ROLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FOOD INDUSTRY

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ABSTRACT

Food demand is increasing with increasing population of the world. Food processing industries are also emerging rapidly. It is need of hour to reduce food waste, optimize supply chain, and improve food logistics, food delivery, and safety of food. Artificial intelligence and machine learning help up to a great extent in achieving these objectives. Machine learning is a new area of data mining that allows a computer program to grow increasingly accurate in predicting outcomes without explicitly programming it. These ML techniques are often divided into two types: supervised and unsupervised learning techniques. This article presents applications of machine learning and artificial intelligence in food industries. Major applications are supply chain optimization, selection of correct crop, logistics, food delivery and predicting maintenance in machinery of food processing.

Keywords: Artificial Intelligence, Machine Learning, Food Industry, Prediction, Monitoring

I. INTRODUCTION

Artificial intelligence usually refers to the artificial fabrication of human minds that can learn natural language, plan it, perceive it or process it [1]. It is the theory and development of computer systems that can generally carry out activities requiring human intelligence, such as visual perception, recognition of speech, decision-making and language translation [3]. Artificial intelligence is an IT industry that mostly works with machines which are built to operate like a human being. John McCarthy (AI's dad) described AI as "the scientific and technical knowledge of developing smart computer programs in particular". Machine learning and profound learning are two of the most often utilized AI methods. These models learn from data and are used for predicting by individuals, firms and government organizations. Machine learning models for the complexity and diversity of data in the food business are nowadays being developed [2] [3]. In food industries with a major aim to design standard, reliable product quality control methods and the search for new ways of reaching and serving customers, while at the same time maintaining low cost, has required deployed AI in order to achieve better customer experience, efficient management of the supply chain, improved operational efficiency, reduced mate size.

This article presents applications of machine learning and artificial intelligence in food industries. Major applications are supply chain optimization, selection of correct crop, logistics, food delivery and predicting maintenance in machinery of food processing.

II. DIFFERENT ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNIQUES

Machine learning is the most important AI technique. Relationship between machine learning and artificial intelligence is shown below in figure 1. This section contains prominent machine learning techniques.
Machine learning (ML) [4] is a new area of data mining that allows a computer program to grow increasingly accurate in predicting outcomes without explicitly programming it. These ML techniques are often divided into two types: supervised and unsupervised learning techniques employ labeled training data for inference (classification, regression), whereas unsupervised learning techniques employ unlabeled data to identify hidden existing patterns (clustering).

The act of transforming an input collection of instances P into a unique collection of characteristics Q, also known as target attributes or labels, is known as classification. Classification techniques such as decision tree classifiers, bayesian classifiers, and artificial neural networks, nearest neighbor classifiers, random forest, and support vector machines are used in a variety of applications [5]. We'll go through each of them briefly. Each strategy is based on the learning algorithm that it utilizes.

A decision tree is one of the most basic and simple classifiers used to solve classification issues. A decision tree is a graph in which occurrences are classified by sorting them depending on their feature values. The decision tree is composed of nodes and branches, with each node representing a classification instance and each branch representing a value that the node might take on. In decision, instance categorization starts at the root node, and instance sorting is done based on feature values.

Predicting the class label for a given collection of input qualities can be challenging in some situations. Furthermore, even when utilizing the specified input attributes set values to match some of the attributes in the training data set, class variables are non-deterministic. This is possible due to the presence of some noisy data and perplexing features that are not considered during analysis. For example, projecting the possibility of heart disease in a given person based on that individual's daily activity.

In this instance, it is probable that the majority of people who consume nutritious foods and exercise on a regular basis are at risk of acquiring heart disease owing to other variables such as smoking, alcohol intake, and potentially inheritance. In such circumstances, the categorization model is created based on well recognized heart disease characteristics, which cannot offer correct information. In such situations, there is a requirement to describe probabilistic correlations between the attribute collection and the class label, and the Bayesian classifier is all about justifying such duties [6].

An artificial neural network (ANN) is based on biological neural networks, which are used to build animal brains. ANN is also known as a connectionist system since it is built up of linked nodes and directed linkages. Each linked connection is assigned a weight and is responsible for sending a signal from one node to another. When a node gets a signal, it processes it before passing it through to another node.

In ordinary ANN implementations, the signal at the link between artificial neurons is basically a real number, and the output of each neuron is determined by a non-linear function of the sum of all its inputs. Because of the
weights of artificial neurons and the connections between them, the signal intensity rises or decreases as learning continues [7].

There are two approaches to building a learning model in ML classification. One of them is that the model begins learning as soon as the training set is available; such models are known as eager learners. Another model observes all training examples but only achieves classification if the test instance's properties perfectly match any of the training instances. Such pupils are known as lazy pupils [8].

The Nearest Neighbour (NN) classifier treats each sample as a data point in a d-dimensional space, where d is the number of characteristics. It is determined the distance between the provided test example and all data points in the training set. The data point X's k-Nearest Neighbors are the k points nearest to the X.

The data point is then categorized based on the class labels of its neighbors. If a data point has more than one class labeled neighbor, the class label with the most class labels is applied to the data point. The precise value of k's nearest neighbors should be established. If the value of k is too low, it may misclassify owing to noise in the training data. On the other hand, if the value of k is too big, there is a risk of misclassification since the collection of nearest neighbors may contain data points that are situated far away from the test attribute's neighborhood.

To begin, Random Forest is a supervised machine learning technique composed of a forest of judgments produced by many decision trees produced using random vectors. This method may be used to solve classification problems as well as regression operations. The random forest's outcome is connected to the number of trees it combines in the forest in such a manner that as the number of trees in the forest rises, so does the chance of attaining more accuracy. It is critical to understand that establishing the forest is not the same as generating decision trees [8].

The main difference between decision trees and random forests is that in random forest classification, identifying the root node and separating the feature nodes happens at random. Random forest categorization is popular due of its advantages. One of these is that it may be used for both classification and regression. Another advantage of this strategy is that it avoids the problem of overfitting if a sufficient number of trees are available. A random forest classifier, in addition, can handle missing data and can be modelled in the case of categorical data.

Random forest classifiers are used in medical, finance, e-commerce, and the stock market. In banking, random classifiers are used to distinguish between loyal and fraudulent clients. Random Forest is used in medicine to discover the optimal mix of medications and to diagnose illness based on a patient's past medical information. In the stock market, Random Forest classifier is used to watch a stock's activity and then detect the loss and profit. Random Forest may be used to estimate user product suggestions in the context of e-commerce.

The Support Vector Machine is the supervised learning model used for categorization (SVM). It has received a great deal of interest in the categorization sector. A noticeable gap separates instances of the various categories in vector space in the SVM model. When a new sample arrives, it is mapped into the specified vector space and its label is assigned to a category based on which side of the gap it falls [9]. An SVM can do non-linear classification effectively by employing the kernel technique.

Clustering, also known as cluster analysis, is the job of arranging a collection of things so that elements in one group are more similar to those in another. As the similarities between things in one group and the dissimilarities between things in other groups rose, so did the clustering. Clustering is the cornerstone of data mining and may be employed in a wide range of applications like image processing, data compression, computer graphics, machine learning, and many more.

Clustering can be used in combination with other object-categorization techniques such as classification, segmentation, and partitioning. When comparing Cluster analysis to classification, we may state that clustering is an example of unsupervised learning. Cluster analysis varies from classification in that classification retains knowledge of classes, but clustering does not maintain knowledge of classes. Furthermore, fresh samples are grouped into established classes in the case of classification, whereas groups are recommended in the case of cluster analysis based on data patterns [9].
III. APPLICATIONS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FOOD INDUSTRY

This section contains applications of machine learning and artificial intelligence food industry [10-14]

- **Supply Chain Optimization**
  As long as food makers are concerned with food safety standards, the journey of food in the supply chain must be made clearer. In this respect, in food production, AI helps in keeping an eye on whole supply chain process. AI helps in price prediction, production process optimization, inventory management and logistics management. AI helps in identifying that in which region a particular crop has grown. A way of estimating demand for transport, pricing and inventory, such as Symphony Retail-AI, prevents us from receiving an oversupply of products that end up being wasteful.

- **Sorting Fresh Product**
  In the past, a producer had to recruit numerous workers to carry out repetitive and repetitive food selecting activities. AI based applications easily selects which particular potato is suitable for chips and which particular potato is more suitable for French fries. Manual sorting is time consuming, cost ineffective and less accurate as well. This potato sorting system is shown below in figure 1. AI based sorting device is also shown in figure 2. Inadequate colored vegetables are also sorted by the same way, reducing the risk of purchasers being thrown. This is possible only because of applying machine learning algorithms together with relevant cameras and sensors.

![Figure 2: Potato Sorting System [15]](image-url)
• **Predictive maintenance and remote monitoring**

It is clear that the production of many things requires big complex systems. Machine learning helps in predictive maintenance of these huge devices. It helps in reducing operating cost, reducing manpower. It also helps in optimum utilization of resources. It helps in achieving more production. It involves machine learning techniques, cameras, sensors and internet connectivity. In good time, maintenance can cut down by up to 50% and the required expenditures by almost 10%. You may create a buzzer on a machine for remote monitoring of intricate mechanisms which will indicate various performance parameters of a particular machine.

• **Predicting Upcoming Products**

AI technology is used to model customer flavor preferences using machine learning and prediction algorithms, and how it responds to new tastes. The data may be divided into population categories to assist corporations build items that correspond to their target audience's preferences. With this, companies might know what items are going to prosper before the shelves are struck. Coca-Cola has placed soft drink fountains, which allow people to personalize their beverages, at several restaurants and other places. Customers may make hundreds of different cocktails by adding additional tastes to their basic drink using these self-service devices. These millennium free-style drink fountains have produced a large volume of information on consumer choice, each of which uses AI to assess hundreds of various beverages per day. CHERRY SPRITE was the first product from this data. Its AI has decided that a large quantity of cherry flavored sprite was made by individuals and that it would do good to produce itself independently.

• **Machine Learning in Food Delivery**

Machine learning plays a vital role in food delivery. It helps in delivering food via smart logistics. It helps in tracking crop products and vegetables. It reduces vegetable waste. It also makes food delivery smart in restaurants. McDonalds’ self-ordering kiosk is shown below in figure 4.
IV. CONCLUSION

Food demand is growing as the world's population grows. Food processing companies are also fast expanding. It is critical to eliminate food waste, optimize the supply chain, and enhance food logistics, food delivery, and food safety. To a large extent, artificial intelligence and machine learning aid in reaching these goals. Machine learning is a new field of data mining that allows a computer program to become more accurate at predicting events without being explicitly programmed. This article discusses machine learning and artificial intelligence applications in the food industry. Major applications include supply chain optimization, crop selection, logistics, food delivery, and anticipating maintenance in food processing machines.

REFERENCES