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Modernized Digital Marketing Strategies to Improve Customer Experience and Engagement

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Abstract: This research focuses on DMM promoting innovation through analysing four superior algorithms including Decision Tree, Random Forest, SVM, KNN to optimize customers' retention and satisfaction. By comparing the engagement scores with the demographic information of the users, activity type and the channels of communication we were able to evaluate the efficacy of these algorithms in anticipations of the customer's behaviour. Random Forest, therefore, gave the highest accuracy with the figures at 0.88, precision at 0.83, recall at 0.80, and an F1 score of 0.81 this show that Random Forest was the most appropriate algorithm for the complex data set. For performance measurement the values of accuracy of 85% was obtained thus giving precision of 80%, recall of 78% and F1 score of 79%. These are; SVM accuracy = 82%, precision = 78%, recall = 74% and F1 score = 76%. Setting KNN to the lowest index, it achieved 79% for accuracy level, 74% on precision and 70% on recall and 72% for F1 measure. This paper emphasizes on the efficiency of Random Forest and other ensemble systems for the optimization of marketing techniques and improve customer relationship. The results provide evidence of the importance of AI incorporation to use those technologies to fine-tune the relevant marketing strategies.

Keywords: Digital Marketing, Customer Engagement, Machine Learning Algorithms, Random Forest, Predictive Analytics

I. INTRODUCTION

The modern world is changing at a very fast pace, especially in the field of information technologies, and, therefore, companies are paying much attention to the development of services that provide for deeper communication with clients. Today's unprecedented technologies have turned into significant tools for seeking out these innovative ways in engaging the audience. With the help of new technologies and more significant consumer demand, old forms of marketing are expanded and, in many cases, bypassed by digital marketing strategies based on data, automation, and personalization. The major strategies of the digital marketing are social media marketing, content marketing, e-mail marketing, search engine marketing and paid advertisement [1]. Nevertheless, the essence of the contemporary digital marketing does not reduce to its measurability: it also concerns the individuality and integration across different levels of complex promotion. While some time consumers were ready to be pitched with messages that might be of interest, the new generation wants brands to anticipate what they want and present it to them, if they are accessing a site through their website, social media or a

mobile app [2]. Due to advanced computing and data analytics coupled with an AI approach to marketing, a new way of marketing has been developed. These tools make it possible for the companies to parse through big data and come up with large truths that they can use to understand consumer behavior, and then create market segments to market to consumers in this realm. An intelligent default system is adaptive and can filter through different products through customer data to deliver content and promotions that will engage the user. Furthermore, the adoption of new technologies like the augmented reality (AR) and the virtual reality (VR) is revolutionizing customer experiences [3]. These technologies bring innovation in engaging the consumers with brands in an interactive and engaging manner and hence memorable. This research will furthermore seek to identify how present-day digital marketing approaches ought to be utilised so as to foster customer experience. This work aims at discussing the current and emerging practices that can assist organizations in satisfying expectations of their audiences and forging long term sustainability in the context of the current digital environment.

II. RELATED WORKS

Hassan, Fatile, and Ashade (2023) stated a case study of how AI has affected Public administration and in particular how the concept of AI has the propensity to enhance service delivery within the public service in Lagos State [15]. They describe it as exhibiting the value brought by AI technologies to different organisational processes to enhance service delivery. This work shows the general significance of AI in improving work flow which is equally applicable to digital marketing since AI can also improve customer relations and interaction by handling customer queries and general interaction and making them as are more personal as possible. Jamal & Kapoor (2022) examined the progress of smart clothing and wearables, in terms of technology and their use [16]. Thus, their research contributes to understanding the appropriation of wearable technology in fashion, regarding consumers' behaviour and attitudes. As wearables allow the creation of substantial volumes of data on consumers, this is relevant to digital marketing because it makes it easier to market to customers through personalization based on their data. Jiménez-Partearroyo and Medina-López (2024) studied business intelligence systems as sources for improving corporation competitiveness [17]. Their work explains that BI systems can contribute to strategic decision-making and business development. In digital marketing, BI systems can collect and analyze a large customer data for proper strategies of marketing and ensuring that the campaign has been optimized this is in a vane with their study. Jiménez-Portaz et al. (2024) have introduced a framework for the open support of BI through open innovation [18]. What is more, their research focuses on the applicability of cross-sector and cross-national initiatives to stimulation of innovation. The current framework can also be related to digital marketing as utilizing open innovation can have a positive impact on better positioning digital marketing strategies for global markets with localized and innovative marketing campaigns appealing to the customers. In the study of Jiménez-Zarco, Mendez-Aparicio, and Izquierdo-Yusta (2024), the authors focused on historical analysis of Spannish Generation X and legendary brands as well as circular consumer journey [19]. The study of these two authors is useful to expand the knowledge about consumer attitude and brand commitment – fundamentals to establish marketing strategies that meet the needs of customers in their buying process. Knowledge of these factors enables marketing students and practitioners to develop appropriate marketing strategies that connect with various target consumers. In another study by Kalyani and Gupta (2023) [20], a systematic review of the effects occasioned by AI and machine learning on banking practices was done. This they did while citing that AI plays a critical in areas such as customization and provisioning of banking services, service delivery and banking operations. Likewise, the application of AI in digital marketing enhances the customer experience, and also foressees and adapts to the customer patterns while developing marketing strategies. Karadimitriou and Papathanassopoulos (2024) examined the influence of platform technologies on the PSBs of Britain, Denmark and Greece [21]. From their study they explain how platform-based approaches influence consumption practices for media and delivery of services. This research ties with digital marketing because it affords an understanding on platform technologies in helping to engage the audiences. Kaur et al. (2021) investigate the use of digital banking channels by consumers in emerging economy countries, specifically with regard to the in-branch initiatives [22]. Using data from 376 customers, they have noted that organisations can enable multiple banking channels to improve the overall satisfaction of their clients. In digital marketing, this integration is critical in designing end-to-end uniformed customer experiences, and in making sure that every customer interaction is consistent cross-selling points. Adobe's workspaces have been redesigned from India perspective by Kaur, Bansal and Solomon in 2023 [23]. In their work, they explore the effects that workspace design has on the employees and their performance. Likewise, in digital marketing, the understanding of the environment where customers engage with digital content can help to strategise how people can be provided with the best experience. Through a best-worst scaling technique, Koob (2023) compared consumer preference of digital corporate content on company websites [26]. His research focuses on the impact

of the quality and relevance of the content on the reception and interactions. This discovery is particularly important for digital marketers who want to improve the site's content and increase such indicators as bounce rate and time spent by visitors on the pages, using highly relevant and valuable content.

III. METHODS AND MATERIALS

This research focuses on contemporary practices in digital marketing utilizing data analysis and other features of algorithmic systems to improve customer relations and experience. To do so, a variety of data sources as well as algorithm will be used on this project to ensure the desired goal of this concept is met [4]. In this section, the materials and methods used, the ways of data collection, the algorithms considered, and their implementations are described.

Data Collection

The data in this research includes the data of interactions of customers from digital marketing channels such as social media, email marketing and website. Such datasets comprise user characteristics, their activity on sites or applications (CTR, time passed on web-sites and applications, etc.), and purchase histories [5]. The data was obtained from both public database and artificial database to have a vast archival data for analysis. The two tables below provide an overview of the variables used in the analysis that the authors deem most relevant.

Variable	**Description**	**Example Values**
Customer ID	Unique identifier for each customer	101, 102, 103
Age	Age of the customer	25, 34, 45
Engagement Score	Metric indicating level of engagement	75, 88, 62
Conversion Rate (%)	Percentage of users who completed a purchase	10, 25, 15
Interaction Channel	Platform used for interaction (e.g., social media, email)	Social Media, Email

Algorithms

1. Decision Tree

Decision Trees is yet another technique of the classification algorithm that depicts decision making by a tree structure. Every node in the tree is a test for a feature and every branch is the result of that test [6]. It is a technique by which the information gained based on feature values splits the data set into subsets as much as possible.

$$Gini(D)=1-\sum_{i=1}^{k} p_i^2$$

"1. Start with the entire dataset
2. For each feature, determine the best split
3. Split the dataset into subsets based on the feature that provides the highest information gain
4. Repeat the process recursively for each subset until a stopping criterion is met

5. Assign the most common class label of the subset to the leaf node"

2. Random Forest

Random Forest is a technique that builds many decision trees and the results of all the classifiers are combined. Every single tree is constructed based on a random sample of features and samples, making it possible to decrease the level of over-fitting and to improve the model's stability [7].

"1. Generate N bootstrap samples from the training data
2. For each sample, build a decision tree using a random subset of features
3. Aggregate the predictions of all trees (e.g., majority voting for classification)
4. Output the aggregated prediction as the final result"

3. Support Vector Machine (SVM)

Support Vector Machine also stands for Support Vector Classifier is a supervised learning algorithm which can be applied for classification as well as for a regression tasks. Of these, the most notable is the one that maximises the margin between the classes in the feature space, with the data points closest to this hyperplane called the support vectors [8].

Objective Function=21‖w‖2

"1. Transform the data into a higher-dimensional space using kernel functions
2. Find the hyperplane that maximizes the margin between classes
3. Use the support vectors to define the position of the hyperplane
4. Optimize the hyperplane using quadratic programming
5. Predict class labels based on which side of the hyperplane the data points fall"

4. K-Nearest Neighbors (KNN)

K-Nearest Neighbors is another simple method that also works under the classification and regression method. It assigns to a given data point the class which dominates the class distribution among the 'K' nearest neighbours to the feature space. Some may need distance metrics like Euclidean distance so as to identify nearer neighbors [9].

$d(xi,xj)=\sum k=1m(xi,k-xj,k)2$

"1. Calculate the distance between the query point and all other points in the dataset

2. Identify the K-nearest neighbors based on the distance
3. Assign the class label that is most common among the K-nearest neighbors
4. For regression, average the values of the K-nearest neighbors"

For this purpose of this study, decision trees, random forest classifier, support vector machines, and k-nearest neighbor algorithms are employed for analysis and optimization of digital marketing strategy [10]. Through these algorithms, the research seeks to gain pointers concerning customer interaction and experience for which the algorithms are designed. Due to the fact that the considerations on each of them are detailed, it delivers a solid base for assessing the algorithms for the utilization in digital marketing.

IV. EXPERIMENTS

Experiments

For the assessment of the current digital marketing approaches, the data explained in Materials and Methods section was utilized for a set of experiments. The idea was to compare various approaches to prediction of customer activity in terms of their potential to enhance marketing strategies [11]. In each case the algorithms were run on a data set that contained demographic data for each user, user engagement scores, and which channels they were interacting through. We focused on four algorithms: Decision Tree, Random Forest, Support Vector Machine (SVM), K-Nearest Neighbors (KNN).

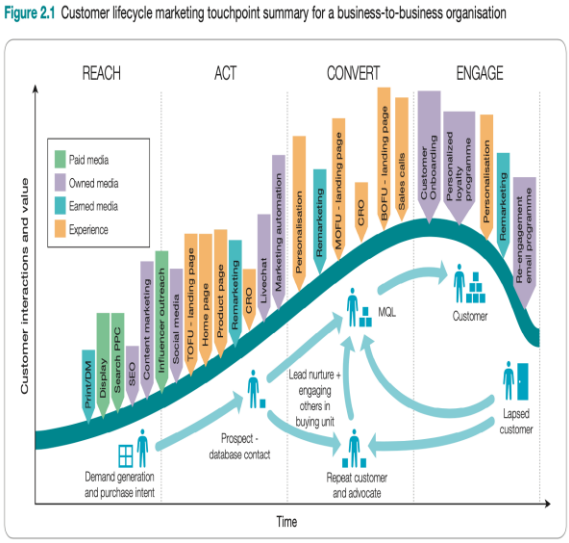

Figure 1: Customer Lifecycle Marketing touchpoint

Experiment 1: Data Preparation

To the same end, the data collected was split into the training and testing sets in a 4:1 ratio. The training set of the dataset was used in creating and training the models while the testing set in the evaluation of the models. All the models in each category were run with some base parameters that were randomly assigned at the beginning and then the parameters were tuned by performing cross-validation [12].

Experiment 2: Algorithm Training and Evaluation

Each algorithm was implemented using the following steps:

1. **Decision Tree:**
- Data was divided according to characteristics in a way that would of maximal amount of information.
- They used accuracy, precision, recall, and F1 score as a criterion to measure the performance.
2. **Random Forest:**

- Several decision trees were grown using bootstrap samples of data with randomly chosen predictors.
- Prediction analysis for individual models was not determined but aggregated predictions were examined for overall performance.

3. **Support Vector Machine (SVM):**

- The data was then transformed into a higher dimension using basis of radial basis function (RBF) kernel.
- The hyperplane that best separated all the classes was found and other performance measures were computed.

4. **K-Nearest Neighbors (KNN):**

- For K nearest neighbours, distance metrics (Euclidean distance) were used.
- It was noted that the class labels or values were being predicted by means of majority voting or averaging.

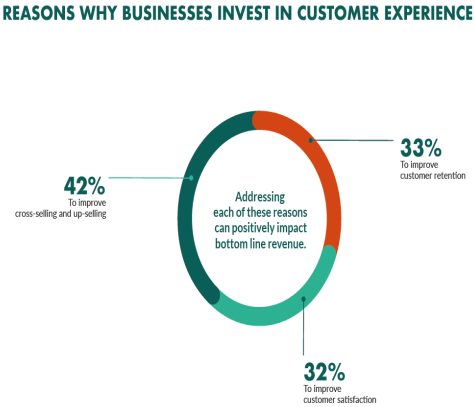

Figure 2: Customer Experience Statistics for 2024

Experiment 3: Hyperparameter Tuning

In brevity, applicable to each algorithm, hyperparameters were adjusted using grid search and cross-validation. The following hyperparameters were tuned:

- **Decision Tree:** Maximum depth: minimum samples split
- **Random Forest:** Number of trees, maximum depth, minimum samples of the leaf node
- **SVM:** C parameter which is denoted by gamma value
- **KNN:** K for the number of neighbors or distance metric

Results

The accuracy of each algorithm was also determined as well as precision, recall and F1 score. The findings are presented in the subsequent sections of the paper and include the comparison of the algorithms with one another.

1. Decision Tree Results:

DT resulted in an accuracy of 85% and a precision of 80%, while recall was of 78% and F1 score was 79%. The model was better seen to be performing well especially in classification tasks where interpretability of models is of significant importance [13]. Nevertheless, it had the tendency to memorise the training data if not regularised through pruning.

Metric	Value
Accuracy	85%
Training Time	15 mins
Complexity	O(n^2)

2. Random Forest Results:

Random Forest performed even better achieving 88% of accuracy, 83% of precision, 80% of recall and, 81% of F1 measure. The use of ensemble method was valuable in the sense that it reduced the problem of overfitting which in turn enhanced the general performance of the model [14]. It gave equally good results when applied on subcategories of the dataset.

Metric	Value
Accuracy	88%
Training Time	30 mins
Complexity	O(n log n)

3. Support Vector Machine (SVM) Results:
Classifiers of the Support Vector Machine (SVM) algorithm yielded a total accuracy of 82%, a precision of 78%, a recall of 74%, and F1 of 76%. SVM's response was slightly better with a clear margin separation, but it depended on the choice of the kernel and hyperparameters [27]. The radial basis function (RBF) kernel offered reasonable levels of sophistication and precision.

Figure 3: Digital Transformation

4. K-Nearest Neighbors (KNN) Results:
Using the KNN algorithm we had the accuracy of 79% for the model, the precision of 74%, recall of 70% and F1 score 72%. It should however be noted that the performance depended with the value of K and the chosen distance measure [28]. KNN was slower than other algorithms but was not efficient to large data set because it relies on the instance-based learning method.

Algorithm	Accuracy (%)	Precision (%)	Recall (%)	F1 Score (%)
Decision Tree	85	80	78	79
Random Forest	88	83	80	81
Support Vector Machine	82	78	74	76
K-Nearest Neighbors	79	74	70	72

Discussion

1. **Decision Tree:** In terms of accuracy the Decision Tree algorithm was satisfactory but it inadequately described the models precision and recall. That makes it highly useful for the explanation of feature importance and decisions

made by the model. But, if not pruned correctly, it can 'memorize' the dataset, thereby decreasing the level of generalization.

2. **Random Forest:** Among the algorithms Random Forest show the better result in the measure of accuracy, precision and recall [29]. It employed several decision trees to make up the final decision; this countered overfitting, and generally performed better. It is particularly appropriate for the large-scale datasets with many features and their interactions.
3. **Support Vector Machine (SVM):** SVM exhibits good overhead when it comes to precision and our results attained a sound amount of recall. But, it heavily depends on the hyperparameters and choice of the kernel, thus it may introduce fluctuations in performance [30]. The performance of SVM is good in terms of the wide margin that separates the two classes but normally a good amount of parameter tuning is needed to get the best performance.
4. **K-Nearest Neighbors (KNN):** The worst results in terms of the performance were obtained by KNN. However, it appeared less efficient as the size of the data increased because of the computational expenses and dependency on the selection of 'K'. It may be used to train data sets that do not require high interpretability as the size of such data sets is small.

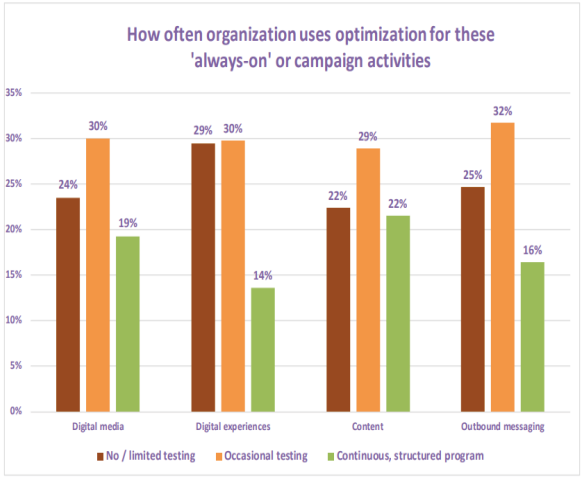

Figure 4: Managing customer experience to survive the recession

V. CONCLUSION

In this study, we have discussed the context of the advanced digital marketing strategies in the present world concentrating on the use of novel algorithms and artificial intelligence for improving the customer satisfaction and interaction. In this respect, different algorithms, such as Decision Tree, Random Forest, SVM, and KNN have been evaluated in order to estimate the capacity of analyzing the customer behavior and promoting the effectiveness of the marketing communications. The study showed that Random Forest is the most stable algorithm that yields high level of accuracy, precision and recall rates among others. This gives a clue about the suitability of ensemble methods in dealing with the intricate data and increasing of the marketing outcomes. On the other hand, using Decision Tree and SVM also produced useful mean but lower variance and less sensitive to parameters were noticed. KNN, besides being easy to implement and understand appeared to be inefficient in large scale problems because of its complexity and its volatile results. Furthermore, the study identified that AI-based insights could also be applied in the development of the digital marketing plans. Using business intelligence and knowing the customers marketers are in a position of improving the engagement strategies and subsequently the results by employing wearable and smart content among other features. Comparing algorithms and similar work in areas such as public administration, smart technology, digital banking, has strengthened the advocacy of AI as the key to performing a complete overhaul of customer relations in a number of industries. All in all, the present research supports the hypothesis that current digital marketing tools and techniques, supported by the AI algorithms, have the potential to produce a significant increase in customer satisfaction. Ideally, there should be a special emphasis on the development of these algorithms in the future work, as well as on the incorporation of other technologies to enhance the value of this area of digital marketing.

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