RECOMMENDATION SYSTEM BASED SMART SHOPPING CART

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Abstract: The paper aims at the billing automation of purchased products using Smart Shopping cart to minimize the time spent for scanning each product manually using Barcode Scanners with recommendation systems to enhance the customer's experience at supermarkets and hypermarkets. It begins with object detection using YOLO algorithm with the camera module mounted within the shopping cart. The similar recommendations for the chosen product is displayed through the touch screen display. The customers can view the description, cost, quantity of the product and the total cost of the products from the bill generated within the Web Interface. Then the customers can get through the bill counters only to perform payments. This considerably reduces the waiting time of the customers in long queues towards the bill counters and also the efforts of the bill counter attenders of scanning all the purchased products and it minimizes the checkout time for each customer at the bill counters.

Keywords **- Smart Shopping cart, Object Detection, YOLO, Web Interface.**

I. INTRODUCTION

Recommendation algorithm is one of the fascinating and widespread application of machine learning which is most commonly used in the business application. In today's world, every customer is masked with multiple choices. For example, when someone looks for a book to read without any specific idea of what they want, a lot of time is lost in looking around on the internet and exploring through various sites hoping to strike for the best one. Mostly they end up looking for recommendations from other people. Instead of wasting more time, it would be easy for us if we get recommendations for similar choices tailored to our taste based on the preferences.

Fig.1 Recommendation System

Recommendation systems are used in variety of applications, and are mostly recognized for playlists generations for video and music services like Youtube, Amazon Prime, Spotify and Netflix product recommenders for services such as Amazon, or content recommenders for social media platforms such as Facebook, Twitter, Instagram, LinkedIn etc.,

II. EXISTING WORK

In the supermarkets and the hypermarkets, the customers spend most of their shopping time in standing in long queues at the bill counters to complete the tedious billing process for all the purchased products of the customers and that too if any occasion or festive season occurs the crowd will be huge and the billing time will increase proportionally. To overcome this drawback, the smart shopping cart [2][4] is used. Using which the customers can add the products to the cart themselves using Barcode scanner attached with the cart and they can make billing [7] themselves and it is also easy for the customers to estimate the bill. This can considerably reduce the manpower at the bill counters and in turn reduce the efforts and investment. The customers can use the bill counters only to make payment for the purchased products. These measures enhances the customer's shopping experience [6] at the supermarkets.

Every supermarket provides the customers with shopping trolley to carry their purchased products around the supermarket. In this smart shopping cart [2][4], we have proposed to make the billing [7] by the customer themselves using Barcode technology with the Barcode labels and Barcode scanners attached with the shopping cart. Each product in the supermarket is attached with a distinct Barcode label and the customers simply have to add-on every product which they wish to purchase into the shopping cart by scanning the Barcode label of the product using the Barcode scanner mounted within the shopping cart and then get through the bill counter for checkout. This considerably minimizes the waiting time of the customer's in long queues as the traditional method involves scanning each product by the bill counter attenders which is a time consuming and tedious process. This method is developed using the shopping cart, RaspberryPi board, touch screen display, Barcode label and Barcode scanner. Each product is pinned with a unique Barcode label to easily identify it. The customer scans each product to read the product description before adding the product into the cart using the Barcode scanner. The customer can view the product information through the touch screen

display connected with the RaspberryPi board which displays the product description, quantity, total cost of all the products. It also helps the customers to estimate the total cost of all the purchased products before reaching the bill counter. The customers can use the bill counter only to make the payment for the purchased goods and this considerably reduces the efforts of the bill counter attenders. This enhances the customer's experience [6] in the shopping malls.

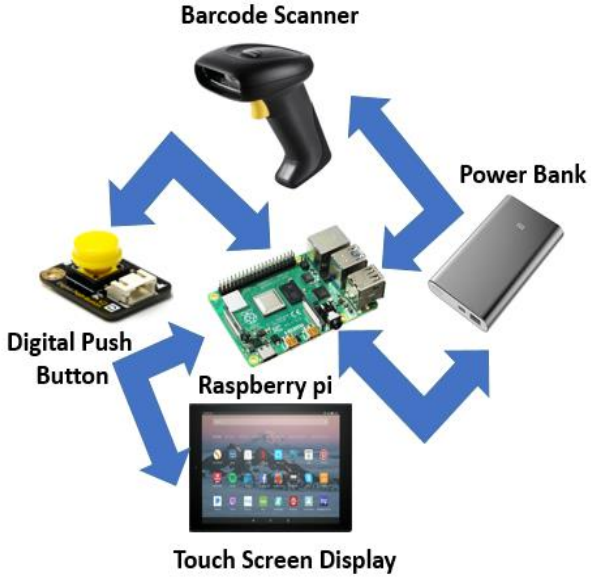

Fig.2 Block Diagram

The Hardware portion of this method includes components such as shopping cart, RaspberryPi board, touch screen display, Barcode scanner and Digital push button. The touch screen display is connected with one of the Display interface ports of the Raspberrypi board to view the product description and total cost of all the products. The Barcode scanner is connected to one of the USB ports of the RaspberryPi board and it is used to read the information from the Barcode label of the product. Finally, the Digital push button is attached with one of the General Purpose Input / Output pins of the RaspberryPi board.

The Software portion of this method consist of Raspbian Operating System. Raspbian is one of the versions of linux operating system. The Raspbian OS is compatible to work with RaspberryPi board. The RaspberryPi board consists of in built 4GB RAM which is used as temporary storage and SD card which can be used for external or permanent storage. All the applications and software's required for processing can be stored in external storage for further processing. The power for the RaspberryPi board comes from the 2A power supply of any power bank which gives power to operate the RaspberryPi board for performing operations. The Raspbian OS can be remote accessed using applications such as VNC viewer to the desktop or laptop to make it perform as a mini computer using which we can run the Raspbian OS in the Windows or other operating system to perform further operations.

In this method, each product is attached with a Barcode label. These labels are uniquely generated and attached to each product by the manpower of the supermarkets which is a tedious and time consuming process. But once the Barcode labels are attached, these labels can be easily read by the Barcode scanner attached with the shopping cart. Then the customer can view the product description in the touch screen display which is connected to one of the USB ports of the RaspberryPi board. This helps the customer to estimate the total cost of the purchase before reaching out towards the bill counter for payment. The software itself generates an automatic bill [7] by the customer itself. So, the customers use the bill counters only to make payment for the purchased products. This considerably reduces the waiting time of the customers waiting in long queues towards the bill counters and the efforts of the bill counter attenders to manually scan all the purchased products of the customer which is a tedious process and it literally consumes more time to complete the billing [7] process for each customer.

But the drawback in this method is the use of Barcode labels. As each product has to be attached with unique Barcode labels which involves more manpower and also increases the investment of the shopkeepers. But this method reduces the waiting time of the customers in long queues at the bill counters. As each product has to be scanned to add to the bill by a bill counter attender manually and as it takes more time to make the billing [7] process for each customers. As in this method, the customer itself generates the bill for his purchased products and uses the bill counter to make the payment for the purchased products and get through the checkout after completing the payment. These measures enhances the customer's shopping experience [6] in the supermarkets.

III. PROPOSED WORK

In this paper, we have proposed to develop a smart shopping cart [2][4] with the recommendation system to enhance the customer's shopping experience [6]. First, to begin with the hardware components includes a shopping cart connected with RaspberryPi 4 model board with 4GB RAM and a SD card which acts as the ROM and the power supply is from the power bank and the Raspbian OS which is a version of Linux built specifically for the RaspberryPi are used. The board is connected to the camera module to capture the image of the products placed towards the camera and after the object is detected, then the recommendations for the selected product can be viewed from the touch screen display and the customers can add all the products to the cart option available in the web interface which they wish to purchase. The customers can increase the quantity of the products using the arrow keys available near the product price and the customers can empty the products added to the cart using the Clear cart option available in the web interface and the total cost increases simultaneously when new products are added to the cart and the web interface itself generates a bill which comprises of total cost of all the purchased products added to the cart at that moment.

Then the software process starts by applying the pre-trained models of the products built with the TensorFlow modules and then followed by Region of Interest (ROI) Selection and Feature extraction to perform filtration on the portion of the image on which to

perform further processing leading to subsequent learning and generalization steps for better system understanding and human interpretations. And finally the object detection [9][12] is performed using YOLO [1] algorithm and then the recommendations for the chosen product is shown in the touch screen display and the recommendations are mostly based on other brands providing the same product within the same price range and also on the other products launched by the same company and combo offers available for chosen product. Then the customers purchase products according to their needs and then proceed to the billing section only to pay for their purchased products. In contrast to the existing work of scanning each product manually using the Barcode Scanners, we have proposed to perform object detection [9][12] using YOLO [1] algorithm for the identifying the product chosen by the customer to be added to the cart and also can increase the quantity with the web interface and then select other products which they wish to purchase and then the web interface itself generates a bill of total cost of all the purchased products added to the cart and then proceed to the bill counter where the employee does not scan all the products and just checks the total cost of the purchased products and then accept the payment from the customer in terms of cash, debit/credit card and mobile payment applications such as Google Pay, PhonePe, Paytm, PayPal etc., and then the shopping process is completed after the payment is made and the bill is generated for the purchased products of the customer.

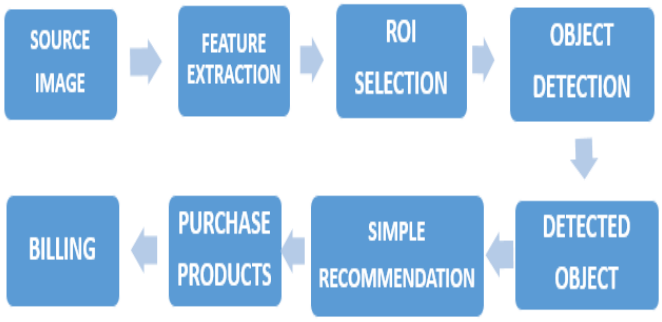

Fig.3 Process Flow Diagram

IV. IMPLEMENTATION

4.1 Source Image

The source image is obtained by capturing the product placed towards the camera module mounted with the RaspberryPi board and then the image of the product is obtained for further processing such as ROI selection, Feature extraction and Object detection by the YOLO [1] algorithm.

4.2 Feature Extraction

Feature extraction starts from an initial set of measured data and then builds derived values and features which are meant to be informative and non-redundant and it eases the consecutive learning and inferential steps and in some cases leading to better human interpretations for other processing. The process of determining a subset of the initial features is also called feature extraction and the selected features are expected to form the relevant information from input data and the desired track may be performed with the help of the reduced representation rather than using the complete initial data for system interpretation and other processing.

4.3 ROI Selection

A region of interest (ROI) is a part of the image that you want to perform filtration and further operations on it in some way. A region of interest are samples within a data set which are identified for a specific purpose and POIs are the individual points of interest which lie within a ROI where POI is a specific point location which someone may find useful or interesting. ROI defines the borders or labels of an object under consideration for the specific portion to be considered for further processing and interpretations.

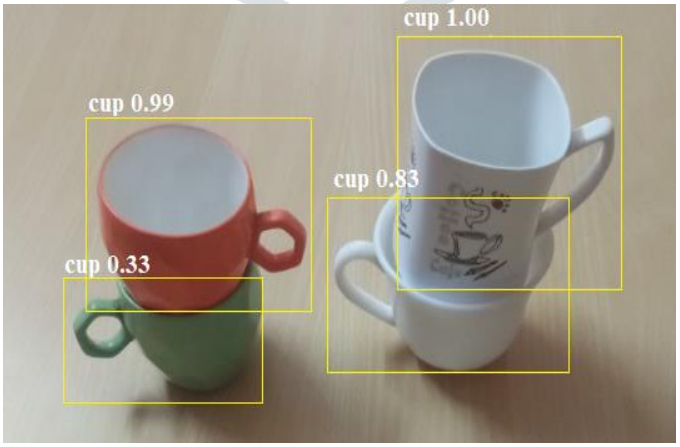

Fig.4 Region of Interest Selection

4.4 Object Detection [YOLO Algorithm]

In this module, we have planned to detect the object using YOLO (You Only Look Once) [1] algorithm. The YOLO framework deals with object detection in a different way. It takes input as a whole image in a single instance and then performs prediction to determine the bounding box coordinates and the class probabilities for these boxes. The biggest favor of using YOLO is its great

speed and it is especially fast and has a processing speed of 45 frames per second. The YOLO [1] object detection [9][12] algorithm is used for real time object detection, which is one of the most convincing object detection algorithms used nowadays. Object detection is the demanding capability of the autonomous vehicle technology in the near future.

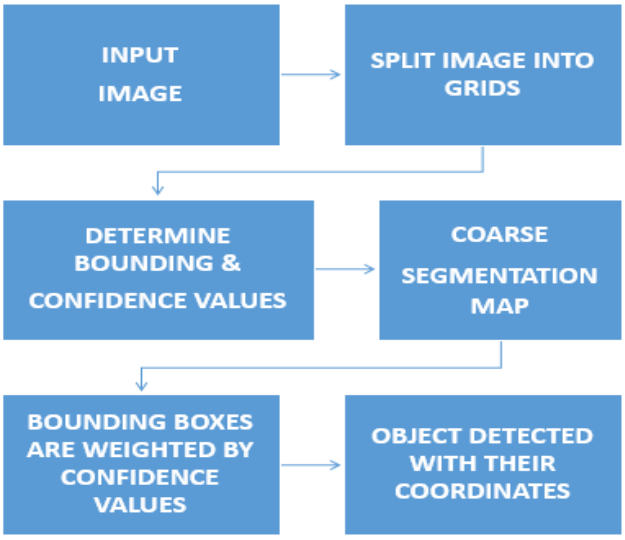

Fig.5 Working of YOLO algorithm

Object detection [9][12] is one of the classical problems in computer vision where you work to recognize what and where specifically what are the objects present in a given image and also their position in that image. The main trouble of object detection is more complicated than the classification, which objects can be recognized but it does not mention the location of the object in the image. In addition to that, classification does not operate on images containing more than one object in the image. In that case, YOLO uses a totally distinct approach. YOLO [1] is based on the clever convolutional neural network (CNN) for performing object detection [9][12] in real-time operations. The algorithm begins with a single neural network to the full image, and then partition the image into regions and performs prediction of bounding boxes and probabilities for each region in the image. These bounding boxes of the given image are weighted against their predicted confidence values.

The working of the YOLO [1] algorithm begins with the input image and then image is split into grids called as bounding boxes and then these bounding boxes and confidence values are determined and the coarse segmentation map of the image is created and then finally the bounding boxes of the image are weighted against their confidence values to obtain the object detection of the product with the name and the confidence value of the object in the output image.

Fig.6 Detected Object

The YOLO loss function is broken down into three parts: bounding-box coordinates determination, bounding-box score prediction, and class-score prediction. YOLO uses the following equation to identify loss and optimize confidence:

$$
\begin{aligned}
Loss = & \\
& \lambda_{coord} \sum_{i=0}^{s^2} \sum_{j=0}^{A} \mathbb{1}_{ij}^{obj} [(b_{x_i} - b_{\hat{x}_i})^2 + (b_{y_i} - b_{\hat{y}_i})^2] \\
& + \lambda_{coord} \sum_{i=0}^{s^2} \sum_{j=0}^{A} \mathbb{1}_{ij}^{obj} [(\sqrt{b_{w_i}} - \sqrt{b_{\hat{w}_i}})^2 + (\sqrt{b_{h_i}} - \sqrt{b_{\hat{h}_i}})^2] \\
& + \sum_{i=0}^{s^2} \sum_{j=0}^{A} \mathbb{1}_{ij}^{obj} (C_i - \hat{C}_i)^2 \\
& + \lambda_{noobj} \sum_{i=0}^{s^2} \sum_{j=0}^{A} \mathbb{1}_{ij}^{noobj} (C_i - \hat{C}_i)^2 \\
& + \sum_{i=0}^{s^2} \mathbb{1}_{i}^{obj} \sum_{c \in classes} (p_i(c) - \hat{p}_i(c))^2.
\end{aligned}
$$

4.5 Simple Recommendation

Recommendation is based on the specific object detected using the cart camera and it shows the recommendations of the other companies providing the chosen product and also shows the other products produced by the same company and displays the combo offers available with the chosen product and price comparison with other products using which the customer can choose the products with special discounts and offers and purchase products at a reasonable price and get benefitted out of it.

The customers can view these recommendations using the web interface through the touch screen display mounted within the cart. These recommendations also help the customers be aware of the available stock in the supermarkets and purchase products and goods accordingly.

Fig.7 Product Recommendation

4.6 Purchase Products

The customers can choose all the products listed in the touch screen display and it shows all the available stock of products present in the shopping mall and also get recommendations about similar products they are looking for and also about various discounts and offers that are available for the customers to choose from. While purchasing the products the customers can perform adding and removing of products from the cart anytime as they wish from the checkout option available in the top right corner of the web page based on the customer opinion and they can increase the quantity of the products purchased from the arrow keys present near the corresponding products.

Products in your cart!

ID	Image	Product	Price	Quantity	Total Price
100		Liefde yellow bowl	₹ 319.00	1	₹ 319.00
101		Cello H2O 1000ml Bottle	₹ 381.00	1	₹ 381.00
102		Larah By Borosil Mimosa Glass	₹ 574.00	1	₹ 574.00
105		Colgate ZigZag Black Soft Toothbrush	₹ 95.00	1	₹ 95.00
107		Gift Toy Soft sweet and soft Love balloon teddy bear 30cm (Pink)	₹ 120.00	1	₹ 120.00
108		Ajanta Orpat Analog Red Clock	₹ 299.00	1	₹ 299.00
		Continue Shopping	Grand Total		₹ 1,788.00

Fig.8 Products added to the Cart

The customer can view the product id, product image, product name, product price, product quantity, product price, total cost of all the products which are added to the cart currently, Clear Cart option to clear all the products added to the cart database to begin with an empty cart and Continue Shopping option to go on with the last viewed products which are available in the web interface and continue choosing products to add products to the cart, which eases the customers while performing shopping and reduce the time spent by the customers looking for an particular product and the customers can be aware of the available stock of the supermarket and it considerably reduce the manpower in the supermarkets as the Smart shopping cart [2][4] aids the customers [6] by enhancing their shopping experience.

4.7 Billing

The billing [7] of the product comes with description of the product and cost of the product, total number of item and total cost of the products which can be viewed from the touch screen display which is developed with PHP and XAMPP. The Customer can perform adding and discarding of products in the cart according to the customer opinion and it simultaneously adds the total sum of the products added to the cart at that moment and the customer can be constantly be aware of the total cost before going to the billing counter and fix their purchase up to the planned limit. At First, the required PHP page is developed with CSS, Bootstrap is used for the design and then database is created using the XAMPP and declared variables such as product_code, product_name, product_price, product_image, to store the product information in the cart_system database to execute and view the purchase information in the touch screen display to enhance the customer's experience [6] in the shopping mall and also the customers can be aware of the available stocks present in the supermarkets.

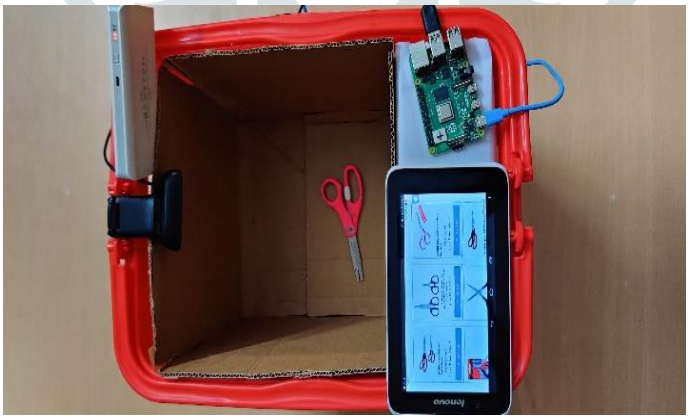

Fig.9 Smart shopping cart

V. CONCLUSION

This paper proposes a method to implement Smart Shopping Cart which helps in enhancing the customer's experience by adding products into the cart by performing object detection using YOLO algorithm and then provide recommendations such as price comparison based on different companies and combo offers available for the chosen product. This could help the customers know the available stock of the supermarket using the web interface through the touch screen display and a bill is generated with product id, product name, product price and total cost of all the products purchased at that moment which can be viewed by the customer with the cart display and they can be aware of the total cost of the purchased products at any time during the shopping. So, that they don't go beyond their limit or purchase and to get rid of the existing method of scanning the products based on the Barcode labels using the Barcode scanner as it consumes more time for billing all the purchased products for each customers and increases the waiting time for the other customers standing in the long queues and So, this method reduces the delay and the customers approach

bill counters only to execute the payment process based upon the total amount displayed in the cart display and this considerably reduces the billing time for each customers and it eases the billing process for the bill counter attenders and minimize the checkout time for each customers.

VI. FUTURE WORK

This method can be further enhanced by providing a virtual map of all the products available in the supermarket and so, the customers can easily localize their desired product in the large locality and minimize the large manpower deployed in the supermarkets to aid the customers with their shopping and also propose to automate the payment processing by generating QR code for making payment though mobile payment applications and also make payments through credit or debit card reader or card machine to process payments and further this method with such upgrading's will not require any bill counters compulsorily at the supermarkets which considerably reduces the cost and efforts of the shop owners and bill counter attenders and also reduce the waiting time of the customers in long queues towards the bill counters.

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