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LRFS: ONLINE SHOPPERS' BEHAVIOR-BASED EFFICIENT CUSTOMER SEGMENTATION MODEL

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ABSTRACT— In the realm of digital commerce, online shopping has witnessed unprecedented growth globally, becoming a cornerstone of modern consumer behavior. This research introduces an advanced customer segmentation model, named LRFS, which builds upon the traditional LRF framework (Length of Relationship, Recency of Purchase, and Frequency of Purchase), specifically tailored for the e-commerce sector. The innovation of the LRFS model lies in the integration of a novel component, ''S'' which quantifies the Staying Rate relative to the revenue generated by customers on a specific website. This addition aims to enhance the granularity and efficacy of customer segmentation by leveraging data extracted from Google Analytics. To operationalize the LRFS model, this study employs two renowned clustering algorithms, KMeans and K-Medoids, analyzing the dataset through the lens of three distinct dimensionality reduction techniques: PCA (Principal Component Analysis), t-SNE (t-Distributed Stochastic Neighbor Embedding), and Autoencoder. This methodological approach facilitates a robust comparative analysis between the LRFS model and its predecessors LR, LF, and LRF utilizing K-Means clustering to evaluate the precision of customer cluster assignments. The empirical findings of this research underscore the superiority of the LRFS model in achieving more accurate and insightful customer segmentation.

Index Terms – Customer segmentation, unsupervised machine learning, K-means,

I. INTRODUCTION

E-commerce, synonymous with online shopping, has become an integral component of contemporary digital lifestyles, enabling transactions of goods and services across global boundaries with unprecedented ease. This digital marketplace serves as a vital platform for third-party transactions over the internet, where consumers can effortlessly explore merchandise, place orders, and make payments online, culminating in the delivery of products directly to their doorsteps via internet courier services. The advent of the Covid-19 pandemic further underscored the convenience and necessity of online shopping, propelling it to become the preferred method for procuring goods amidst government restrictions and health concerns, thereby cementing e-commerce's role as a pivotal aspect of modern consumer behavior, supported by continual advancements in internet technology. In response to the burgeoning trend of online shopping, businesses have increasingly turned their attention to analyzing consumer purchasing behaviors with the aim of enhancing service offerings, boosting customer satisfaction, fostering repeat purchases, and ultimately driving profitability. At the heart of these efforts lies the practice of customer segmentation, a strategic process that enables businesses to dissect their customer base into distinct groups based on shared characteristics such as demographics, purchasing patterns, and brand preferences, thereby allowing for the delivery of targeted marketing messages and personalized shopping experiences. The complexity and volume of data inherent in e-commerce necessitate sophisticated approaches to customer segmentation. The RFM (Recency, Frequency, Monetary value) model and its variants have been widely adopted for their efficacy in identifying valuable customer traits. Moreover, the integration of data mining and machine learning techniques has revolutionized the ability to emulate the personalized interactions characteristic of small business-customer relationships. Clustering, a form of unsupervised machine learning, plays a crucial role in this context, enabling the identification of customer groups with similar purchasing behaviors, which can then be targeted with tailored marketing strategies, thereby enhancing customer retention and attracting new clients.

Recognizing the competitive landscape of the e-commerce sector, this research endeavors to develop a sophisticated model

dedicated to the segmentation of online shoppers.

By integrating a suite of unsupervised algorithms and dimensionality reduction techniques, the study aims to dissect and understand customer behavior in the online shopping milieu more deeply. At the core of marketing strategy lies the imperative to augment sales and ensure the sustained profitability of businesses. This objective demands a granular understanding of customer behavior during online interactions and transactions. Service providers and manufacturers are tasked with not only forecasting future purchasing trends but also identifying and mitigating any deterrents to purchase decisions.

II. LITERATURE SURVEY

A. The interaction effect of comprehensiveness between social media and online purchasing intention in Jordanian pharmacies

This empirical paper examined the moderating role of comprehensiveness between social media and online shopping intention among customers of Jordanian pharmacies. Technology acceptance model (TAM) and the theory of planned behaviour (TPB) were the applied theories in this study. Data were collected from potential customers using a survey questionnaire. A total of 198 usable questionnaires were obtained and the data were analyzed.

Partial least squares structural equation modeling (PLS-SEM) was used in the outcome examination. The results show a positive impact of social media on online shopping intention. Further, comprehensiveness moderated the relationship strengths between social media and online shopping intention. This paper finds that focusing on social media strategies such as adopting intimacy, decreasing the perceived risk, and increasing trust could motivate online shopping among customers. Pharmacies in Jordan may consider these findings and achieve them by providing more comprehensive information in their advertisement and announcement.

B. predicting the client's purchasing intention using machine learning models

In this paper, we introduce a prediction algorithm that will determine the likelihood that a client will purchase from a website or not. This system is part of a global e-commerce solution that will help the clients to get the best possible experience. The paper presents an overview of the e-commerce system's various components and

their various steps and also an activity diagram of the system, which shows the various steps that the platform can perform. It also provides a general idea of the system's workflow.

C. K-means clustering approach for intelligent customer segmentation using customer purchase behavior data

E-commerce system has become more popular and implemented in almost all business areas. E-commerce system is a platform for marketing and promoting the products to customer through online. Customer segmentation is known as a process of dividing the customers into groups which shares similar characteristics. The purpose of customer segmentation is to determine how to deal with customers in each category in order to increase the profit of each customer to the business. Segmenting the customers assist business to identify their profitable customer to satisfy their needs by optimizing the services and products. Therefore, customer segmentation helps E-commerce system to promote the right product to the right customer with the intention to increase profits. There are few types of customer segmentation factors which are demographic psychographic, behavioral, and geographic. In this study, customer behavioral factor has been focused.

III. PROPOSED SYSTEM

The overview of our proposed system is shown in the below figure.

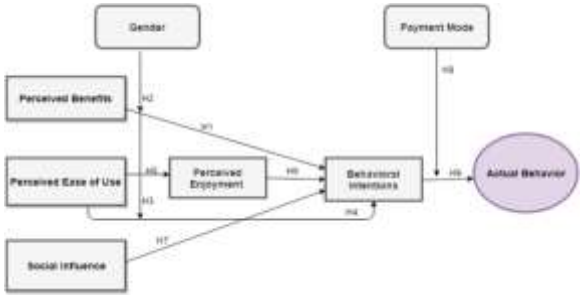

Fig. 1: System Overview

Implementation Modules

Train and Test Model

- ✓ In this module, the service provider split the Used dataset into train and test data of ratio 70 % and 30 % respectively. The 70% of the data is consider as train data which is used to train the model and 30% of the data is consider as test which is used to test the model

Remote User

- ✓ In this module, the remote user register to the system, and login to the system valid username, and password. After login successful, he can perform view profile, predicting customer segmentation.

Graphical Analysis

- In this module, display the graphs like accuracy and predicted ratio of the system. Various factors take into consideration for the graph analysis. In this phase plot the charts like bar chart and so others.

IV. RESULTS

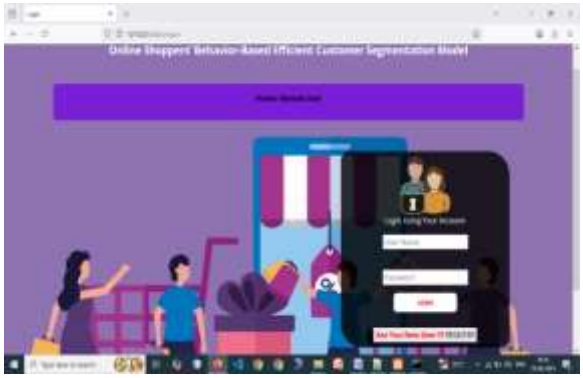

Fig.2: Home Page

Fig.3: Registration Page

Fig.4: Profile Page

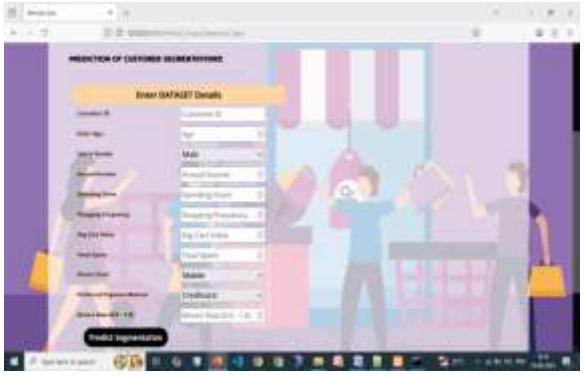

Fig.5: Customer segmentation Prediction

V. CONCLUSION

The objective of this paper was to present a detailed methodology for carrying out a new LRFS model for online shoppers by taking additional variable S into account. In the vast field of customer segmentation research, this was probably the first work in which a link has been formed between Google Analytics features like Exit Rates or Page Values and the conventional LRF model. After analyzing each of the components of LRFS against Revenue, a feature from the original dataset, some interesting insights have been found about

the relationship between each of the components of the model. For example, if a customer has a long association with the website, it does not mean that the customer is going to be still interested and spend more money on the website. Applying different dimensionality reduction approaches along with three different clustering algorithms had worked very well for some combinations, while not suitable for others. On the other hand, the K-Means algorithm has performed well with all dimensionality reduction techniques. K-Median with t-SNE and Autoencoder showed decent performance whereas K-Medoids with PCA together did have more overlappings comparatively. While conducting the research, there were some constraints associated with the used dataset.

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