Expiry Classification and Improved Efficient Delivery Mechanism of Packaged Food Product Using XGBoost Algorithm and Haversine Formula

Abhishek Desai, Kundan Dhore[(⊠)], Sandesh Kanagal, Ritesh Naik, and Swapnil Gharat

Information Technology Department, Rajiv Gandhi Institute of Technology (Mumbai University), Mumbai, India
dhorekundan14@gmail.com

Abstract. Supply chain management and typical small scale independent retailer's poor infrastructure, poor management approach, makes Supply chain management at state-of-the-art levels is challenging in the present situation. There are mainly unorganized retailers dominating the Indian retail market. Retailers who are haphazard homogeneous class present in today's markets. There has been a significant growth in organized retailers entering the retail industry in recent years. There are several drawbacks associated with the existing supply chain that serves mainly independent retailers. Among the current supply chain's major disadvantages are numerous intermediaries, wastage and quality degradation, poor infrastructure, and high costs. These observations explore ways of improving transportation and supply chain management within the food processing industry. Several factors contribute to the inefficiency of transportation and handling systems. This results in a lack of consistency in the supply of quality raw materials to processing, packaging, and distribution companies. In today's competitive market, it is extremely difficult to successfully maintain high quality, low cost products without any additional costs from suppliers. As a network process, supply chain management involves people, organizations, information, activities, and resources. Uncertainty and variation in supply affect supply chain accomplishment, so SCM must be able to accommodate them. A Streamlining supply chains in an effective way is through information sharing systems. In our proposed system the quality classification of food products with expiry dates using machine learning technique improves the SCM. The system uses XGBOOST algorithm which makes the classification with perception and clarification than K-Means algorithm.

Keywords: supply chain management (scm) · xgboost · k-means · classification

1   Introduction

It comprises people, firms, movements, information, and assets as part of a seamless, integrated, non-segregated network. The food processing industry is one where supply chain management is especially critical to ensure high quality, low costs, and limited raw material resources. Raw materials have to be of high quality and be used in safe conditions for the food industry to carry off a high caliber finished edibles [1, 3].

A successful SCM involves coordinating input and output of statistics, material, and financial amenities throughout all of the participating organizations. This ensures that the right product is at the right place, in the right condition, at the right time, and at the right price. Managing supply chain is a vital part of marketing goods and services. It's crucial to realize that SCM not only reduces costs, but also maintains the quality of goods and services. In varied sectors around the world, supply chains play a major role in this direction [2, 5].

Marketing perishable foods, like fruits and vegetables, are largely dependent on supply chains. A wide range of climatic conditions, geographical spread of production, pre- dominantly in rural areas, numerous utilization ways, and Because of poor supply chain infrastructure, Fruit and Vegetable supply chain management systems are more complicated. Marketing experts argue that proper SCM can not only increase their profit margins and efficiency, In addition it enhancing the welfare of different groups, such as farmers, wholesalers, and consumers, eco-friendly products also enhance the welfare of society as a whole [6, 4].

2   Existing System

Manufacturing supply chains have historically been studied as individual processes by researchers and practitioners. The supply chain has become increasingly critical over the years due to its performance, design, and analysis [8, 10, 12].

There has been a significant increase of attention to manufacturing due to a number of factors, rising manufacturing expenses, shrinking manufacturing bases, shortened product life cycles, balancing the playing field within manufacturing, and globalization of markets [9, 13].

Currently, most of supply chain management systems are based on manual operations. Its main task is to accept requirements from different areas, verify them and process. The need for computerization arose because of inaccuracy and irregularities. The technology based supply chain management systems heavily rely on either block chain or hardware components like RFID connections, which increases the cost and maintenance of the system. It also has a high probability of system failure if components are not check regularly [7, 11, 14].

3 Proposed System

A Supply Chain is a process, where the products are accurately tracked from their origin to the final consumer. It involves multiple planning processes for organizing the supply chain, demand chain, production chain, distribution chain, operations chain, and sales channel. Using pandas and from H2O XGBoost library, the expiry date analysis was performed Visualization through graph and training had been done using XGboost algorithm for which google colab platform is used

This trained mode is then used to classify the expiry dates of food products available at the store and classifies the food products according to their expiration dates.

- Using Web UI, the interface between the manufacturer and the retailer will be achieved.
- Shelf life and estimated time of delivery can be analysed using algorithm like XGBoost algorithm, haversine distance method.
- On demand orders, the shortest and efficient way can be found for on-time delivery.

An owner/retailer can use this analysis to determine the sequence in which products should be consumed.

4 Implementation

Shelf life is the key aspect in every delivery mechanism. The database of packed product is examined and classified according to their shelf life.
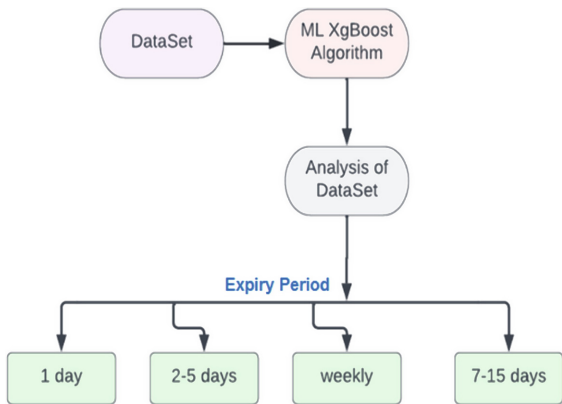

Fig. 1. Process Flow Diagram of Food Product Classification

Name	Category	SubCategory	Expiry_date
Premia Tea Masala	Dairy & Beverages	Beverages	03-01-2021
Amul Butter	Dairy & Beverages	Dairy	09-01-2021
Society Tea	Dairy & Beverages	Beverages	02-01-2021
Wagh Bakri Premium Leaf Tea Pouch	Dairy & Beverages	Beverages	06-01-2021
Brooke Bond Red Label Tea	Dairy & Beverages	Beverages	09-01-2021
Tata Tea Agni	Dairy & Beverages	Beverages	06-01-2021
Brooke Bond Red Label Natural Care Tea	Dairy & Beverages	Beverages	07-01-2021
Girnar Royal Cup Tea	Dairy & Beverages	Beverages	09-01-2021
Tata Tea Premium	Dairy & Beverages	Beverages	09-01-2021
Taj Mahal Tea	Dairy & Beverages	Beverages	07-01-2021
Tata Tea Gold	Dairy & Beverages	Beverages	09-01-2021
Society Masala Tea	Dairy & Beverages	Beverages	10-01-2021
Wagh Bakri Navchetan Tea	Dairy & Beverages	Beverages	05-01-2021
Nutralite Fat Spread	Dairy & Beverages	Dairy	06-01-2021
Tetley Lemon & Honey Green Tea Bags	Dairy & Beverages	Beverages	04-01-2021
Brooke Bond Taaza Tea	Dairy & Beverages	Beverages	05-01-2021
Mother Dairy Pasteurized Butter	Dairy & Beverages	Dairy	07-01-2021
Delicious Fat Spread	Dairy & Beverages	Dairy	02-01-2021
Tata Tea Gold Care	Dairy & Beverages	Beverages	01-01-2021
Lipton Green Tea Bags - Honey Lemon	Dairy & Beverages	Beverages	08-01-2021
Society Masala Flavour Tea Pouch	Dairy & Beverages	Beverages	05-01-2021
Amul Garlic & Herbs Buttery Spread	Dairy & Beverages	Dairy	09-01-2021
Tata Tea Teaveda	Dairy & Beverages	Beverages	08-01-2021
Girnar Detox Desi Kahwa Green Tea	Dairy & Beverages	Beverages	03-01-2021
Amul Butter School Pack	Dairy & Beverages	Dairy	09-01-2021
Brooke Bond Taj Mahal Tea Bags	Dairy & Beverages	Beverages	07-01-2021
Nutralite Fat Spread UKE	Dairy & Beverages	Dairy	06-01-2021
Girnar Jumbo Gulabi CTC Leaf Tea	Dairy & Beverages	Beverages	08-01-2021
Lipton Green Tea Bags - Pure & Light	Dairy & Beverages	Beverages	03-01-2021

Fig. 2. Sample dataset of E-commerce Products

E-commerce product dataset is fetched from Kaggle.com which consists of 8650 entries which has product id, product name and products expiry dates.

The classified dataset is then used to calculate the reachability zone for the products i.e. within local area, District and state.

- Retailer is the end person to whom the products will be delivered. Retailer will access the portal and define the delivery location.
- Haversine formula is then implemented to estimate delivery time.
- The products that are reachable to the preferred retailer location are sorted and displayed to the retailer.
- The retailer can place order and can view their delivery status.
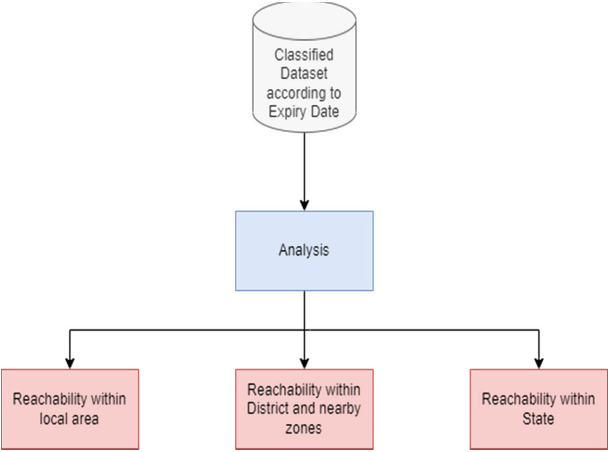- The portal is then updated, once the product is delivered

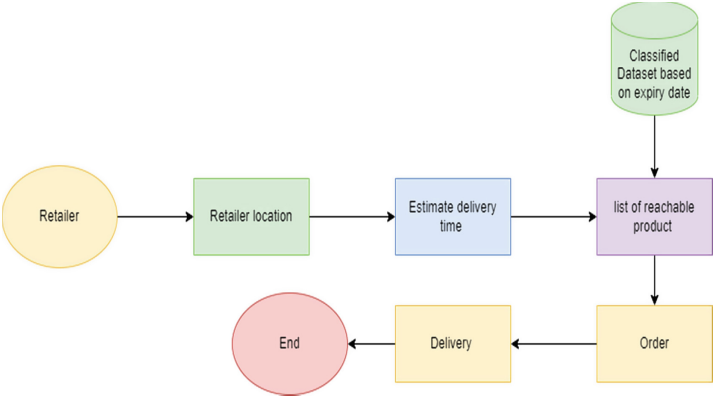**Fig. 3.** Classification according to delivery location

Fig. 4. Process flow of delivery mechanism

5   Results

The product dataset from the manufacturer is preprocessed and cleaned and is further send for classification. The dataset is consists of various food products with mentioned expiry date. The classified expiry dates are plotted on Y-axis and corresponding count of products on X – axis. The result shows the graphical representation of number of products with respect to expiry date and the results will vary from date to date with the scale of number of products.

According to the shelf life of classified products and delivery time estimation the list of reachable products is displayed to retailer.

The Fig. 6 shows the distributor location and the geographical boundaries for a product which are estimated using their shelf life.
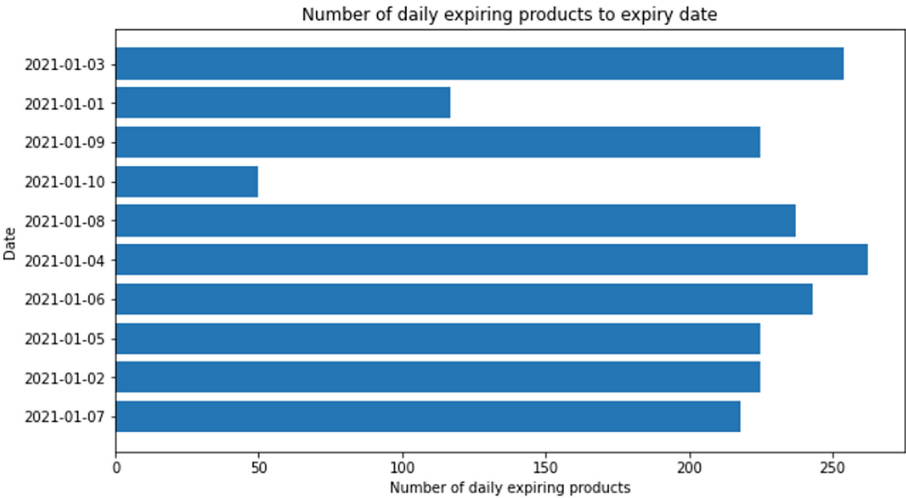
Fig. 5. Classification of Products. X – Axis: Number of daily expiring products. Y – Axis: Expiry date
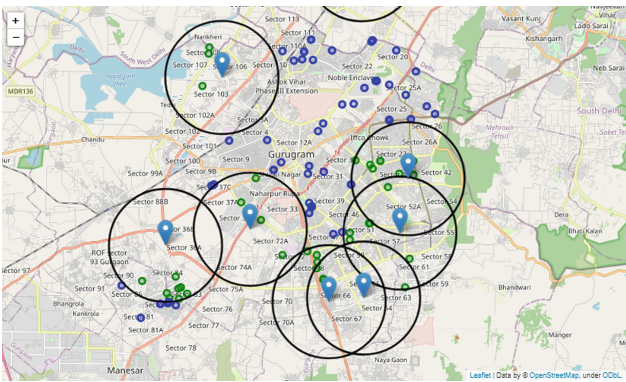

Fig. 6. Cluster of distributors location

6 Scope

This system is used for classification of food products expiration period. The scope of this system is to build an easy and handy food supply chain which can be used in different industries like food processing, packaging and distribution. It can be used to provide suggestion on the accurate way to utilize of the food project. For example, if the food has reached at over stale stage, the suggestion regarding composting will be provided to the user via notification that ensures the food is not wasted, but utilized optimally.

7 Conclusion

Planning the path of a material in a supply chain is what supply chain planning is all about and the most important part of this journey is sales distribution before it expires. Therefore, categorizing products according to their expiration dates will help increase revenue. The visualized classification of expiration dates of products will assist the owner/retailer in planning/determining the sequence of products to be consumed first.

References

1. Dr. Sunil Karam-chandani, Kartik Nair, Krina Shah, Bhavya Sekhani.: Expiry Prediction and Reducing Food Wastage using IoT and ML. International Journal of Electrical and Computer Engineering Systems (2021).
2. Madumidha Subramanian, Venmuhilan Boopathi, U. Vandhana.: A procedure for Tracing Supply chains for Perishable Food Based on Blockchain, Machine Learning and Fuzzy Logic. MDPI journal (2020).
3. Madumidha Subramanian, Venmuhilan Boopathi, U. Vandhana.: A Theoretical Implementation: Agriculture-Food Supply Chain Management using Blockchain Technology. ResearchGate (2019).
4. Fran Casino, Thomas K. Dasaklis, Venetis Kanakaris, Socrates Moschuris.: Modeling food supply chain traceablity based on blockchain technology. 9th IFAC, Berlin (2019).
5. Naitik M Patel, Vivek A Deshpande.: Supply Chain Management for Food Processing Industry. International Journal of Innovative Research in Science, Engineering and Technology (2015).
6. Fan Wu, Lixia Wu.: DeepETA: A Spatial-Temporal Sequential Neural Network Model for Estimating Time of Arrival in Package Delivery System. Association for the Advancement of Artificial Intelligence (2019).
7. M. Barbosa.: Uncovering research streams on agri-food supply chain management: A bibliometric study. Global Food Security, 100517 Volume 28 (March 2021).
8. Shoue Chen, Sandrayee Brahma, Jonathon Mackay, Changyong Cao, Bahar Aliakbarian.: The role of smart packaging system in food supply chain. Journal of Food Science, 13 February (2020).
9. Affaf Shahid, Ahmad Almogren, Nadeem Javaid, Fahad Ahmad Al-Zahrani, Mansour Zuair, Masoom Alam.: Blockchain-Based Agri-Food Supply Chain: A Complete Solution, IEEE (2020).
10. Hao Fu, Cuiping Zhao, Chuanxing Cheng, Hengyun Ma.: Blockchain-based agri-food supply chain management: case study in China. International Food and Agribusiness Management Association (2020).
11. Showkat Ahmad Bhat, Nen-Fu Huang, Ishfaq Bashir Sofi, Muhammad Sultan.: Agriculture-Food Supply Chain Management Based on Blockchain and IoT: A Narrative on Enterprise Blockchain Interoperability. MDPI Journal (2021).
12. Fran Casino, Venetis Kanakaris, Thomas K. Dasaklis, Socrates Moschuris, Spiros Stachtiaris, Maria Pagoni.: Blockchain-based food supply chain traceability: a case study in the dairy sector. International Journal of Production Research (2020).
13. Fran Casino, Venetis Kanakaris, Thomas K. Dasaklis, Socrates Moschuris, Nikolaos P.Rachanioti.: Modeling food supply chain traceability based on blockchain. IFAC (2019).
14. Marina Segura, Concepción Maroto, Baldomero Segura, José Carlos Casas-Rosal.: Improving Food Supply Chain Management by a Sustainable Approach to Supplier Evaluation. MDPI Journal (2020).