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COMPARATIVE ANALYSIS OF FORECASSTING TECHNIQUES FOR ITS EFFECTIVENESS

Sanober Shaikh Assistant Professor TSEC
Dr. G. T. Thampi, Principal TSEC
sanober.shaikh@thadomal.org

Abstract- It is observed that differing problem domains with varying complexity and intrinsic characteristics demonstrate varying learning abilities, when subjected to Deep Learning and Machine Learning processes, it is also resulting in varying learning outcomes with differing algorithms. This paper is trying to have close look at Prediction Models and its effectiveness in many of the functional domain. Depending on the type of input data considered, a model's resulting out of idealization of functional problems with some degree of abstraction, found to results in varying accuracy for the same input data. This paper describes the approach that shall zero in on the best prediction algorithms for different types of domains to achieve faster and better results. Pervasiveness of quantum computing shall make time complexity a non-issue of algorithms and throws up new approaches to formulate these algorithms. We are exploring the futuristic scenarios with quantum computers getting used in businesses and research laboratories working on machine learning techniques with large amount of data for training of neural networks.

Key words-Prediction Techniques, Machine Learning, Deep Learning, idealization, quantum computing, neural networks

1. INTRODUCTION

In today's digital era everyone wants to know beforehand what will happen in the future. That is why researchers are doing prediction in almost all the domains. So correct and accurate prediction is very important. Forecasting is making systematic predictions about the future based on history. Forecasting helps us to analyze current and historical data to predict future demand. A forecast model can be beneficial to all types of domains. When forecasting is accurate, it brings enormous commercial benefits. Businesses that spend time studying their own success as well as the general market are better positioned to predict the changes and adjust when the unexpected occurs. Weather forecasting is one of the critical predictions. Accurate predictions are used to save life and property before the time. In this paper comparison of different machine learning algorithms is studied.

2. LITERATURE SURVEY

The objective of this review of the literature is to locate, assess, and interpret all important research on various prediction techniques, including machine learning, deep learning, quantum machine learning, and quantum deep learning.

2.1 Different types of forecasting techniques

For accurate data prediction, different forecasting techniques such as finding different types of trends, patterns or relationships using data mining, machine learning and deep learning are used. Various problem domains such as stock market, crop yield prediction, weather forecasting, disease outbreak, GDP Growth etc. can be used. Forecasting methods include Logistic Regression (LR), Artificial Neural Network (ANN), Support Vector Machine (SVM), Random Forest (RF), Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), and Auto Regressive Integrated Moving Average (ARIMA) etc. Hybrid modelling integrates different algorithms to achieve better accuracy. Based on the doma in different hybrid models are used.

2.2 Different problem domain which can benefit from forecast

Depending on the model or technique used for forecasting, forecasting systems may be divided into three categories: statistical models, artificial intelligence models, and hybrid models. A mathematical representation of the observed data is referred to as a statistical model and are mostly concerned with linear datasets. Examples of frequently employed statistical models are ARMA, ARIMA, and their variations. These models make use of historical information. AI models can be classified into two categories as Machine learning model and deep learning. Classification, LR, Decision tree, ANN, SVM, CNN, RNN, and LSTM networks are some of the popular AI models utilized for different forecasting applications. These models perform better in forecasting because they are adept at handling nonlinear datasets.

2.2.1 Forecast of weather patterns:

According to Reference [1], weather predictions are created by gathering information about the atmosphere's current condition and applying an understanding of its changing dynamics. To acquire information for weather forecasts, a range of instruments can be utilized, such as barometers, radar, and thermometers. Weather forecasting also requires the use of additional parameters, such as the current and historical weather information, observation of the motion of wind and clouds in the sky, and detection and confirmation of changes in air pressure. Accurate weather prediction is crucial in many commercial sectors. New technologies like IoT and cloud computing have made it possible for weather forecasting to utilize enormous amounts of data. The numerous forecasting models, methods, and approaches employed by various researchers in weather forecasting are described in depth in this study. Random forest is one of the most trustworthy high-dimensional ensemble classifier for data with good accuracy. RNN and LSTM are considered to be among the most effective models for time series prediction.

TABLE-1: COMPARISON OF DIFFERENT PREDICTION ALGORITHM FOR WEATHER PREDICTION

Ref	KN	RF	AN	ML	ML	SV	RN
[2]	√			√			
[3]				√			
[21]		√					
[22]		√			√	√	
[23]			√			√	√
[24]		√					

As discussed in many research papers it is observed that Random Forest [21, 22, 24, 42, 43] and Support Vector Machine [22, 23] are used in many papers as prediction models. The prediction outcomes of the random forest model are more accurate than those of regression models and SVM models. The random forest machine learning model has a strong R2 score and a minimal error value. Apart from these, many hybrid models are used for accurate weather forecasting. The approach suggested by Khashei and Bijari is a hybrid model that mixes the ARIMA and ANN models together and is more efficient as compared to typical standalone models [3]. To improve the effectiveness of forecasting models, hybrid models combine any two models.

2.2.2 Forecast of Agriculture:

According to Karthikeya, K. Sudarshan, and Disha [4], the KNN method is used to estimate agricultural productivity. Humidity, temperature, rainfall, and soil type are significant elements that influence crop variations and predictions regionally.

A precise crop production forecast model, according to authors [12] can assist farmers in choosing what to produce and when. There are several methods for predicting agricultural yields. Predicting crop yields is one of agriculture's most difficult tasks, and various models have been put out and proven thus far. This task calls for the use of several datasets since a variety of variables, including climate, soil, seed type, weather and fertilizer use, have an impact on crop productivity. They found that the technique used in these models most frequently was Artificial Neural Networks, and that the most frequently utilized characteristics were temperature, rainfall, and soil quality. CNN is the most often used deep learning approach, with DNN and LSTM. [12]

TABLE-2: COMPARISON OF DIFFERENT PREDICTION ALGORITHM

Ref	AN	SV	RF	CN	LST	KN
[34]			√			
[35]	√					
[36]			√			
[37]		√	√			
[6]			√			
[5]			√			
[12]				√	√	
[4]						√

Crop production predictions must be accurate in order to develop successful agricultural and food policy at the regional and worldwide levels. Due to its resistance to noise and overfitting, the Random Forest classification approach (machine learning-based classifier), as mentioned by Asli, Oslem, and Okuz outperform a number of tree-based methods because they are immune to noise and overfitting. As many trees as the user desires may be formed using RF, which is also quick and resilient against over-fitting. A dependable strategy to create crop maps with high accuracy for agricultural fields is to use the RF method in conjunction with the parcel-based approach [5].

RF performs better than other methods in forecasting agricultural production across all evaluated geographies and crops [5, 6, 34, 36, and 37]. According to the study's conclusions, an RF algorithm offers a lot of promise as a substitute statistical modelling method for crop production predictions. RF may over fit data in cases where there is a large concentration of training data, while its accuracy may degrade in instances where there is a low concentration of training data [6].

2.2.3 Forecast of outburst of a disease:

Spread of any vector borne disease is due to climatic variability. To forecast the outburst of disease, a variety of forecasting models are employed, including Regression techniques such as Decision Tree, Random Forest, Linear regression, Support Vector Machine etc. As discussed by Seema and Pradnya [7], time series and regression models are compared on nine cities of Maharashtra. Based on the region, accuracy of models will change. The factors considered here are only climatic variations. RMSE, MAE and R2 values are compared for both the models. Decision tree regression yields the lowest RMSE, MAE, and R2 values when compared to other regression techniques. In comparison to other time series forecasting techniques for the Maharashtrian metropolis of Mumbai, the Facebook prophet technique provides the lowest values for RMSE, MAE, and R2. Different combinations of ARIMA models provided the greatest match for the remaining cities.

Three models SVM, SSL and DNN are compared with accuracy, ROC and F1 score parameters. Performance-wise, SSL is the best according to Juhyeon Kim and InsungAhn. The prevalence of infectious illnesses varies for a variety of factors, including climate, living style, population, and more. [8]

Viral disease prediction and time series regression models are important for realizing the transmission of disease and creating efficient policies to address the issue. The basic goal of time-series regression modeling is to systematically compile historical data across time in order to develop the best model that can precisely describe the framework. Since the best time series prediction needs the best fitting model, more caution should be taken while making model adjustments. Auto regressive models like AR, MA, ARMA and SARIMA are among the most often used time series models for predicting infectious outbreaks.

TABLE – 3: COMPARISON OF DIFFERENT PREDICTION ALGORITHM FOR OUTBRST OF DISEASE

Refer	DN	KN	RF	LST	AN	SVM	DN	ARIM
[7]								√
[8]	√					√	√	
[25		√	√	√				
[26			√		√	√		
[27					√			
[28						√		

According to the findings, a hybrid strategy is more accurate in forecasting disease outbreaks.A hybrid model CNN-LSTM was suggested to estimate the number of verified COVID-19 cases using a time-series dataset [29]. The ARIMA and the GRNN model performed better at predicting hepatitis incidence in Heng [30].

It has been found that the random-forest time series model outperforms the SVM and ANN. SVM's accuracy is superior to that of RF and ANN [44].

2.2.4 Prediction Algorithm for Stock Market:

As discussed by Almira and Azra [11] Monte Carlo and ARIMA are used to predict the Stock prices. For short time prediction ARIMA model is more accurate than Monte Carlo and for longer time duration Monte Carlo gives better results.

TABLE- 4:
COMPARISON OF DIFFERENT PREDICTION ALGORITHM FOR STOCK MARKET

Reference	ANN	SVM	RF	CNN	RNN	ARIMA	Monte Carl
[14]			√				
[15]	√			√			
[16]		√					
[17]	√				√	√	
[11]						√	√

[18]	√		√				
[19]		√	√				

As referred to in the paper [32] a hybrid model consisting of the prediction rule ensembles (PRE) and deep neural network (DNN) was used for prediction the stock prices. As discussed in [45] SVM gives highest accuracy in comparison with RF and ANN.

2.2.5 Prediction algorithm in Quantum Computing:

In essence, quantum computing is employed to accelerate the algorithm. So the enormous data set's training time can be shortened as a result. The traditional computer will take a long time to produce the output if there are many factors involved in the input data set or if the data is made up of random variables and is very vast. So at this time Quantum Computing prediction algorithms can be used to do early or on time prediction.

Monte Carlo techniques are used to simulate the likelihood of various outcomes when random variables are involved. These models can be computationally expensive to operate. The result of Monte Carlo on a classical computer takes a lot of time. By that time the simulation's findings might not be relevant. The new technique from CQC (Cambridge Quantum Computing) tried to use quantum computing to simulate more random variables, increasing the scope and precision of predictions. It does this by employing a hybrid strategy in which some of the simulation is run on traditional computing systems and some of it is done on quantum computers.[38]

Authors in [39] have proposed a new hybrid approach for finance related forecasting which consists of deep quantum and deep classical neural networks. Deep classical neural networks serve as a measuring tool to derive security pricing from anticipated quantum density matrices, together with a deep quantum neural network for quantum prediction. In terms of the number of hidden layers, the deep quantum network is computationally tractable and uses a novel quantization approach for financial time series.

Scheme proposed in [40] is verified by predicting the closing prices on the stock market. Research on QNN is still in its theoretical stages right now.

Using simulated data generated by a supervised quantum machine learning model in [41], Rigetti used a hybrid quantum approach which adds a quantum convolutional layer in place of one layer of the OPC (Offshore Precipitation Capability) traditional neural network and enhanced the model's capacity to forecast bad weather.

CONCLUSION

Depending on the research problem and goals either descriptive or predictive model can be used. To make inferences from the collected data and provide a description of what occurred, descriptive models are utilized. Future forecasts are made using predictive models. To solve the issue at hand, it is essential to choose the appropriate algorithms, and both the algorithms and the supporting platforms must be able to handle the volume of data. For the same input data, various machine learning algorithms yield different results. Data input and different parameters determine which algorithm is the best in each given field.

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