring of the diseased plant

collecting the samples of the diseased plant

fertilizers can be compared to know more about the quantity and price

Disease identification by manual testing center

testing the soil for moist, dryness and fertility

previous plots of fertilizer can have the plant , which should be checked earlier

observe the healthy plant from top to toe

A quantitative analytical approach can be done

levels of feeding the plant becomes a point to notice

compare the yield of crops with many set of fertilizers

3.1 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	In inventory system, the demand of products may be vague and the consumption time may vary according to the product value.
2.	Idea / Solution description	Our technological system stores the details of the inventory, maintenance of stocks, and produce weekly reports.
3.	Novelty / Uniqueness	Maintenance and development of the data is made easier by containerization through docker application.
4.	Social Impact / Customer Satisfaction	The user views the product visual graph being able to reduce wastage of excess products and convey the buyers beforehand.
5.	Business Model (Revenue Model)	Retailers order fast-moving products and the right number of stocks from suppliers by analyzing the sales of particular products.
6.	Scalability of the Solution	Virtual machines are more flexible. The use of Kubernetes and containerization allows user to scale and change the numbers of supplies via command line interface.

3.4 Problem Solution Fit

Project Title: Inventory Management System for Retailers   **Project Design Phase-I – Problem Solution Fit**   **Team ID:** PNT2022TMID08600

Define CS, fit into CC	**1. CUSTOMER SEGMENT(S)** `CS` Who is your customer? i.e. working parents of 0-5 y.o. kids o People of all ages. o Customer in need of supports.	**6. CUSTOMER CONSTRAINTS** `CC` What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices. o Cost of product. o Product quality. o Delivery cost. o Poor communication. o Delivery delay.	**5. AVAILABLE SOLUTIONS** `AS` Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking o Check delivery date. o Compare cost of the products with other products.	**Explore AS, differentiate**

Focus on J&P, tap into BE, understand RC	**2. JOBS-TO-BE-DONE / PROBLEMS** `J&P` Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides. o Maintaining up to date products. o Ordering the light amount and not in excess. o Purchasing the products in lower price thanselling price. o Having competitive stock pricings.	**9. PROBLEM ROOT CAUSE** What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations. o Contacting suppliers and getting good deals from them. o Contacting suppliers and getting good deals from them.	**7. BEHAVIOUR** What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace) o Customer feedback for improvement of application. o Having sufficient bandwidth to support ondemand consumers.	**Focus on J&P, tap into BE, understand RC**

Identify strong TR & EM	**3. TRIGGERS** `TR` o Having the stock price high. o Lack of application service. **4. EMOTIONS BEFORE/AFTER:** `EM` BEFORE – Untrusted, lack of knowledge of stocks. AFTER - Trusted, clear minded, having sound knowledge of stocks, etc.	**10. YOUR SOLUTION** `SL` o Deploying the application in a cloud server that tracks the real-time inventory and manages them. o Notifies when the stocks are low and needsto be restocked.	**8. CHANNELS of BEHAVIOUR** `CH` ONLINE – Can access all the services and details. OFFLINE - Notification about stock management.	**Identify strong TR & EM**

4   REQUIREMENT ANALYSIS

4.1 Functional Requirements

S. No	Component	Description	Technology
1.	User Interface	User interaction with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript
2.	Application Logic	Logic for a process in the application	Python-Flask
3.	Database	Data Type, Configurations etc.	MySQL
4.	Cloud Database	Database Service on Cloud	IBM DB2
5.	File Storage	File storage requirements	IBM Cloud Object Storage
6.	App Container	Contain the whole application in a single container	Docker Container / IBM Container Registry
7.	Infrastructure (Server / Cloud)	Application Deployment on Local System /Cloud Local Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry,Kubernetes.
8.	Send Mails	Sending mails about stocks available in the Inventory to the Retailer	SendGrid

4.2 Non-Functional Requirements

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	HTML, CSS, Javascript, Flask
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	IBM Cloud Security
3.	Availability	Justify the availability of application (e.g., use of load balancers, distributed servers etc.)	Python-Flask

5 PROJECT DESIGN

5.1 Data Flow Diagrams
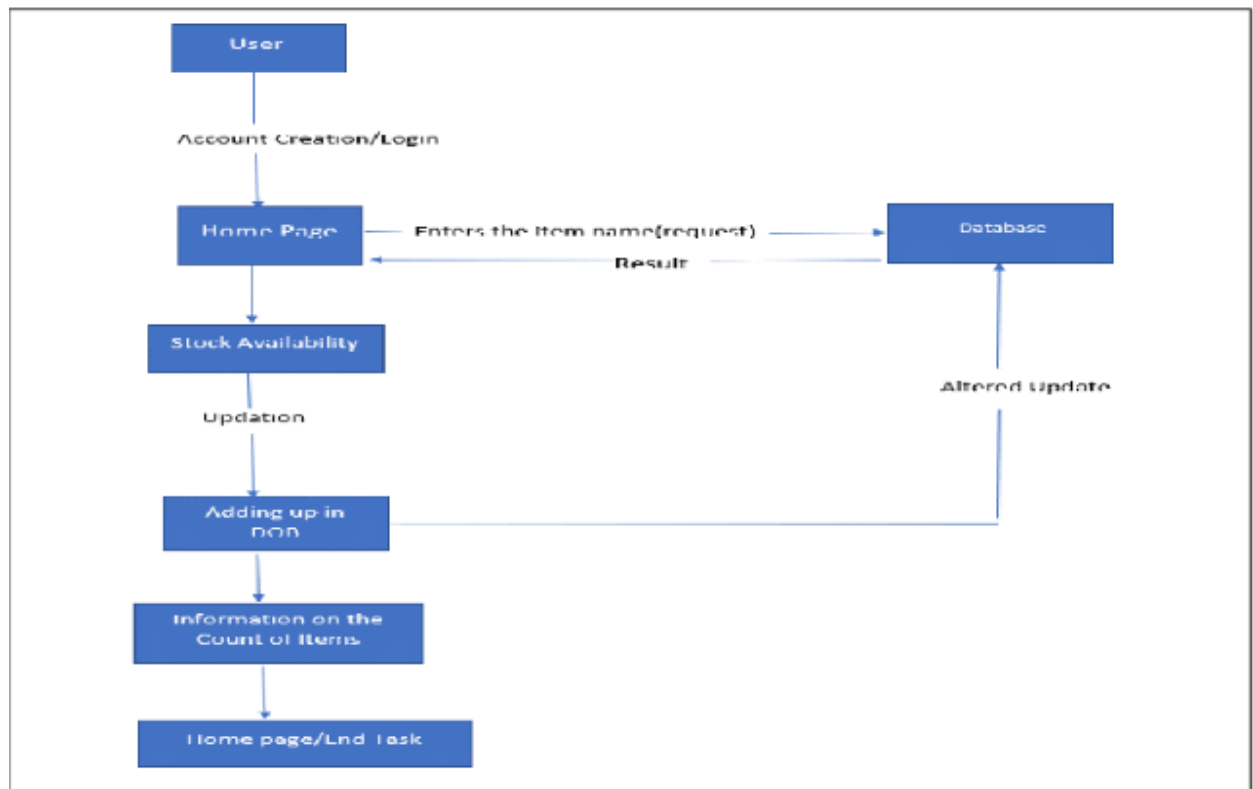
5.2 Solution & Technical Architecture
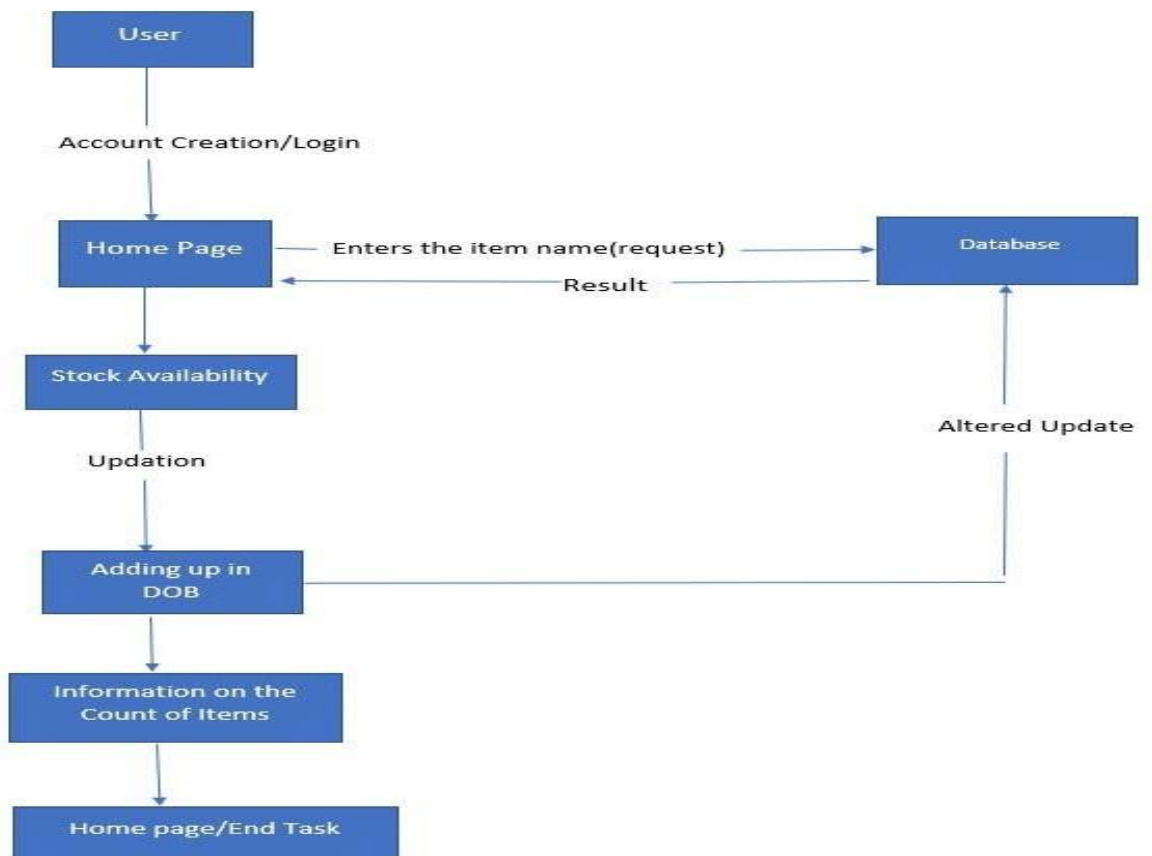
5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Retailer(user)	Registration/Login	USN-1	I can register/login to the application by providing credentials.	Verification email will besent	High	Sprint-1
	Homepage	USN-2	Choose the Stock availability tab	As a user,I can check thestocks for its availability	High	Sprint-1
		USN-3	As a registered user, I can monitor the stocksthat are added into the Database.	Stock/Item monitoring isdone as a whole	High	Sprint-3
	Dashboard	USN-4	Being a retailer,I can add or remove thestocks status in the Database	Altering and updation intothe database is done.	High	Sprint-4

6 PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration/Login	USN-1	I can register/login to the application byproviding the credentials	1	High	Aravindh Naveen Ravindran Balaji Vetriselvan
Sprint-2	Home page	USN-2	Once the registration is over, Choose the stock availability tab to monitor the products present in the database	1	High	Aravindh Naveen Ravindran Balaji Vetriselvan
Sprint-3	Menu	USN-3	The authenticated user can make any changes to the existing database which gets replicated inthe user interface	2	Medium	Aravindh Naveen RavindranBalaji Vetriselvan
Sprint-4	Dashboard	USN-4	The place where all the entries are made tomeet the requirements	2	Medium	Aravindh Naveen Ravindran Balaji Vetriselvan

6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	5 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 Reports From JIRA

Roadmap
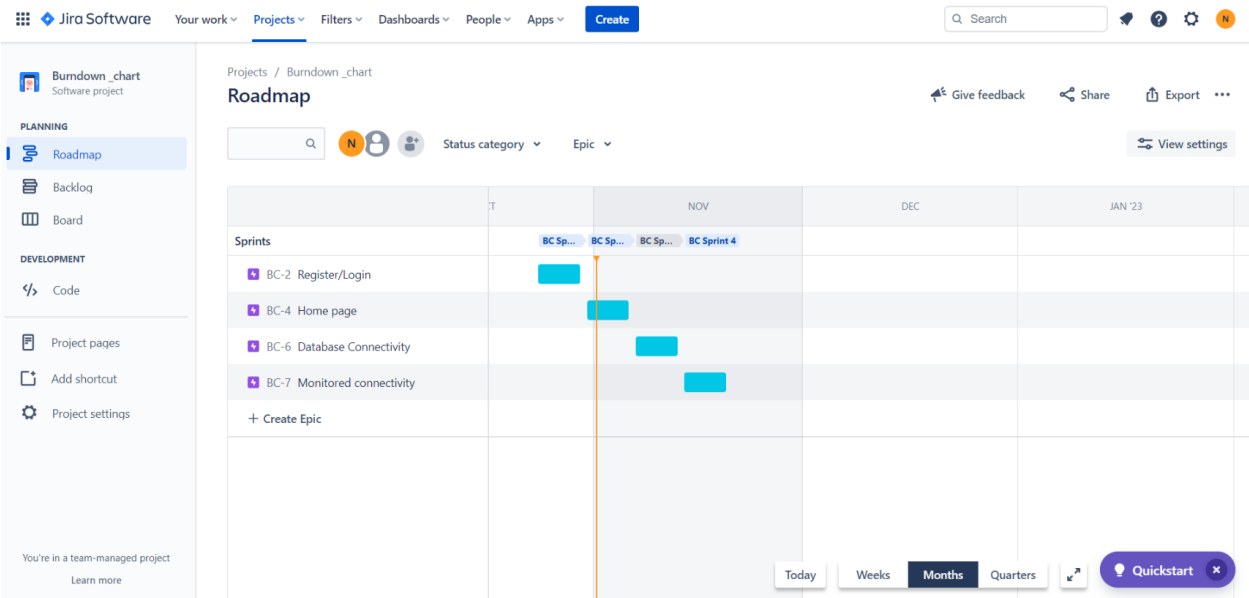
Burndown Report
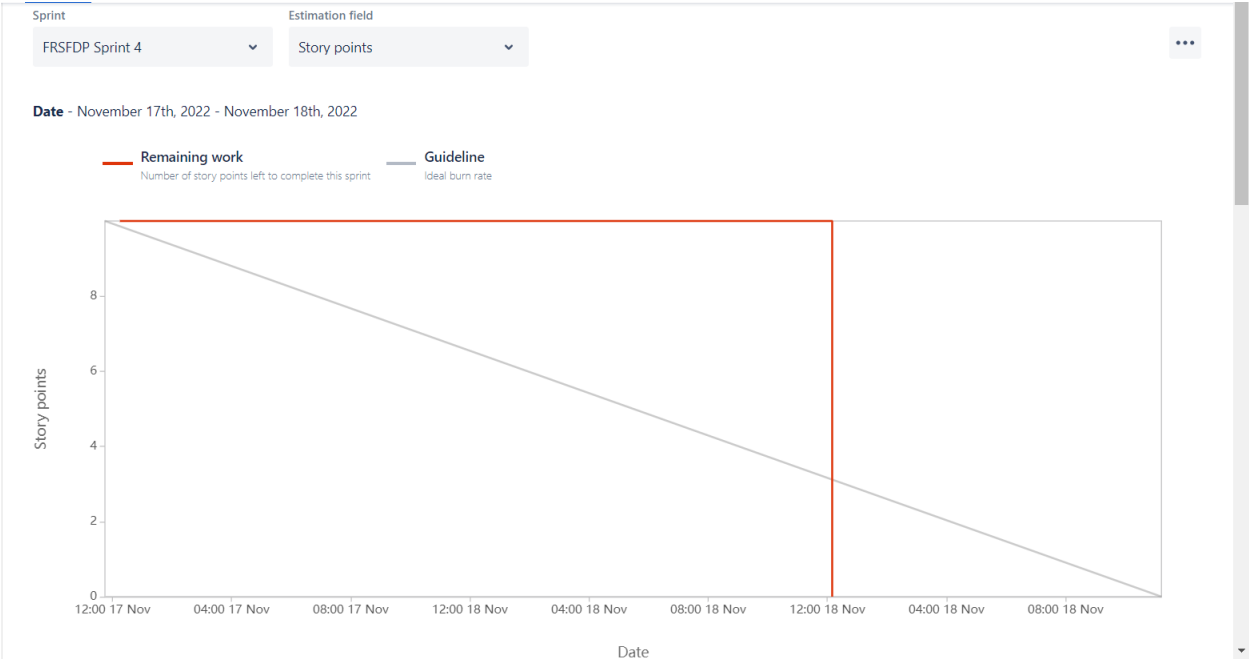
Velocity Report
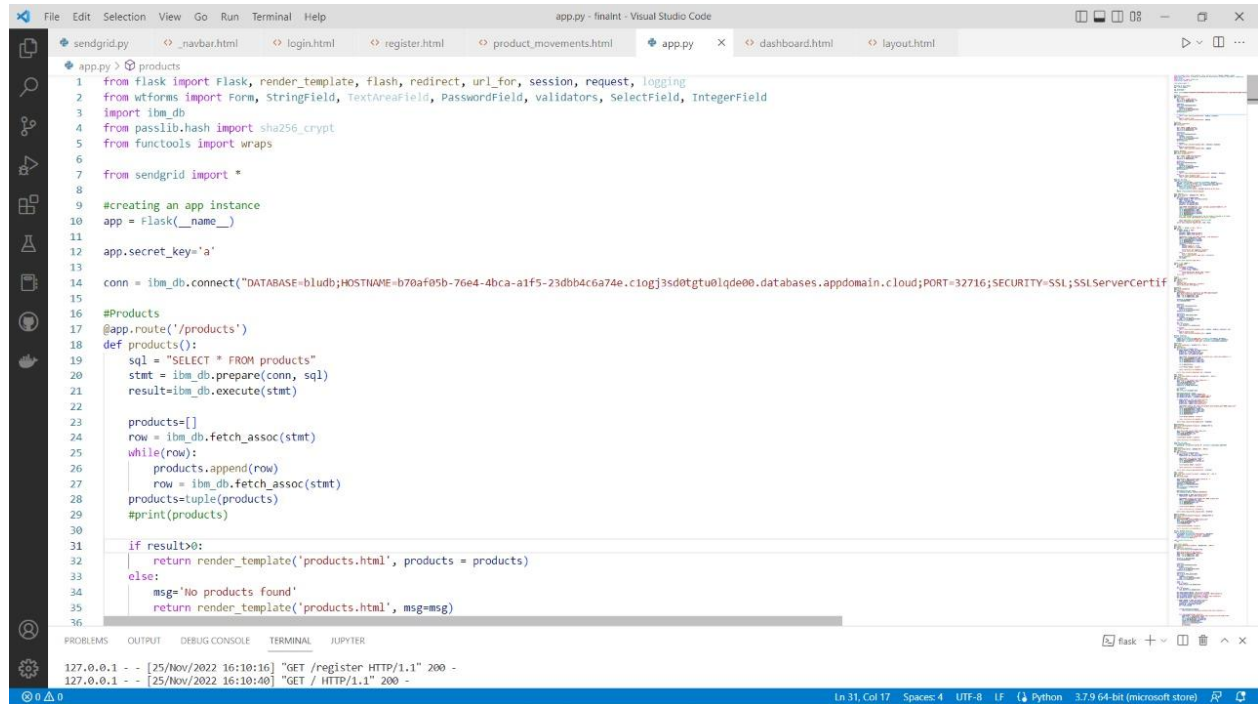
Velocity report

> How to read this report

Commitment
The amount of work in the sprint when it began.

Completed
The amount of work done during the sprint.

7   CODING & SOLUTIONING

7.1 Python – app.py

7.2 dashboard.html

{% extends 'layout.html' %}

{% block body %}
  <style>
  **</style>

**
   <h1>Dashboard <small>Welcome {{session.username}}</small></h1>
   <hr>
    {% for location in locations %}
    <div>
     <h3 class="mt-4 text-primary" >{{location}}</h3>
     <table class="table table-striped">
        <thead>
          <tr>

```html
            <th>Product</th>
            <th>Warehouse</th>
            <th>Qty</th>
          </tr>
        </thead>
        <tbody>
          {% for product in products %}
            {% if product.LOCATION_ID == location %}
          <tr>
           <td>{{product.PRODUCT_ID}}</td>
           <td>{{product.LOCATION_ID}}</td>
           <td>{{product.QTY}}</td>
          </tr>
            {% endif %}
          {% endfor %}
        </tbody>
      </table>
      <hr>
      </div>
    {% endfor %}
{% endblock %}
```

8 ADVANTAGES & DISADVANTAGES

1. **It helps to maintain the right amount of stocks:** contrary to the belief that is held by some people, inventory management does not seek to reduce the amount of inventory that you have in stock, however, it seeks to maintain an equilibrium point where your inventory is working at a maximum efficiency and you do not have to have many stocks or too few stocks at hand at any particular point in time. The goal is to find that zone where you are never losing money in your inventory in either direction. With the aid of an efficient inventory management strategy, it is easy to improve the accuracy of inventory order.

2. **It leads to a more organized warehouse:** with the aid of a good inventory management system, you can easily organize your warehouse. If your warehouse is not organized, you will find it very difficult to manage your inventory. A lot of businesses choose to optimize their warehouse by putting the items that have the highest sales together in a place that is easy to access in the warehouse. This ultimately helps to speed up order fulfilment and keeps clients happy.

3. **It saves time and money:** an effective inventory management system can translate to time and money saved on the part of the business. By keeping track of the product that you already have at hand, you can save yourself the hassles of having to do an inventory recount in order to ensure your records are accurate. It also allows you to save cash that would have otherwise been spent on slow moving products.

4. **Bureaucracy:** even though inventory management allows employees at every level of the company to read and manipulate company stock and product inventory, the infrastructure required to build such a system adds a layer of bureaucracy to the whole process and the business in general. In instances where inventory control is in-house, this includes the number of new hires that are not present to regulate the warehouse and facilitate transactions. In instances where the inventory management is in the hands of a third party, the cost is a subscription price and a dependence on another separate company to manage its infrastructure. No matter the choice you go for, it translates to a higher overhead cost and more layers of management between the owner and the customer. From the view point of the customer, a problem that requires senior management to handle will take a longer period of time before it will be trashed out.

5. **Impersonal touch:** another disadvantage of inventory management is a lack of personal touch. Large supply chain management systems make products more accessible across the globe and most provide customer service support in case of difficulty, but the increase in infrastructure can often mean a decrease in the personal touch that helps a company to stand out above the rest. For instance, the sales manager of a small manufacturing company that sells plumbing supplies to local plumbers can throw in an extra box of washers or elbows at no charge to the customer without raising any alarms. This is done for the sake of customer relations and often makes the customer feel like he is special. While free materials can also be provided under inventory management, processing time and paper work make obtaining the material feel more like a chore for the customer or even an entitlement.

6. **Production problem:** even though inventory management can reveal to you the amount of stock you have at hand and the amount that you have sold off, it can also hide production problems that could lead to customer service disasters. Since the management places almost all of its focus on inventory management to the detriment of quality control, broken or incorrect items that would normally be discarded are shipped along with wholesome items.

9   CONCLUSION

Inventory management is a useful method for simplifying all the warehousing activities of the organization. With this technique, the company can now access and determine its stock and inventory with efficiency to smoothen all the business operations. It has also proved to be a valuable tool for maintaining the working capital requirement. It provides for proper evaluation of the different types of inventories, i.e., stock in hand, opening and closing stocks, raw material, finished goods, etc. This data is also used to prepare the cost sheet. Globalization has challenged businesses to reposition inventory within its supply chain to take advantage of production economies in remote locations and drive reductions in cost of goods sold.

10   FUTURE SCOPE
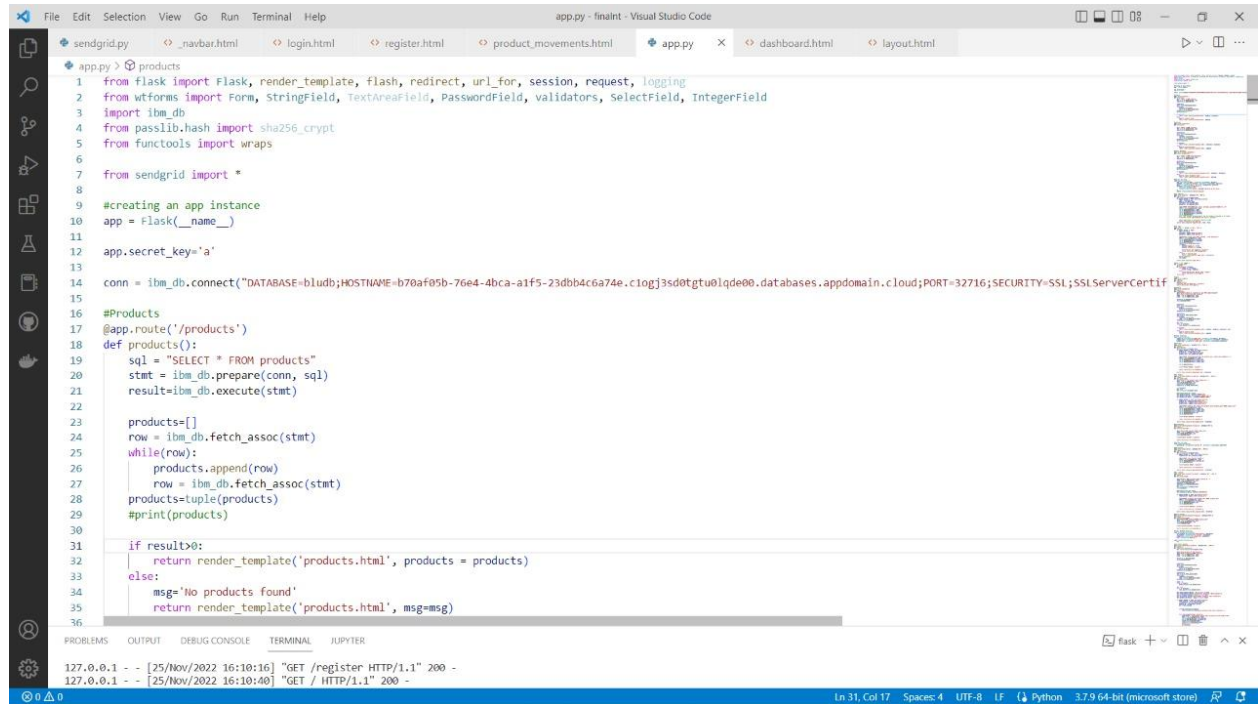
AI will assist businesses in making decisions, especially routine ones, with greater accuracy and with higher levels of sophistication. Computers will learn from experience and will respond to changes with greater levels of quality and certainty. Humans will rely increasingly on AI to make profitable business decisions that balance cost with customer service. In summary, successful companies will embrace the challenges of inventory management in the 21st century by levering the technology that is being offered through the Fourth Industrial Revolution. More important, companies will look at inventory as a strategic asset, that when properly deployed will deliver increased value and competitive advantage. Effective collaboration between supply chain partners will take on increased importance. The intensifying risks inherent with global sourcing in combination with a better appreciation of TCO will motivate companies to rethink their global inventory strategies.

11 APPENDIX

Source Code

Python – app_feretilizer.py

dashboard.html

```
{% extends 'layout.html' %}

{% block body %}
  <style>
  </style><br><br>
  <h1>Dashboard <small>Welcome {{session.username}}</small></h1>
  <hr>
    {% for location in locations %}
    <div>
    <h3 class="mt-4 text-primary" >{{location}}</h3>
    <table class="table table-striped">
      <thead>
        <tr>
          <th>Product</th>
          <th>Warehouse</th>
          <th>Qty</th>
        </tr>
      </thead>
      <tbody>
```

```
{% for product in products %}
  {% if product.LOCATION_ID == location %}
<tr>
 <td>{{product.PRODUCT_ID}}</td>
 <td>{{product.LOCATION_ID}}</td>
 <td>{{product.QTY}}</td>
</tr>
  {% endif %}
 {% endfor %}
    </tbody>
   </table>
   <hr>
   </div>
  {% endfor %}
{% endblock %}
```

GitHub Link

https://github.com/IBM-EPBL/IBM-Project-3208-1658505518