SMART TROLLEY FOR SUPERMARKET SYSTEM

2020 – 078

Project Proposal Report

B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

September 2020

SMART TROLLEY FOR SUPERMARKET SYSTEM

2020 – 078

Project Proposal Report

P.Satheesan IT17095136

S.Nilaxshan IT17037648

R.Thisanthan IT17386296

R.Priyanka IT17033374

B.Sc. (Hons) Degree in Information Technology

Department of Information

Sri Lanka Institute of Information Technology

Sri Lanka

September 2020

DECLARATION OF THE CANDIDATE & SUPERVISOR

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
P.Satheesan	IT17095136	
S.Nilaxshan	IT17037648	
R.Thisanthan	IT17386296	
R.Priyanka	IT17033374	

The supervisor/s should certify the proposal report with the following declaration.

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date

Jesuthasan Alosius

ABSTRACT

Electronic commerce has developed to such an extent to provide convenience, comfort, and efficiency in day-to-day life. Nowadays there are lot of shopping malls are emerging. A supermarket is a place where customers come to purchase their daily using products and pay for that [1]. Lots of people spending too much of time in the supermarket to purchase their goods. Because there is no proper way to pay the bills, they have no idea about present day deals / offers and people face difficulties in choosing the products from the large variety of products. The study aimed to provide a smart trolley for a supermarket which helps the customers to get benefit through the system. Techniques such as recommendations, voice assistant, and image processing and loyalty customer program are used in order to enhance the performance of a smart trolley. Loyalty card is used to identify each customer. Product recommendation system analyses customer needs and recommend best products to both new and existing customers in order to attract the customers and help them to make purchasing decisions. Customers can able to get the location of all products in the supermarket. Voice assistance will help customer to get details about deals/ offers and upfront without the need of reading the lengthy product specification and also without the need of any interaction with customer support executive. Smart trolley contains scanner which will scan the product and display all the information in the LCD screen. It helps the customer to get the bill for their purchase in a flexible manner.

Keywords: - Recommendation, Voice Assistant, Image Processing, Loyalty customer Program

ACKNOWLEDGEMENT

First and foremost, it is a genuine pleasure to express my deep sense of gratitude to my Research Supervisor, Mr. Jesuthasan Alosius for his fullest support, dedication, enthusiasm, and overwhelming desire he expressed throughout the project to make this research a success. I gratefully acknowledge his patience at the time of long piece of writing this report. My sincere thanks go to Ms. Janani Tharmaseelan, my Co-Supervisor who enlightened me with her vast amount of knowledge and for her support and motivation during the monitoring of progress. I would like to thank Dr. Janaka Wijekoon, Lecturer-In-Charge of Comprehensive Design & Analysis Project for giving precise account on this module during the lecture hours. Finally, Thanks for everyone who support us in various way to convert my thesis to successful thesis

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Shopping mall is a place where individuals get their everyday necessities [2]. The people always need something to help them doing a works rather doing themselves because of their engaged life. In this inventive world, each malls and supermarkets utilize shopping trolleys to help customers to choose and purchasing the items which they expect to buy. Smart trolley system provides fast purchase and great convenience to customers. This system works only for those customers which are having the loyalty card of the supermarket. The proposed system starts to work when a customer gets into the supermarket and take the trolley. Each trolley has its own RFID reader. So, the smart trolley reads the RFID tag which is in the loyalty card of the customer. There is a QR scanner facility to read the QR code of the product which the shows the price, weight etc. The QR scanner is working by using image processing which helps to read the QR code of the product. So, customers can easily get to know the total amount and can purchase according to their budget. And, with this there is no need for customer to wait in the queue for the scanning for the product items for billing purpose. The customer requires downloading a mobile application. Recommender Systems are intelligent engines that collect information related to what a customer has previously seen or bought, with the aim of providing personalized suggestions on unobserved items that are likely to be of interest. It analyses customer needs and suggest the best possible shopping list. Voice assistant is programmed for the customers to answer the questions that are related with supermarket. Voice assistant can understand what the customer is saying and have in build replies in text message to the user. The product will reduce the efforts and time consumption of the customers.

1.1 Background

In the early days of retailing all products had to be fetched by an assistant from shelves on one side of a counter while the customers stood on the other side and pointed to what they wanted [3]. Also, many foods did not come in the individually wrapped consumer-size packages taken for granted today, so an assistant had to measure out the precise amount desired by the consumer. These practices were obviously labor-intensive and therefore quite expensive. The shopping process was slow, as the number of clerks employed in the store limited the number of customers who could be attended at one time.

The concept of a self-service grocery store was developed by Clarence Saunders and his Piggy Wiggly stores. His first store opened in Memphis, Tennessee in 1916. Saunders was

awarded several patents for the ideas he incorporated into the Piggy Wiggly stores. The stores were a financial success and Saunders began to offer franchises.

A&P was another successful early chain in Canada and the United States, having become common in North American cities in the 1920s [3]. The general trend in retail since then has been to stack shelves at night and let the customers get their own goods and bring them to the front of the store to pay for them. Although there is a higher risk of shoplifting, the cost of appropriate security measures will be ideally overweighed by the economies of scale and reduced labor costs [3].

1.2 Literature Survey

- **Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket** [2]

  This paper proposes a small trolley system which provide fast purchase and great convenience to customers. The main objectives of this proposed system are eliminating human labor to push trolley and reducing the time of the queue in supermarket. This automatic trolley system is an intelligent system which contributes as an efficient system in shopping mall to follow human and avoid the obstacles in the path. The proposed system starts to work when a customer gets into the mall and take the trolley. Each trolley has its own RFID reader. So, the trolley follows the customer who has the corresponding RFID card called as user card. The movement of the system is controlled by the ultrasonic sensor and RFID tag. The QR scanner working with the help of image processing used to read the QR code of the product which the customer is taking, and it shows the price and other details of the product. Figure shows the block diagram of automatic trolley system.

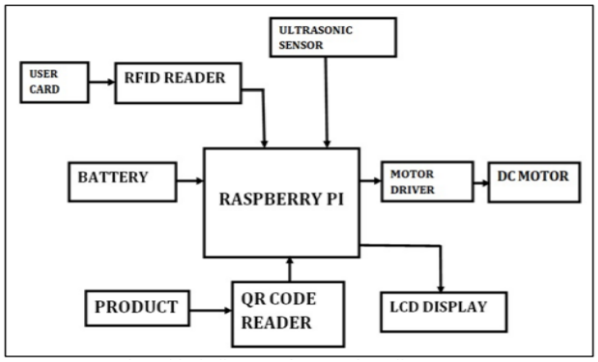


Figure 1: Bock diagram of automatic trolley system

- **RFID Based Smart Trolley for Supermarket Automation** [4]

  This paper proposes a trolley based on RFID reader for supermarket. In the electronic hardware system RFID reader is fitted. Every product in the supermarket contain the RFID tag, it has unique ID number to identify the product. The RFID reader gets information about the product from RFID tag, and when the customer put the product in to the trolley, when item is shown in front of the reader, the amount of the item is added to the purchase bill, and is shown on the LCD display. The trolley can find the rack number displayed on the LCD. Customer can remove the items from the trolley where the cost is removed from the total cost. The trolley gives an alarm signal to indicate that the customer budget has exceeded. Figure 2 shows the block diagram RFID based Smart trolley for supermarket automation.

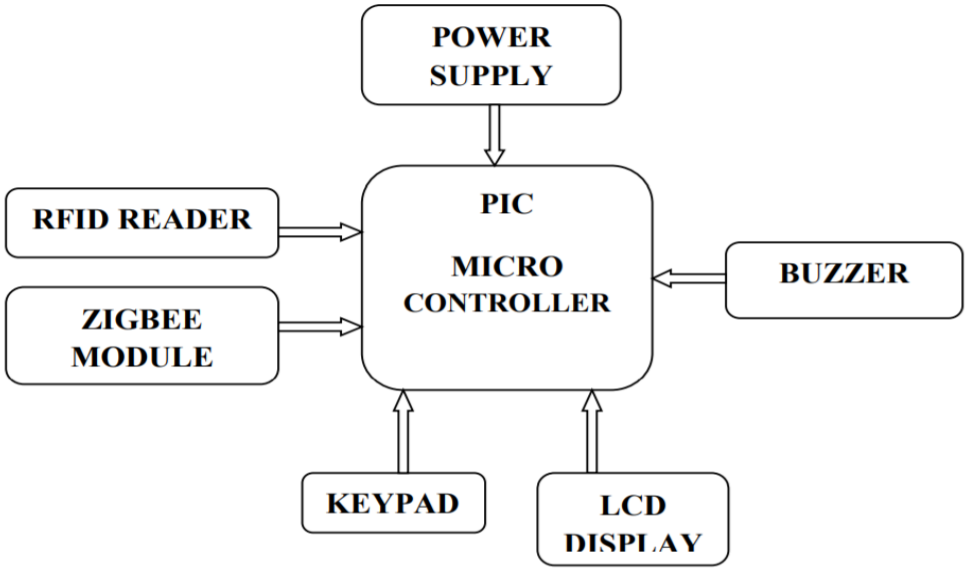


Figure 2 : Block diagram RFID based Smart trolley

- **Automated Smart Trolley for Supermarkets** [5]

In this paper, trolley is designed using RFID reader and display. The reader can read RFID tags in which details of the products are present. Each product in the supermarket have RFID tag that holds whole information about that product including price, quantity, etc. Customer can scan the product tags to RFID reader and add the products to the cart by switch present in the trolley for adding and removing of products. The total products in trolley amount is calculated automatically and displayed on display. There would be a system for billing where customer would scan their tag ID and transfer the product details for billing. Shopping end button is pressed if customer finishes up shopping. When it is pressed, by using Zigbee details of the customer purchased is displayed on display. Payment is also made by paying total amount. Figure 3 shows the block diagram of the smart trolley.

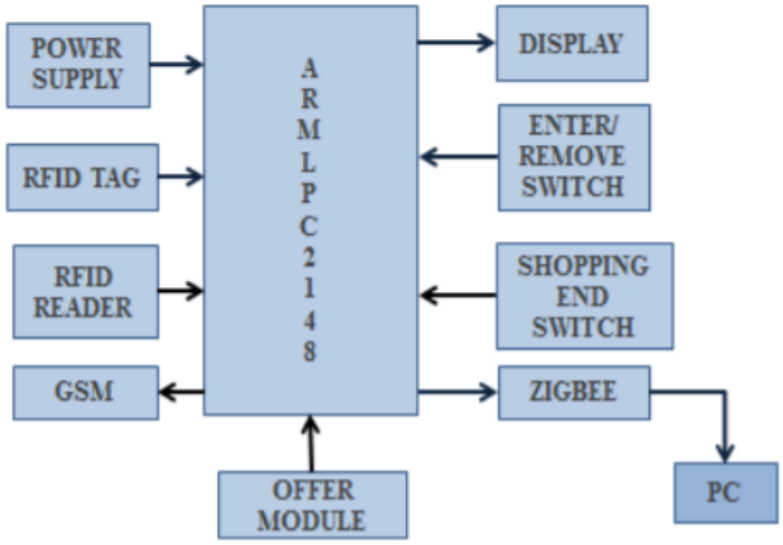


Figure 3: Block diagram of supermarket

- **Smart Trolley using Smart Phone and Arduino** [6]

In this paper, each membership card of the regular customer which is provided by the supermarket has the RFID tag. RFID Reader is attached to shopping trolley which detects the presence of the regular customer and with this, shopping trolley will act as a Smart Trolley. The regular customer requires downloading a mobile application and then the smartphone act as a barcode scanner. With the help of barcode scanner, the barcode is generated which is send to Arduino through Bluetooth Module. Once the user is done with his/her shopping and near to billing counter, user press the button on the trolley and data which is displays on the LCD would transfer to the computer. This is done by using NRF24L01 which is a serial peripheral interface and with this data will be transfer from the trolley to the computer at the billing counter. Figure 4 shows the block diagram of smart trolley.

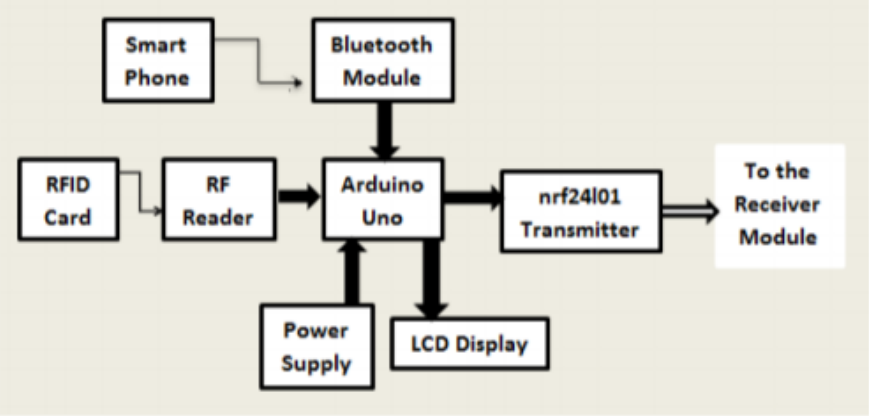


Figure 4: Block diagram of smart trolley

- **Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft** [1]

The paper proposes an automated billing system using RFID and ZigBee communication. Each product in the supermarket has RFID tag, to identify its type. Every cart contains PID (Product Identification Device). Specifically, PID contains a microcontroller, LCD, an RFID reader, EEPROM, and ZigBee module. The system recommends products to the customer on the LCD screen in-order to support the customer to purchase products using the centralized database. The centralized database will give product recommendation and information about the product on the LCD screen. Figure 5 shows the block diagram of smart trolley.

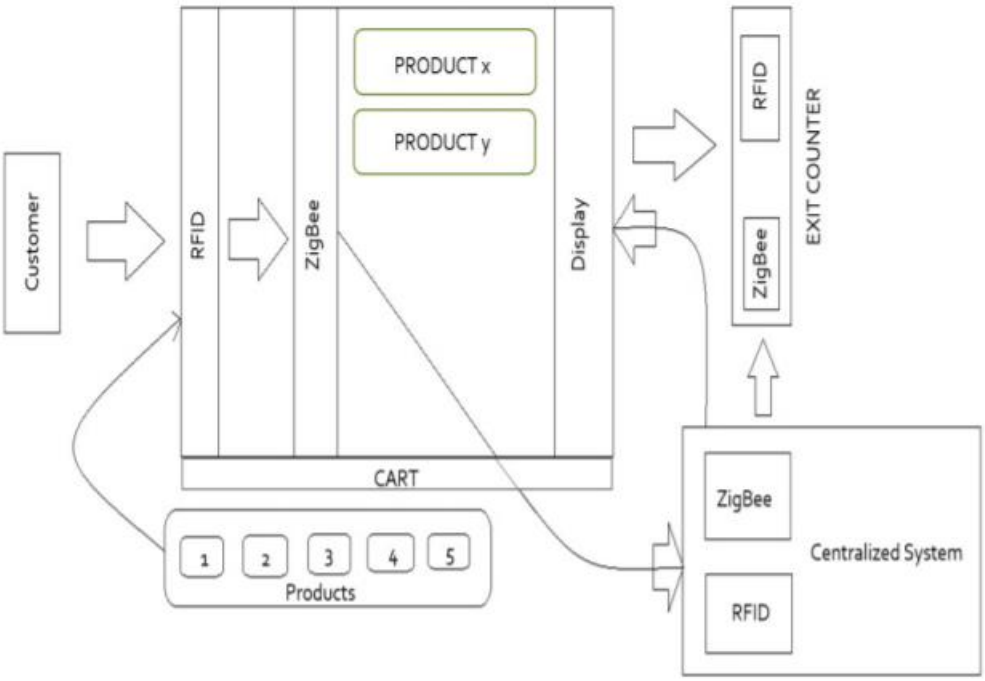


Figure 5: Block diagram of smart trolley

- **Smart trolley in Mega Mall** [7]

  This paper proposes microcontroller based automatic trolley which can able to follow customers while purchasing products. Microcontroller is used as it is less bulky, cheap and requires less power. The trolley maintains safe distance between customer and itself. Optical sensor is used for obstacle detection. If the product is shown in-front of the barcode reader it will display the number of products collected, cost of current item and total cost. Delete button is provided if a customer wants to remove the products. Quantity mismatch detector is used if customer place the product in the trolley without scanning barcode. The figure 6 shows the block diagram of the smart trolley.

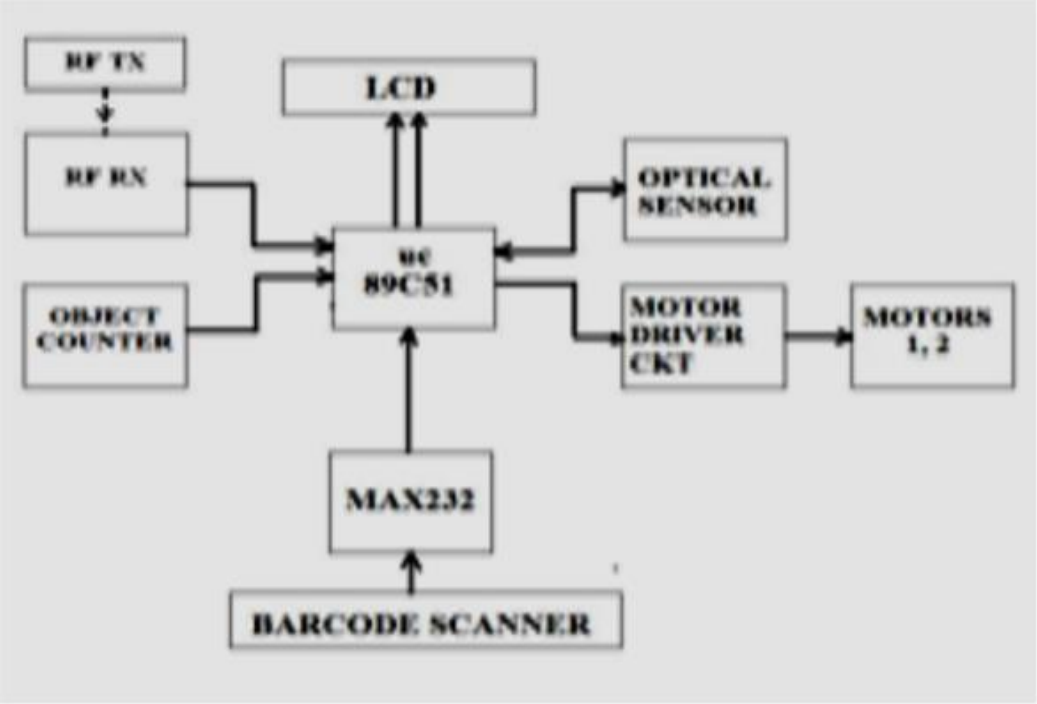


Figure 6: Block diagram of smart trolley

- **Smart trolley using IOT** [8]

  The paper proposes a smart trolley to save the time and manpower. Each trolley has a RFID reader which, reads the RFID tags of products. Every product in the supermarket has the RFID tag. Prize of the product, name of the items, and the bill of the shopping items are displayed in the on the LCD display. RFID is used as it can able to read forty tags at a time.

- **Automated shopping trolley for supermarket billing system** [9]

  The paper proposes an intelligent shopping basket. The main objectives of this proposed system are reducing manpower, reducing time spent at the billing counter, increasing customer satisfaction and making customer aware of the total bill. The trolley allows the customer to self-scan the barcode of purchased products. The scanned products are automatically billed, and customers can make

use the counter to pack the products. Figure 7 shows the block diagram of the smart trolley.

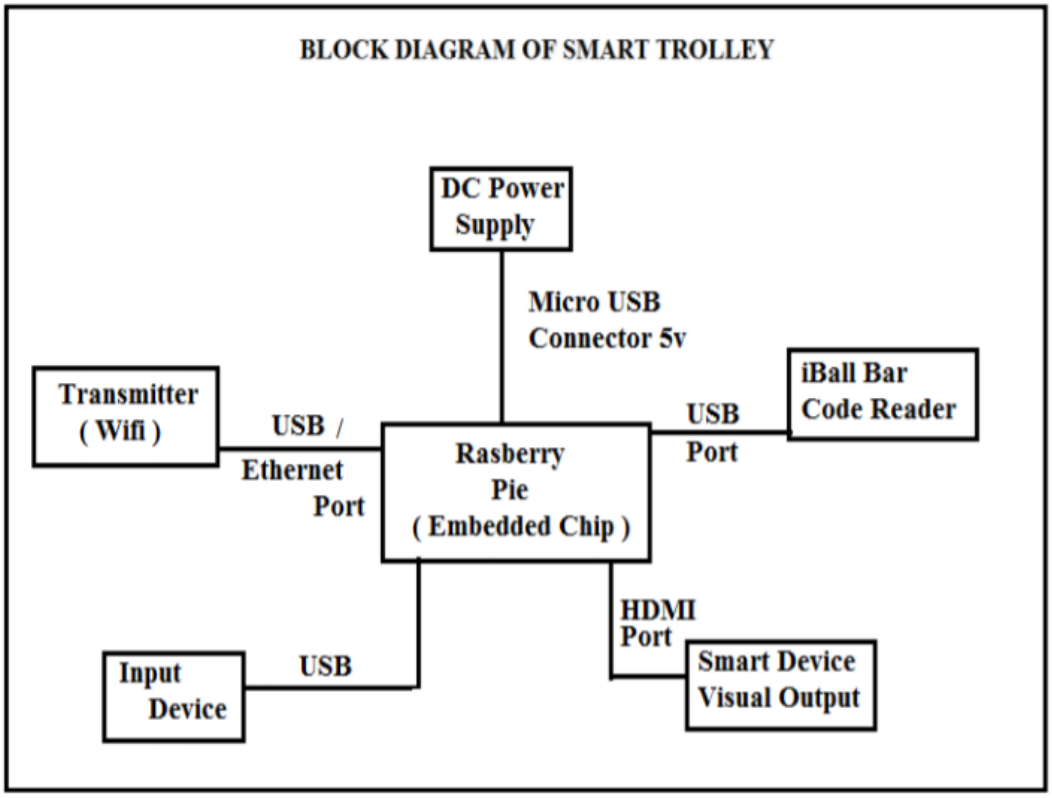


Figure 7: Block diagram of smart trolley

- **Design of an Intelligent shopping basket using IOT** [10]

  The paper proposes intelligent shopping basket which has the bar-code scanner. The user can self-scan the barcode of the purchased products. The ultra-sonic sensor present in the barcode scanner can automatically detects the product. Automatic bill generation is done after this. Weight sensor is used to detect weight and it helps to avoid the error that can happen when barcode scanner unable to read the barcode of the product. Figure shows the automated smart trolley.

Figure 8 : Automated smart trolley

- **RFID based Advanced shopping for supermarket** [11]

  The paper proposes a shopping trolley that comprise of a RFID reader to scan the product. Every customer use unique RFID based customer card that contain information about the customer. IR sensor is used to warn if a customer drops the product inside the trolley without scanning the product. After purchasing products customer can able to pay the bill through the card. The figure shows the block diagram of the proposed model.

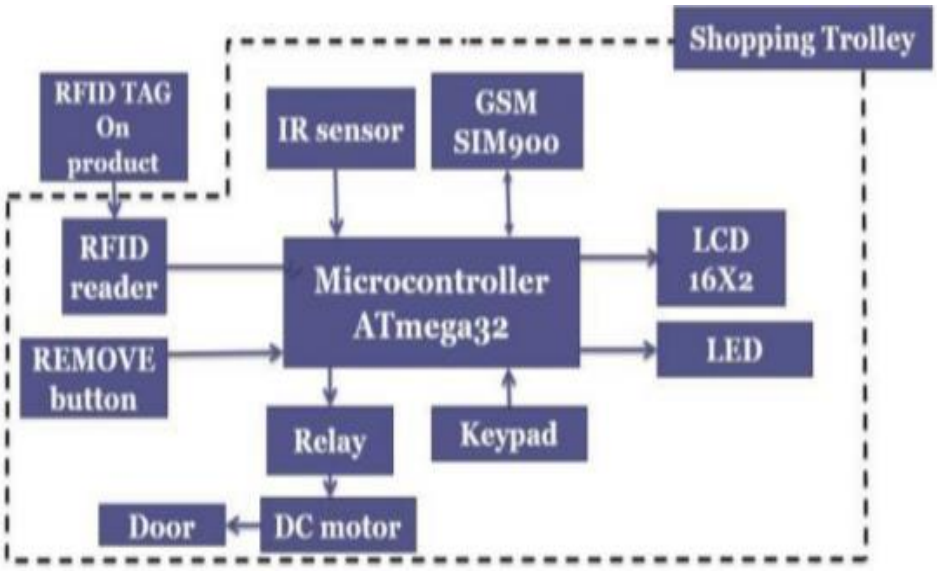


Figure 9 : Block diagram of proposed model

1.3 Research Gap

Table 1: Comparison of related research

	Online Payment	Loyalty Customer Program	Weight Sensor	Detect Product Image	Recommendation	Voice Assistant	Location
Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft [1]	✓	✓	✗	✓	✓	✗	✗
Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket [2]	✓	✓	✗	✓	✗	✗	✗
Smart Trolley using Smart Phone and Arduino [6]	✓	✓	✗	✓	✗	✗	✗
Smart Trolley in Mega Mall [7]	✓	✗	✗	✓	✗	✗	✗

Automated Smart Trolley for Supermarkets [5]	✓	✗	✗	✓	✗	✓	✗
Smart Trolley using IOT [8]	✓	✗	✗	✓	✗	✗	✗
RFID Based Smart Trolley for Supermarket Automation [4]	✓	✗	✗	✓	✗	✗	✗
Automated shopping trolley for supermarket billing system [9]	✓	✗	✗	✓	✗	✗	✗
RFID based Advanced shopping for supermarket [11]	✓	✓	✗	✗	✗	✗	✗
This research	✓	✓	✓	✓	✓	✓	✓

2. METHODOLOGY

This chapter explains about the methodology we intend to adopt to achieve the overall aim of proposing effective mechanism to develop a smart trolley for supermarket.

The proposed mechanism will be carried out by utilizing the following four components effectively.

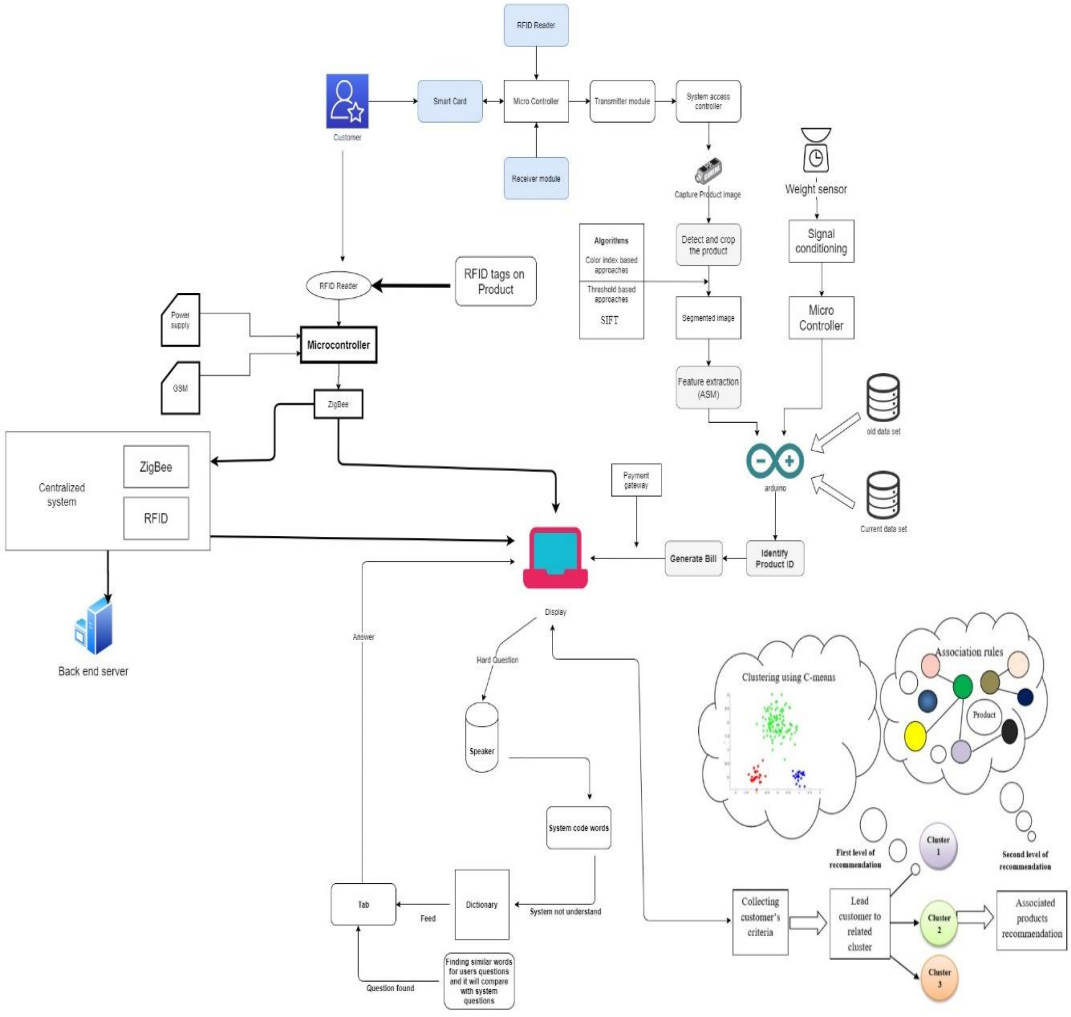


Figure 10: High level Diagram

The Smart Trolley is designed with additional features compared with the usual trolley in all supermarkets. This Smart trolley includes camera with ultrasonic sensor, weight scanner, RFID reader, microphone and LCD display. Here we must provide the Loyalty card which is a RFID card to the customer.

When customer punch the Loyalty card (RFID card) near the trolley RFID reader, it will find the loyalty customer details and customer can access the trolley. Here, RFID reader will get the card access and send it to the micro-controller. The micro-controller then sends the card details to the transceiver, which sends it to the server. The server then receives the relevant information and sends it back to the micro-controller using the same transceiver.

Customers can easily scan the products to buy and the trolley displays all the information related to the product in the display (weight, quantity and price). Customer has to place the product near the camera which is in the trolley to scan products before placing the product inside the trolley. Camera will automatically take the image of the product. The image of the product will be checked with the image already stored in database using the Open CV BF Matcher method. Weight is measured by weight sensor when scanning the items to be purchased and placed inside the trolley. Weight sensor is used to match the measured weight with the actual weight to avoid false activities. Each time when the products are placed inside the trolley the product's weight is checked. If any customer after purchasing the product changes his mind and wants to return the product, he just has to scan the product again, product picture will be taken to confirm intended product from the Smart Trolley's system and remove them from the system. After scanning, purchased product information is received, the microcontroller displays billing information on the LCD display.

In the billing counter, if more than 5 people are lined up, system will alert to do a self-checkout. The no of customers lined up in the bill counter is found by object tracking through camera. Vision-based real-time people counting comprise all techniques which are able to extract the number of people who are present in an observed area. The system includes the product recommendation at two stages. In the first stage, recommendation is done in prior to the purchasing of product. In the second stage, recommendation is done in consequent with the purchasing of product. Firstly, data on previous purchases of products are collected. Initially, product recommendation system recommends the products that have closely related with the criteria of customers. In the second stage, it recommends the purchasing of associated products with the desired product of customers to complete the buying process and to make customers aware of potentially related

products with their desired products. The relationship between products can be explored in terms of a data mining application called association rule mining.

New customers mean obviously the customers with no purchasing history. The system recommends products in two ways. In one method, the most popular products are recommended to the new customers. Most popular products are identified through ratings given by the regular customers of the supermarket. In the other method, products are recommended based on product description. K-means clustering is used to find top words in each cluster based on product description. In case where a word appears in multiple clusters, the algorithm chooses the cluster with the highest frequency of occurrences of the word. The recommendation system display items from the corresponding product clusters based on the product descriptions. The Location of each product if already fed into the system and when the customer searches the product needed the trolley displays its location.

First, the customer could ask questions using microphone, then the system will come up with an answer. From the implemented system.it will we displayed through the display. Certain code words will be already fed up in the system, when the customers ask a question, if those words are missing, the synonyms will not be understood by the system (ex: place =location). In such cases, the meaning is found through a dictionary search and then the answer will be displayed to the customer. This part will focus on introducing Facebook sentence embedding's and how it can be used in building QA systems.

2.1. Commercialization Aspect of the Product

Currently the number of consumers going to the supermarket is increasing. Customers often prefer to go to the supermarket rather than small shops. Shopping at the supermarket is easy for people and can save time. As a result, there is a need of the supermarket and its profitability will increase, making purchases through this system easier.

Many customers worry that they have enough money to pay for all the things they want to buy until they pay the bill. Many customers do not receive the full amount of the bill before payment. But with the help of this system customers can know total bill amount while making purchases. Supermarket customers don't need to contact a shopkeeper to find out information or other aspects of their goods when making purchases. The customer can get the details with the help of the Voice Assistant. Product Recommendation system acts as a filtering system that finds the most relevant items that a particular user would

like to purchase. Overall, the system can improve the customer satisfaction that leads to increase in sales.

3. TESTING & IMPLEMENTATION

3.1 Testing

Testing is performed in-order to evaluate whether the system works as expected.

Types of tests that were conducted on the system are listed below.

1. Unit Testing
2. Integration Testing
3. System Testing
4. Component Testing

Unit Testing – Each unit (loyalty customer program ad self-checkout alert, image processing, product recommendation voice assistant) of the system was tested to make it as error-free.

Component Testing – System was tested by using different methodologies.

Integration Testing- This testing is done to check whether integrated components work properly or not.

System Testing – This testing was done to verify whether the system meet its requirements and functionality.

Table 2 : Testing

Test id	Test description	Expected result	Actual result	Test status
1	Results based on Item-based Collaborative Filtering	Recommending highly co-related items for the item selected by the customer	As expected	Pass

Test id	Test description	Expected result	Actual result	Test status
2	Results based on User-based Collaborative Filtering	Finding the most similar customer for the existing customer	As expected	Pass
3	Results based on k-means Clustering	Chooses the cluster for the product description with the highest frequency of occurrences of the word	As expected	Pass
4	Results based on Association Rule Mining	Recommending best product based on the generated association rules.	As expected	Pass
5	Results based on image processing	The system finds the shape of the product successfully	As expected	Pass
6	Results based on weight sensor	The system compares the actual weight of the product and the weight measured by the weight sensor successfully	As expected	Pass
7	Results based on voice assistant	The system gives the appropriate answers for the queries properly	As expected	Pass

8	Results based on RFID Reader access	The system accesses the RFID card properly and view the customer profile	As expected	Pass
9	Results based on Product location view	When customer search the product, the System display the exact location of product	As expected	Pass
10	Results based on self-checkout alert	The system detects whether number of customers in the counter exceeds 5 or not properly	As expected	Pass

3.2 Implementation

Languages and technologies which were used to implement the system are listed below.

- MATLAB
- Python
- Machine learning
- Android studio
- Java
- Visual basic
- Raspberry Pi

3.2.1 Code Implementation

Product Recommendation

The code segment in the figure 11 below shows how products recommended to the new customers. Most popular products were recommended to the new customers. Most popular products were identified by the ratings provided by the customers. The ratings were sorted in the descending order to find the products with the highest rating. Here we can choose the number of products recommended to the customers according to the need. Here this code takes top ten products with the highest rating.

```
most_popular = popular_products.sort_values('Rating', ascending=False)
most_popular.head(10)
```

Figure 11 : Code segment of finding popular products

The code segment in the figure 12 below shows how top ten similar items were found. If a customer chooses the product with 'Product_ID- 21873' the system finds the similar items by using the item-item similarity matrix.

```
top_10_similar_items = list(
    item_item_similarity_matrix\
        .loc[21873]\
        .sort_values(ascending=False)\
        .iloc[:10]\
    .index
)
```

Figure 12: Code segment of finding top similar items

The code segment in the figure 13 below shows that the products are clustered into 5 groups using k-means and top five products were selected from each group.

```
true_k = 5

model = KMeans(n_clusters=true_k, init='k-means++', max_iter=100, n_init=1)
model.fit(X1)

print("Top products per cluster:")
order_centroids = model.cluster_centers_.argsort()[:, ::-1]
terms = vectorizer.get_feature_names()
for i in range(true_k):
    print_cluster(i)
```

Figure 13: Code segment of finding top products per cluster

The code segment in the figure 14 below shows that Apriori algorithm is used with passing minimum support as 0.0045, minimum confidence as 0.2, minimum lift as 3 and minimum length as 2.

```
association_rules = apriori(records, min_support=0.0045, min_confidence=0.2, min_lift=3, min_length=2)
association_rules = list(association_rules)
```

Figure 14: Code segment of Apriori algorithm

The figure 15 shows the code segment that is used to get the details of all products from database.

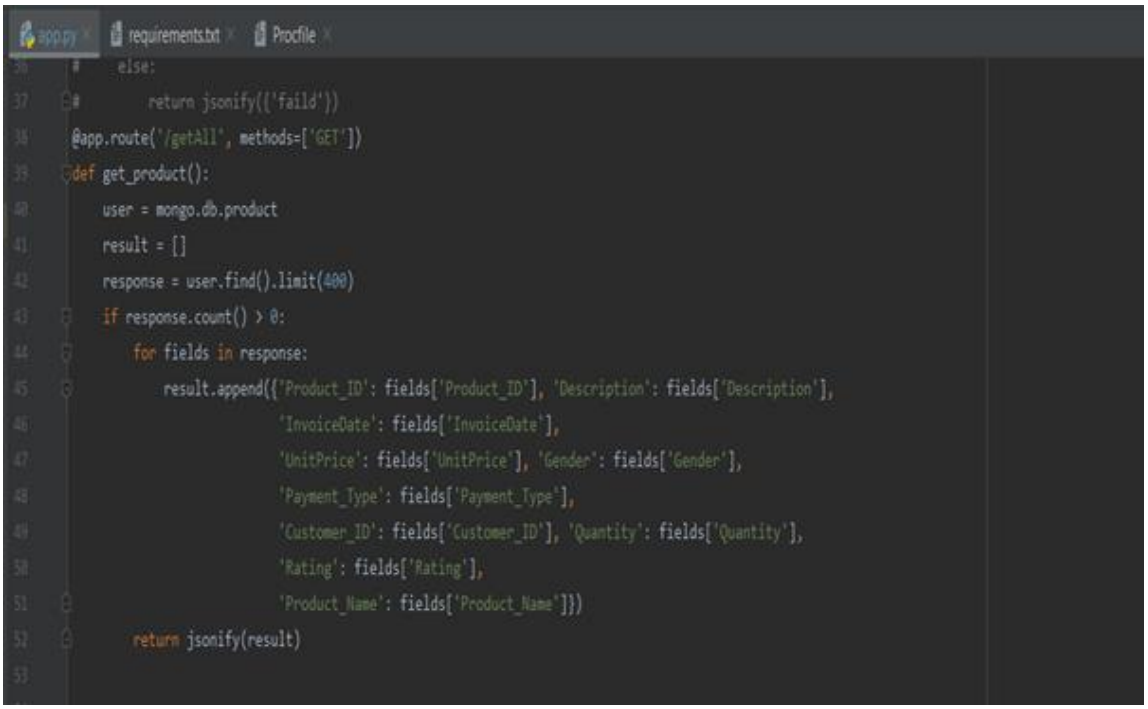


Figure 15: Get All products

The figure 16 and figure 17 shows the code segment that is used to integrate the recommendation model.

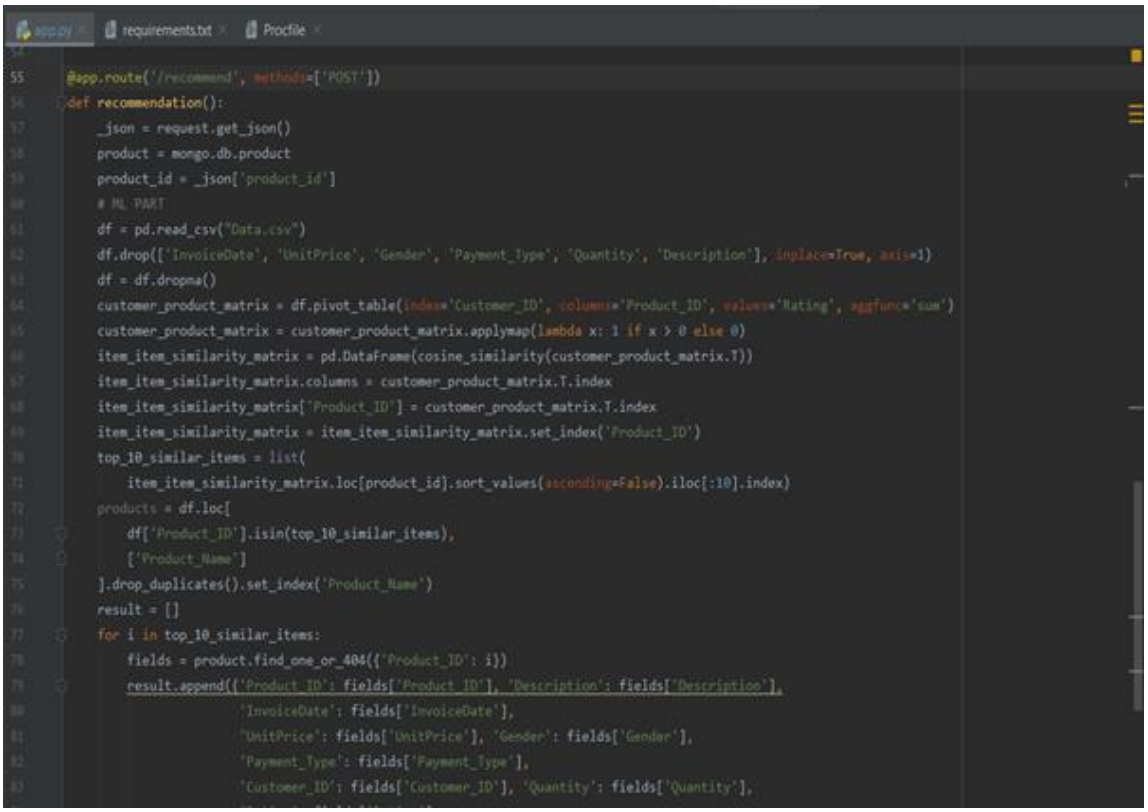


Figure 16: Recommendation system model Integration 1

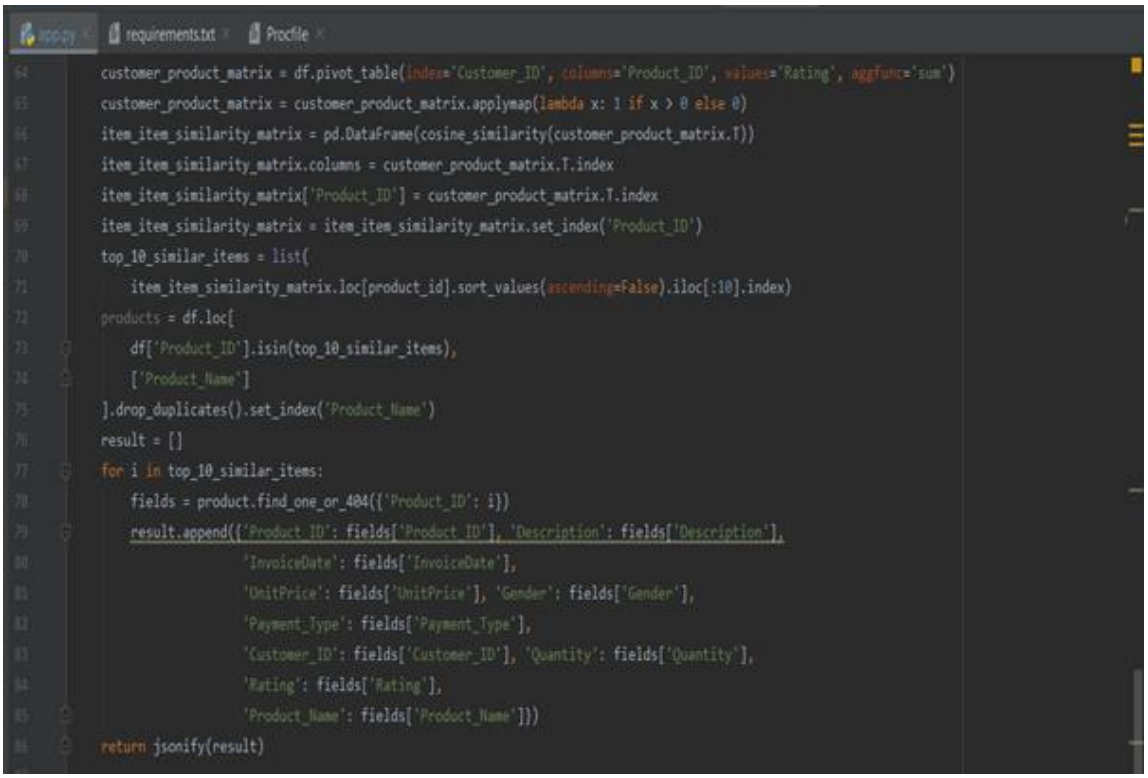


Figure 17: Recommendation system model Integration 2

Loyalty card management and self-checkout alert

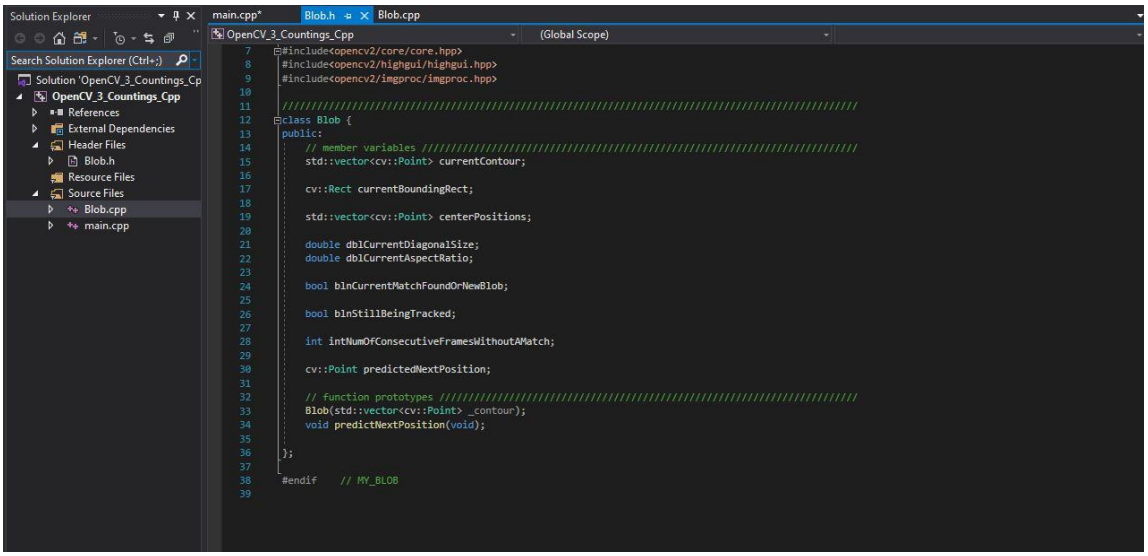


Figure 18 : open cv method declarations

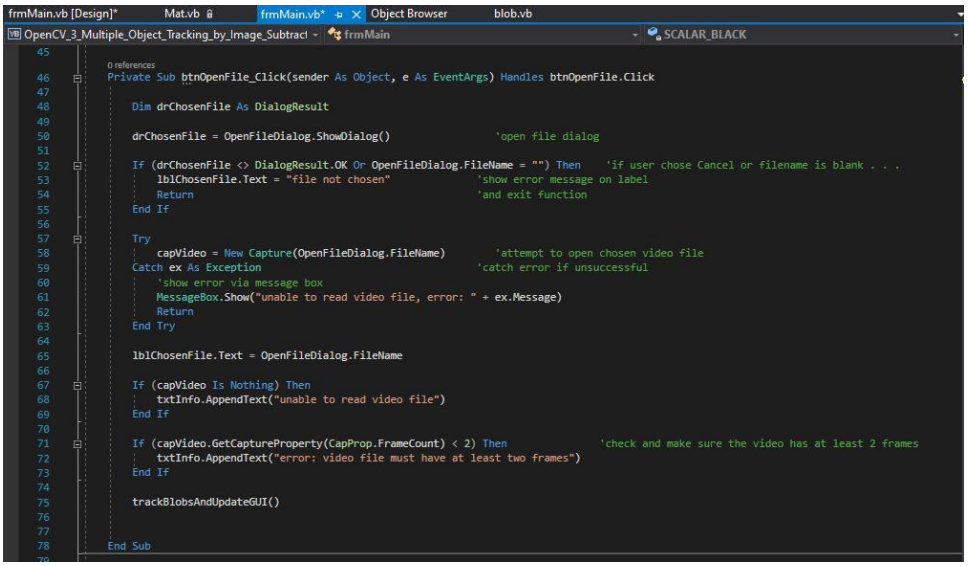
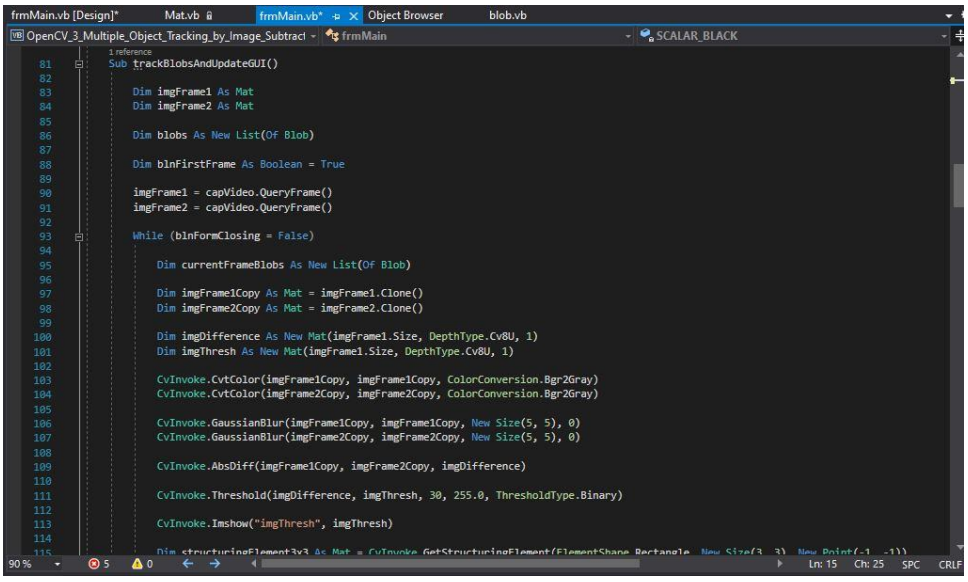
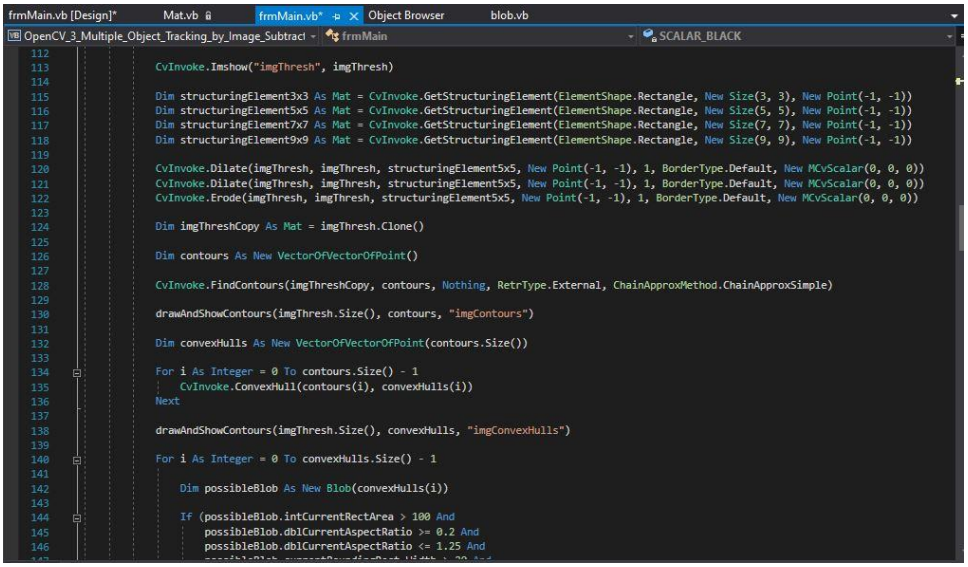


Figure 19 : button open file method



```
frmMain.vb [Design]*   Mat.vb   frmMain.vb*   Object Browser   blob.vb
OpenCV_3_Multiple_Object_Tracking_by_Image_Subtract   frmMain   SCALAR_BLACK
1 reference
Sub trackBlobsAndUpdateGUI()

    Dim imgFrame1 As Mat
    Dim imgFrame2 As Mat

    Dim blobs As New List(Of Blob)

    Dim blnFirstFrame As Boolean = True

    imgFrame1 = capVideo.QueryFrame()
    imgFrame2 = capVideo.QueryFrame()

    While (blnFormClosing = False)

        Dim currentFrameBlobs As New List(Of Blob)

        Dim imgFrame1Copy As Mat = imgFrame1.Clone()
        Dim imgFrame2Copy As Mat = imgFrame2.Clone()

        Dim imgDifference As New Mat(imgFrame1.Size, DepthType.Cv8U, 1)
        Dim imgThresh As New Mat(imgFrame1.Size, DepthType.Cv8U, 1)

        CvInvoke.CvtColor(imgFrame1Copy, imgFrame1Copy, ColorConversion.Bgr2Gray)
        CvInvoke.CvtColor(imgFrame2Copy, imgFrame2Copy, ColorConversion.Bgr2Gray)

        CvInvoke.GaussianBlur(imgFrame1Copy, imgFrame1Copy, New Size(5, 5), 0)
        CvInvoke.GaussianBlur(imgFrame2Copy, imgFrame2Copy, New Size(5, 5), 0)

        CvInvoke.AbsDiff(imgFrame1Copy, imgFrame2Copy, imgDifference)

        CvInvoke.Threshold(imgDifference, imgThresh, 30, 255.0, ThresholdType.Binary)

        CvInvoke.Imshow("imgThresh", imgThresh)

        Dim structuringElement3x3 As Mat = CvInvoke.GetStructuringElement(ElementShape.Rectangle, New Size(3, 3), New Point(-1, -1))
90 %   5   0   Ln: 15   Ch: 25   SPC   CRLF
```

Figure 20 : Mat format defined



```
frmMain.vb [Design]*   Mat.vb   frmMain.vb*   Object Browser   blob.vb
OpenCV_3_Multiple_Object_Tracking_by_Image_Subtract   frmMain   SCALAR_BLACK
    CvInvoke.Imshow("imgThresh", imgThresh)

    Dim structuringElement3x3 As Mat = CvInvoke.GetStructuringElement(ElementShape.Rectangle, New Size(3, 3), New Point(-1, -1))
    Dim structuringElement5x5 As Mat = CvInvoke.GetStructuringElement(ElementShape.Rectangle, New Size(5, 5), New Point(-1, -1))
    Dim structuringElement7x7 As Mat = CvInvoke.GetStructuringElement(ElementShape.Rectangle, New Size(7, 7), New Point(-1, -1))
    Dim structuringElement9x9 As Mat = CvInvoke.GetStructuringElement(ElementShape.Rectangle, New Size(9, 9), New Point(-1, -1))

    CvInvoke.Dilate(imgThresh, imgThresh, structuringElement5x5, New Point(-1, -1), 1, BorderType.Default, New MCvScalar(0, 0, 0))
    CvInvoke.Dilate(imgThresh, imgThresh, structuringElement5x5, New Point(-1, -1), 1, BorderType.Default, New MCvScalar(0, 0, 0))
    CvInvoke.Erode(imgThresh, imgThresh, structuringElement5x5, New Point(-1, -1), 1, BorderType.Default, New MCvScalar(0, 0, 0))

    Dim imgThreshCopy As Mat = imgThresh.Clone()

    Dim contours As New VectorOfVectorOfPoint()

    CvInvoke.FindContours(imgThreshCopy, contours, Nothing, RetrType.External, ChainApproxMethod.ChainApproxSimple)

    drawAndShowContours(imgThresh.Size(), contours, "imgContours")

    Dim convexHulls As New VectorOfVectorOfPoint(contours.Size())

    For i As Integer = 0 To contours.Size() - 1
        CvInvoke.ConvexHull(contours(i), convexHulls(i))
    Next

    drawAndShowContours(imgThresh.Size(), convexHulls, "imgConvexHulls")

    For i As Integer = 0 To convexHulls.Size() - 1

        Dim possibleBlob As New Blob(convexHulls(i))

        If (possibleBlob.intCurrentRectArea > 100 And
            possibleBlob.dblCurrentAspectRatio >= 0.2 And
            possibleBlob.dblCurrentAspectRatio <= 1.25 And
```

Figure 21 : Mat format defined counting

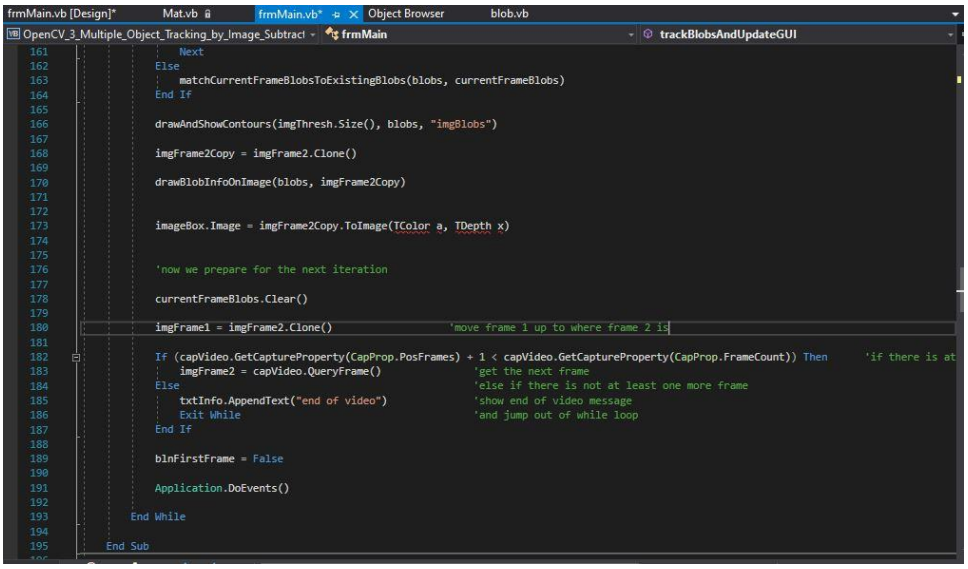


Figure 22: Move frame 1 up to where frame 2

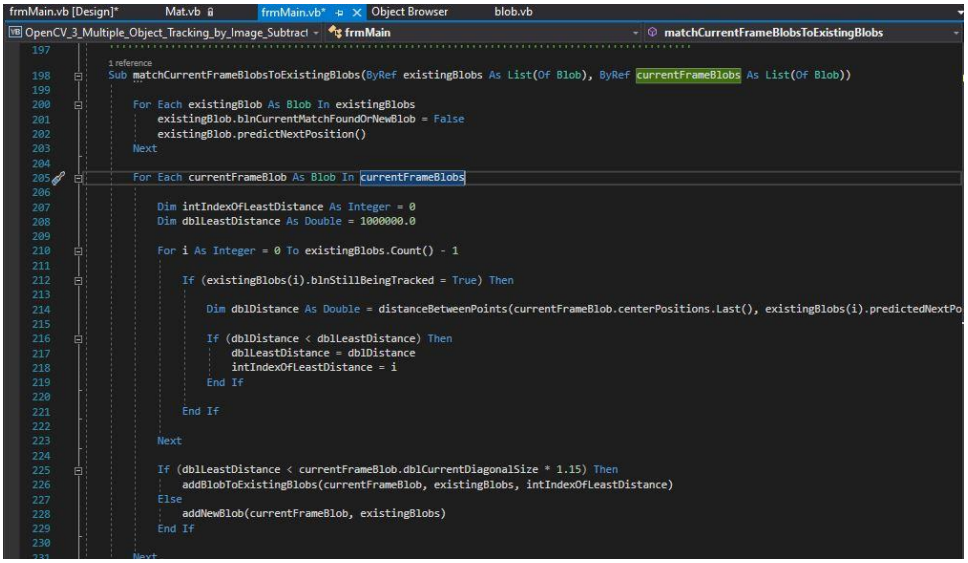


Figure 23: Match Current Frame Blobs to Existing Blobs

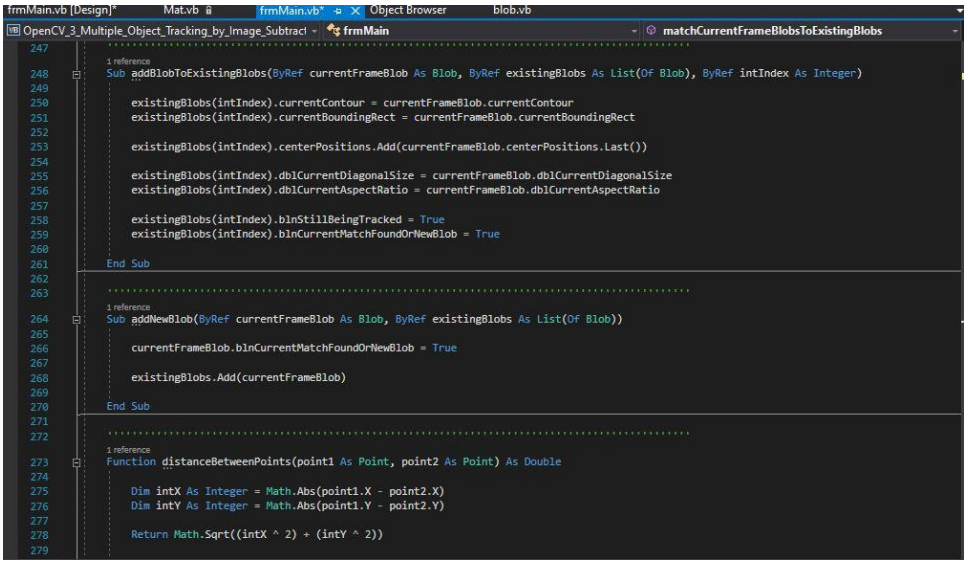


Figure 24: Add Blob to Existing Blobs

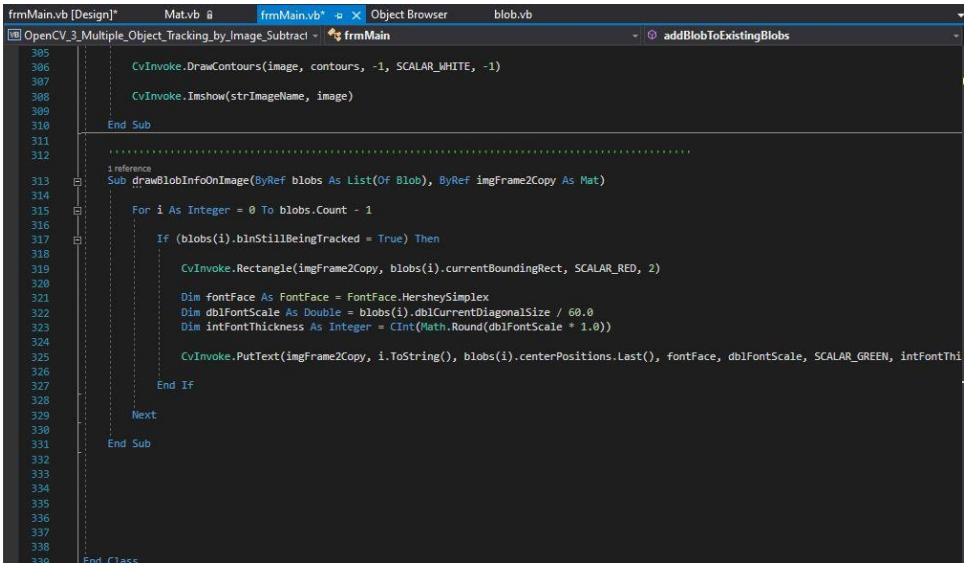


Figure 25: Draw Blob Info on Image

Chat bot

```
In [14]: train.iloc[0,0]['paragraphs'][1]

Out[14]: {'context': 'This is about sugar',
          'qas': [{'answers': [{'answer_start': 248, 'text': '300 Rupees'}],
            'question': 'what is the price of sugar?',
            'id': '5733bf84d058e614000b61be'},
           {'answers': [{'answer_start': 441, 'text': 'yes, its nearby fruits'}],
            'question': 'Do you have brown sugar packets?',
            'id': '5733bf84d058e614000b61bf'},
           {'answers': [{'answer_start': 598, 'text': 'yes sure'}],
            'question': 'can you give me 2kg sugar?',
            'id': '5733bf84d058e614000b61c0'},
           {'answers': [{'answer_start': 126, 'text': 'yes we have'}],
            'question': 'do you have loose sugar?',
            'id': '5733bf84d058e614000b61bd'},
           {'answers': [{'answer_start': 908, 'text': 'at Kanthale'}],
            'question': 'from which place are you importing sugar?',
            'id': '5733bf84d058e614000b61c1'}]}

In [15]: # valid.iloc[1,0]['paragraphs'][0]
```

Figure 26: convert json to pandas data frame

python_audio.py

```
import speech_recognition as sr

while True:
    r = sr.Recognizer()

    with sr.Microphone() as source:

        print("say something")
        audio = r.listen(source)

        try:
            print("text:"+r.recognize_google(audio));
        except sr.UnknownValueError:
            print("Sorry could not recognize your voice")
```

Figure 27: speech to text

```
In [8]: questions = []
        answers_text = []
        answers_start = []
        for i in range(train.shape[0]):
            topic = train.iloc[i,0]['paragraphs']
            for sub_para in topic:
                for q_a in sub_para['qas']:
                    questions.append(q_a['question'])
                    answers_start.append(q_a['answers'][0]['answer_start'])
                    answers_text.append(q_a['answers'][0]['text'])

        df = pd.DataFrame({"question": questions, "answer_start": answers_start, "text": answers_text})

In [9]: df.shape

Out[9]: (87599, 3)

In [10]: df.to_csv('C:\\Users\\priya\\Desktop\\project\\Datasets\\train-v1.1.csv', index = None)
```

Figure 28: convert json to pandas data frame

```
In [5]: train = pd.read_json('C:\\Users\\priya\\Desktop\\project\\Datasets\\train-v1.1.json',encoding='utf8')

In [6]: valid = pd.read_json('C:\\Users\\priya\\Desktop\\project\\Datasets\\dev-v1.1.json',encoding='utf8')

In [7]: train.shape, valid.shape

Out[7]: ((442, 2), (48, 2))

In [12]: train.head(3)

Out[12]:
```

	data	version
0	{'title': 'Smart trolley of supermarket', 'par...	1.1
1	{'title': 'Beyoncé', 'paragraphs': [{'context'...	1.1
2	{'title': 'Montana', 'paragraphs': [{'context'...	1.1

Figure 29: convert json to pandas data frame

Image Processing

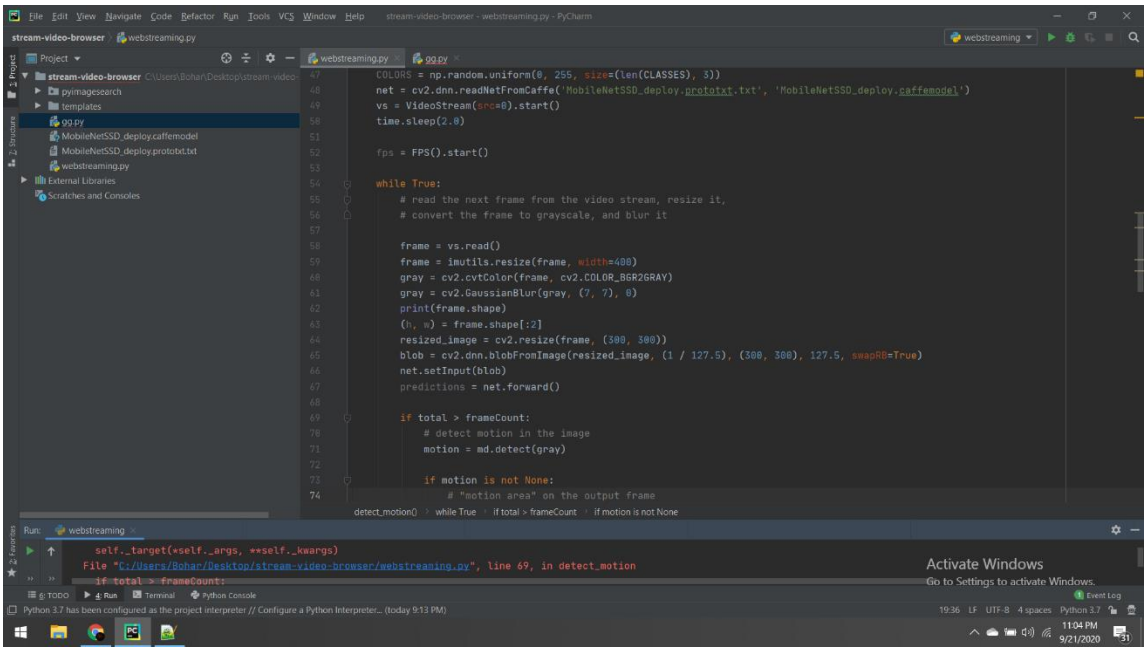
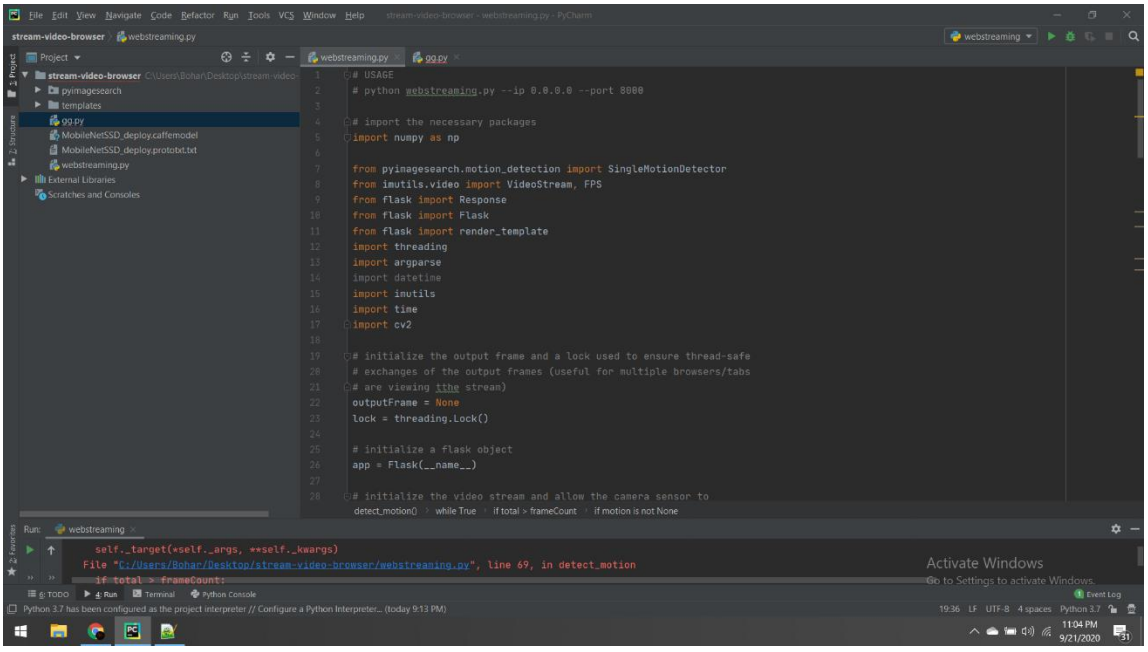


Figure 30: Image filtering



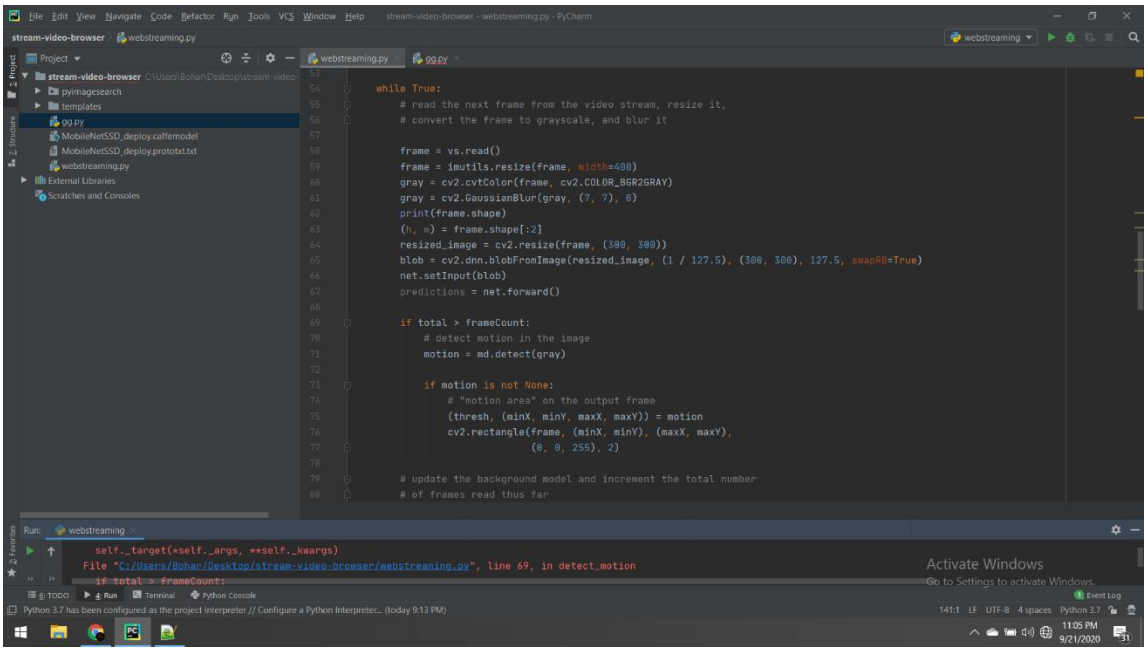


Figure 31 : Product model Integration

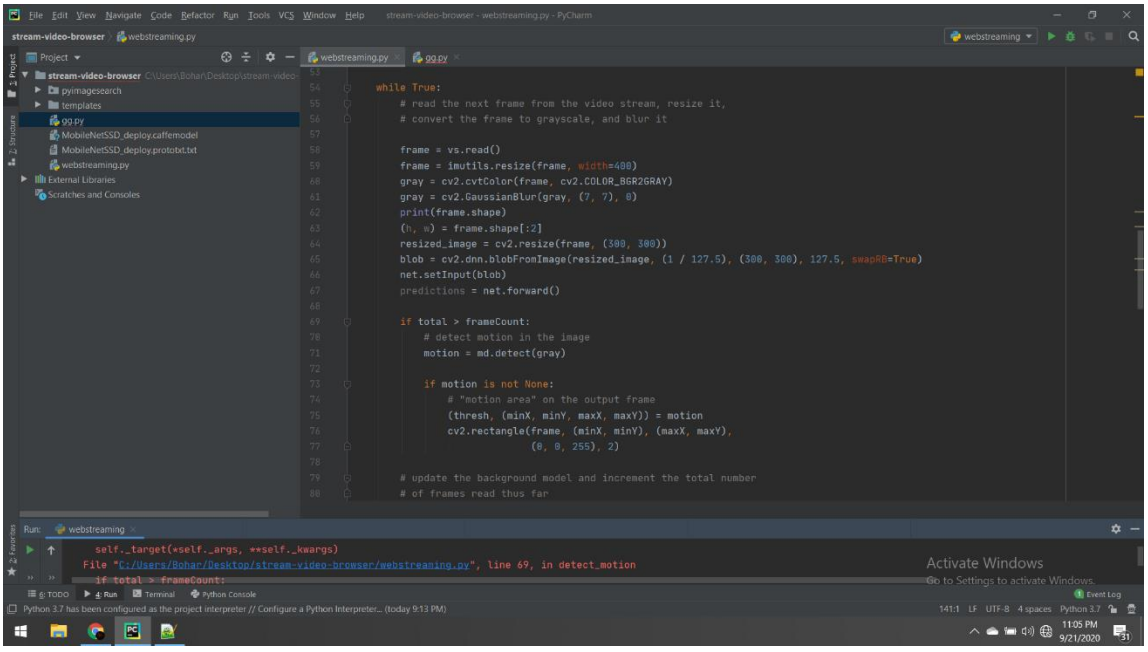


Figure 32: Product image validation

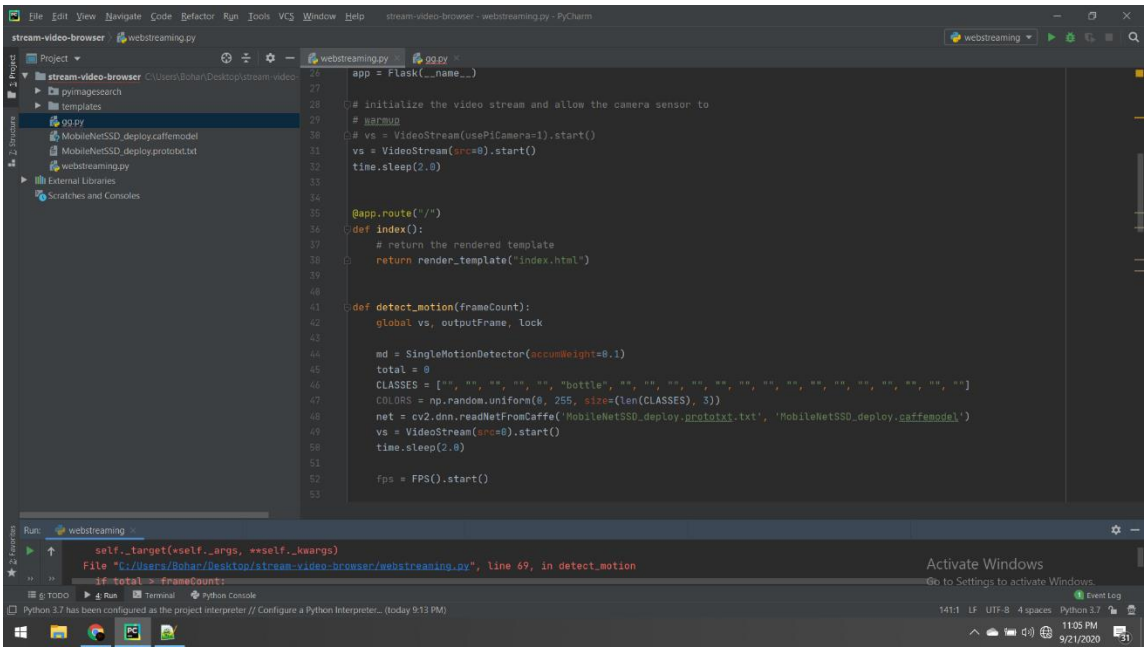


Figure 33: Product shape identification

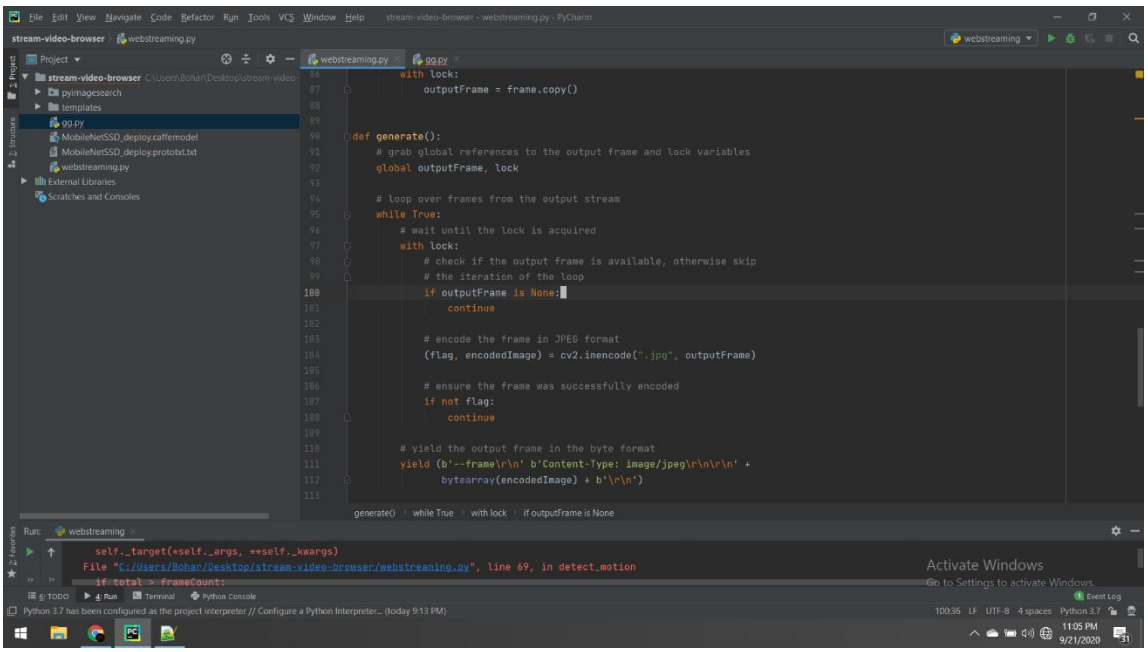


Figure 34: Convert product images to layers

4. RESULTS AND DISCUSSIONS

4.1 Result

When customer punches the RFID Card (customer loyalty card) in RFID Reader, it viewed the customer access profile and customer can access the trolley. We maintain the RFID card for collecting new customer data and collecting customers purchase history. Through this customer data can be collected. Figure shows how data is collected.

Figure 35 : RFID Card

Figure shows the end product of the supermarket that contains image recognition, weight sensor and display.

Figure 36 : Smart Trolley

Image recognition – Camera used to identify scanned items and verify purchase

Weight sensor- Measures the weight of the product.

LCD Display – Displays billing information

Figure shows how billing information is displayed in the smart trolley

Figure 37: Billing Information

Figure shows how products are added into the shopping cart.

Figure 38: Products in the shopping cart

Figure shows how the system display the total bill in the smart trolley.

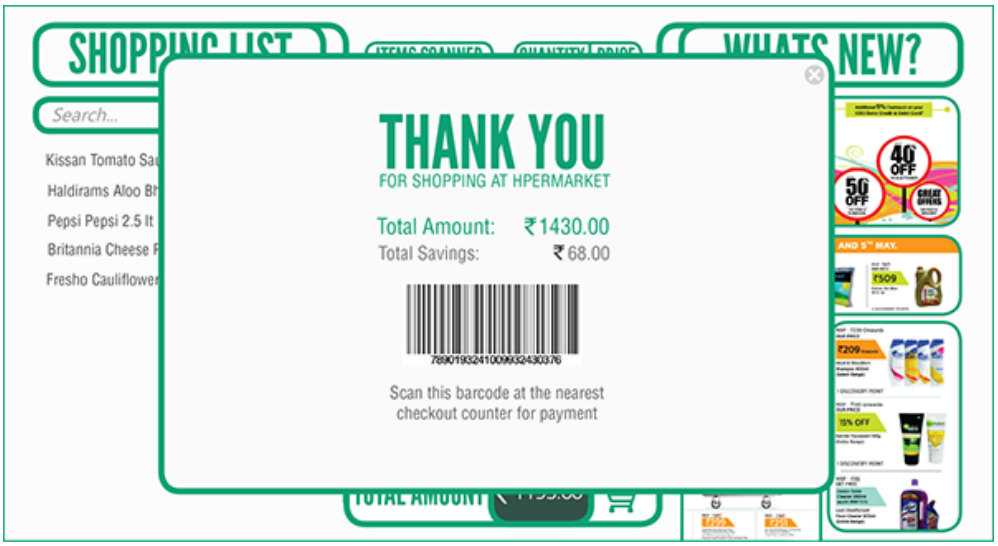


Figure 39: Total bill

Location of each product is already fed into the database and when customer search for the product, product location will be display in message.

Figure 40: Searching for a product

Figure shows how the system shows the searched product.

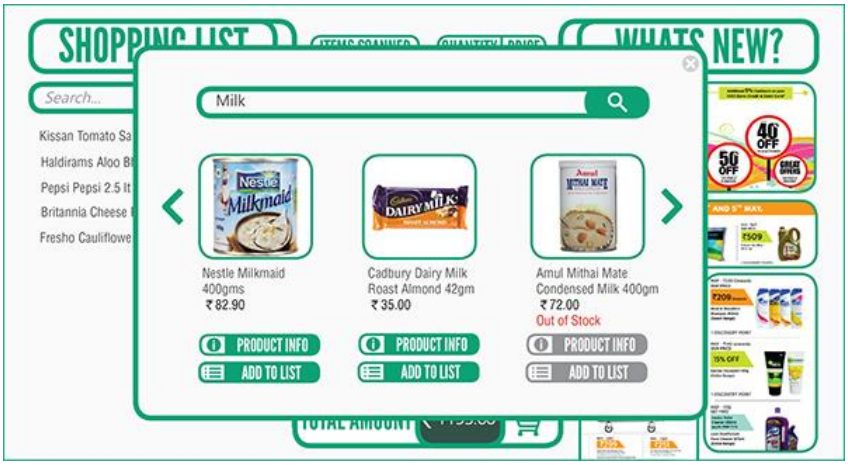


Figure 41: Results of searched product

Figure shows if customer searches the product location how the system displays the location.

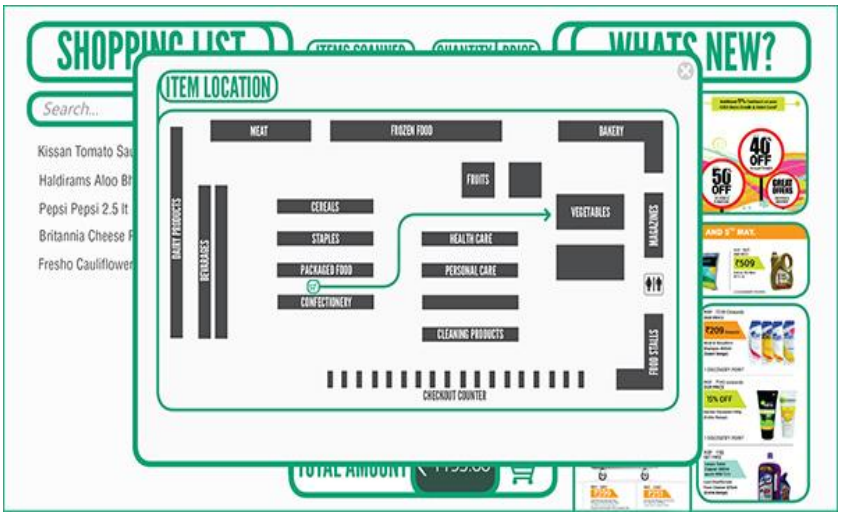


Figure 42: Location of product

The system recommends products to the customer in two circumstances. One is before choosing product. The other one is after choosing product. Figure shows how the systems recommends products to customers.

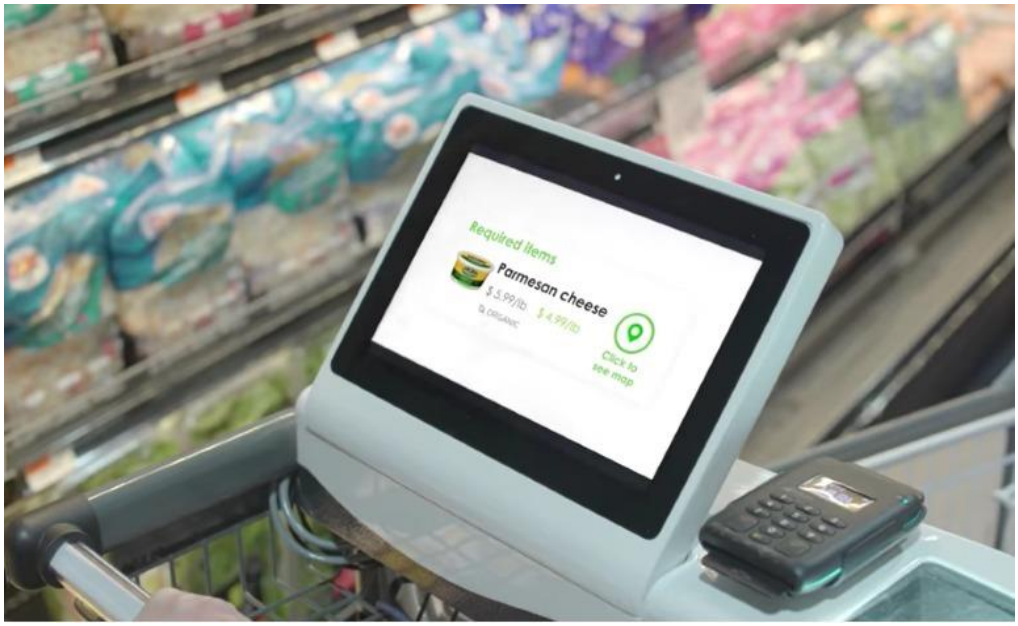


Figure 43: Recommending products

In billing counters, if more than five people are lined up alert message will be displayed in the LCD display. Here object tracking method is used through camera. Techniques used here are vision based real-time people counting comprise which can able to extract the number of people, who are present in an observed area.

Figure 44: Count the people in counter

4.2 Research Findings

A survey is conducted to get feedback from random people about the smart trolley.

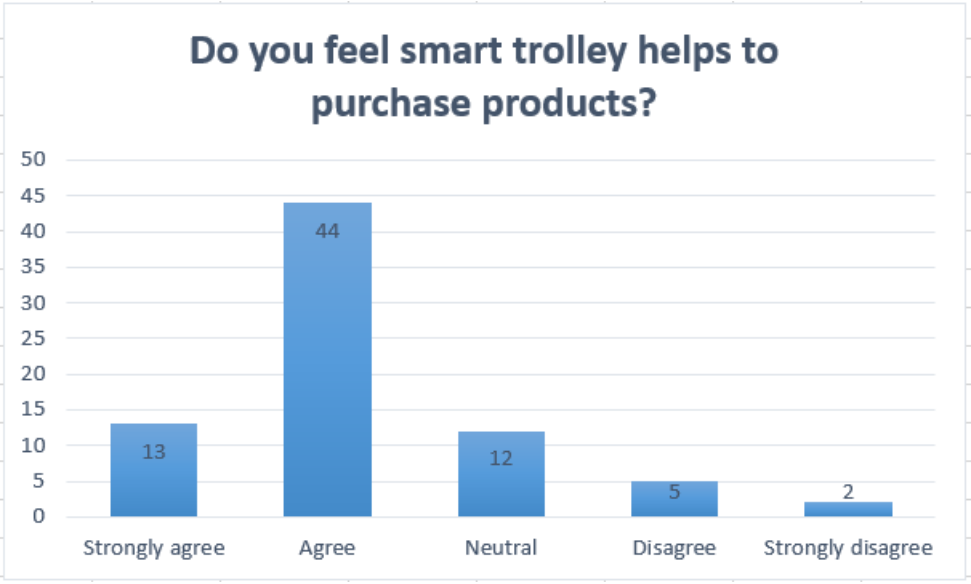


Figure 45: Bar chart of what people feel about smart trolley

Out of 76 people, 13 people agree that smart trolley helps to purchase products. 44 people strongly agree that smart trolley helps to purchase products. 12 people feel neutral that smart trolley helps to purchase products. 5 people disagree that smart trolley helps to purchase products. 2 people strongly disagree that smart trolley helps to purchase products. As most of the people agree that smart trolley helps to purchase products, we can state that smart trolley helps to purchase products.

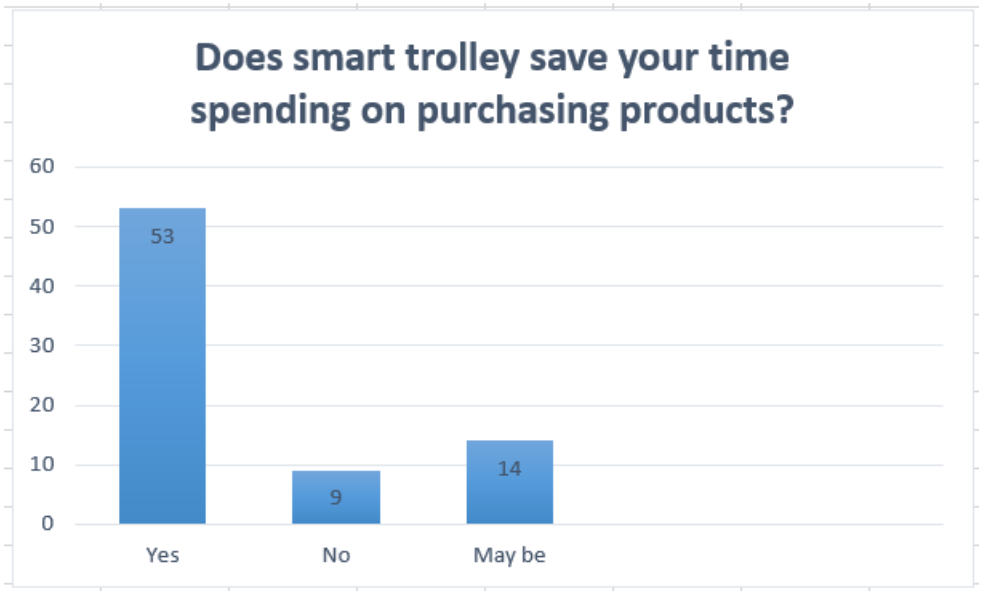


Figure 46: Bar chart of whether smart trolley saves time spending on purchasing products

Figure shows that out of 76 people, 53 people felt that smart trolley saves the time spending on purchasing products. 14 people felt that smart trolley might save the time spending on purchasing products. 9 people felt that smart trolley does not save the time spending on purchasing products. As most of the people felt that smart trolley saves time it clearly states that there is a need for smart trolley in supermarkets.

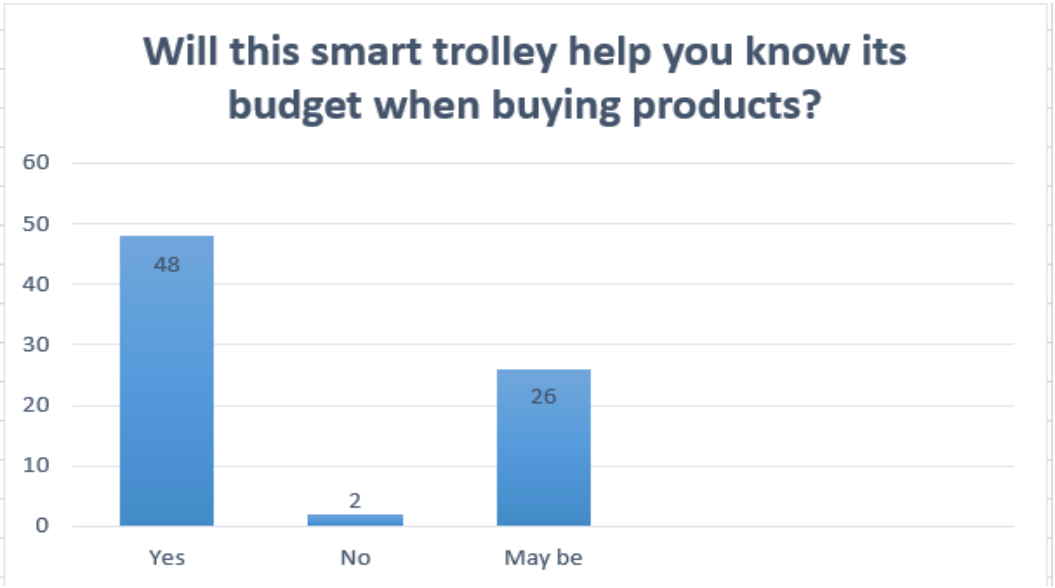


Figure 47: Bar chart of whether smart trolley helps to know budget before purchasing product

Figure shows that out of 76 people, 48 people felt that smart trolley helps to know budget before purchasing products. 26 people felt that smart trolley might help to know budget before purchasing products. 2 people felt that smart trolley does not helps to know budget before purchasing products. As most of the people felt that smart trolley helps to know budget before purchasing products it clearly states that there is a need for smart trolley in supermarkets.

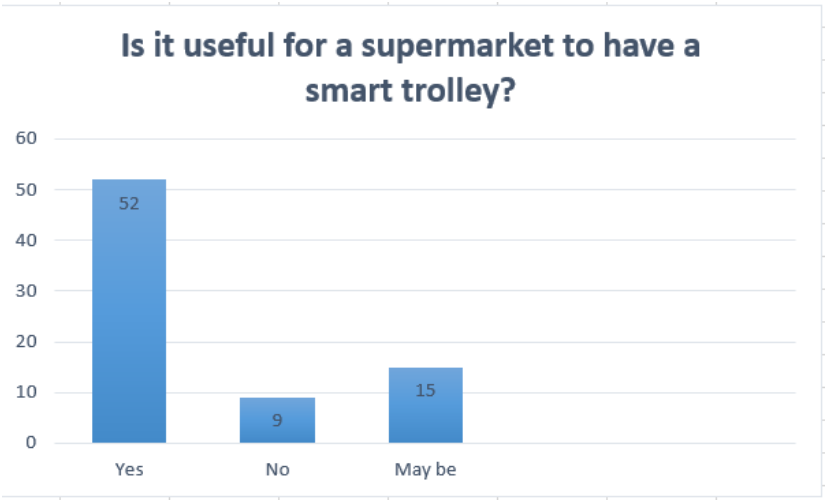
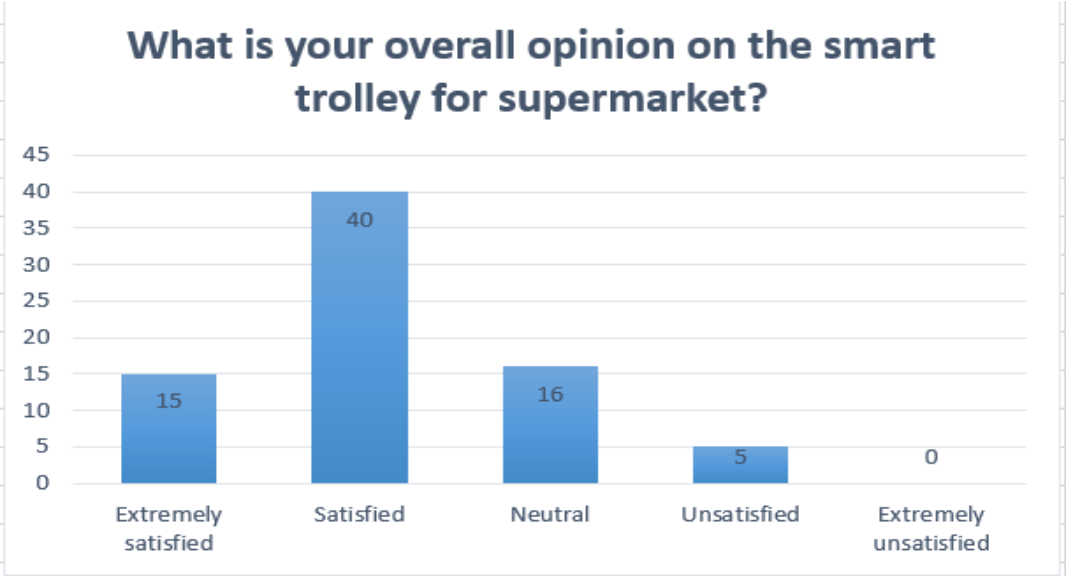


Figure 48: Bar chart of whether smart trolley is useful

Figure shows that out of 76 people, 52 people felt that it is useful for a supermarket to have a smart trolley. 15 people felt that smart trolley it is useful for a supermarket to have a smart trolley. 2 people felt that it is not useful for a supermarket to have a smart trolley. As most of the people felt that it is useful for a supermarket to have a smart trolley it clearly states that there is a need for smart trolley in supermarkets.

Figure 49 : Bar chart of whether people believe smart trolley makes shopping easier

Figure shows that out of 76 people, 53 people believe that smart trolley will make the shopping easier. 18 people believe that smart trolley might make the shopping easier. 2 people will believe that smart trolley will not make the shopping easier. As most of the people believe that smart trolley will make the shopping easier it clearly states that there is a need for smart trolley in supermarkets.



Out of 76 people, 15 people extremely satisfied on the smart trolley usage. 40 people satisfied on the smart trolley usage. 16 people feel neutral on the smart trolley usage. 5 people unsatisfied on the smart trolley usage. No one extremely unsatisfied on the smart trolley usage. As most of the people agree extremely satisfied on the smart trolley usage, we can state that smart trolley helps to purchase products.

4.3 Discussion

The smart trolley identifies the loyalty customer using RFID and allow access to smart trolley. The customer scans the products using the camera fitted in the trolley before placing the product inside the trolley. When customer places the product in the trolley the system checks the actual weight with the weight measured by the weight sensor. If weight mismatches the system will shows an alert to the customer. The system recommends products to the customer in prior to choose a product as well as in consequent with choosing of product. Voice assistant give appropriate answers to the customer queries.

Based on the survey results it clearly shows that people are expecting to have a smart trolley in the supermarket as they feel that it helps to purchase products, save the time spending on purchasing products, makes the shopping easier, helps to know the budget before purchasing products. Therefore, it is necessary to have a smart trolley in supermarket.

4. CONCLUSION

Smart trolley is designed by considering the changing trend in supermarkets. Smart trolley makes the billing of goods in efficient, easier and fast way. Each product in the supermarket has the RFID tag on it. System gives discounts for the customers depending upon customer buying habits. Therefore, by making use of this, the supermarket system will become easier. System displays the number of products in trolley and total cost of the products on the LCD screen by using image processing. It will also provide anti-theft system for a supermarket with the help of the weight sensor which matches the weight displayed in the screen with the weight calculated by the weight sensor. System will also give suggestions to the customers to select products as customers are subjected to severe difficulties in supermarkets due to the consumption of considerable time to search a product and select their desired product among many kinds of products with nearest standard. Voice assistant is built in the trolley in order to help the customers to know about deals/offers in the supermarket. Main objective of this research is to develop smart trolley for the enhancement of supermarket to make the customers to get benefit through the system.

REFERENCES

1. F. I. R. S. A. A. B. Ankush Yewatkara, "Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft," *7th International Conference on Communication, Computing and Virtualization 2016* , pp. 793-800, 2016.
2. A. S. A. K. R. Divya T M, "Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket," *3Department of Electrical and Electronics Engineering* , 2019.
3. "New World Encyclopedia," [Online]. Available: https://www.newworldencyclopedia.org/entry/Supermarket. [Accessed 25 February 2020].

4. A. P. A. G. A. K. M. M. J. ANJALI PERADATH, “RFID Based Smart Trolley for Supermarket Automation,” *International Research Journal of Engineering and Technology (IRJET)* , vol. 4, no. 7, 2017.
5. H. K. Sivaraman, “Automated Smart Trolley for Supermarkets,” *International Journal of Engineering Research & Technology (IJERT)* , vol. 6, no. 13, 2018.
6. N. G. S. K. a. A. G. Harpreet Singh Bedi, “Smart Trolley using Smart Phone and Arduino,” *Journal of Electrical & Electronic Systems,* vol. 6, no. 2, 2017.
7. S. J.S.Awati, “Smart Trolley in Mega Mall,” *International Journal of Emerging Technology and Advanced Engineering* , vol. 2, no. 3, 2012.
8. G. P. K. G. Shraddha Nitnaware, “Smart Trolley using IOT,” *International Journal for Research in Applied Science & Engineering Technology (IJRASET),* vol. 5, 2017.
9. Myanmar, M. and Myanmar, M. (2020). Myanadadmar. [online] Myanadadmar. Available at:https://www.academia.edu/37529712/Design_and_Implementation_of_Smart_Trolley_for_Automatic_Billing_System [Accessed 01 Feb. 2020].
10. Jayshree, G., Gholap, R. and Yadav, P., 2014. *RFID Based Automatic Billing Trolley*. [online] Academia.edu. Available at: <https://www.academia.edu/31998197/RFID_Based_Automatic_Billing_Trolley> [Accessed 18 July 2020].
11. Gangwal, U., Roy, S. and Bapat, J. (2013). Smart Shopping Cart for Automated Billing Purpose using Wireless Sensor Networks. [online] Thinkmind.org. Available at: https://www.thinkmind.org/download.php?articleid=sensorcomm_2013_7_30_10155 [Accessed 04 Feb. 2020].
12. Ishak, I., Munawwir, M. and Ismail, S. (2017). A SMART TROLLEY WITH RFID IMPLEMENTATION: A SURVEY AMONG CUSTOMERS. [online] www.researchgate.net. Available at: https://www.researchgate.net/publication/322537108_A_SMART_TROLLEY

_WITH_RFID_IMPLEMENTATION_A_SURVEY_AMONG_CUSTOMERS [Accessed 23 Feb. 2020].

13. J. A. Hoffer et al. Morden Database Management, (2013) 11rd edition. London: Pearson Education Limited, [Accessed 18 June. 2020].

14. RachanaDoshi , AmritaSutar , SonaliAher , Sanvida Dalvi , Prof. B R Chandani (2017). RFID Based Automatic Billing Trolley. [online] https://ijesc.org. Available at: https://ijesc.org/upload/f23c2b7cedefe1238ad24b72929af4ba.RFID%20Based%20Smart%20Trolley%20for%20Automatic%20Billing%20System.pdf [Accessed 26 Feb. 2020].
15. P. Chandrasekar and T. Sangeetha, "Smart shopping cart with automatic billing system through rfid and zigbee," in Information Communication and Embedded Systems (ICICES), 2014 International Conference on. IEEE, 2014, pp. 1–4.

16. Yewatkar, F. Inamdar, R. Singh, A. Bandal et al., "Smart cart with automatic billing, product information, product recommendation using rfid & zigbee with antitheft," Procedia Computer Science, vol. 79, pp. 793–800, 2016.

17. P. Chandrasekar and T. Sangeetha, "Smart shopping cart with automatic billing system" in Information Communication and Embedded Systems (ICICES), 2014 International Conference on. IEEE, 2014, pp. 1–4.

18. P. Chandrasekar, T. Sangeetha "Smart shopping cart with automatic billing system", International Conference on Information Communication and Embedded Systems (ICICES2014)

19. Youssef, Sherin M., and Rana M. Salem. "Automated barcode recognition for smart identification and inspection automation." in Expert Systems with Applications, vol.33, pp. 968-977, 2007.

20. Abdel-Hakim, Alaa E., and Aly A. Farag. "CSIFT: A SIFT descriptor with color invariant characteristics." in IEEE Computer Society Conference on Computer Vision and Pattern Recognition, vol. 2, pp. 1978-1983, 2006.

21. Castillo-Carrión, Sebastián, and José-Emilio Guerrero-Ginel. "SIFT optimization and automation for matching images from multiple temporal sources." in International Journal of Applied EarthObservation and Geoinformation, vol. 57, pp.113-122, 2017.

22. Aparna, S., and M. Ekambaram Naidu. "Video Registration Based on SIFT Feature Vectors." in Procedia Computer Science, vol. 87, pp. 233- 239, 2016.

23. Gecer, B., Azzopardi, G. and Petkov, N. "Color-blob-based COSFIRE filters for object recognition" in Image and Vision Computing, vol. 57, pp. 165-174, 2017.

24. Chi, Ma, Wang Guosheng, Ban Xiaojuan, and Ying Tian. "SIFT-based matching algorithm and its application in ear recognition." in IEEE International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI), pp. 691-695, 2016.

25. Zhao, Yan, YuweiZhai, Eric Dubois, and Shigang Wang. "Image matching algorithm based on SIFT using color and exposure information." in Journal of systems engineering and electronics, vol. 27, pp. 691-699, 2016.

26. Zhou, Zhiping, Shimeng Cheng, and Zhongmin Li. (2016). MDS-SIFT: An improved SIFT matching algorithm based on MDS dimensionality reduction.

[online] IEEE Available at: https://ieeexplore.ieee.org/document/7811078 [Accessed 14 Mar 2020].

27. Collet, Alvaro, Dmitry Berenson, Siddhartha S. Srinivasa, and Dave Ferguson (2009). Object recognition and full pose registration from a single image for robotic manipulation. [online] www.researchgate.net. Available at: https://www.researchgate.net/publication/224557494_Object_recognition_and_full_pose_registration_from_a_single_image_for_robotic_manipulation. [Accessed 14 Mar 2020].

28. Bruno, Alessandro, Luca Greco, and Marco La Cascia. (2016). Views selection for SIFT based object modeling and recognition. [online] www.ijareeie.com. Available at: https://www.ijareeie.com/upload/2017/july/75_E60707654.pdf [Accessed 14 Mar 2020].

29. S. A. K. R. Divya T M, "Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket," *3Department of Electrical and Electronics Engineering* , 2019.

30. N. G. S. K. a. A. G. Harpreet Singh Bedi, "Smart Trolley using Smart Phone and Arduino," *Journal of Electrical & Electronic Systems,* vol. 6, no. 2, 2017.