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Research Article

Optimizing Service Enterprise Marketing Policies using Supervised Attention Multi-Scale Temporal Convolutional Network

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ABSTRACT

While scientific and technical advancements have increased consumer knowledge, existing market economic models are rapidly deteriorating due to these same issues. To adapt to changing customer demographics in the digital age, marketing tactics must be constantly updated and optimized. In this Manuscript, Optimizing Service Enterprise Marketing Policies using Supervised Attention Multi-Scale Temporal Convolutional Network (SEMP-SAMSTCN) is proposed. Initially, the data gathered from dataset Marketing Analytics dataset. Collected data are pre-processed to Handling missing values and data cleaning using Pseudo linear Maximum Correntropy Kalman Filter (PMCKF).Later, pre-processed image are given to SAMSTCN for effectively predict the sales. In general, SAMSTCN predicts does not express adapting optimization strategies to determine optimal parameters to ensure accurate data prediction. Hence, proposed utilize Adaptive Lightning Attachment Procedure Optimizer (ALAPO) enhance Efficient Predefined SAMSTCN accurately predict the sales. Then, the SEMP-SA-MSTCN is implemented to Python and the performance metrics such as, accuracy, precision and recall. Finally, the performance of SEMP-SA-MSTCN method provides 20.47%, 24.35%, and 276.78% high accuracy, 19.57%, 25.45%, and 29.75% higher Precision and 18.55%, 23.35%, and 27.63%higher recall while compared with existing Marketing Policy In Service Enterprises Using Deep Learning Model (MPISE-DNN), Lightweight deep learning model for marketing strategy optimization and characteristic analysis (LW-MSO-DCNN) and Evaluating cross-selling opportunities with recurrent neural networks on retail marketing (ECSO-RM-RNN) respectively.

Keywords: Adaptive Lightning Attachment Procedure Optimizer, Pseudolinear Maximum Correntropy Kalman Filter, SAMSTCN.

INTRODUCTION

This organization prioritizes accurate sales forecasting. To sustain efficiency in marketing organizations, suppliers must develop more accurate and time-saving forecasting methods. In today's fast-paced environment, manually carrying out this process poses considerable dangers to firm management and would take significant time. In short, it's unwanted. The business sector is crucial to the economy's health and must meet rising consumer demand to survive. Businesses typically aim to target a specific segment of the consumer population inside their market. It's crucial for the business to adopt a forecasting system to achieve its objectives [1]. To create accurate estimates, analysts must analyze a wide range of data, including industry trends, client activity, and other factors. This study has the potential to help companies improve their financial management. Forecasting can be used for a variety of purposes, including estimating future sales volumes and projecting product demand [2]. Consumers may now evaluate and challenge products and services without ever leaving the material platform and linked financial service thanks to advancements in computer communication technology throughout the information era. Any attempt to move the market is likewise significantly hampered by it . More information is available to consumers. In addition, they expect round-the-clock service and like to explore new things. As purchase characteristics vary, marketers must consider user psychology and tailor campaigns accordingly. Advancements in technology and digitization have accelerated marketing shifts. Interactive decision systems have led to tremendous growth in biometrics, smart card, and e-commerce applications

Using deep learning models in service organizations' marketing programs allows for highly individualized customer targeting via advanced analysis of consumer behavior and preferences. These models can use massive volumes of data to predict trends and customer demands with better precision than traditional approaches, resulting in more effective marketing campaigns.

Below is a summary of this research work's principal contributions.

- In this manuscript, Optimizing SEMP-SA-MSTCN is proposed. The data is gathered from Marketing analytics dataset Collected data preprocessed by utilizing PMCKF [3].
- It has been suggested that a SAMSTCN is predict the sales.

The remaining paper is organized as follows: Section 2 provides a review of the relevant literature, Section 3 outlines the proposed method, Section 4 shows the results along with a commentary, and Section 5 concludes the work.

LITERATURE REVIEW

Among the regular investigation depends on Predictive sales with the help of deep learning; some of the recent investigations were presented here

Karunambiga et al., [4] have suggested MPISE-DNN.The proposed technique is then assessed using traditional criteria. Corporate performance and well-being are most positively impacted by Work organization and innovation, job complexity and autonomy, and outsourcing and cooperation. Organisation and inventiveness in the workplace are also vital. It has a low recall rate and great accuracy.

Su et al., [5] have suggested LW-MSO-DCNN. This research examines the link among psychology and sales development, and proposes a fusion model that uses deep learning's neural network topology to anticipate preferences. It provides high precision and it provides low recall.

Kalkan et al., [6] have presented ECSO-RM-RNN. This study offers a different approach to a well-known business issue: anticipating which goods or services clients are likely to buy next time might increase cross-selling efficacy. The structure revolves around a recommender system that operates on extra data configurations. It provides high accuracy and it provides low accuracy.

Jin et al., [7] have presented Sustainable digital marketing under big data: utilizing an AI random forest model. The primary goal of the current study is to effectively incorporate artificial intelligence (AI) and sophisticated big data analytics into the field of digital marketing, supporting the development and optimization of long-term digital marketing strategies. It provides high precision and it provides low recall.

Wang et al., [8] have suggested effective client segmentation in digital marketing with the use of swarm intelligence and deep learning. In order to effectively categorize customers, this paper combines an enhanced social spider optimization approach with an unsupervised deep learning model known as a self-organizing map. The customer data is examined using a feature engineering technique that employs a SI model known as Modified SSO to choose the customer's behavioral traits.It provides high accuracy and it provides low precision.

Yang et al., [9] have developed E-Commerce Marketing Optimization of Agricultural Products Based on Deep Learning and Data Mining. E-commerce combined with agricultural product marketing effectively reduces the middlemen in agricultural product sales. Across the nation, a large number of professional e-commerce villages have emerged, and the quantity of rural e-commerce businesses is still increasing. It provides high precision and it provides low recall.

Peng et al., [10] have suggested New Media Marketing Strategy Optimization in the CI-DMLA. This article uses relevant theories, such as new media, marketing, and catering industry marketing strategies, to investigate related concepts and characteristics of new media, explain the impact of new media development on the catering industry and audience groups, and examine the catering industry from multiple perspectives. It provide high recall and it provides low precision.

PROPOSED METHODOLOGY

In this section, Optimizing SEMP-SA-MSTCN is presented in Figure 1. This method consists of 5 stages: dataset preparation, pre-processing, prediction. As a result, a complete explanation of all stages is given below,

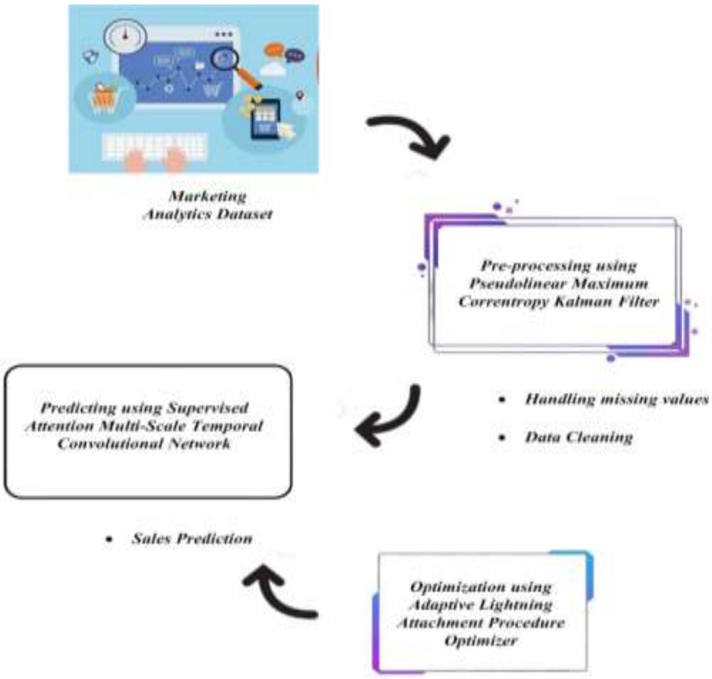

Figure 1: Block diagram for the proposed SEMP-SA-MSTCN method

DATA COLLECTION

Initially, the data gathered from marketing analytics dataset [11]. Analyzing data to calculate the success and effectiveness of marketing campaigns is acknowledged as marketing analytics. With the aid of marketing analytics, you can maximize your marketing objectives, learn more about your target audience, and get a better return on investment. Analytics for marketing benefit both advertisers and customers.

PRE-PROCESSING USING PSEUDO LINEAR MAXIMUM CORRENTROPY KALMAN FILTER

This section, PMCKF [12] is discussed. In pre-processing segment, PMCKF is used to removal of the image background. The Pseudolinear Maximum Correntropy Kalman Filter (PMCKF) has various applications in signal processing and state estimation. An additional objective is to integrate insect pest recognition systems with multi sensor data (visual, infrared, or environmental sensors) to improve their accuracy and dependability is given in equation (1),

$$A_{P,Q} = \int Z(p,q)\, l\, E_{YX}(p,q) \tag{1}$$

where, $A_{P,Q}$ denotes the shift-invariant mercer kernel, $E_{YX}(p,q)$ is the joint distribution function, Z denotes the sampling period, p, q is the power spectral density and l is the mean sample. This proposed lower bound is used as a benchmark for algorithm evaluation in insect pest detection systems is given in equation (2),

$$l(p,q) = A_\sigma (p-q) \tag{2}$$

where, l is the mean sample, p, q is the power spectral density and A_σ is the Gaussian kernel. For instance, the target's lowest and/or maximum speed is limited to falling inside a specific range is given in equation (3),

$$y_l = B\, y_{r-1} + Z_{r-1} \tag{3}$$

where, y_l is the state vector, B is the represent noise, Z is the process noise, y_{r-1} is the time-varying variance and r is the statistically independent.

Prediction Using Supervised Attention Multi-Scale Temporal Convolutional Network

In this section, SAMTCN [13] discussed to sales prediction. The SAMSTCN has various advantages for temporal data analysis and prediction tasks. SAMTCN dynamically balances the significance of various time scales and spatial locations through the use of supervised attention processes, improving pothole detection accuracy alterations; and it given in equation (4),

$$b(t) = z(t) + m(t) \tag{4}$$

where, $b(t), z(t)\, and\ m(t)$ denotes the effective marketing interventions. In actual use, SAMSTCN begins by first obtaining hierarchical characteristics at various temporal scales from the production and it given in equation (5),

$$B(t,l) = |B(t,l)| \exp(j\theta_b(t,l)) \tag{5}$$

where, $|B(t,l)|$ denotes extensive overhauls; $j\theta_b$ denotes digital marketing platforms. It also makes the classification model more resilient to changes in illumination and environmental circumstances and it given in equation (6),

$$B^D(t,l) = |B(t,l)|^D \frac{B(t,l)}{\max(|B(t,l)|, \zeta)} \tag{6}$$

where, $B^D(t,l)$ denotes image estimate layer; ζ denotes constant value. Finally, SAMTCN predict the sales. Here, ALAPO is employed to optimize the SAMTCN. Here, ALAPO is employed for tuning the bias and weight parameter of SAMTCN.

OPTIMIZATION USING ADAPTIVE LIGHTNING ATTACHMENT PROCEDURE OPTIMIZER

The optimization depends on ALAPO [14].With multiple benefits, the ALAPO is an effective tool for optimization tasks. In order to efficiently explore and utilize the search space, it dynamically modifies its parameters, which improves convergence rates and solution quality. Furthermore, the strong mechanism of ALAPO avoids premature convergence, guaranteeing a comprehensive analysis of possible alternatives.

3.4.1. Stepwise procedure for ALAPO

In this case, a stepwise procedure is defined to get the exact amount of SAMTCN based on ALAPO. At first, ALAPO creates a uniformly distributed population to maximize the parameter SAMTCN. Ideal solution promoted using the ALAPO algorithm, linked to the flowchart given in Figure 2.

Step 1: Initialization

Every individual in the population is a possible point of breakdown and can serve as a starting point for leaders who are moving upward or downhill.

$$Y^0_{p,q} = Ma_p + Na_p - Y_{pq} \tag{7}$$

where, $Y^0_{p,q}$ define the initial number of population, Ma_p define the objective function of the average point and Na_p define the random potential solution.

Step 2: Random Generation

Input parameters made at randomly. Based on their specific hyper parameter conditions, the Optimal Progressive value is selected.

Step 3: Fitness Function

From initialized values, an arbitrary solution is produced. It is given in equation (8)

$$FitnessFunction = Optimizing\ (W^T\ and\ N_l) \tag{8}$$

where X represent the increase the accuracy and Y represent the increase the precision.

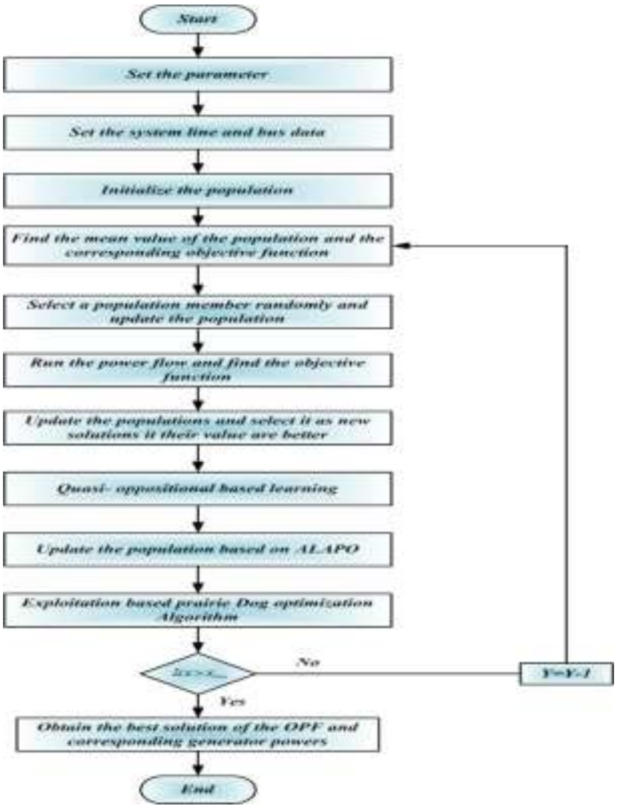

Figure 2: Flowchart of Adaptive Lightning Attachment Procedure Optimizer

***Step 4*:** Quasi Opposite Based Learning $b(t)$

During this phase, the optimizer investigates solutions that are nearly opposite in the solution space. The optimizer eventually converges on a solution that balances competing objectives, increases safety and efficiency, and minimizes risk as it iterates is given in equation (9),

$$D_{p,q} = b(t)^{(Xa_p + Xa_p)\omega} / 2 \tag{9}$$

where, Xa_p define the goal function of the average point, $b(t)$ denotes the effective marketing interventions, ω define the shape function, $D_{p,q}$ define the opposite point of the search position, and Xa_p define the random potential solution.

Step 5: Exploitation Based Prairie Dog Optimization Algorithm N_I

The exploitation phase in optimization algorithms refers to the point at which the algorithm uses its present knowledge to exploit promising parts of the search area to find the optimal solution during the exploitation phase; the algorithm focuses its search on parts of the search space that have demonstrated the potential for optimal solutions. The exploration phase is given in equation (10),

$$BC_{p+1} = F\,Y\,best_{p,q} + BHN_I \tag{10}$$

where, BC_{p+1} define the best solution, Y define the candidate solution, F define computational resources, $best_{p,q}$ define the best population solution and BH define the distance vector.

Step 6: Termination

The weight parameter W^T *and* N_I from SAMTCN optimized enhanced by support LULC, reiteration functions until location information $y = y + 1$ is met. The flow chart for ALAPO is given in figure 2.SAMTCN is optimized with ALAPO for predicting the sales with greater accuracy.

RESULT AND DISCUSSION

The proposed SEMP-SA-MSTCN's result is examined. The proposed SEMP-SA-MSTCN is executed in Python platform on computer with 12 GB RAM, Intel ®core (7M) i3-6100CPU @3[U1] .70 GHz processor Under some performance metrics, the number of iterations corresponds to the number of batches required to complete one epoch. The performance of SEMP-SA-MSTCN method is evaluated under some metrics including accuracy, precision and recall is assessed. The acquired outcomes of proposed technique are evaluated to existing MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN methods.

Performance measures

The crucial stage selecting optimal classifier. It evaluated to comprising Accuracy, recall and Precision.

4.1.1. Accuracy

The ability to determine a assessment with accuracy, or accuracy, is represented by equation (11),

$$accuracy = \frac{TP + TN}{TP + TN + FN + FP} \tag{11}$$

here, TP implies True Positive, TN implies True Negative, FP Signifies False Positive, FN Signifies False Negative.

4.1.2. Precision

Precision estimation many positive labels had expected with greater accuracy. It is calculated using equation (12)

$$\Pr ecision = \frac{TP}{(TP + FP)} \tag{12}$$

Performance Analysis

Fig 3 to 5 portrays simulation findings of SEMP-SA-MSTCN approach. Then, the proposed SEMP-SA-MSTCN technique is likened with existing MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN method.

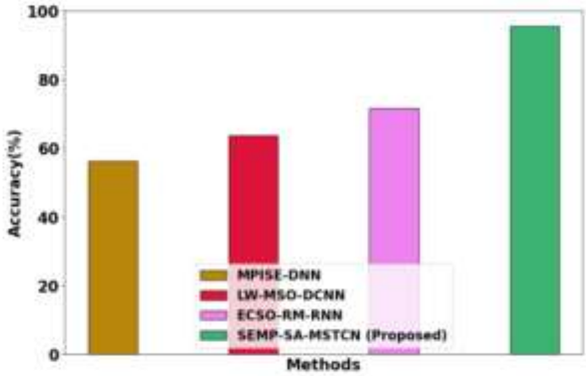

Figure 3: Performance analyses of Accuracy

Figure 3 illustrates Performance analyses of accuracy. The proposed SEMP-SA-MSTCN technique reaches in the range of 19.36%, 25.42% and 27.27% higher accuracy compared to existing MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN method respectively.

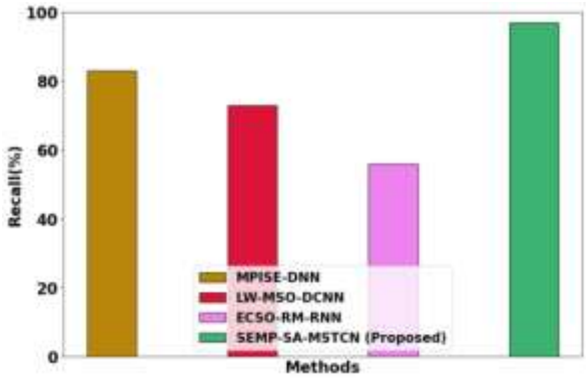

Figure 4: Performance analyses of Recall

Figure 4 illustrates Performance analyses of recall. The proposed SEMP-SA-MSTCN technique reaches in the range of 18.36%, 26.48% and 28.57% higher accuracy compared to existing MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN method respectively.

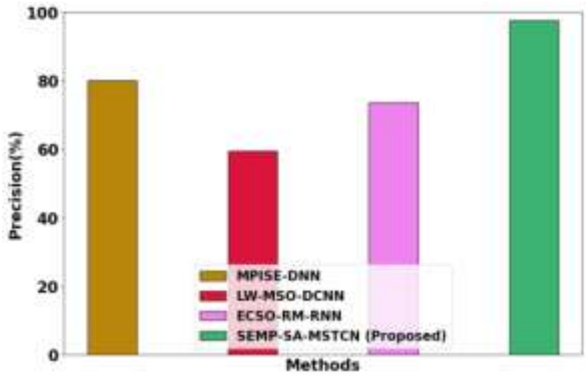

Figure 5: Performance analyses of Precision

Figure 5 illustrates Performance analyses of Precision. The proposed SEMP-SA-MSTCN technique reaches in the range of 20.36%, 23.42% and 26.72% higher accuracy compared to existing MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN method respectively.

Discussion

Optimizing Service Enterprise Marketing Policies using SEMP-SA-MSTCN is developed in this paper. The SEMP-SA-MSTCN technique improved accuracy, recall, and predicts the sales. When compared to existing approaches such as MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN the SEMP-SA-MSTCN method outperformed them in terms of predict the sales For example, for various circumstances, the method achieved 20.47%, 24.35%, and 276.78%high accuracy, and 18.55%, 23.35%, and 27.63%higher precision than existing methods. Deep learning models can improve client segmentation, tailored recommendations, and predictive analytics in service organizations' marketing strategies, allowing them to optimize customer satisfaction and retention.

CONCLUSION

In this section, Optimizing Service Enterprise Marketing Policies using SEMP-SA-MSTCN was successfully implemented in python. The proposed method SEMP-SA-MSTCN is used predict sales. Evaluating the performance of approach, the results highlight distinct improvements and achieving, 20.47%, 24.35%, and 276.78%Accuracy and 18.55%, 23.35%, and 27.63%precisionare compared with existing methods like MPISE-DNN, LW-MSO-DCNN and ECSO-RM-RNN respectively. Future work could include creating more powerful deep learning models that use immediate consumer feedback and predictive data to dynamically optimize and personalize marketing strategies in service firms.

Data Availability Statement: Data sharing does not apply to this article as no new data has been created or analyzed in this study.

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