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AN EFFECTIVE AND REAL TIME PRODUCT DEMAND FORECASTING MODEL USING ML

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ABSTRACT

In today's environment, business intelligence (BI) is crucial in developing a strategy and implementing data-driven activities. Business intelligence (BI) is a vital component of a decision support system that assists an organization in analyzing data and making choices throughout the business process. To estimate future company demands, machine learning is applied. One of the most crucial parts of commercial decision-making is demand prediction. For demand forecasting, sales data which are not pre-processed is received from the market and future sales/product demands are predicted based on the data. This forecast is based on data collected from a number of sources. On a weekly, monthly, and quarterly basis, to assess goods/commodity demand, the machine learning techniques examines data from a variety of sources. In estimation of demand, accurate precision is not negotiable, the high precise the model of the system, the high efficient it is. In addition, by comparing planned and actual data and determining the proportion of inaccuracy, this study will assess efficiency.

I. INTRODUCTION

Business intelligence is crucial in assisting organizations in making decisions regarding their future operations in this age of technological progress. Corporate intelligence is described as the methodologies, strategies, and concepts that have a beneficial influence on business choices by utilizing systems based on facts. Unstructured and uninformative data is transformed into useful data through framework and machinery, all-encompassing information. The above mentioned vital information aids in the development of innovative plans, functional superiority, calculated perception, and making a strong decision for the organization's future. In the current and near future, intelligence on business is poised to play a critical role in practically every type of organization. Intelligence on business is a must-have for all sorts of businesses in all industries for analytics and good decision-making. It not only enhances corporate organization’s efficiency and effectiveness, along with this it decreases expenses and eliminates dropping in business. This is beneficial with client retention and attractiveness, as well as increasing revenue and a range of other significant benefits. BI anticipates future market tendencies. In the creation of a BI model based on demand forecasting for a given organization, one implement is machine learning, while another is automation. Forecasting demand is a subset of predictive analytics that has gained in prominence over time. In demand forecasting, there have traditionally been two primary assessment methodologies utilized. Quantitative assessment and qualitative assessment are the two types of evaluation. With the advancement of research, these approaches have been expanded into new categories, and some new methods for forecasting concepts and combinations have been presented. Demand forecasting is the estimation of future product/service demand based on current and historical data as well as various market factors. As with many organizations, the future is unpredictable, and we have no idea what product demand will be in the future. As a consequence of analyzing past and ongoing market data, this can estimate following demand and produce items that will be in great demand in the near future. As a result, we will be able to produce the essential products ahead of time based on market demand. Aside from the products that the company needs to make, this will also decide possible buyers for the company/production facility. Finally, a correct prediction may result in a profit for the company. To put it another way, demand forecasting is a critical component of effective management planning. Demand forecasting is equally advantageous to industrialized countries with uncertain industrial demand requirements.

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II. LITERATURE SURVEY

A. Study of Monthly Electricity Sales Forecasting Based on Seasonal Adjustment and Multi Factor Correction Method:

This paper was published in 2018. Methodology used are Holt Winters Multiplication model and a multifactor correction prediction model which is dependent on seasonal adjustment. There are limitations. This forecasting model for electricity sales is limited to Tianjin, China. It isn't a generic product. The Holt Winters model will provide monthly power sales characteristics, but it will not provide an accurate smoothing effect. [1][2][3].

B. Water Demand Prediction using Support Vector Machine Regression:

This paper was published in 2019.Methodology used are Regression Method and Support Vector Machine is used for Implementation. There are limitations. These regression and SVM techniques produce graphical output, which makes distinguishing between them challenging. This application is not appropriate for real-time use. Results are less precise. Small data sets were employed. [4][5][6].

C. Predictive Agricultural Demand Insights using Machine Learning:

This paper was published in 2020. Methodology used is Smart Basket Algorithm using apriori. This paper's limitations include the fact that it is only applicable to agricultural lands and that it is not a generic application. The smart basket algorithm's support calculation is time-consuming because it must go through the complete data set. It takes a long time to compute. [7][8][9]

D. Sales Prediction based on Machine Learning:

This paper was published in 2021.Methodology used is Deep Learning Models, Regression model and XGBoost (Gradient Boosting Decision Tree (GBDT)). The paper's disadvantages include that Deep Learning takes a big amount of data to perform better than other techniques and that training it is incredibly expensive due to complicated data models. On sparse and unstructured data, XGBoost performs poorly. Gradient Boosting is highly sensitive to outliers since each classifier is driven to fix the mistakes made by the previous learners. The method as a whole isn't very scalable. [10][11][12].

E. Commodity Price Evaluation Based on Improved Data Mining Methods:

This Paper was published in 2020. Methodology used is KNN Algorithm and Root Mean Square error (RMSE). The accuracy of KNN algorithms is dependent on the quality of the data, and with enormous data, the prediction stage may be slow. It necessitates a large amount of memory, as all of the training data must be stored. It takes a long time to compute. Root Mean Square Error is a fantastic loss metrics for a model to optimize because it can be computed quickly and penalizes particularly bad predictions. [13][14][15]

III. METHODOLOGY

A. Machine learning:

The study of computer algorithms which will grasp and improve by itself through incident and information is called machine learning (ML). It is regarded as an element of artificial intelligence. Algorithms of Machine Learning will utilize learning data set to build a prototype which estimates or decides without the need to be explicitly instructed to perform like above mentioned. Algorithms of Machine Learning are used in a variety of fields such as medical science, spam filtering, voice recognition, and machine vision, when it is difficult or impossible to develop typical algorithms to do the necessary tasks. Machine learning Techniques: Machine learning utilizes two methods: supervised learning and unsupervised learning.

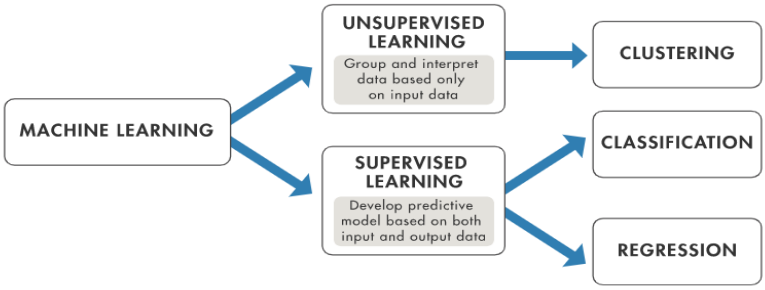

Figure 1: Machine learning types

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B. Unsupervised Learning Technique:

Unsupervised learning reveals latent patterns and fundamental design in information. This is utilized to get conclusions from information sets that lack tagged replies. Clustering is one of the highly used unsupervised learning approach. This is utilized in exploratory information survey to identify latent patterns or groups. Cluster survey uses involves gene sequence scanning, retail exploration, and item identification .A mobile phone provider, for example, this can utilize machine learning to predict the number of members in a group that rely on its towers in order to optimize the places where cellular phone towers are built. Because a cellular phone can only communicate with single cell phone tower at a time, the team employs clustering techniques to improve signal reception for groups of customers, or clusters. Common clustering approaches include K-means and k-medoids, hierarchical clustering, Gaussian mixture models, hidden Markov models, self-organizing maps, fuzzy c-means clustering, and subtractive clustering.

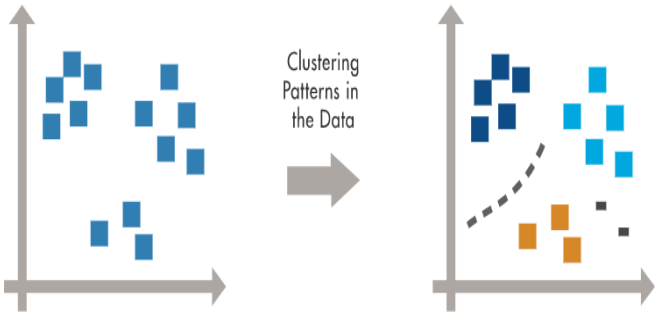

Figure 2: Clustering of data (Example for unsupervised learning)

C. Supervised Learning Technique:

It's a predictive model that's utilized for activities that require the prediction of one value using other values from the available data set. Predefined labels will be used in supervised learning. It assigns a label to an object depending on the parameters of one of a set of labels. In supervised learning, we can use a variety of algorithms to develop models, which involves K Nearest Neighbour, Naive Bayes, Decision Tree, ID3 algorithm, Random Forest Algorithm, Support Vector Machine, Regression methods, and more. This choose the best algorithm for predictions based on the requirements, labels, parameters, and data set available. When there is uncertainty, algorithms are employed to build a model that makes evidences based on the predictions. We employ the "Random Forest Technique" in this project for prediction, which is an efficient algorithm that works well with a wide range of parameters. It also produces precise results or makes precise predictions.

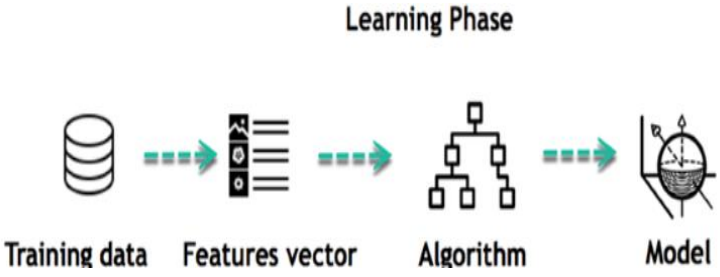

Figure 3: Supervised learning technique illustration

D. Random Forest Algorithm:

Random forest is a supervised machine learning technique utilized to address classification and regression issues. This produces decision trees from a variety of sources, employing the maximum vote for classification and the minimum for regression. One of the most essential properties of the Random Forest Algorithm is its capacity to handle information sets with both continuous and categorical variables, as in regression and classification. This exceeds other methods for classification problems.

E. Random Forest Algorithm Steps:

The working of random forest algorithm is as given below.

Step 1: A random seed is selected, and samples from the training dataset are extracted at random while the class distribution is preserved.

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Step 2: With the above selected information set, an arbitrarily selection of characteristics through the original information set is selected depending on client-specified criteria. Because of the huge calculation and substantial risk of over fitting, all of the inserted values are removed.

Step 3: For each tree in a dataset, only R attributes are selected at arbitrarily, where M is the total number of inserted attributes in the information set and R < M.

Step 4**:** The attributes from this collection produce the finest way of split when the gini index is used to construct a decision tree prototype. The procedure is repeated for every branch until the final step, which specifies that leaves are nodes that are too small to divide, is met

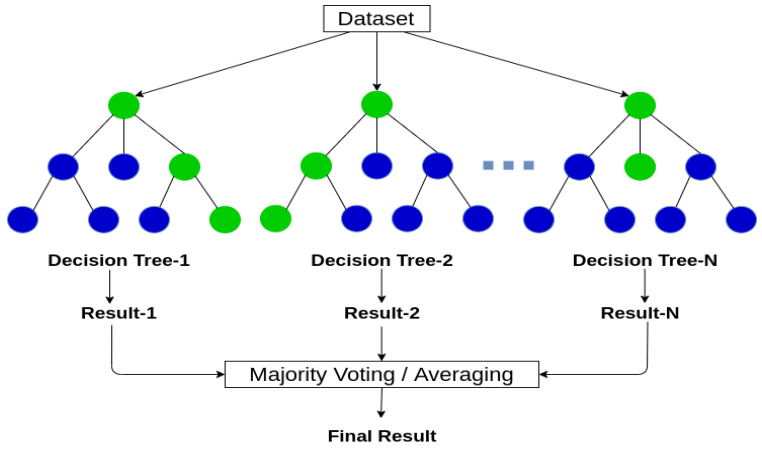

Figure 4: Random Forest Illustration

IV. FLOWDIAGRAM

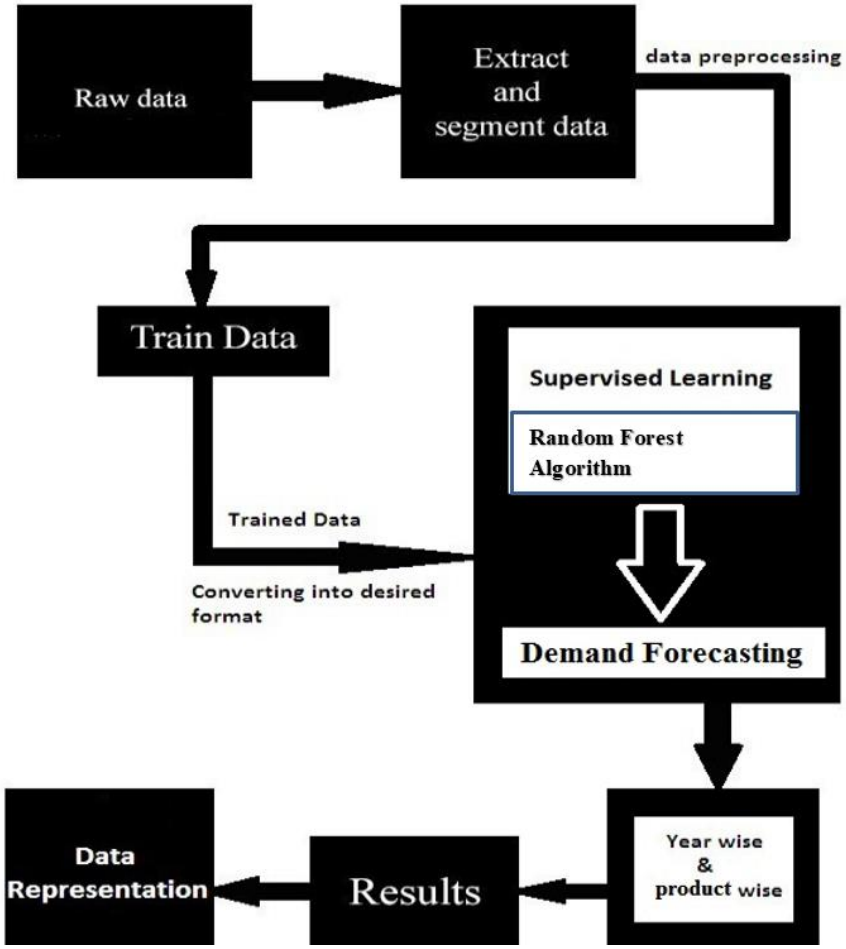

Figure 5: Flow Diagram of our project

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V. COMPARISION TABLE

Paper Title	Author	Year	Model	Accuracy	Datasets Required
Study of Monthly Electricity Sales Forecasting Based on Seasonal Adjustment and Multi Factor Correction Method	Zhung Jian, Li Kai Liu Zhanzhan Liu Ruimin	2018	Holt Winters Multiplication model and a multifactor correction prediction model	Less	Monthly electricity sales data of Tianjin city are collected.
Water Demand Prediction using Support Vector Machine Regression	Amrita Tamang Samiksha Shukla	2019	Regression Method and Support Vector Machine	Average	Measurable information from various consumption units and meters from water supply networks.
Predictive Agricultural Demand Insights using Machine Learning	Ruchi Sharma, Riya Kapoor, Nisarg Bhalavat, Chintan Oza	2020	Smart Basket Algorithm using Apriori	Average	Collected manually by using the method of F2H farm to home.
Sales Prediction based on Machine Learning	Zixuan Huo	2021	Deep Learning Models, Regression model and XGBoost (Gradient Boosting Decision Tree(GBDT))	Less	Walmart's real data sets as well as categorized sales data.
Commodity Price Evaluation Based on Improved Data Mining Methods	Yunling Liu, Yansong Lv	2020	KNN Algorithm and Root Mean Square error (RMSE)	Average	Old notebook sales data from the jd e-commerce platform are gathered.

VI. CONCLUSION

Because the contemporary era is characterized by technical growth. Business intelligence (BI) practices are also in great demand. When business intelligence (BI) techniques are integrated throughout an organization, accurate and effective decision support is achieved. BI helps a company's stability, sustainability, and productivity. Demand forecasting is becoming increasingly important for organizations. Businesses previously had to do these computations by hand or other irrational approaches. Forecasting has impacted an organization's business philosophy and culture as the market has grown more dynamic and resilient. It has also significantly boosted executive support, cooperation, and transparency. Because the organization does not have production units and acquires items based on projections, prediction of demand enhances functional efficiency and decreases dropping in business and waste in this system. High forecast accuracy supports in the development of a market strategy, boosting stock turnover, cutting supply chain costs, and enhancing customer satisfaction. This study looked into the usefulness of time series and rule-based forecasting. Forecasting estimations show that Deep AR models' performance is extremely accurate and similar. As a result, the percentage error numbers are quite low, and Deep AR models give good predicting accuracy. The model gives more accurate findings as the data amount grows. New research could be linked to stock optimization, depending on its correctness. As a result, the stock/product optimization point can serve as a fresh start.

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