SMART MART – A Smart Shopping Experience Using Computer Vision

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*Abstract*— Recently, many attempts have been made to reduce the time required for payment in various shopping environments. In addition, as the 4th Industrial Revolution era, artificial Intelligence technology is advancing and IoT devices are becoming more compact and cheaper. So, by integrating these two technologies, access to building an unmanned environment on behalf of human beings to save users’ time became easier. In this paper, we propose a smart shopping cart system based on low-cost IoT equipment and deep learning object detection technology. The proposed smart cart system consists of a camera for real-time product detection, an ultrasonic sensor that acts as a trigger, a weight sensor to determine whether a product enters or out of shopping cart, and an application of smartphone that provides a UI for a virtual shopping cart, and a deep learning server where learned product data are stored. Communication between each module is made of TCP/IP and HTTP network, and YOLO darknet library, an object detection system is used by the server to recognize the product. The user can check the list of items put in the smart cart through the app of the smartphone and automatically pay. The smart cart system proposed in this paper can be applied to implement unmanned stores with high cost-performance ratio. We have designed a cart, which uses artificial intelligence to help the customer add his product easily. After adding his products, the customer can use the same software to checkout and pay the supermarket using mobile banking.

Keywords— Raspberry Pi- 4, React, MongoDB, Python, TensorFlow, YOLO

# Introduction

Nowadays in Supermarkets, customers must spend a long time in the queue to get their products billed. This causes too much discomfort, and due to which the Customer may not come back to the shop that often because of which the retail owners may lose their customers. We thought how we could solve this issue and then we came up with an idea to solve these issues. We can have a self-checkout, and customized shopping experience. The customer data can be stored in a database, which would help the owner have a good customer loyalty. Retailer can serve more customers in the same amount of time. In Many Research papers, Computer Vision and Deep Learning have been used for making the shopping experience more efficient as there are many advantages of it like Reduced Time, Paper wastage, Reduced manpower etc. In [1] They used infrared sensors to determine the product movement and they have also used a charging method with the help of Raspberry PI which recognizes the product and stores it in their database and makes their cart ready for online payment without the involvement of the cashier and making their experience even better. We are creating a system with more advance features with more personalized focus toward the user’s choice and making them stay even more in the mart and converting them into a more loyal customer.

# SOCIAL IMPACT

Reduced Time: The biggest advantage of smart mart is time efficiency. It helps to reduce the queue and save time in today's fast paced society; it goes hand in hand with busy people. Virtual assistant: The virtual assistance inside the mart would help the customer locates his products inside the mart, thereby reducing the time for searching his products. Paper wastage: Reduce paper wastage since the bill will be sent to the customer mail-id. Utilization of available space: With reduced use of cashier’s, the size of the shop can be reduced. Reduced manpower: Very few employees are required to run the shop and can be utilized for other services.

# IMPLEMENTATION

In Machine Learning we have created a Recommendation Model using CNN of Myntra Fashion Dataset where basically with the help of Image Data, we recommended similar items a user would buy. We have also created our object detection model with MobileNet Framework for this Model as it had the highest precision accuracy, and we used the Fruits and vegetable dataset from Kaggle to train our dataset. We trained our models for 50 epochs and used Early Stopping for this case and implemented our model on Streamlit through which we created an Interactive dashboard for our testing purposes.

Diagram

Description automatically generated

Fig.1 *Flow chart of our system design*

Diagram

Description automatically generated

Fig.2 *Steps for the shopping procedure*

In the Machine learning model, it will detect in real time what kind of product is added to the cart with the raspberry pi and its rpi cam attached to it, which will define what product it is and accordingly continue updating the cart.Now in the remaining part we will improve our model performance by creating a ROI and making inference time better by reducing the weights of our model and testing with the model in Real-Time.

A screenshot of a banana

Description automatically generated with low confidence

Fig.3 *Webpage of our ML model predicting the store item with its calories*

A picture containing text, indoor

Description automatically generated

Fig.4 *Our ML model detecting the superstore item like bottle*

*in this picture*

In development, we have created a working log-in page for our website and once we get the dataset, we will start working on Backend using Mongo DB. For Front -end we will start making required web pages using the dataset we will fetch from Mongo DB. In the Web Development side, we created our E-commerce Website, with interactive features where the customer could login to the website and add a product to the cart and then make a payment.

Graphical user interface, website

Description automatically generated

Fig.5 *Our Smart Mart Shopping Website*

We have had integrate our website with the model and make a connection to the Raspberry Pi through which we will make our feed input Real-time. When the user enters our mart. He/she will get a cart. There will be a 3 camera inside the cart in length breadth and the back of the cart. There will also be a tablet attached to the cart which will have our shopping site web app opened where the user can log in with their phone number/ email id and we will save their data in our database (mongo dB). If he/she is our existing customer, then they can log-in with their credential already saved in our db. After the connection is established, the ultrasonic sensor in the shopping cart recognizes the product when the user puts/pulls out the product and stores the video/image entered from the RPI camera attached to the cart in the RPI for few seconds then it sends message to the central server(firebase/Aws) indicating that the streaming has started over the TCP/IP network. Then our server reads the image/video from the RPI and then uses deep learning to determine the type, the quantity, and entry/exit of the product and passes this information to the web app on user smart tablet provided in the cart using TCP/IP network. Upon receiving the message, the web app adds/delete the product data in the virtual shopping cart. Once the shopping is completed the user will be redirected to our payment page where he/she can pay with online banking (Paytm, google pay, net banking) there will be detailed information of his/her product. Once the payment is successful the user will get a signed token number which will act as receipt which he/she should use to exit the mart.

A picture containing red, indoor, set

Description automatically generated

Fig.6 Smart *Basket with the RPI Camera attached to it*

A picture containing text, paper cup

Description automatically generated

Fig.7 *Smart Basket with the RPI attached to it*

# FUTURE GOAL

The goal of this project is to create a fully end to end working model with an in-app integration where we will be working more on development of our app and creating a user-friendly interface and improving our computer vision model to improve the accuracy in extracting visual features (produce & barcode items) for instant recognition. We are also planning to work more on recommendation so customers can search, locate, and compare products while they shop, and we can offer real-time recommendations based on cart content or location to increase basket size. Customers can also request assistance with a single tap, and, we can add an augmented reality feature where customer can get in-app navigation related to the product shelf and where is it located and continue with their Smart shopping experience.

# V. RESULTS AND CONCLUSION

With the increasing demand for facial recognition in daily use, this is the right time to build the system. In this project, we have discussed two different algorithms which are image detection and face recognition and how they can be used together to create a new mode of payment and a system which can be used to turn the shopping marts into smart mart. There can be many more measures such as iOS suitable app, in-app chatbot, admin side interface, etc. which can be done to improve the quality and security of the system and make help more businesses.

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