REPORT ON

RETAIL STORE STOCK INVENTORY ANALYTICS

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PROJECT REPORT

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1. INTRODUCTION 1.1 Project Overview

As a retail business owner, one of the worst scenarios that can occur to the stores are product stock-outs, dead stock or excess inventory. In order to overcome such disadvantage this project was developed.

1.2 Purpose

Our project **"Retail Store Stock Inventory Analytics"** is done in order to help stores and e-commerce sellers satisfy the customer, reduce costs and increase profits.

2. LITERATURE SURVEY 2.1 Existing Problem

The maintenance of inventory manually is hard. It's hard to determine the demands and satisfy the customer at same time. The shortage of stock and overflow of stock is the major problem in retail inventory management.

2.2 References
Paper- 1: Combination of Advanced Robotics and Computer vision for Shelf

Analytics in a Retail Store. **Year:** 2017

Author: Gopichand Agnihotram, Navya Vepakomma, Suyog Trivedi, Sumanta Laha, Nick Isaacs, Srividya Khatravath, Pradeep Naik, Rajesh Kumar.

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Description: Large-scale retail store associates are constantly faced with the challenge of managing store operations smoothly and maintaining the products in full stock on the product support devices (retail shelves). Keeping track of the quantities of each individual Stock

solution being presented here aims at automating the

associates which result in reducing the manual effort. The solution proposes the use of a Double Robot to

the retail shelves at real time. These images are processed using developed solution to address various retail store challenges such as stock out problems and misplaced products. An alert generating mechanism has also been incorporated into the solution to alert the store associate via email or a text message, when a product is

References: https://ieeexplore.ieee.org/document/8423894

Paper- 2: Development of Smart Sensor Array Mat for Retail Inventory

Management
Year: 2022
Author: Ruiqi Lim, Musafargani Sikkandhar, Ming-Yuan Cheng. **Description:**

Inventory management of retail market involve manual stock keeping

process that is labour intensive and prompt to human error. Hence, results in

mismatching of items with the inventory record and loss of sale up to 4%. Thus,

there is a need to monitor the movement of the goods on the retail shelves. In this

paper, we disclosed the fabrication of large piezo-resistive sensor mat, which is

able to display the product base structure shape for tracking the stock inventory in

retail store. Each square-shaped sensing pixel is of 5 mm in dimension with the

sensing area of 4×4 mm ^{2}. The detected shape of the product is displayed on the

graphical user interface (GUI) using the PC. The fabricated sensor mat is

characterised for functional resistance range of 10KΩ to 900KΩ with a 98mN

resolution. The sensor mat has an uniformity error of 2.2%, and repeatability error

of 3.1%. The longevity and durability of the sensor mat is validated for 7 days and

through 1000 times drops test respectively. The proposed sensor mat is also

demonstrated with five different products for shape detection.

References: https://ieeexplore.ieee.org/document/9816441

Paper- 3: Towards Intelligent Retail: Automated onShelf Availability Estimation Using a Depth Camera

Year: 2020
Author: Annalisa Milella Antonio Petitti ,Roberto Marani Grazia Cicirelli, Tiziana

Description:

Efficient management of on-shelf availability and inventory is a key

issue to achieve customer satisfaction and reduce the risk of profit loss for both

retailers and manufacturers. Conventional store audits based on physical inspection

of shelves are labor-intensive and do not provide reliable assessment. This paper

describes a novel framework for automated shelf monitoring, using a consumer-

grade depth sensor. The aim is to develop a low-cost embedded system for early

detection of out-of-stock situations with particular regard to perishable goods

stored in countertop shelves, refrigerated counters, baskets or crates. The proposed

solution exploits 3D point cloud reconstruction and modelling techniques,

including surface fitting and occupancy grids, to estimate product availability,

based on the comparison between a reference model of the shelf and its current

status. No a priori knowledge about the product type is required, while the shelf

reference model is automatically learnt based on an initial training stage. The

output of the system can be used to generate alerts for store managers, as well as to

continuously update product availability estimates for automated stock ordering

and replenishment and for e-commerce apps. Experimental tests performed in a

real retail environment show that the proposed system is able to estimate the on-

shelf availability percentage of different fresh products with a maximum average

discrepancy with respect to the actual one of about 5.0%.

References: https://ieeexplore.ieee.org/document/ 8963979

Paper- 4: Exploiting Egocentric Vision on Shopping Cart for Out-Of-Stock

Detection in Retail Environments **Year:** 2021

Author: Dario Allegra, Mattia Litrico, Maria Ausilia Napoli Spatafora, Filippo Stanco, Giovanni Maria Farinella

Description:

Continuous detection and efficient monitoring of Out-Of-Stock

(OOS) of products in retail environments is a key factor to improve stores profits.

Traditional methods require labour-intensive human work dedicated to checking

for products to refill raising the requirement of automatic solutions to detect OOS.

In this work, we focus on the problem of OOS detection from an egocentric

perspective proposing a new weak annotation of the EgoCart dataset. We

benchmark the considered challenge employing a deep learning approach for the

detection of OOS areas. Specifically, we train a Convolutional Neural Network

(CNN) to predict attention maps useful to find OOS in retail areas and hence

suggest the retail employers where to intervene. We evaluate results with both

objective measures and a subjective analysis provided by human which has

reviewed the obtained OOS attention maps. The achieved performance

demonstrates that the proposed pipeline is promising to help the refilling process in

the retail domain

References: https://ieeexplore.ieee.org/document/9607839

Paper- 5: Store-sales Forecasting Model to Determine Inventory Stock Levels

using Machine Learning **Year:** 2022

Author: Akanksha Akanksha, Devesh Yadav, Deepak Jaiswal, Ashwani Ashwani, Ashutosh Mishra

Description:

Predicting sales had been a common practice. Sales prediction plays

a crucial role in the business world. It gives accurate and dependable information

related to current and previous events, also the events that are expected to occur in

the future. However, because traditional sales approach lack insight into customers'

buying patterns, they can no more help businesses in keeping up with the pace of a

competitive business world. Machine Learning evolvements have resulted in major

changes in sales and marketing fields. Many key aspects like consumers' buying

patterns, target audiences, and estimating sales for upcoming years can be

determined easily, all thanks to the advancements in machine learning and thus

helping the sales team in the companies for making plans for a boost in sales.In the

proposed methodology, the study of several forecasting methods used in the

forecasting of the future sales of stores keeping previous year's sales in view. We

tried linear regression model, Random Forest and XGBoost regressor. But linear

model performed poor, so it is not included here. The prediction models

implemented herein are random forest regressor and XGBoost regressor. Both of

the regression techniques give better accuracy and less RMSE (Root Mean Squared

Error) value than linear model. XGBoost perform best in all the three models.

References: https://ieeexplore.ieee.org/document/9850468

2.3 Problem Statement Definition

The major problem in retail store stock inventory is to predict the demands of the stocks in accordance with customer. The big problem in inventory is the overflow of stocks. Sometimes the stock remains dead because of the lack of demand for that particular stock. At times there is shortages of stock due to the demand in that certain period. Taking care of inventory manual is very hard. It need a lot of labour.

So this project was developed to meet all the problems mentioned above.

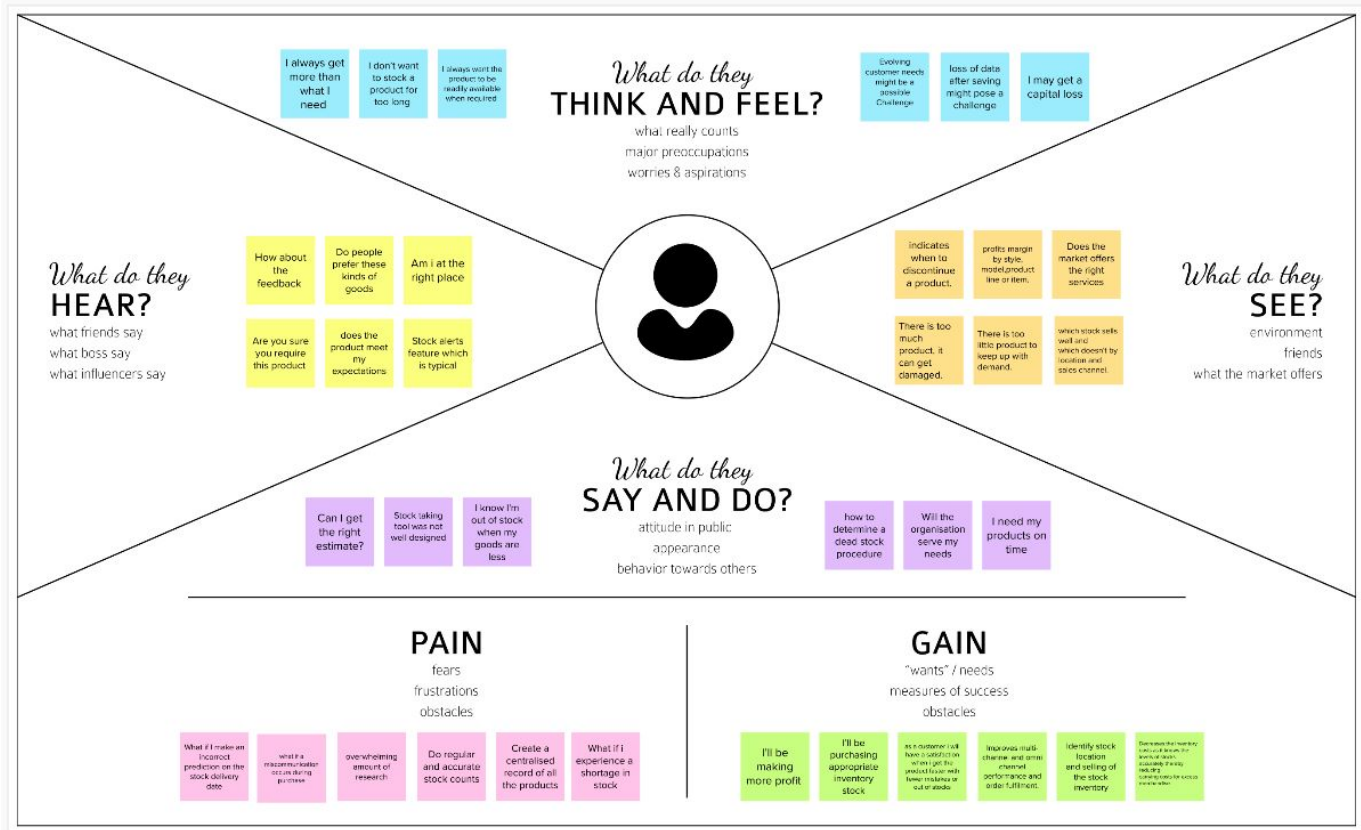## 3. IDEATION & PROPOSED SOLUTION 3.1
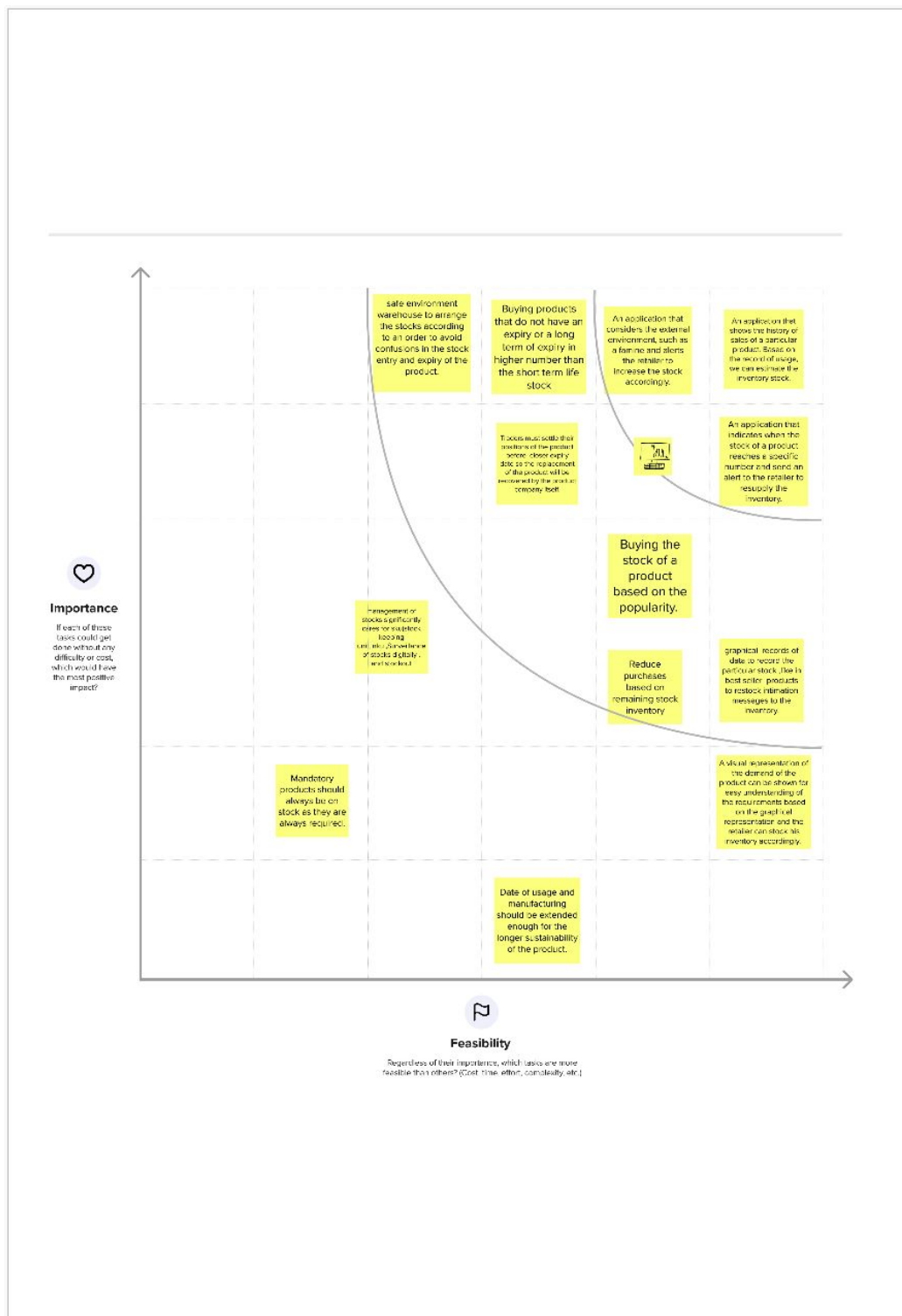## Empathy Map Canvas

3.2 Ideation & Brainstorming

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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**

Sell older stock first	Prioritize with ABC analysis	Take forecasting seriously
Establish Par Levels	Track the metrics.	
Determine dead stock procedure.	Plan for fluctuating sales	Use JIT control method	Use Physical Inventory Audit
Set recorder points for each product	Use FIFO method	Add branding	Verify accuracy	Use EOQ
Give out samples.	Create procedure for returns	Utilize OTB inventory planning	Prepare contingency plan
Be proactive with supply chain	Choose appropriate fulfillment option	

3.3 Proposed Solution S. No. Parameter Description

		Problem Statement (Problem to be solved)	Demands are uncertain. Need to avoid shortages and overflow of stock. Manual work should be
	1		

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2	Idea / Solution description	To meet crisis like shortage and overflow of stock FIFO method can be used. In order to avoid manual work online inventory can be
3	Novelty / Uniqueness	We use FIFO method to overcome crisis and use ABC analysis as well as physical inventory audit.
4	Social Impact / Customer Satisfaction	To satisfy the customer new brands are added and contingency plans
5	Business Model (Revenue Model)	Introduction of new brands can increase revenue. At times we also get to know which product was sold high by
6	Scalability of the Solution	The solution is capable of changes when it is necessary. Like using ABC analysis shortage

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3.4 Problem Solution Fit

1. CUSTOMER SEGMENT(S) CS Who is your customer? The one who purchases the product.	6. CUSTOMER CONSTRAINTS CC What constraints prevent your customer from taking action or limit their choices of solutions? Product quality	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	
2. JOBS-TO-BE- DONE / PROBLEM J&P Which jobs-to-be- done (or problems) do you address for your customers? There could be	9. PROBLEM ROOT CAUSE RC What is the real reason that this problem exists? What is the back story behind the need to do this job?	7. BEHAVIOUR BE What does your customer do to address the problem and get the job done? Address about the product quality, quantity, price, guarantee, quality of	

Focus on JP, tap into BE, understand RC

Focus on JP, tap into BE, understand RC

Define CS, fit into CC

Explore AS, differentiate

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| | 3. TRIGGERS TR

What triggers customers to act?
Satisfaction of

4. EMOTIONS: BEFORE / AFTER EM
How do customers feel when they face a problem or a job and afterwards?

If the product quality is good it feels happy. If the product quality is bad it feels bad about that product | 10. YOUR SOLUTION SL
If you are working on an existing business, write down your current solution first fill in the canvas, and check how much it fits reality.

If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits

To meet crisis like shortage and overflow of stock FIFO method can be used. In order to avoid manual work online inventory can be maintained using | 8. CHANNELS OF BEHAVIOUR CH

ONLINE

What kind of actions do

customers take online?

OFFLINE

What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

See the product quality, review. Deliver on time. | |

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4. REQUIREMENT ANALYSIS 4.1 Functional Requirements

FR	Functional	Sub Requirement (Story /
FR-	User Registration	Registration to IBM cloud
FR-	User	Confirmation via Email

| FR-	User Login	Login with username Login
FR-	Profile update	Update the user credentials
FR-5	Uploading Data	Collect the customer details as well as product detailsUpload the product details into IBM
FR-6	Recommendation	The user will get the recommendation about

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4.2 Non- functional Requirements

NF	Non-Functional	Description
NFR-1	**Usability**	They are used to have enough inventory to capture every possible sale while avoiding
NFR-2	**Security**	This can be used only by the users who have their proper
NFR-3	**Reliability**	Avoid over or under stocking Ensure accurate inventory valuation Prevent order delay
NFR-4	**Performance**	From this, the model can predict the dead stocks and highly profitable stocks. The accuracy of this model will be
NFR-5	**Availability**	It can give retailers real-time visibility into stock levels, avoid stock outs, keep inventory carrying costs low and help

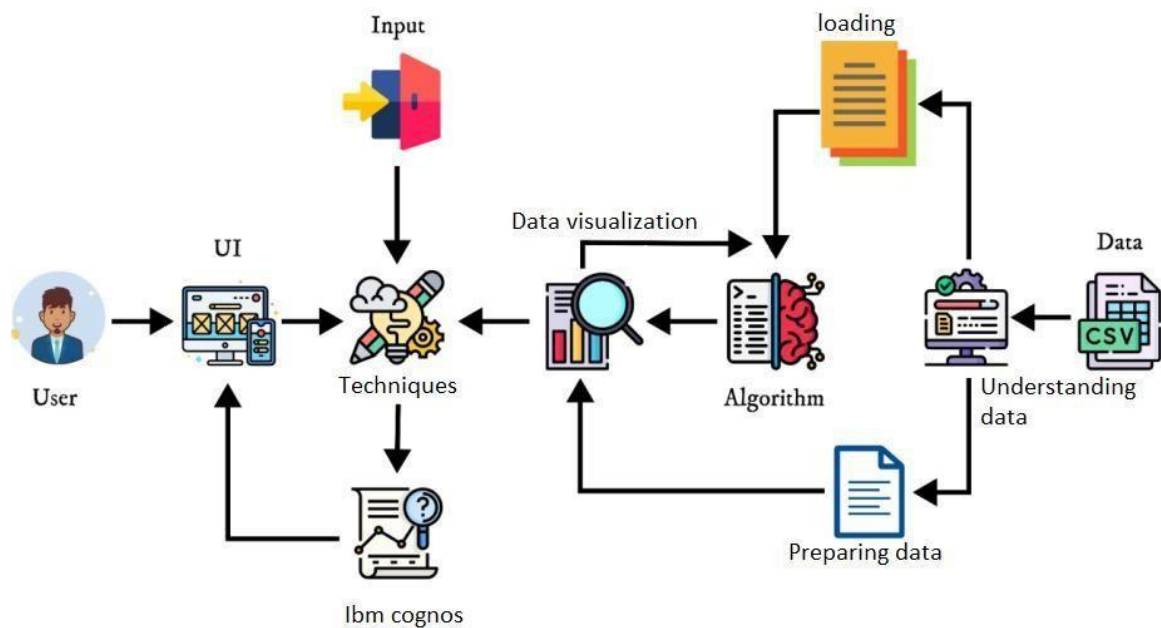| NFR -6	Scalability	More users can be accessed at the same time without any issues. The feedback of the

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5. PROJECT DESIGN 5.1 Data Flow Diagrams
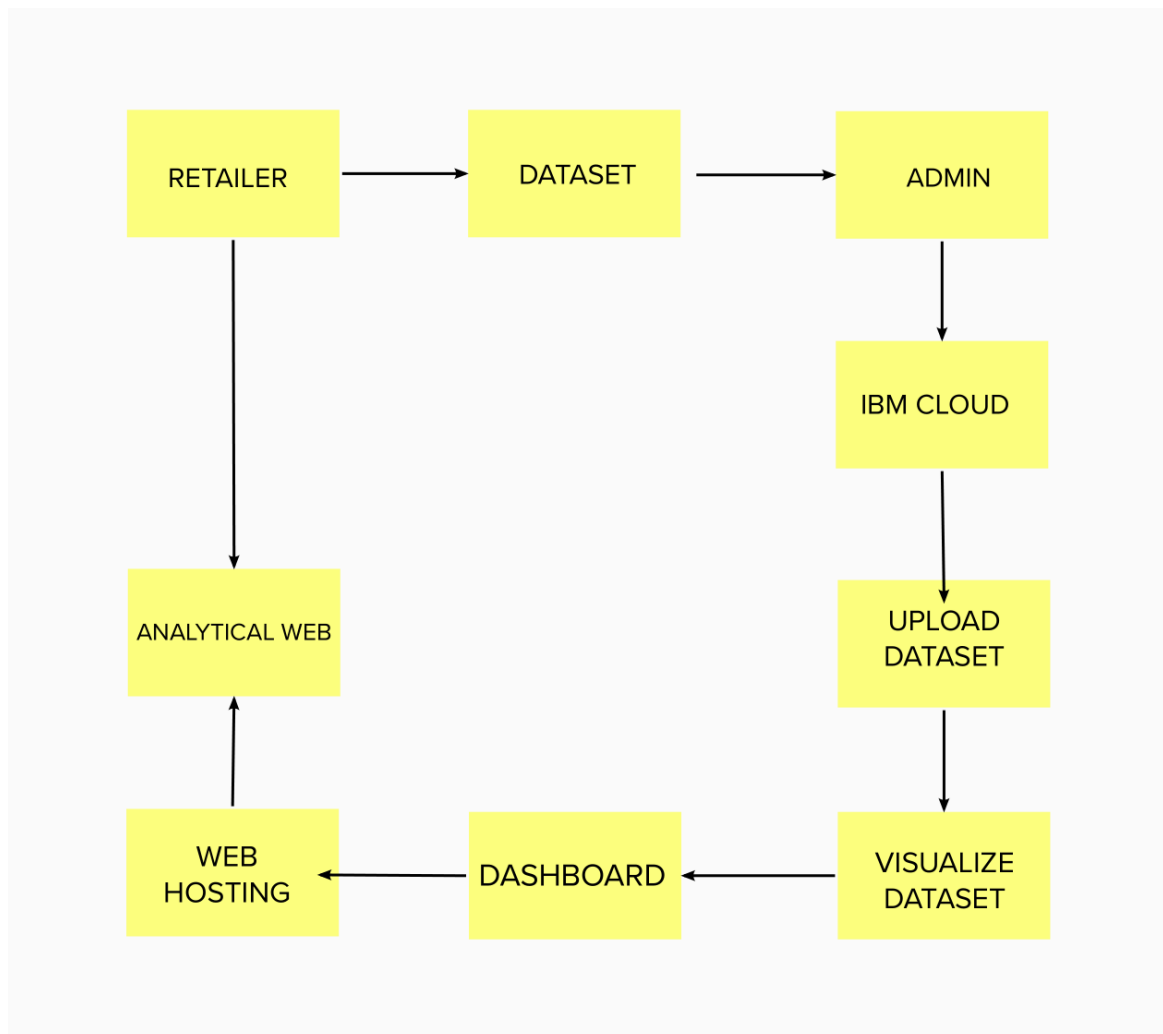
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5.2 Solution & Technical Architecture

5.3 User Stories

User Type	Functional Require	User Story Num	User Story / Task	Acceptance criteri	Priority	Release
Customer (Mobile user)	Dashboard	-USN	As a user, I can view the charts and graphs representation of the dataset	I can access my account / dashb	High	Sprint- 1
Customer (Web user)	Dashboard	-USN	As a user, I can view the charts and graphs representation of the dataset and	I can access my account / dashboard	High	Sprint- 1

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Admini strat or	Login	Adm in- 1	As a admin,I can log in to the IBM account by	I can access my accou	High	Spri nt- 1
	Upload	Adm in- 2	As a admin,I can log in into my account and use the cloud object storage service of the IBM cloud to store and	I can access my cloud storag e	High	Spri nt- 1
	Visualiz e	Adm in- 3	As a admin,I can visualize my dataset for the specified constraints to	I can visuali ze my data	High	Spri nt- 2

6. PROJECT PLANNING & SCHEDULING 6.1 Sprint Planning & Estimation

Spri nt	Functiona l Requirem	User Story Numbe	User Story / Task	Stor y Poin	Priori ty	Team Members

Sprint-1	IBM Cognos account creation	-USN 1	The created Cognos Account for each person in the team. account is in	2	High	Anupriya M Ramya P Swathi G Pradeshwaran G
Sprint-1	Data collection	-USN 2	The data is collected and the understandin	2	High	Anupriya M Ramya P Swathi

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Sprint-2	Data Preparation	-USN 3	As a user the accurate data that is prepared viewed. collected prepared restructuring & clean	3	High	Anupriya M Ramya P Swathi G Pradeshwaran G
Sprint-2	Data Exploration	-USN 4	As a user, the visualized data can be view for better understandin	8	High	Anupriya M Ramya P Swathi G Pradesh

Sprint-3	Build Visualization Charts	-USN 5	As a user, I can view the visualization better in the chart form.		8	High	Anupriya M Ramya P Swathi G
Sprint-3	Dashboard Creation	-USN 6	As a user, I can view the different visualization		8	High	Anupriya M Ramya P Swathi
Sprint-4	Report Creation	-USN 7	As a user, I can view the detailed report of the sales, stock,		8	High	Anupriya M Ramya P Swathi G
Sprint-4	Story Creation	-USN 8	As a user, I can view the story to get better understanding of sales,		8	High	Anupriya M Ramya P Swathi G Pradesh

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6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on	Sprint Release Date (Actual

Sprint-1 4 Sprint-2 11 Sprint-3 16 Sprint-4 16

6 Days 6 Days 6 Days 6 Days

24 Oct 2022 31 Oct 2022 07 Nov 2022 14 Nov 2022

29 Oct 2022 05 Nov 2022 12 Nov 2022 19 Nov 2022

2 29 Oct 2022

11 05 Nov 2022

16 07 Nov 2022

16 14 Nov 2022

7. CODING & SOLUTIONING

```html
<!doctype html>
<html>
<head>
<meta charset="utf-8">
<meta name="viewport" content="width=device-width,
initial-scale=1.0"> <title>demo</title>

</head>
<body bgcolor="#D8F8F7 ">

<h1 align="center"><b>Retail Store Stock Inventory
Management</b> </h1>

<hr>
<h2><b>Dashboard </b></h2>

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<iframe src="https://us1.ca.analytics.ibm.com/bi/?
perspective=dashboard&amp;pathRef=.
my_folders%2FDashboard%2B1&amp;closeWindowOn
```
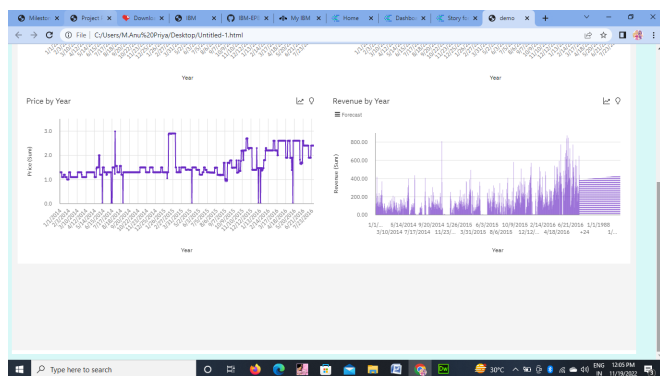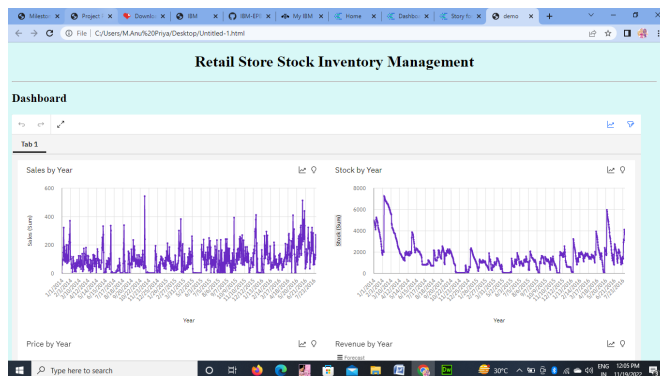
LastView=true&ui_a
ppbar=false&ui_navbar=false&shareMode=em
bedded&action=vie
w&mode=dashboard&subView=model0000018
488ffd7b5_00000000" width="1300" height="1000"
frameborder="0" gesture="media" allow="encrypted-
media" allowfullscreen="">

</iframe> </body>
</html>

8. RESULTING

9. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

➢ It reduces manual labor.
➢ It helps to predict the demands.

➢ The correct prediction of demand leads to avoidance of dead stock

and helps with the shortages of the stock.
DISADVANTAGES:

➢ If there occurs any error in prediction it cause loses.

10. CONCLUSION

The project "Retail Store Stock Inventory Analytics" was developed to satisfy the retailer or ecommerce customer and in order to maintain the stock at the demand level. It helps to overcome the crisis like overflow of stock or dead stock

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or with nearly expiring items. This analytics helps in prediction, so using prediction the shortage of the stock can't be happen. Since the project is done as web app, it helps to meet with the need of labor for maintaining the inventory.

11. APPENDIX

Story link:

https://us1.ca.analytics.ibm.com/bi/?
perspective=story&pathRef=.my_folders%2F
Story%2Bfor%2BRetail%2BStore&action=view&sceneI
d=model000001848e7404 a7_00000000&sceneTime=0

Dashboard link:

https://us1.ca.analytics.ibm.com/bi/?
perspective=dashboard&pathRef=.my_folders

%2FDashboard&action=view&mode=dashboard&subVie
w=model0000018436ed 9cae_00000000

Github link:

https://github.com/IBM-EPBL/IBM-
Project-54355-1661855691