GSJ: Volume 10, Issue 11, November 2022, Online: ISSN 2320-9186
www.globalscientificjournal.com

Smart Customer Analysis System for Supermarket

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Abstract— **Researchers are focusing on making grocery shopping safer and more enjoyable for customers because of the pandemic. This system will have both a mobile and a desktop application developed. We employ a webcam and an image processing model to determine whether or not a consumer is wearing a face mask. The system will issue a voice command warning if they don't have a face mask on. An image processing model is used to figure out how many people are using the system. It is possible to forecast what customers will buy based on their previous purchases as soon as you enter the store. Customer satisfaction and new customers can both be improved by using this module. This program can also send customers to the location/rack where the relevant goods are housed. The barcodes on the product can be used to determine the product's location, which is then displayed as an augmented reality representation. By using data from a bigger set of customers, this system can forecast what customers will do in the future based on their current behavior.**

Keywords—forecast, augmented reality, image processing

I. INTRODUCTION

Big Data management systems and technologies, such as Google's and Yahoo's, have sprung out in response to the recent boom of Internet data. Rapid technological advances and the Internet have resulted in an enormous amount of data being generated, ranging from commercial transactions to social networks to scientific studies. The mining and analysis of such a large volume of data may lead to more qualitative outcomes that benefit humans in critical areas such as health, economy, national security, and justice. Due to the ever-increasing volume of data, computation and management expenses are relatively significant. Data storage in huge data centers to analyze and better understand customer behavior is becoming increasingly important as customer analysis is at the core of all enterprises' operations. On the ground, corporations access and process vast amounts of data so they may better understand their product sales and consumer purchases. From tiny businesses to giant corporations, owners try to keep track of information that may be beneficial to them. Increasingly high-quality network services are now possible due to both the amount of Internet data and the rapid advancement of technology. Aside from health and economic information, the Internet is used by many people for other kinds of information as well.

Consequently, firms focus on the information and personal transactions that their clients want in order to provide them with individualized promotions. In addition, businesses give their consumers cards so that they may keep track of every purchase detail, resulting in an enormous volume of data and search methods for data processing. Historically, many analysts have been involved in data collecting and processing. As data volumes continue to grow, analysts need to employ particular methodologies to ensure that their findings are accurate because of their large size. Due to their increased volume, these methods must also make use of sophisticated software tools in order to do automatic data analysis. Since data collecting is now so straightforward, it can now be described as such. In order to have a better knowledge of how customers think and act at a certain time of year, analyzing a dataset is essential. Various categorization and clustering approaches are available to assist analysts in gaining access to the thoughts of their customers. In this article, supervised machine learning techniques are used in the process of mass marketing, and more especially in the specific field of supermarket goods[01].

In addition to the advancement of digital technology, the profusion of social networks has spawned a great number of reviews and comments on products and services, events, and personalities. Consumers are accustomed to relying on other people's reviews in order to make a purchasing decision. In addition, businesses are keenly interested in hearing customer feedback on their products or services and, as a result, make adjustments to their marketing and product development strategies as necessary.

According to data from the World Health Organization (WHO), the two most common ways for the COVID-19 virus to spread are through respiratory droplets and through direct physical contact. One of the preventative methods that can restrict the transmission of some viral respiratory illnesses, such as COVID-19, is wearing a medical mask. This is one of the preventative strategies. In light of this, it is essential to correctly display a mark in public locations such as supermarkets and shopping malls. In this article, we propose a method called Face Mask Detection that can determine whether or not a person is wearing a mask correctly. There have only been a handful of studies done on the identification of face masks in video broadcasts. OpenCV, TensorFlow/Keras, and Deep Learning will be used, together with a two-phase architecture for detecting face masks, in order to obtain a high level of accuracy in the process[04].

II. LITERATURE REVIEW

Content-based filtering suggests goods that are comparable to what a certain person has previously appreciated. Standard distance metrics like the cosine coefficient can be used to determine how similar two objects or profiles are when they are represented as vectors in the space of features. Text documents and user queries (or preferences) are both represented as vectors in the space of keywords or phrases in the vector-based model of information retrieval (I.R.). The vector's coordinates are determined by the words' discriminating values. There is no distinguishing value in using the term "computer" when recommending web pages from a site that reports on computer industry news. Only a small percentage of web pages will use the term "product recommender"; hence the term is likely to have a high discriminating value. TFIDF ("term frequency/inverse document frequency") is a typical metric in the IR literature for calculating document feature discriminating value[02].

Many organizations have recently implemented an electronic sales transaction system in an effort to provide their customers with a more convenient and dependable shopping experience. Retailers, on the other hand, have access to a wealth of information on their customers. As the volume of data grows, researchers are developing more efficient methodologies and rule algorithms for market basket analysis. The "Profset model" has also been developed by researchers to help consumers select the best products from a supermarket's inventory. This strategy uses cross-selling potential to select the most intriguing products from a wide range of goods. Additional research was done by Li et al. on the creation of an E-supermarket recommendation model. A personalized recommendation system for government-to-business e-services was created by Lu and his colleagues[03].

The recognition of small objects in remote sensing photographs is a subject that has received a lot of attention in the field of computer vision, and numerous solutions to the difficulty of this task have been offered. [06] and [07] are examples of traditional approaches that can be used for this problem. In recent years, thanks to the development of deep learning, CNN-based algorithms have seen widespread use in the field of remote sensing tiny object recognition due to the high accuracy that these approaches provide. A singular value decomposition network was developed by Zou et al. [08] for the purpose of ship detection in spaceborne optical images. This network offers a straightforward and effective method for learning the characteristics of remote sensing images. A rotation-invariant convolutional neural network, or R.I.C.N.N., was proposed by Cheng et al. [09] to detect multiple objects in high-resolution optical remote sensing images. The method of objection detection was made more sensitive by the use of numerous models, multi-stage cascades, and other integrated approaches by Ouyang et al. [13]'s proposal to combine CNN with the deformation model. Because of the enormous number of people working there, the likelihood of getting sick in a supermarket is quite high. Despite the fact that there are inspectors stationed at the entrance of the supermarket to check the masks and temperatures of customers as they enter the building. However, there are still some persons who do not wear masks in certain shops, which presents a significant risk to the general public's health and safety. In other words, as a result of this, there is a greater chance that an infected individual may pass the virus on to another person. As a result, the primary emphasis of this study is on the identification of face masks in real-time. To this end, some developers have developed a new dataset known as COVID-19- Mask, the purpose of which is to automatically determine whether or not customers are wearing masks[05].

It is common knowledge that one of the most important components in ensuring that an unmanned vehicle operates in a safe manner is the detection and recognition of traffic signs. In order to improve the recognition of traffic signs, Sermanet et al. [10] suggested providing the classifier with multi-stage features through connections that skipped layers. Two convolutional neural networks (CNNs) were developed by Zhu et al. [11] in order to concurrently localize and classify traffic signs. Convolutional neural networks (CNNs) can be trained using a method called hinge loss stochastic gradient descent, which was described by Jin et al. [12]. This method offers higher test accuracy as well as faster and more stable convergence.

III. RESEARCH OBJECTIVES

The core goal is to create user-friendly software to improve grocery procedures utilizing our components. Introduce a system that sends a consumer an automatic voice message if he enters the market without a face mask to maintain healthy practices. As clients enter the market, design a system that uses image processing to identify between new and returning customers. Develop a system so the owner can study the things customers are frequently tempted to buy, receive a monthly report on them, and offer discounts on those products. Help the buyer use the app to find the desired goods. The mobile app suggested related products. Automatically retrieve client input on the market and products using computer vision on surveillance cameras and recognize burglars using face detection.

1. Using face detection, confirm that customer wears a face mask

The webcam at the entryway uses an image processing model to determine if a customer is wearing a face mask or a disguise. The system will notify the consumer if they are not wearing a face mask. The face mask will be detected at the entry using a Convolutional Neural Network (CNN) method and tools such as Keras and TensorFlow. Face data will be collected both with and without a mask, as well as training data through the use of a live camera and matching learning and prediction. Next, the system will check to see if the customer has been using face masks the entire time they've been shopping there. They will be analyzed as a group by the system, and the percentage of this group will be displayed.

2. Taking the customer to the product through the application using RFID reader, Barcode reader, and A.R. technology and recommended related searched products.

Once the customer has entered the market, the app will direct him in the direction of the product he wants to buy so that he can easily locate it. RFID tags are attached to each rack, and products are organized in the racks based on their barcodes. The product's A.R. view will be viewed using A.R. technology. Upon arrival at the store, the smartphone app

displays suggested alternatives to the item he originally sought. Recommendations will be made using a matching learning system.

3. Using computer vision to obtain automated feedback on the products and market that the customer is buying as well as to analyze the behavior and identify the thieves in advance.

As a convenience for customers, this component provides automated feedback on what things the user is purchasing while also employing computer vision to identify suspicious customers or those in need of assistance. When a suspect client's conduct is detected by the system's analysis of consumer behavior, security officers are notified via the system. The system will notify an assistant if it determines that a customer is in need of assistance. Deep learning algorithms are used to harvest data from retail outlets automatically. A.I. algorithms can recognize, track, and assess client activity in retail businesses by leveraging real-time surveillance video.

4. Calculating the number of customers entering the market through an image processing model and analyzing the products that the customer buys the most, and providing discounts.

To get the customer count, we will use a barcode scan to get the customer count. Customers have a barcode, and when they enter the supermarket, they have to put forward that bar code. Then it will be scanned by a barcode scanner. After that, we will train a model by matching learning, and then all customer counts will be saved in the system. The system will generate a report regarding the customer count.

Customers are offered a discount for the products which they buy more. Here, we will analyze the customer purchase pattern. First of all, we need to gather data set regarding the customer's purchase products. Then we will train a model using deep learning. After that, we predict the Items that the customer buys the most monthly and provide a discount for those products. In this case, customers are offered a discount if they purchase more than the purchase price set by the market. We need to gather data set regarding the monthly purchase prices of customers. Then we will train a model using deep learning. We will predict consumers who buy more than the purchase price set by the supermarket and assign a particular discount for them.

IV. Research Methodology

We intended to come up with a plan for a smart system that could be implemented in a supermarket, one that would improve the shopping experience for customers while also making the supermarket run more smoothly. The suggested system will make things less complicated not only for customers but also for people who own businesses. For this system, we suggested designing applications for both the web and mobile devices.

Customers are required to wear face masks to enter the store because of the pandemic condition in the country. When a shopper enters the store, our system would first use an image processing model to identify the shopper's face, and then it would identify any face masks worn by the shopper. The technique that will be used to identify face masks is called Convolutional Neural Network, or CNN for short. A voice warning will be triggered by the system if the consumer is not wearing a face mask. In addition, the system keeps track of whether consumers continue to wear masks within the store, and if they do, it conducts a collective analysis of the data collected from those customers. Following that comes a representation of the group in the form of a percentage.

Customers are counted as they enter the supermarket by a system that employs a matching learning algorithm, and the system then stores this information. Customers will each be provided with a unique bar code, which they will need to present to get access to the supermarket. A barcode scanner will then read the barcode, and the information will be saved in the system. The website will consistently display the current real-time customer count. The system will provide a report on clients who buy more than the predetermined amount at each supermarket. This data may be analyzed by the proprietor, who can then make arrangements for a discount to be given to such customers. In addition to this, the system examines the shopping habits of the clients and compiles a report detailing the items that are purchased the most frequently by those customers. After that, the proprietor will be able to give clients a price break on the things they buy in large quantities. An algorithm is going to be used to examine the purchasing habits of the customers.

In the event that the client is unable to locate the item that he is interested in purchasing, he needs only conduct a search for the item using the mobile application. After that, the mobile application will read the RFID and barcode of the product that was searched for, and it will display the relevant location by pointing in the appropriate direction. A barcode is utilized to identify the item, while radio frequency identification (RFID) is used to identify the stored rack. In order to point it in the right way, we will be using A.R. technology. Not only that, but once the user has arrived at the appropriate location, the system will also suggest other products that are linked to the product that was looked for. As a result, this will be a very effective technique for clients to learn about a variety of products all at once. To make product recommendations that are comparable to others, an algorithm that uses machine learning will be utilized.

At this point, gathering feedback from customers is in its infancy. As a result of this, we have proposed the introduction of a brand-new system that will automatically collect input from customers. During this stage, the system will identify the consumer's facial impressions and, with the help of an image processing model, will generate automated customer feedback about the products they purchased and the supermarket. The system will not only recognize potential burglars based on their behavior when using that image processing model, but it will also distinguish potential thieves when utilizing computer vision. The field of computer vision is ideally suited for implementations on a large scale as well as applications that span multiple industries. Since there is no need for any physical sensors, the expenses connected with installation and maintenance are much lower when compared to those associated with other techniques of researching user behavior.

Because COVID-19 places restrictions on the number of consumers who are permitted to enter the business, there is a quota that must be adhered to, which means that some

customers must wait in line. The software that runs the system keeps a record of customers, allowing the client to check at any time to know how many other people are currently in the shop. Because of this, they are able to save time. Additionally, it can be utilized to ascertain the number of clients who pay a daily visit to the establishment. In addition, it is important to collect analytical data to facilitate both short-term and long-term decision-making.

V. Results and discussion

The choice analysis that is based on classification and clustering methods is going to be presented in this subsection. As will be seen in the following section, this approach compiles eight fundamental characteristics of the supermarket database as well as eleven distinct classification schemes in order to do additional research on our dataset. Researchers in [8] employed clustering to discover clients who had a spending history that was comparable to their own. In addition, as indicated by [18], there are a variety of ways in which the level of customer loyalty to a store can be quantified. To be more specific, a person is deemed to be loyal to a particular supermarket if they make repeated visits to the store and purchase particular items from the supermarket. In spite of the fact that the percentage of repeat customers appears to be less than thirty percent, the number of products purchased by these consumers accounts for more than fifty percent of the total. Because the dataset from the supermarket only contained numbers for each category, we decided to form our own clusters for the consumers and the products instead. To be more specific, we determined the distances between each location and the sales of each product. Based on these findings, we then defined three groups for the items and two categories for the distances.

VI. Conclusion

When business managers conduct customer behavior analysis, they are able to gain a long-term perspective on factors such as average purchase value, customer lifetime value, primary audience segments, and the requirements of these groups. When you have access to objective data and insightful analysis, future development, marketing, and scaling become much simpler tasks. You are aware of which areas to investigate further, how to best appeal to potential clients, and which functionalities to enhance. Through the development of a model of consumer store choice dynamics, the purpose of this research is to achieve a deeper comprehension of the purchasing habits of consumers. Only a cursory glance has been given to store choice dynamics across the entirety of marketing literature. As part of our ongoing effort, we intend to build a platform that makes use of the recommendation network. Customers will have the ability to select from a wide variety of selections on brand-new products that are offered at more affordable costs. In the following step, we might explore taking into account extra features of the supermarket dataset in order to improve the accuracy of the classification. In conclusion, we might conduct a survey to gain further insights and obtain an alternate verification of the level of engagement displayed by the users.

Acknowledgment

We are grateful to all of those who contributed to our research. We would not have been able to make any forward in our investigation without their assistance. We want to express our gratitude to the individuals, including our supervisors, who help us maintain our professionalism and ensure that we are acting in the most ethical manner possible. We would not have been able to effectively complete the job without their dogged determination. This proposal paper was much easier to complete thanks to the assistance of our co-supervisor. To assure the success of our research project, our fellow researchers assisted us in a variety of different ways. We would also like to express our gratitude to everyone, but especially to our parents and the rest of our family, for the emotional and financial support, they have given us. In conclusion, we would like to express our gratitude to all of our close friends and members of our team who assisted us with this research.

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