Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 4, April 2024

Proposal for an End to End System for Workout Management

Vishal Ayyori, Manasi Mhatre, Yash Kharte, Aditya Choudhari, Priyanka Sherkhane
Student, Computer Engineering, Pillai College of Engineering (Panvel), Navi Mumbai,410206 India.
Faculty, Computer Engineering, Pillai College of Engineering (Panvel), Navi Mumbai,410206 India.

Abstract: **- An End to End System for Fitness and Workout Management is a software solution designed to manage workout and automate the day-to-day operations of a fitness center. The system provides an easy-to-use interface for users to manage, learn, and have a proper idea about fitness. Users can easily view schedules, workout forms, products required for fitness goals, etc. This system is a virtual trainer which will be more useful than a personal trainer in terms of cost, time, and knowledge. The Workout Management System will be an end to end workout planner and everything required for muscle building and maintenance. The algorithms that we are going to use in this project are MoveNet for Posture detection and correction during workout), K means algorithm for customer segmentation (Gym products), and kNN (k- nearest neighbor) algorithm for cart abandonment analysis (Gym products). By automating many of the tasks involved in maintaining fitness, this system allows users to focus on providing excellent customer service and improving the overall workout experience.**

***KeyWords*: —Workout Management, Workout Monitoring, Workout Management, Recommendation.**

I. INTRODUCTION

In today's health-conscious world, the demand for efficient fitness management solutions is rising. Traditional methods often lack personalization and can be costly and time-consuming. To address these challenges, we propose an innovative system: the End-to-End System for Fitness and Workout Management. This system aims to streamline workout planning, form correction, product recommendation, and engagement analytics using advanced technologies and user-friendly interfaces. By combining MoveNet for real-time posture detection, K-means algorithm for personalized product recommendations, and k-Nearest Neighbor (kNN) algorithm for cart abandonment analysis, our system offers a holistic approach to fitness management. It provides users with a virtual trainer that optimizes costs and time, while also empowering fitness centers to deliver exceptional customer service. Through this paper, we explore the architecture, functionalities, and potential impact of our system in revolutionizing the fitness industry and promoting healthier lifestyles worldwide.

II. LITERATURE SURVEY

The rapid growth of e-commerce and online shopping has led to the emergence of numerous research efforts aimed at optimizing the shopping experience and understanding customer behavior. This literature survey explores a selection of relevant studies on the applications of machine learning and customer segmentation in the context of e-commerce. The referenced papers cover various aspects of e-commerce, including cart abandonment mitigation, customer segmentation, and the use of machine learning techniques.

This paper by M. R. Islam Rifat, M. Nur Amin, M. H. Munna, and A. Al Imran addresses the critical issue of checkout abandonment in e-commerce [1]. It presents an end-to-end machine learning system designed to mitigate this problem.
L. Rajput and S. N. Singh's work focuses on customer segmentation in e-commerce, utilizing the K-means clustering algorithm [2]. This approach helps e-commerce businesses tailor their strategies to different customer segments more effectively. N. Gankidi, S. Gundu, M. v. Ahmed, T. Tanzeela, C. R. Prasad, and S. Yalabaka delve into customer segmentation using machine learning, contributing to a deeper understanding of customer behavior and preferences [3]. Rausch, Theresa, Derra, Nicholas, and Wolf, Lukas, explore the prediction of online shopping cart abandonment using machine learning approaches, shedding light on the factors influencing this behavior [4]. S. Koul and T. M. Philip's research delves into customer segmentation techniques in the e-commerce domain, offering insights into how businesses can better target their customer base [5].
V. R. Maddumala, H. Chaikam, J. S. Velanati, R. Ponnaganti, and B. Enuguri present an approach to customer segmentation using machine learning in Python, demonstrating the practical applications of these techniques [6]. J.-S. Kim's work explores the application of dual-action neural networks for efficient human action recognition in the context of virtual sports training, which may have relevance in the e-commerce sector for personalized fitness solutions [7]. Kukar-Kinney and Close Scheinbaum provide a foundational study on the determinants of consumers' shopping cart abandonment, which remains a critical issue in e-commerce [8]. S. R. Regmi, J. Meena, U.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 4, April 2024

Kanojia, and V. Kant discuss customer market segmentation using machine learning algorithms, contributing to a comprehensive understanding of customer behaviors and preferences [9]. E. Y. L. Nandapala and K. P. N. Jayasena provides practical insights into customer segmentation using the K-means algorithm [10].
I. V. R. Domingo, C. J. Sunga, and M. Comia discuss the implementation of image recognition and artificial neural networks in the context of fitness training, which may have applications in e-commerce for personalized fitness recommendations [11]. Chatterjee and Li's study presents a multi-stage model of online shopping behavior, shedding light on the complexities of shopping cart abandonment [12]. T. Kansal, S. Bahuguna, V. Singh, and T. Choudhury explore customer segmentation using K-means clustering, contributing to the understanding of effective segmentation techniques [13]. Garima Sharma, Ankita Nainwal, Bhaskar Pant, Vikas Tripathi, and Mr. Akash Chauhan provide insights into customer segmentation using machine learning techniques [14]. Y. Wang, S. He, X. Wei, and S. A. George focus on the development of an effective human action recognition model based on 3D Convolutional Neural Networks (CNNs), which may find applications in the e-commerce sector for behavior analysis [15]. A. Nagarkoti, R. Teotia, A. K. Mahale, and P. K. Das explores real-time indoor workout analysis using machine learning and computer vision, which could be relevant for fitness-related e-commerce applications [16].

III. PROPOSED SYSTEM

Our proposed system, the End-to-End System for Fitness and Workout Management, encompasses a comprehensive suite of features aimed at enhancing the fitness experience for users and streamlining operations for fitness centers. At its core, the system consists of three main modules: Workout Monitoring, Customer Segmentation, and Cart Abandonment Analysis.

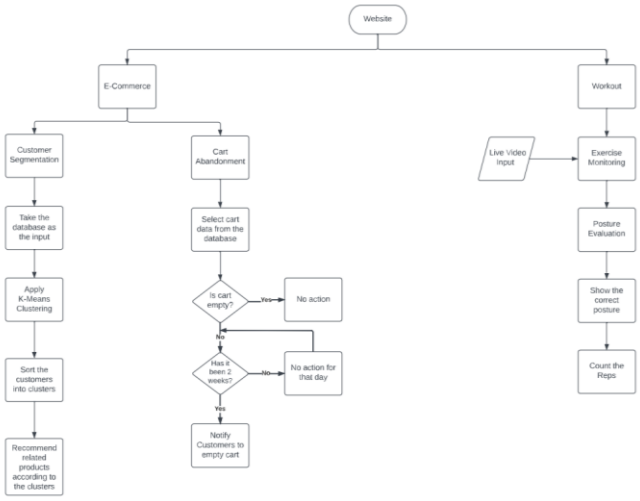

Figure 1.1: Proposed System Flow

1. Workout Detection :

For real-time posture detection during workouts, we plan to employ advanced techniques such as MoveNet and MediaPipe pretrained Models. These frameworks offer robust capabilities for human pose estimation, allowing us to accurately track users' movements and provide feedback on form and posture. Additionally, we will explore the use of convolutional neural networks (CNN) models, precisely MoveNet to further refine our posture detection algorithms. By combining these technologies, we aim to develop a comprehensive workout monitoring system that ensures users perform exercises with correct form, minimizing the risk of injuries and optimizing workout effectiveness.

2. Customer Segmentation :

Customer Segmentation is used to segment the customers according to their behaviour and their goals. These segmentations are acquired using K-means Clustering because the scalability, speed, flexibility and effectiveness of this algorithm is high.

Elbow method to find number of clusters

$$WCSS = \sum_{i \in n} (X_i - Y_i)^2$$

K means Algorithm :

$$f = \sum_{i=1}^{n} \sum_{j=1}^{k} \left\| x_i^{(j)} - c_j \right\|^2 \quad (3)$$

where,
$x_i^{(j)}$ is the chosen data point,
c_j is the cluster centre, and
$\left\| x_i^{(j)} - c_j \right\|^2$ is the distance between cluster centre and data point.

Recommendations will also be further added on the basis of similar kinds of customers.K-means clustering involves selecting k clusters, initializing centroids within the data range, assigning data points to the nearest centroid based on distance, recalculating centroids as cluster means, and iterating until convergence, defined by stable assignments or minimal improvement in the objective function .

3. Cart Abandonment :

Customer Shopping Cart Abandonment Rate (%) = [Completed purchases / Shopping carts created] * 100 By K-Nearest Neighbor , we will classify Abandonment Rate by a majority vote of its neighbors. The values which lay closely

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 4, April 2024

together within the predictor space (i.e., neighbors) will have the same class label. The class is thereby assigned by taking the majority vote of the k nearest neighbors, with k being the number of neighbors that are considered during the classification task. The nearest neighbors are determined with the help of arbitrary distance functions (e.g., Euclidean distance). For new observations the nearest neighbor within the training set is defined by

$$d(x, x_{(1)}) = \min_{k}(d(x, x_k))$$

Depending upon the class label , Email Notifications will be sent to Users .

IV. SYSTEM DESIGN AND COMPONENTS

The design of the proposed system for workout management involves several interconnected components that work harmoniously to provide users with a seamless and personalized fitness experience. Below, we outline the key components of the system along with their functionalities and interactions:

1. Front-end Interface:

Functionality: The front-end interface serves as the user-facing component of the system, providing users with an intuitive platform to interact with various features and functionalities.

Components: This includes user interfaces for workout planning, form correction, product recommendation, and engagement analytics.

Interactions: Users can access personalized workout routines, view posture correction suggestions, browse recommended products, and receive notifications based on their engagement behaviour.

2. Workout Monitoring Module:

Functionality: The workout monitoring module is responsible for real-time posture detection during workouts, ensuring users perform exercises with correct form and minimizing the risk of injuries.

Components: This includes integration with frameworks such as MoveNet and MediaPipe for pose estimation, as well as algorithms for analyzing posture data and providing feedback.

Interactions: Video input from cameras is processed to detect users' movements, and feedback on posture correctness is provided in real-time through the front-end interface.

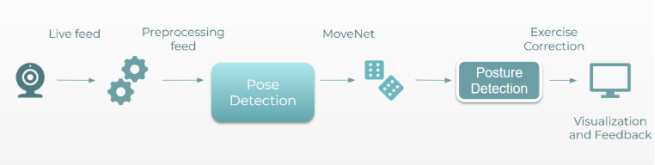

Figure 1.2: Workout Monitoring Module

3. Customer Segmentation

Functionality: The customer segmentation module categorizes users into distinct segments based on various factors such as fitness goals, exercise preferences, and demographic information.

Components: This includes algorithms such as Random Forest and K-means clustering for analyzing user data and generating segmentation insights.

Interactions: User data, including workout history, preferences, and demographic information, is analyzed to identify common patterns and segment users accordingly. Personalized recommendations are then provided based on the user's segment.

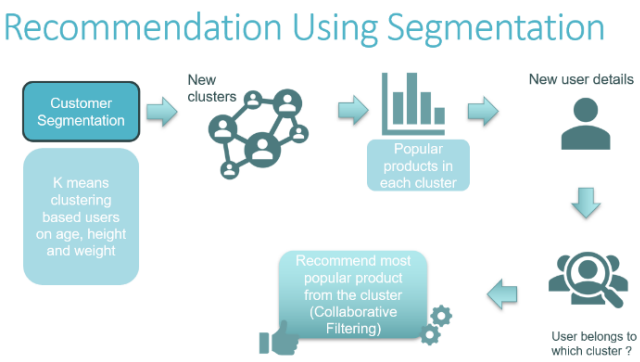

Figure 1.3: Recommendation using Customer segmentation

4. Cart Abandonment Analysis Module:

Functionality: The cart abandonment analysis module predicts and mitigates cart abandonment by identifying users at risk of abandoning their carts and deploying targeted interventions to encourage completion of purchases.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 4, April 2024

Components: This includes algorithms such as K-nearest neighbors (KNN) and predictive modeling techniques for analyzing user behavior and predicting churn.

Interactions: User interactions with the e-commerce platform, including browsing history, session duration, and product interactions, are analyzed to identify potential cart abandonment. Personalized notifications and incentives are then deployed to re-engage users and optimize conversion rates.

V. IMPLEMENTATION AND RESULT

Implementation of the proposed system for workout management will involve several key steps, including data collection, algorithm selection and implementation, system development, testing, and deployment. Below is a detailed plan outlining the implementation process:

1. Data Collection:

Given that pretrained models are being used for posture detection, data collection for this aspect of the system is not required. However, data may still need to be collected for other components of the system such as customer segmentation and cart abandonment analysis.

2. Algorithm Selection and Implementation:

a. Workout Monitoring:

- Utilizing pre-trained models such as MoveNet or MediaPipe for posture detection.

- Implementing algorithms for real-time analysis of posture data and feedback generation.

b. Customer Segmentation:

- Selecting algorithms such as Random Forest and K-means clustering for segmenting users with better accuracies.

- Implementing these algorithms to group the user data.

- Generating segmentation insights about customers for recommendation.

c. Cart Abandonment Analysis:

- Choosing predictive modeling techniques like K-nearest neighbors (KNN) or decision trees for cart abandonment prediction.

Figure 1.2: Cart Abandonment Flow

- Implementing these algorithms to analyze user behavior and predict cart abandonment.

3. System Development:

a. Front-end Interface:

- Developing user interfaces for workout planning, form correction, product recommendation, and engagement analytics.

b. Back-end Logic and Database:

- Developing server-side code for data processing, algorithmic computations, and storage of user information.

- Setting up databases for storing user profiles, workout data, product information, and engagement metrics.

4. Testing:

a. Unit Testing:

- Conducting unit tests to verify the functionality of individual modules and components.

b. Integration Testing:

- Performing integration tests to ensure seamless communication between different parts of the system.

c. End-to-End Testing:

- Conducting end-to-end testing to evaluate the system's performance in real-world scenarios, including posture detection accuracy, segmentation effectiveness, and cart abandonment prediction accuracy.

5. Deployment:

Deploying the system to a production environment, ensuring scalability and reliability.

Monitoring system performance and user feedback to identify and address any issues that arise post-deployment.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 4, April 2024

Providing training and support to users and administrators to familiarize them with the system's features and functionalities.

6. Evaluation and Iteration:

Evaluating the system's performance against predefined metrics, such as accuracy, user satisfaction, and business impact.
Iterate on the implementation based on evaluation results and feedback from users and stakeholders.
Incorporating any necessary improvements or enhancements to enhance the system's effectiveness and usability.
By following this implementation plan, we aim to develop a robust and user-friendly system for workout management that leverages advanced algorithms and technologies to deliver personalized fitness recommendations and optimize user engagement.

VI. CONCLUSION

In conclusion, the proposed workout management system represents a significant advancement in the fitness technology sector. Our objective is to address key challenges in fitness management, such as identifying posture, segmenting customers, and analyzing cart abandonment, through the utilization of advanced algorithms and pretrained models. The implementation plan encompasses data collection, algorithm selection and integration, system development, testing, and deployment, offering a systematic approach to the development and implementation of the system.
Through the implementation of intelligent automation and seamless connectivity, our solution has the ability to revolutionize individuals' perspectives on exercise and wellness. By providing personalized guidance, real-time monitoring, and targeted engagement strategies, our solution aims to optimize health outcomes, elevate user satisfaction, and reshape the fitness industry.

REFERENCES

[1]. M. R. Islam Rifat, M. Nur Amin, M. H. Munna and A. Al Imran, "An End-to-end Machine Learning System for Mitigating Checkout Abandonment in E-Commerce," 2022 17th Conference on Computer Science and Intelligence Systems (FedCSIS), Sofia, Bulgaria, 2022, pp. 129-132, doi: 10.15439/2022F167.
[2]. Chung, J.-L.; Ong, L.-Y.; Leow, M.-C. “Comparative Analysis of Skeleton-Based Human Pose Estimation”. Future Internet 2022, 14, 380. https://doi.org/10.3390/fi14120380
[3]. L. Rajput and S. N. Singh, "Customer Segmentation of E-commerce data using K-means Clustering Algorithm," 2023 13th International Conference on Cloud Computing, Data Science & Engineering (Confluence), Noida, India,
[4]. S. C. Shapiro and H. R. Smith. A scrabble crossword game playing program. Springer, 1988.
[5]. A. W. Appel and G. I. Jacobson. The world’s fastest scrabble program. Communications of the ACM, 31(5):572-578, 1988.
[6]. S. Koul and T. M. Philip, "Customer Segmentation Techniques on E-Commerce," 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), Greater Noida, India, 2021, pp. 135-138, doi: 10.1109/ICACITE51222.2021.9404659.
[7]. V. R. Maddumala, H. Chaikam, J. S. Velanati, R. Ponnaganti and B. Enuguri, "Customer Segmentation using Machine Learning in Python," 2022 7th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, 2022, pp. 1268-1273, doi: 10.1109/ICCES54183.2022.9836018.
[8]. J. -S. Kim, "Efficient Human Action Recognition with Dual-Action Neural Networks for Virtual Sports Training," 2022 IEEE International Conference on Consumer Electronics-Asia (ICCE-Asia), Yeosu, Korea, Republic of, 2022, pp. 1-3, doi: 10.1109/ICCE-Asia57006.2022.9954758.
[9]. Kukar-Kinney, Monika & Close Scheinbaum, Angeline. (2009). The determinants of consumers' shopping cart abandonment. Journal of the Academy of Marketing Science. 38. 240-250. 10.1007/s11747-009-0141-5.
[10]. S. R. Regmi, J. Meena, U. Kanojia and V. Kant, "Customer Market Segmentation using Machine Learning Algorithm," 2022 6th International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2022, pp. 1348-1354, doi: 10.1109/ICOEI53556.2022.9777146.
[11]. E. Y. L. Nandapala and K. P. N. Jayasena, "The practical approach in Customers segmentation by using the K-Means Algorithm," 2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS), RUPNAGAR, India, 2020, pp. 344-349, doi: 10.1109/ICIIS51140.2020.9342639.
[12]. I. V. R. Domingo, C. J. Sunga and M. Comia, "iGYM: Implementation of Image Recognition Using Silhouette Extraction and Artificial Neural Network as Gym Instructor," 2022 6th International Conference on Communication and Information Systems (ICCIS), Chongqing, China, 2022, pp. 109-112, doi: 10.1109/ICCIS56375.2022.9998150.
[13] Chatterjee, Patrali & Li, Shibo. (2005). Shopping Cart Abandonment at Retail Websites - a Multi-Stage Model of Online Shopping Behavior
[14] T. Kansal, S. Bahuguna, V. Singh and T. Choudhury, "Customer Segmentation using K-means Clustering," 2018 International Conference on Computational Techniques, Electronics and Mechanical Systems (CTEMS), Belgaum, India, 2018, pp. 135-139, doi: 10.1109/CTEMS.2018.8769171.
[15] Garima Sharma, Ankita Nainwal, Bhaskar Pant, Vikas Tripathi, Mr Akash Chauhan. (2021). Customer Segmentation Using Machine Learning. Ilkogretim Online - Elementary Education Online, 20(3), 3230–3237. https://doi.org/10.17051/ilkonline.2021.03.335
[16] Y. Wang, S. He, X. Wei and S. A. George, "Research on an Effective Human Action Recognition Model Based on 3D CNN," 2022 15th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI), Beijing, China, 2022, pp. 1-6, doi: 10.1109/CISP-BMEI56279.2022.9980092.
[17] A. Nagarkoti, R. Teotia, A. K. Mahale and P. K. Das, "Realtime Indoor Workout Analysis Using Machine Learning & Computer Vision," 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Berlin, Germany, 2019, pp. 1440-1443, doi: 10.1109/EMBC.2019.8856547.