

Real-Time Customer Behavior and Satisfaction Insight System in Shopping Malls

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Abstract— The research this research was tasked to perform on the different technologies; Pose Network and Move-Net, to monitor the customers in shopping malls, with other studies pointing out the weaknesses of the systems in exactly identifying and interpreting customer interests is the study. Basically, these systems--mainly, pose detection systems--are used to set customer attributes and ignore other multiplicity of behaviours of the customer, which may be potentially influencing those attributes it is Concurrently, the other option that we are providing to this problem which is the integration an advanced person detection framework known as YOLO with Deep SORT algorithms that can tell the customer movement direction precisely is offering improvement. The technical aspect of our model we have the ability to increase the accuracy of the proposed model as well as its flexibility and adaptability as compared to the methods which are in existence. Also, we provide fast and anonymous PC feedback collection through QR codes that lets us to determine the final results of the survey chatter of customer interactions. The report of our attempt to clean code will enable the operators of shopping malls to know customer preferences, annoyances, and satisfaction levels with the use of computer vision and machine learning. A well-grounded decision will be the starting point of data-driven approach that will profit the customers through operational efficiency of the mall.

Index Terms— Customer Behavior analysis, Real Time insights, Shopping mall analysis, Natural Language Processing, YOLOv10.

I. INTRODUCTION

Understanding customer behavior is crucial for most businesses whether they are focused on personalizing their customer journeys or on making their operations efficient, particularly in large shopping malls. Thus, the significance of instant insights based on the data-driven approach should be recognized, as the purchase decisions of the customers and their preferences keep the store alive which then helps to establish the business' position. This research is providing a never-before-seen customer behavior analysis method using natural language processing and advanced analytics, which are empowered by deep learning. A multi-layered style of dealing with customers in terms of characteristics topics like the diversity of sets of customer movement patterns, the level of user engagement with mall service offerings, and the type of the textual feedback will be chummed out by the system as insights to enhance the quality of decision- making by mall operators.

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The latter is achieved by the system that uses video-based tracking in conjunction with Deep SORT to recognize body movement patterns, the busiest zones, and the most popular paths. Also, it not only will quantify customer interactions with various digital touchpoints, such as mobile apps or kiosks, in order to derive their level of engagement and preference but it also will be a measure of their interaction time. Furthermore, it will exploit the advanced NLP methods in order to gauge sentiment regarding customer reviews, social media reactions, and other informational text feedback. These simultaneous real-time behavioral, textual, and the tracking analysis approaches combined together do not only allow companies to offer excellent customer services but they also help businesses to position the stores rightly so that customers are satisfied with the shopping experience and marketing strategies are thus set right.

This is the mission of scientists consequently they are finding different ways in which to narrow down the gap between raw data and business insights in such fashion that the companies get equipped to cover their responsibility towards the new challenges of the market and customer behavior. Deep SORT technology and NLP analytics work in combination to deliver the benefits of improving customer experience and operational efficiency. The use of QR codes alongside the advanced technologies thus allowing the business to gather the necessary data and decide in a data-driven way is or will be one of the most effective means of strategic adaptation to the future retail experience. While this kind of a technology bundle could open up retail operations, it comes with a bonus by which customers are engaged and their satisfaction is guaranteed.

II. LITERATURE SURVEY

Merad et al. introduced proposal a re-identification strategy which took into account particle filters along with the multiple object tracking for better tracking accuracy in a crowded environment. The proposition of theirs is that it is a very useful tool for behavioural marketing as it helps in the removal of identity switchover and record customer routes. Their methodology is significant in the analysis of client movement, however, they did not take the time to get the necessary information about the emotional state [1]. Khadija et al. explored the RTMs and their effects on retail shopper spending stating that they do positively affect shopping among moderate and heavy buyers, but there was no gain among light ones. The study underscores the importance of promotions that are customer behaviour-based [2]. Scott et al. sought this specific experience, by delving into the topic of variety-seeking behaviour. They found out that leisure shoppers do the most flexible when it comes to the number of ways they make their choices, which means a lot of variety is to be expected. Besides the psychological attributes like the need of the information and deal blobs that underpin such behaviour, personalized retail experiences are created through this [3]. Jianyi et al. conducted a study to use EEG to detect a facial expression's influences on emotional feedback towards bodily expressions. It was discovered that facial expressions greatly affect the emotional reactions to body languages. This application of emotion-detecting systems during customer behaviour analysis might make it practical [4]. This work by Merad et al. was aimed at the bettering of the multi-object tracking in densely populated environments by utilizing the particle filters and re-identification algorithms. These ways are sine qua non to accurately follow customers' tracks between various retail areas. Nevertheless, the emotion of the people was not involved in their survey [5].

III. METHODOLOGY

We have investigated customer behaviour analysis systems based on past works including Pose Network and Move Net in the study of this time. There are some problems with these systems that need to be solved: misidentification of customer interests through the wrong interpretation of poses or poses only but not the user behaviour. In comparison to others earlier on, the creation is one of such kind that will carry out this high-precision matter by taking up the newest YOLO person detection framework as well as the Deep SORT algorithm to follow the individuals. In addition to maintaining the same accuracy and availability, our approach also allows the customers to give their feedback directly into the real-time system using QR codes. This guarantees that the system will be able to use the feedback for a wider analysis of consumer interaction. All the data can be recorded on the live video that is taken through a wireless network of strategically positioned CCTV cameras that provide the coverage needed for the whole mall to be intact. According to the above, the raw video is converted to a format in the necessary form so that the advanced object detection and multi-object tracking algorithms can be further used on it. This leads to the analysis of the consumer movement in the malls

and the investigation of the shopper interaction at the same time in a seamless way. Engagement is basically calculated by the use of standard metrics representing various states. As a consequence of the distinction process, the donor analyses those regions where some are sellers (customers and sellers), and in the meanwhile, the age and gender are also the output of the algorithm, thus making it worldwide. The action-oriented report combines intelligence on where and how to act the best in store layout design, marketing strategy improvement, and customer experience enhancement respectively. The ongoing real-time video output has been showing a variety of customer actions and moments from many parts of the mall; thereby, it is giving analytical material that will help make informed decisions.

A. Technique for Video Pre-processing and Enhancement:

Video pre-processing is a vital first step in the analysis; the clearer the input data the better the findings. Techniques such as filters, noise rejection, or removal of disturbances that have occurred due to external interference from the video feed without destroying its integrity are not bad choices. The application of stabilization techniques where shakiness and unsteady flows are eradicated in the cameras and environments, will deliver straighter paths and more dependable live streams. The segmentation technique aims at designating the part of the context that is directly involved with the customer's interaction with the products, thus simplifying the analysis in the specific area and highlighting the most important data. The steps taken by AI, provide the Required infrastructure for the video based analysis of the consumer's behaviour which is reusable,repeatable, and robust.



Fig. 1 Architecture

B. Customer Behaviour Analysis for Better Data- Driven Decision-Making

Customer behavior analysis combines advanced detection techniques with data-based reporting that informs actionable insights. Real-time video monitoring of individual customers, even under occlusion or interruption conditions, relies on deep learning algorithms like CNNs. Classical behavioural assessment identifies key activities such as walking, standing, sitting, and denoting specific hand gestures as reaching, touching, and lifting/placing; this wider scenario adds to understanding the interaction between the consumer and the product. Thoroughly, and from different angles, marketing specialists can measure customer engagement. This might be based on the time a person stays in that particular location besides satisfaction scores. For instance, imaging based on the data like heat maps that present the most travelled areas, flow analysis plots to display the best arrangement of the mall, and product performance scores versus sales, can offer solutions that will, in turn, improve customer satisfaction by, for example, providing better service, better product placement, and better overall mall management.

C. QR Code-based Data Collection

Data collection using a QR code for monitoring shoppers in shopping malls is real-time. Mall management can understand customers' needs more pleasantly with this QR code-based monitoring system that allows customers the freedom to provide their feedback, preferences, and shopping patterns in the freedom to do so. The mall can then use this customer engagement to understand the mall to a greater depth. Movement in the mall is being tracked using Deep SORT to analyze visits and offer surveys and customer interactions in real-time. The combination then results in personalized customer experiences, space in stores being better used and the resources be deployed optimally.



Fig. 2 Feedback

IV. RESULTS AND DISCUSSION

An advanced detection and tracking algorithm gives access to real-time tracking features that are able to analyze consumer behavior closely, the way they move, times they spent in different areas, and the extent of their engagement. Thanks to Natural Language Processing (NLP), businesses now can easily detect and analyze the customer's feedback. In fact, NLP is relevant by interpreting customer suggestions that have a hard time getting through to companies. Sometimes, QR codes were helpful for data collection in a way where more exact identification of purchases and shopping preferences for the customer is possible. Real-time reporting for quicker decision making would make it easier to get the right layout, distribute the resource to the right people, and offer personal customer experiences.



Fig. 3. Sarees Categories

Fig 3 namely products should be arranged in sarees, dresses, western wear, children, shirts, pants, and t-shirts, which are the fundamentals in understanding of customer behaviour. These are shopping times, purchased goods, verbal participation of clients, and the fulfilment of their own desires. By this, the report will show consumer interest in different sarees styles, periods of time, and consumer feedback on fabric quality, pricing, and design. Identically, other costume classifications would be the way to go in allowing fading out, fitting preferences, and shopper interactivity levels to come into play. You can process customer feedback to create tailored recommendations that will minimize the inconvenience of the shopping decision for the companies and, thus, will improve their decision- making.



Fig.4. Detecting and Analysing the Customers

The fig 4 is a live example that pictures the real- time customer behaviour analysis system at a shopping mall using YOLO and Deep SORT. The system can people spot in a shopping mall, virtually follow their movements over a fixed period, and further create a report of hourly spent in different areas of the mall. The bounding box coverage is visible around the detected persons as well as the seconds gone by the adoption of YOLO for object detection and Deep SORT for object tracking empowers mall engineers to make better decisions about how and where people move. Collecting the data, store managers can give necessary spatial information, improving customer service, and guiding marketing strategies

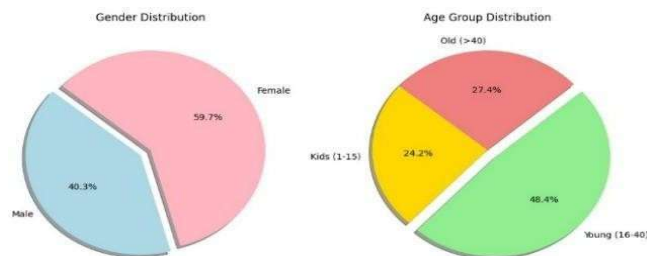


Fig. 5. Distribution of Gender and Age Groups of Customers

The fig 5 refers to the left pie chart which is displayed and reveals that 59.7% of the customers who were surveyed were males and 40.3% were women. The remaining pie chart is about the characterization of customers by age group, 24.2%, and 48.4%, and 27.4% are labelled as children, adolescents, and older people, respectively. The situation provides mall managers with a medium of resources to allow for demographic determination, therefore, in the light of this, to locate the proper place of a store, advertising, and other business's adjusting to the needs of the customer.

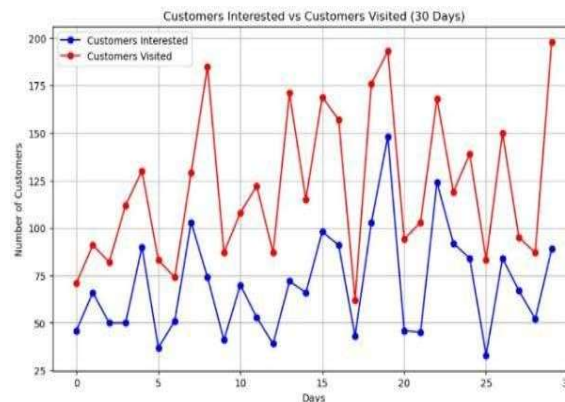


Fig. 6. Customers Interested vs. Customers Visited

The figure 6 refers to depicts the appeal line (blue line) in connection with the actual visits of customers each day (red line), which were evenly spread across a period of 30 days. The number of days is depicted on one axis, and the other one on the second one shows the number of customers. The multiplicity in potentially vital patterns for the relation of customer interest and the footfalls by time is a key component of this kind of data; customers

could be kept long or short, hence, the changes in the other part of the trends would be observed. This tool is most likely a means of giving the mall officials a head start in their first quests of shopping behaviour patterns, depending on which, they may fix their marketing campaigns and get customers involved.

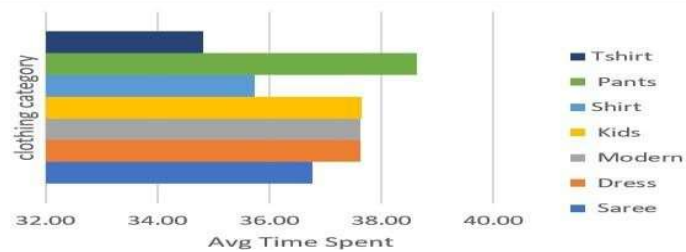


Fig. 7. Average Time Spent in Clothing

Fig 7 is the average monthly times for the category of clothing, which would reflect of consumer preferences and involvement in the first Pants, Kids Wear, Modern, and dresses, that is a measure of interest. The time values for time spent were, therefore, flexible and gave retailers the opportunity to examine store layouts and personalized recommendations. These methods help retailers to make better inventory management, to improve advertising offers, and to increase customer satisfaction and loyalty using existing data.

V. CONCLUSION

Natural Language Processing (NLP), Deep SORT, and QR code technology are the areas main capacities of the project to build operational around for the collection of real-time mall customer behaviour data. A system like these ones helps mall managers collect and render insights on the dealer traffic, time spent on products, and engagement levels which essentially leads to the best optimization process on both merchandising and resource allocation thus, customers are provided shopping experiences. Furthermore, using QR codes simplified the transaction of data and allowed a more profound understanding of customer needs. The response to the dwell time on products is about the value perceived to be higher than the expressions of customer interest of which consequently the space is made for the companies to bring together product display and marketing strategy. The analysis shows that there are highly targeted promotions and good direction for location and store operations based on the customers' interest and actual visits. Progress that can be seen in handling computation issues may uncover the full potential of this project. In the brief, the retail business analytics would get the benefits of a higher level of customer experience, bigger business performance, and intelligence-driven management by implementation of this system.

VI. FUTURE SCOPE

AI-driven recommendations for personalized promos, will be the upcoming innovations. Besides, in AR advanced behaviour analysis for providing users asynchronous real-time feedback via the blockchain model is also planned. QR codes secondary operation of AR can be facilitated by utilizing AR technology or other similar technologies QR codes can replace AR as the most used technology for real-time feedback

REFERENCES

- [1] LI, J., Zeng, J., HOU, K., Zhou, J., & Wang, R. (2020). Application of openpose algorithm to detect consumer behavior in store.
- [2] Falcão, J., Ruiz, C., Pan, S., Noh, H. Y., & Zhang, P. (2020). Faim: Vision and weight sensing fusion framework for autonomous inventory monitoring in convenience stores. *Frontiers in Built Environment*, 6, 568372.
- [3] Liu, J., Gu, Y., & Kamijo, S. (2018). Customer pose estimation using orientational spatio-temporal network from surveillance camera. *Multimedia Systems*, 24, 439- 457.
- [4] LI, J., Zeng, J., HOU, K., Zhou, J., & Wang, R. (2020). Application of openpose algorithm to detect consumer behavior in store.
- [5] Liu, H., Mei, J., Jia, F., Zheng, D., Yuan, J., Wang, Z., & Zhao, Y. (2024, May). AuraPose: Accurate Human Pose Detection and Behavior Recognition via Enhanced OpenPose with Angular Measurement. In *2024 IEEE International Instrumentation and Measurement Technology Conference (I2MTC)* (pp. 1-6). IEEE.