The Influence of Artificial Intelligence Using Decision Making System in E-Commerce

Dr.M.Venkatesh kumar
Professor
Department of Placement
Saveetha School of Engineering
Saveetha Institute of Medical and Technical Sciences
Chennai, Tamilnadu, India.
drmvenkateshkumar@gmail.com

G. Arathy Suresh
PhD Full time Research Scholar
Department of Commerce
Dr. SNS Rajalakshmi College of Arts and Science
Coimbatore, Tamilnadu, India.
arathysuresh372001@gmail.com

Dr.k. Sumathi
Associate professor and Head
Department of commerce
Dr. SNS Rajalakshmi College of Arts and Science
Coimbatore, Tamilnadu, India.
sumathikathir2003@gmail.com

Dr.S.Thangamani
Associate professor and Head
Department of Commerce with Finance
Dr. SNS Rajalakshmi College of Arts and Science
Coimbatore, Tamilnadu, India.
thangamani2579@gmail.com

Dr. M.Umamaheswari
Research Coordinator and Associate Professor
Department of Business Administration
Dr. SNS Rajalakshmi College of Arts and Science
Coimbatore, Tamilnadu, India.
dr.umamaheswari.m@gmail.com

C. Hema Bharathi
Assistant Professor
Department of Physical Science and Information Technology
Tamil Nadu Agricultural University
Coimbatore, Tamilnadu, India.
chb6@tnau.ac.in

2024 International Conference on Integration of Emerging Technologies for the Digital World (ICIETDW) | 979-8-3315-4117-0/24/$31.00 ©2024 IEEE | DOI: 10.1109/ICIETDW61607.2024.10941592

***Abstract*— E-Commerce is one of the potential idea and network developments which influence the present business world. It spreads worldwide and reaches people rapidly due to its massive benefits and trading approach. Artificial Intelligence (AI) has become an integral part of the e-commerce industry, providing retailers with new and innovative ways to manage and grow their business. One of AI's key advantages is its capacity to offer tailored product recommendations based on user information including shopping patterns, search terms, and browsing habits. By using AI algorithms to analyze this data, retailers can offer customers relevant product recommendations that are more likely to result in a sale. Automating customer support is a further area where AI is useful. Chatbots that are driven by AI can offer all times, immediate service to customers, increasing their satisfaction and speeding up response times. Retailers may now streamline their customer care procedures and concentrate on other aspects of their businesses thanks to this. By forecasting demand, identifying popular products, and ensuring that the relevant products are in stock at the appropriate moment, AI can assist merchants in streamlining their inventory management procedures. Retailers can lower the risk of overstocking or understocking products, which can result in missed sales and lower profitability, by using AI to manage inventory. Furthermore, AI can be used for fraud detection by analyzing customer behavior, purchase history, and other data points. This helps retailers to prevent fraudulent transactions and reduce chargebacks, which can result in significant financial losses. Finally, by examining competition prices, demand, and other factors, AI can assist businesses in optimizing their pricing strategy. By setting the right price, retailers can maximize profits and increase sales. The Main objective of this work is, using advanced technologies to analyze the Ecommerce data and prediction of sales accurately. Different ML and DL algorithms using this work for E-Commerce analysis and Prediction.**

Keywords—Artificial Intelligence, Algorithms, E-Commerce, Naive Bayes, KNN, XGBoost, Neural Network.

I. INTRODUCTION

E-Commerce (Electronic Commerce) is one of the important part in the present business world. The expansion of integration of information and communications technology (ICT) results to rising of economy of developing countries through e-commerce. [4] DM technique plays important role in e-commerce recommender system. The essential elements of e-commerce such as internet, data mining, web mining, e-commerce and its types, recommender system and its ontological structure, collaborative filtering techniques and its limitations and scope of the research are explained further.

Sales data collection and data analysis are the major domains engaged by data scientists around the world. The conventional data mining processes and data collection processes are not efficient against huge set of data handling platforms. Sales data analysis is the crucial process nowadays to mine the regularly collected data from various sales points for evaluating the ground performance of a particular company [3]. This process is motivated to observe the improvement or problems of the sales team about all products. In addition, the next level of sales data analysis finds the future product demands through well-defined sales data prediction models. The sales data prediction and analysis models are implemented to take decision about the product-specific and customer-specific classifications through various modes. Analyzing and predicting multiple product data for online and physical marts are challenging tasks than single product analysis practices. On the mentioned choices, the sales data can be analyzed through various periods of business year to get future updates (timeline) [2]. Similarly, the comparison between actual sales rate and expected sales rate of notable products shows the business statistics to diagnose the business issues immediately. In addition, the regular sales data collections and sales analysis help to monitor daily business growth on various market products [1]. Fig 1 shows the ML process for sales prediction.

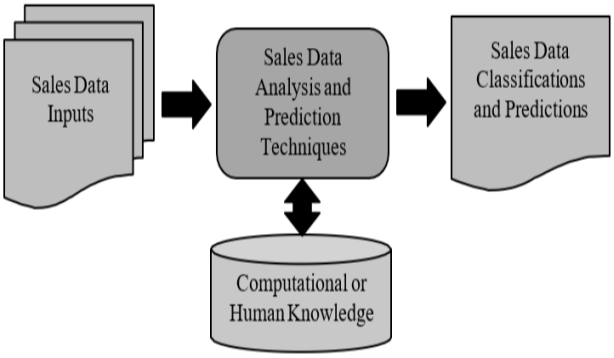

Fig. 1. Shows Machine Learning process

Data mining is extracting information, knowledge and immersing patterns from large databases. It is a domain used to retrieve the data, preprocess the data and analyze the data for further prediction. It is one of the most important research area used for predictive modeling. [4] Database data, data warehouse data and transactional data can be mined from large sources. The major tasks performed by data mining are descriptive mining and predictive mining. The common properties available in the existing data will be expressed by descriptive data mining. [5] The predictive method efforts to predict the future occurrences in advance, based on the information collected from the available datasets.

In e-commerce, prediction objectives are crucial for optimizing operations, enhancing customer experience, and driving business growth. Implementing these prediction objectives typically involves leveraging data analytics, machine learning, and AI techniques to analyze historical data and identify patterns that can inform future actions and decisions.

- The aim of the research is to provide a better predictive model in forecasting the sales of outlet item in e-commerce by comparing the performance of predictive models created using machine learning or deep learning using the defined objectives.
- This research seeks to determine whether a deep neural network technique, with its superior ability to interpret relationships between features, can be used to predict the sales of outlet items in E-Commerce more accurately than machine learning techniques.
- Specifically, it seeks to review related pieces of literature

Analyze content based on large-scale predictions, as well as to develop predictive models using various learning techniques and evaluate the performance of these models based on performance metrics.

II. Samples and Techniques

A. *Overview of Machine Learning and Data Mining Technologies*

Machine learning uses computers that apply algorithms to the data to provide the necessary knowledge [15]. It can take many brilliant decisions so that the process will succeed. Artificial intelligence is a part of machine learning,it can be defined as a method that helps computers to learn how to make predictions based on data. This method makes computers able to learn without a detailed way of programming. It (machine learning) can be considered as a learning system that can find different spam or non-spam email messages, i.e. classifying spam messages intoa spam folder and non-spam messages into another folder. [7] It is used several times in many fields, such as medical field diagnosis to detect tumors, auto-driving cars, computational biology like DNA sequencing, analysis in the stock market, recognizing faces, detecting motion, aerospace, and predictive maintenance in manufacturing and drug detection. Machine learning is very useful when there is a shortage of skilled professionals for the detection of the phenomenon [5].

It maintains accuracy of the predicted outcome. Human accuracy may not be accurate like in reading the images. Usually, machine learning is a better option because of its advantages. It is more accurate than a human's result and accuracy when it is data- driven. Several times humans are not able to show what they know. Machine learning does not need a human expert [6].

It's an automatic method to search for hypotheses explaining data. It is cheap and can be applied to any type of task.[12]. Supervised learning is the machine learning category that predicts a specific result from a dataset. Fig 2 shows the process of the ML process.

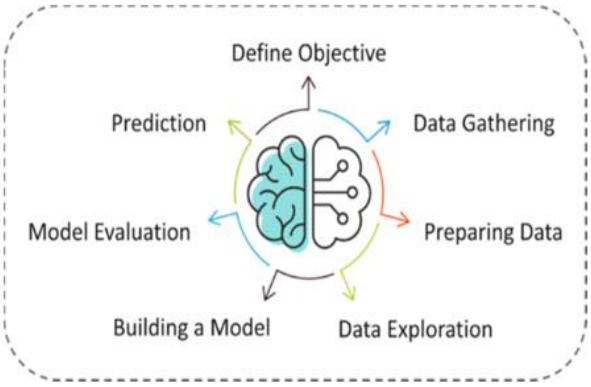

Fig. 2. Shows Machine Learning process

Supervised learning can be accomplished in two steps. The first one is training the machine learning model with existing labeled data (data labeled with the outcome which has values "0" or "1") to teach the model with higher accuracy. The second one is expecting the trained model to predict with high accuracy with the true outcome from new data without human interference. This is the purpose of supervised learning to build models that generalize [9]. Supervised machine learning can also be used for any prediction within some time frame using previous data.

Unsupervised learning is the learning task that shows how to represent data in the best way and it does not conclude the right or wrong answer. [16] Applications for unsupervised learning like gene sequence analysis, object recognition, and market research. For example, if someone is studying the purchasing behavior of customers in Amazon or any shopping mall, it may create different clusters such as students, women, children, etc. In this case, it is difficult to know the right or wrong answer about the number of clusters that can be found in the data, which people belong to which clusters, or how to describe each cluster[13].

Machine learning is used for complex problems with complex and large data and many variables. This means that ML is the sole solution to handle hand-written rules, face and speech recognition. It also manages tasks with dynamic rules, such fraud detection from transaction records. [14] It is also a solution for the constantly-changing nature of the data, to which the software must adjust. Examples of this include automated trading, projecting energy consumption, and spotting purchasing trends.

In E-commerce machine learning algorithms involves building a model that can analyze relevant data and make predictions based on patterns it learns from that data. [8] The general outline of the steps are,

Data Collection: Compile a dataset with pertinent attributes (variables).

Data Preprocessing: Handle missing values: Impute or remove them.

Encode categorical variables: Use one-hot encoding to convert category variables into numerical representations.

Scale or normalize numerical features: Make sure the scale of each feature is the same.

Feature Selection: Identify prominent features that contribute to predicting heart disease. Techniques like feature importance, correlation analysis, or dimensionality reduction can be used.

Model Selection: Make the appropriate machine learning algorithm selections.

Train the Model: Divide the dataset into training and testing sets in order to train the model. Utilizing the training set, train the selected models.

Evaluate the Model: Use measures to evaluate the models on the testing set.

Hyperparameter Tuning: Adjust the hyperparameters of the model to enhance its efficiency.

Cross-Validation: To assess the generalization capabilities of the model, use cross- validation.

Interpretability: Depending on the model used, consider interpretability methods to comprehend the prediction process of the model.

Deployment: After completed the model's performance, put it to practical use.

Ethics and Bias: Be mindful of potential biases in the data and ensure fairness in predictions.

Ongoing Monitoring and Maintenance: Update the model frequently when fresh data becomes available. When performance starts to decline, keep an eye out and adjust the model as necessary.

The procedures can be modified in accordance with the needs and features of your dataset and issue. Additionally, to make sure the model meets their expectations and level of knowledge, confer with domain specialists, such as medical practitioners.

B. Data Samples Details

Detailed information on Amazon sales data, such as Design Number, SKU Code, Size, Color, Stock, and Category, is provided by this dataset. This data samples collected from online.

C. Prediction Using KNN

The supervised machine learning method known as k-NN, or k-nearest neighbors, is widely applied in categorization applications. It distinguishes itself from other algorithms by eschewing the creation of a predefined model before making predictions. Instead, K-NN stores all available data and awaits the introduction of new data points. [10] When a new data point is presented, the algorithm classifies it by assessing its similarity to other data points. Operating on the principle of majority voting, an information point's class is determined by K-NN using the agreement of its k-nearest neighbors., where the user specifies the value of k as an integer. In essence, K-NN is a form of lazy learning, as it defers the learning process until the actual prediction is required. Figure 3 shows the different steps of KNN [15].

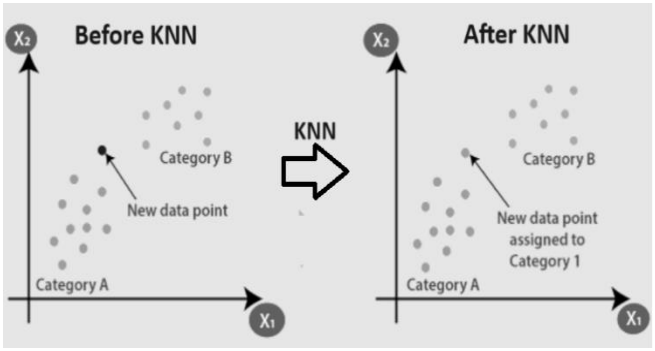

Fig. 3. KNN

Procedures for employing the k-nearest neighbors (K-NN) algorithm:

- Choose K: Decide on the value of K, which signifies the count of nearest neighbors to be considered for classification.
- Compute Distances: Evaluate the distance between the target instance and every other instance in the training dataset.
- Locate K Neighbors: Discover the K instances with the most minimal distances to the target instance. These identified instances then become the "neighbors" of the target instance.
- Voting: Establish the class or label of the target instance by considering the class labels of its K nearest neighbors. This involves employing techniques such as majority voting, weighted voting, or other methods.
- Prediction: Conclude the predicted class label for the target instance based on the outcome of the voting process.

D. Prediction Using NB

Naive Bayes (NB) classification algorithms belong to a group of supervised learning techniques utilizing Bayes' theorem for predictions. They function on the presumption that every feature is distinct from every other feature. Naive Bayes, a widely used and straightforward method in supervised learning, finds applications in diverse fields like text categorization, spam filtering, and medical diagnosis [11]. Due to its quick training process and ease of implementation, Naive Bayes is a popular choice among machine learning practitioners. Stages in applying the Naïve Bayes classifier algorithm:

- Data Preparation for Training: Preprocess and format the training dataset to suit the requirements of the Naïve Bayes algorithm.
- Calculate Class Priors: Compute the prior probabilities for each class label within the training dataset.
- Learn Conditional Probabilities: Derive the conditional probabilities of attributes assigned by the training dataset to each class label. This step assumes feature independence, hence the "Naïve" in Naïve Bayes.

- Prepare Test Data: Preprocess and format the test dataset to match the structure used in relation to the training data.
- Classify Test Instances: For each instance in the test dataset, calculate the posterior probabilities of each class label using the learned conditional probabilities and class priors. The instance should be given the class label with the largest posterior probability.
- Evaluate Performance: Evaluate the Naïve Bayes classifier's performance by contrasting the test dataset's predicted and true class labels.

E. Prediction Using XGBoost

Extreme Gradient Boosting, or XGBoost as it is sometimes shortened, is a potent machine learning method renowned for its accuracy and efficiency [12].

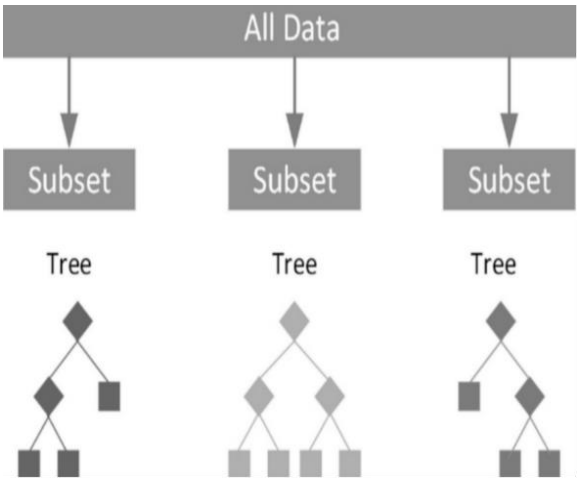

Fig. 4. XGBoost

XGBoost incorporates several key features that contribute to its robust performance:

- Regularization: To reduce overfitting, XGBoost incorporates L1 and L2 regularization terms into its goal function. By preventing the model from memorizing the training set, this guarantees that it will generalize well to new data.
- Tree Pruning: During the tree construction process, XGBoost applies pruning techniques to eliminate splits that do not contribute significantly to improving the objective function. This results in simpler, more effective trees.
- Column Subsampling: XGBoost supports column subsampling, A subset of the features (columns) at each node of the tree is chosen at random. This technique aids in reducing overfitting and enhancing the diversity of weak models.
- Handling Missing Values: The dataset contains built-in support for handling missing values using XGBoost. Instead of treating missing values as a distinct category, the algorithm learns the optimal direction to take when a value is missing.
- Parallel Processing: Utilizing parallel processing techniques, XGBoost efficiently leverages multiple CPU cores for tasks such as tree construction and gradient calculation. This parallelization significantly accelerates the model training process.
- Cross-Validation: XGBoost incorporates integrated cross-validation capabilities, allowing users to evaluate the model's effectiveness and efficiently tune hyperparameters. This aids in optimizing the model's output with unknown data.

F. Prediction Using Feed-Forward Neural Network (FFNN)

Data passes through any potential hidden layers as it moves from the input process to the output process. [13]

.

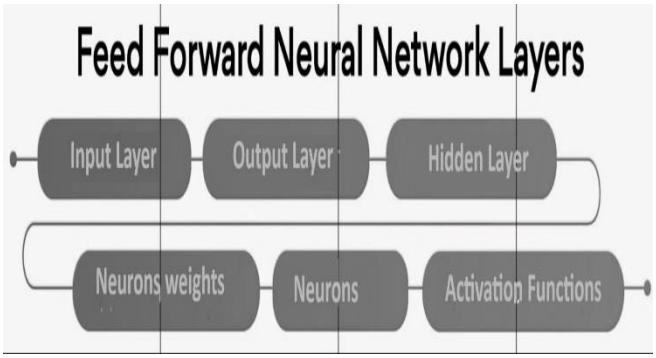

Fig. 5. FFNN

An outline of the main elements and functions of a feed-forward neural network is provided below:

- Input Layer: The first layer from which features are input. An input characteristic is represented by each node in this layer.
- Hidden Layers: The intermediate layers between the output and input layers. Through activation functions and weighted connections, the nodes (neurons) in these layers modify the input data.
- Output Layer: Final layer that generates result for the network. The type of problem (binary classification, multiclass classification, regression, etc.) determines how many nodes are in this layer.
- Neurons (Nodes): To generate the output, every node in the output layer and hidden layer adds a bias term, weights the total of its inputs, and applies an activation function.
- Weights and Biases: The connections between nodes are represented by weights. Every link has a weight attached to it that establishes its strength. Prior to the activation function being applied, the weighted total is increased by the bias term associated with each node.
- Activation Function: Neurons add non-linearity to the model through an activation function.
- Feed-Forward Process: During the feed-forward process, input data pass through the network layer by layer, undergoing transformations through weighted connections and activation functions. Each layer's output serves as the input until the output layer generates the final output, for the subsequent layer.
- Loss Function: An alternative name for the loss function is a cost function, which is used to compare

the output of the network to the real target values. The loss function determines the amount of discrepancy between the predicted and actual numbers.

- Backpropagation: Using backpropagation, the network's weights and biases are updated in accordance with the calculated loss. To minimize the loss, in relation to the model parameters, the weights are adjusted according to the loss's gradient.
- Training: During the training phase, the entire process of forwarding input, calculating the loss, and changing weights via backpropagation is repeated iteratively. The model learns to make better predictions as it adjusts its parameters to minimize the loss.
- Optimization Techniques: Various optimization methods, such as SGD or advanced variants like Adam or RMSprop, are commonly used to optimize the learning process.
- Output: Once trained, by feeding the input through the learned network, the FFNN can be used to forecast fresh, unknown data.

Their key component in deep learning architectures is their capacity to discover intricate relationships in data. Figure 5 depicts the FFNN architecture.

III. Evaluation Formulae

In the E-commerce sales prediction, terms like True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN) are generally used when the prediction problem is framed as a classification task. For example, predicting whether sales will exceed a certain threshold (binary classification).

- True Positive (TP):

  Definition: Predicted sales exceed the threshold, and actual sales also exceed the threshold.

  Example: The model predicts sales will be high, and indeed, the actual sales are high.

- True Negative (TN):

  Definition: Predicted sales do not exceed the threshold, and actual sales also do not exceed the threshold.

  Example: The model predicts sales will be low, and indeed, the actual sales are low.

- False Positive (FP):

  Definition: Predicted sales exceed the threshold, but actual sales do not exceed the threshold.

  Example: The model predicts sales will be high, but the actual sales are low. This is also known as a Type I error.

- False Negative (FN):

  Definition: Predicted sales do not exceed the threshold, but actual sales exceed the threshold.

- Example: The model predicts sales will be low, but the actual sales are high. This is also known as a Type II error.

The Confusion matrix design shows figure 6.

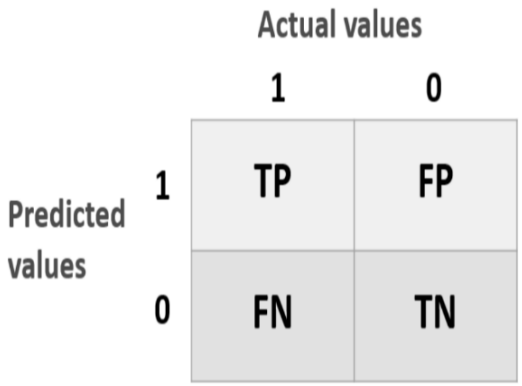

Fig. 6. Binary Matrix

IV. Results and Discussions

The results shows in the figures. Figure 7 is the results of accuracy. KNN gives 85% accuracy, NB gives 87% accuracy, XGBoost gives 90% accuracy, FFNN gives 92% accuracy, and Hybrid method gives 95% accuracy.

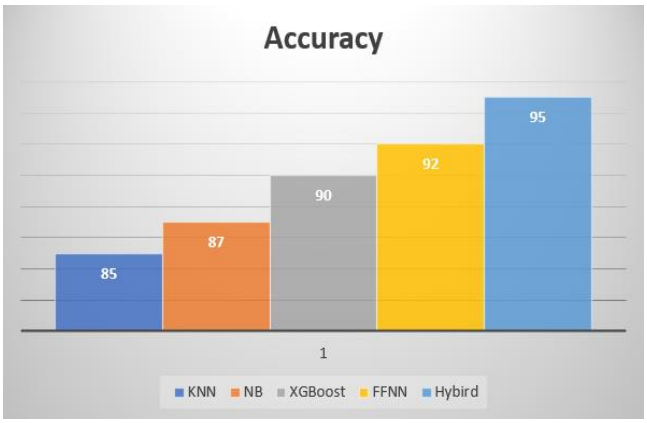

Fig. 7. Accuracy

Figure 8 is the results of Precision. KNN gives 82% Precision, NB gives 83% Precision, XGBoost gives 87% Precision, FFNN gives 90% Precision, and Hybrid method gives 95% Precision.

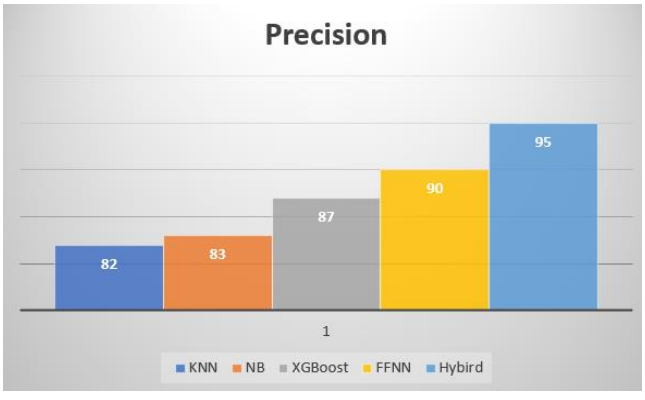

Fig. 8. Precision

Figure 9 is the results of Recall. KNN gives 84% Recall, NB gives 82% Recall, XGBoost gives 85% Recall, FFNN gives 89% Recall, and Hybrid method gives 91% Recall.

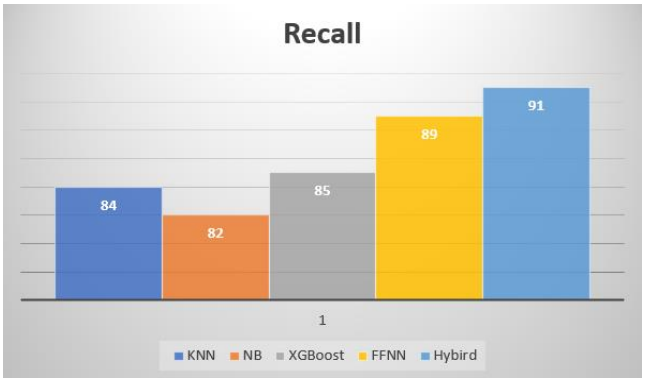

Fig. 9. Recall

Figure 10 is the results of F1-score. KNN gives 84% F1-score, NB gives 85% F1-score, XGBoost gives 89% F1-score, FFNN gives 90% F1-score, and Hybrid method gives 93% F1-score.

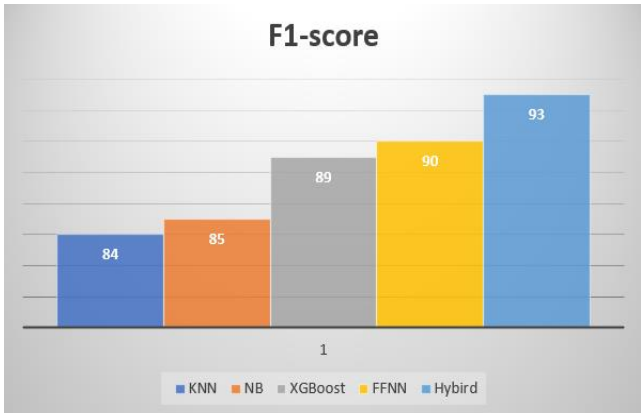

Fig. 10. F1-Score

The results shows hybrid method is satisfied the research work other than ML and DL techniques.

V. Conclusions

The analysis of the overall Machine Learning algorithm plays a very important role inmedical applications. Recently, the most lending technique to handle huge volumes of information in Data Science. E-commerce data stored in large volumes in databases need intelligent-based discovery. All the E-commerce data are large and need more possibilities to analyze. Data Science is the process to analyze a huge volume of accessible E-Commerce data from various futuristic potentials and provides knowledge-based information to the user to predict the E-commerce details accurately.

This present work involved previous or existing studies and comparison with this work worked on a Hybrid Machine learning algorithm for the prediction of E-commerce Details. Since the research is done in offline evaluation mode with large data set, the extension work for this thesis in future is to implement the three proposed algorithm in real time online e-commerce area.

References

[1] J Sreemathy and N Prasath, “Machine Learning based Sales Prediction and Characterization using Consumer Perceptions,” Sixth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2022.

[2] K Anushka Xavier, Chinthakunta Manjunath and et al, “Analytical Methods of Machine Learning Model for E-Commerce Sales Analysis and Prediction,” IEEE International Conference on Contemporary Computing and Communications (InC4), 2023.

[3] Lixia Zhao and Wei Jin, “Application of Web Data Mining and Information Combination Technology in E-commerce,” International Conference on Electronics and Renewable Systems (ICEARS), 2022.

[4] Yulin Luo, Shengxing Xu and Chao Xie, “E-commerce Big Data Classification and Mining Algorithm based on Artificial Intelligence IEEE 2nd International Conference on Electronic Technology, Communication and Information (ICETCI), 2022.

[5] Shuang Li, “Sales Forecasting Model of E-commerce Activities Based on Improved Random Forest Algorithm,” 2nd International Conference on Computer Graphics, Image and Virtualization (ICCGIV), 2022.

[6] Jian Lv, “Optimization of E-Commerce Logistics System Based on Artificial Intelligence Technology,” J. Phys.: Conf. Ser. 1881 032062, 2021.

[7] Karandeep Singh, P M Booma and Umapathy Eaganathan, “E-Commerce System for Sale Prediction Using Machine Learning Technique,” J. Phys.: Conf. Ser. 1712 012042, 2020.

[8] Farah Tawfiq Abdul Hussien, Abdul Monem S. Rahma and Hala Bahjat Abdul Wahab, “Recommendation Systems For E-commerce Systems An Overview,” J. Phys.: Conf. Ser. 1897 012024, 2021.

[9] Ge Zhang, “Customer Management Decision Model and Algorithm Based on Enterprise Sales Forecast,” J. Phys.: Conf. Ser. 1881 022074, 2021.

[10] K.K. Nivethithaa and S. Vijayalakshmi, “Survey on Data Mining Techniques, Process and Algorithms,” J. Phys.: Conf. Ser. 1947 012052, 2021.

[11] Chen Xiaojun and Bian Jiang, “Analysis of the Application of Machine Learning Algorithms in Data Mining,” J. Phys.: Conf. Ser. 1550 032039, 2020.

[12] R. Praveen, D. Praveen Kumar and et al, “Sales prediction using machine learning,” AIP Conf. Proc. 2444, 040001, 2022.

[13] K. Saraswathi, N. T. Renukadevi and et al, “Sales prediction using machine learning approaches,” AIP Conf. Proc. 2387, 140038, 2021.

[14] K Pradeep, R., Revathi, K., Thomas, A.K. and, Srikanth, R., “A Novel Optimized AI Based Model for Traffic Prediction in VANET,” Proceedings of the 5th International Conference on Inventive Research in Computing Applications, ICIRCA 2023, 2023, pp. 1175–1180

[15] M. Vasuki, T. Amalraj Victorie, R. K. K arishmaa Shamim, “Survey On Prediction Of Sales Using Machine Learning Techniques,” International Research Journal of Modernization in Engineering Technology and Science, 2024.

[16] V. Latha Jothi, Aditya B., Arthika S., and Jayashree S., “Sales Prediction using Machine Learning Algorithm,” International Journal of New Innovations in Engineering and Technology, 2023.