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Smart Shopping Trolley using QR Code and ESP32Cam

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***Abstract*—A supermarket is a place where people can purchase all kinds of daily commodities such as fruits, vegetables, dairy products etc. available in a single area. The supermarket has emerged as one of the best way of purchasing area because it reduces the overall space and time for customers as they wander in markets to purchase their requirements. But also, there is a drawback where customers encounter huge rush at peak hours waiting in counters to pay their bill. The cashier at the billing counter uses barcode reader to scan the products. It is observed that they must scan each and every product for billing thus consuming huge time of customers. Hence, there is a demand of developing a smart system which enables an effortless and fast shopping. And, a suitable model that can be installed in all shopping malls, multiplexes and supermarkets. In this paper, we have developed a model by using ESP32cam and QR code which gives a novel solution for smart shopping.**

***Index Terms*— Internet of Things, ESP32Cam, Quick Response code and local webpage.**

I. INTRODUCTION

In this modern era many towns and cities has been upgraded as metropolitan cities where most of the areas are covered for constructing building and lanes. Due to this the marketplace has become more congested and scattered. To solve this our engineers has put worth an idea of installing supermarkets where customers can purchase their daily commodities in one place that too all in a single place. But standing at queue for billing is yet another problem customers are facing so far. Because of this the place will be more crowded which is also a major problem in this pandemic situation. To overcome these issues, we should find a better solution using the existing technologies.

The Internet of Things (IoT) has emerged as a result of the connectivity of billions of smart gadgets, and the maturity of installed sensors made the development of many applications. By using the IoT concept several systems has been proposed so far such as using RFID cards/tags, Arduino, Raspberry pi, pi camera, barcode scanner etc. But these systems are quite costlier which is not a profiteer for industries, also as we know that supermarkets have many numbers of trolleys and since they are costly, they cannot be installed in all trolleys. The problems faced by current shopping system are as follows:

a) Long queues at billing counter
b) Required manpower is more
c) Social distancing due to pandemic situation

Hence, there is a huge challenge for today's engineers to develop a model where it meets the following demands that is:

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(i) Low cost yet effective model.
(ii) The model should be simple to implement for all carts.
(iii) It should be easily understood by all type of customers.
(iv) Low power consumption model.
(v) Maintenance cost should be less.
Thus, we have developed a model where it satisfies all the demands mentioned above. The main component used here is ESP32Cam which is simple, low cost and supports many applications which has been discussed in the further upcoming sections.
The main objective of the system is the trolley made is simple, economical, and user-friendly that it can make its way easily into the shopping malls and margin-free markets where the queues and billing system retards the traditional shopping methods thus forcing them go online for shopping. Well, the solution is The Smart Trolley. Hence, in this paper we discuss in detail system design, working, testing and conclusions. In conclusions we discuss about advantages and disadvantages and future scope of proposed system. The Smart Shopping Cart has the potential to make the shopping experience more pleasurable and efficient for the shopper and the inventory control easier for the store management.

II. Literature Survey

An ample amount of literature survey has been executed to gain the correct details about the existing methodologies which has been detailed below.
In the paper [1] "Smart Shopping Cart" the model is implemented with Raspberry pi and its camera to scan the products developed by Dan Belibov and his team. In this model a Raspberry camera is linked with Raspberry where items are scanned for adding in the cart. They use Intel Neural Compute Stick for configuring a stable Wi-Fi with a processor of the sensor Processing Unit (TPU) developed by Intel. To identify the objects an approach is used which was developed by Google is Tensor Flow where the software
uses to train the system in order to identify the object. Additionally, a weight sensor is used to calculate the net weight after shopping. As we are aware that since Raspberry pi module is costlier it is not possible to
implement in each and every system. They have also stated that the system costs around $262 which is very costly and could not to be installed at all.
Another paper named [2] "An Intelligent Shopping Cart with Automatic Product Detection and Secure Payment System" the system is designed with Arduino UNO by Ponnalagu and Sudipta Ranjan Subudhi. The system contains microcontroller, LCD screen, RFID reader, fingerprint sensor, a keypad and GSM/GPRS module. In order to add the items in the cart the customer has to a scan the RFID tag present in the product through RFID reader and also to add the same item he/she has to press the 4x4 alpha-numeric keypad. After shopping the customer has to enter the UID (Unique Identity Card) number such as Aadhar Card to get access for payment. Secondly, the next step is biometric verification sing fingerprint sensor. Later the customer can pay by UPI payments and QR code where OTP is generated for verification. The above-mentioned steps are very lengthy, and few customers may have less patience to proceed the instructions and they can go for other malls for shopping. SIM card should be installed in every GSM module for operation. Limited number of customers only might understand the procedure. Finally due to this pandemic using fingerprint sensor is not a valid solution currently.
Similarly, the paper [3] "A Smart Trolley for Smart Shopping" the model is implemented with RFID tags on
each product by Tapan Kumar and his team where RFID tags is present in each and every product and database are maintained to manage them. The selected product should be scanned to add to the cart and should be rescanned to remove the product from the cart. After completing his/her shopping the customer should scan the customer card to detect the amount from card for paying the bill. For further confirmation customer can also view the billing details in the online website of the shop. Here the shop owner who is also an admin has the only authority to recharge the smart card of the customer. He can also add, update, or delete a customer's master card. In order to get access of the smart card a keypad is placed in every cart. The system has quite good applications, but the concern is about the database management which is lengthy and tedious process. And also, if any of the customer forgets to bring the smart card, he could not able to do shopping.
On further research a paper [4] called "Design and Implementation of Secure Smart Shopping System using
Arduino" they proposed a model with RF receiver module.
Here, the RF receiver is handed to the child, and it monitors as a childcare unit. If the RF receiver could not be recognized, then the lead goes off which is mounted on the cart indicating the child has moved away from the

parent in the shopping mall. And the process for adding items is similar to the other systems like RFID module used to scan the RFID tags present in each product to add or remove the product from the cart. An additional feature added here is the childcare unit. Along with that a voice board has also been mounted to give instructions through voice messages. For billing an Automated Central Billing System (ACBS) is maintained. Finally, the payment can be made either at the cash counter or via online. Voice message might be a disturbance for other customers and the childcare unit is not a necessary feature for all.

Finally, a paper named [5] "Enhancement of Super Market using Smart Trolley" has been developed by Pranavi and his team using image processing and RFID module. This paper proposes a shopping trolley model with weight sensor to check the overall weight of the cart at the billing time, an ultrasonic sensor is used for obstacle avoidance and a voice assistant for moving the trolley. Here, the items are to be placed in front of camera where it saves the images and sends it to the database management system. And the database matches the product image by using OpenCVBFmatcher method. The system is equipped with many applications, but the major drawback is that it could not be understandable by all types of customers as mentioned in the section 1 and also voice assistance method for moving trolley would not work out during crowded supermarket. Here also a loyalty card is provided to the customers with their details in them. But if he/she forgets to bring it they could not do shopping until they bring the loyalty card. RFID tags are pasted in each and every product along with the product details. Nowadays, hackers can find the radiofrequency ids and they can change the details and cost of the product leading a great loss to the supermarket owners. Another drawback of this system is CCTV like camera should be placed in each and every cart which costs more so that they could not be implemented.

Many attempts have been made through various applications [6-12] to design automation through RFID and Bluetooth [7], FPGA [9], QR code [13], Robot [14-20] many issues and challenges [21] still exists with the present system. Our proposed system used cost effective ESP32 Cam for smart shopping system and detailed in the next section.

III. Proposed Architecture

A. Block Diagram

In our proposed model ESP32Cam is the brain of the system. Since, the ESP32 Cam does not have a USB port to upload the code we use USB to UART (USB-TTL) converter module also called as FTDI programmer developed by Future Technology Devices International Limited. It has FT232RL chip with RXD/TXD transceiver thus supporting communication to the ESP32Cam and high data transfer smoothly with a baud rate ranging from 300 to 3Mbaud at TTL (transistor-transistor logic) levels. It can be operated with a power supply of 5V. The block diagram of our system has been represented below.

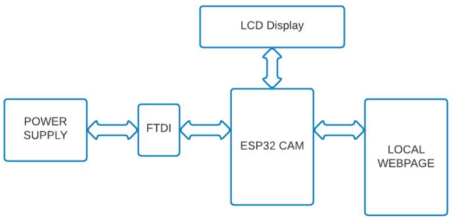

Figure 1. Block diagram of Smart Shopping System

B. Working Principle

Here, we can observe that ESP32Cam controls the entire functions of the system. This module is connected with FTDI programmer which supports the data transfer. ESP32Cam has an in-built Wi-Fi and Bluetooth feature it can create local webpage either statically or dynamically. Every module is assigned with a different IP address for webpage. User can access the webpage by entering the IP address that is generated by the module in the browser once they connect to a network. The only condition is both the module, and the user should connect to the same network. This is one of the main reasons for choosing this module and also it is a low-cost module with multiple applications. So, hereafter when we come to the working principle of our system every product has QR code with the product information stored in it statically. Since, ESP32Cam has an ability to read the QR Code once we place the product's code in front of the module the camera module scans the product details and displays them in 16x2 LCD display. Once it is scanned, we can consider that the product has been added to the cart successfully. If the customer feels the selected item is not interested and has to remove it, he/she can re-scan

the product QR code once again. Once the product is rescanned the item has been removed from the cart successfully. The customer can also monitor the shopping status through the local webpage in his/her smart phone which is also a bill. They can also pay the bill through online as local webpage is provided with a payment option. Finally, either the cashier or the customer can also save the
bill.

C. Circuit Design

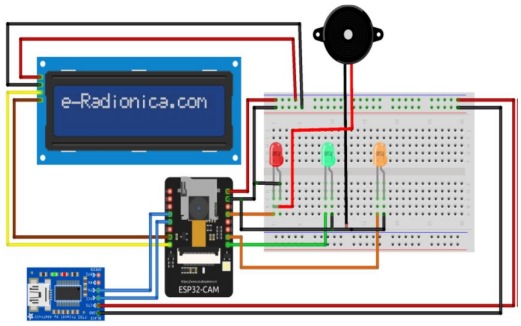

Figure 2.Circuit Diagram for the unit

In the circuit diagram transmitter pin of ESP32Cam is connected to receiver pin of FTDI module and receiver pin of ESP module is connected to transmitter pin of FTDI programmer. 16x2 LCD has soldered with i2c module in order to reduce the pin connections. SDA and SCK pin of LCD i2c module is connected to 15 and 14 pins of esp32cam module respectively. Red, Green, and Yellow leds has further added to the system along with the buzzer. When the system is started yellow led gets on indicating the system is ready to start shopping with a message in the display. When the customer scans the product green led has been programmed to get on stating that the item has been added. The item details along with the quantity has been
displayed in the LCD. After a delay of 2 seconds the green led goes off and yellow led is turned on once again indicating to continue shopping. In the background the item details have updated simultaneously. Suppose if the customer has not interested in the product which has been added already, they can rescan again.

D. Comparison of QR code over RFID

As we can see that most of the shopping systems have been proposed by using RFID (Radio Frequency Identity) tags. These tags can be read by a reader module. But in our system, we have suggested that using QR codes as a better option due to certain reason which has been listed below:

TABLE I. COMPARISON OF RFID AND QR CODE

Sl.no	Features	RFID	QR code
1	Cost	costly	Low cost
2	Security	Can be hacked easily	Unable to hack
3	Proximity	Difficult to read on curved surfaces	Can read at all types of surfaces
4	Time consumption	Requires More time to design	Less time to design

E. Algorithm

Step1: Take a trolley.
Step2: Start the smart shopping system on it.
Step3: Yellow led on, LCD on
Step4: Scan the items you want.
Step5: Yellow led off; Green led on
Step6: The scanned items are now displayed on LCD.
Step7: Green led on; Yellow led on.
Step8: Re-Scan if you want to remove the item from cart
Step9: Yellow led off; Red led on
Step10: Update all actions in webpage (bill) simultaneously
Step11: Choose payment option.
Step12: Finished shopping then end

IV. Results and Discussion

Once the overall circuitry system is designed successfully, we seek for our required results, and these are shown below. The system follows a simple logic that is each product is assigned with a variable. Similarly cost and quantity is also assigned with a unique variable in the code using Arduino UNO software.

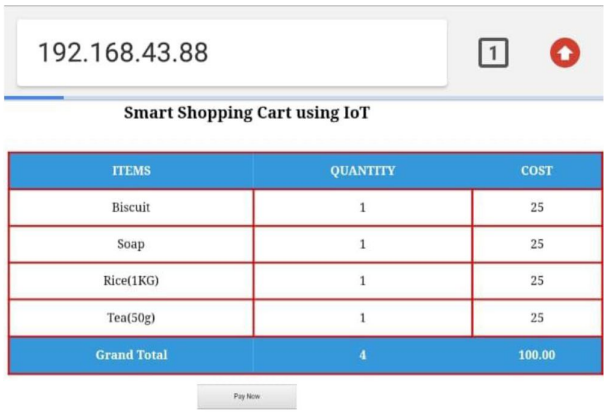

Figure 3. Customer's shopping status in local webpage

Let us take an example from the above. Here, Biscuit and Soap has been added and removed in the cart. Firstly, we assign Biscuit as product1 and Soap as product2, quantity as qty1, qty2 and cost as c1 and c2 respectively for biscuit and soap. If the customer scans the item, then total qty = qty+1 and total cost = c1 + c2. If they are removed, then total qty = qty - 1 and total cost = c1 - c2. This method continues for all the products similarly. If the customer scans the product to esp32cam then that product gets added to the cart successfully and suppose if the customer scans the same product again then it gets removed from the cart. All these processes can be monitored by the customer through a local webpage if the customer's smart phone is connected to the local network. We can also add net weight in the local webpage table for 'n' number of products.

Here, we have used Arduino UNO instead of FTDI programmer due to some soldering issues in the module. In future instead of using Arduino board we can use FTDI/TTL convertors which is small, low cost and easily mountable on the cart.

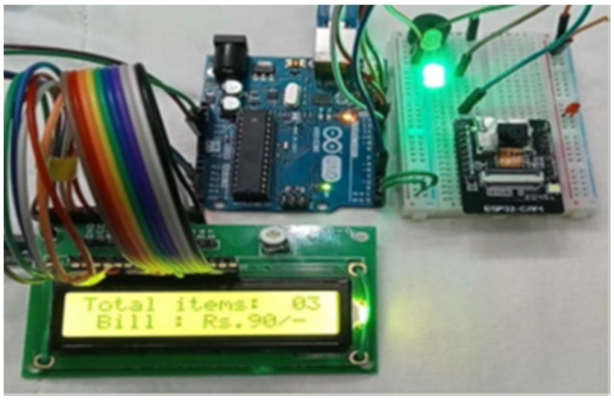

Figure 4. Hardware implementation of the system

V. Conclusion

The time plays a significant role in everyone's life. Therefore, to save the time consumption supermarkets has been introduced in many main cities. We can still save our time in the shopping malls and supermarkets. One of the best technology for this is Internet of Things. Thus, by using this IoT concept we have developed prototype called "Smart Shopping Trolley using ESP32Cam and QR Code". Our proposed system is very reliable, low cost

and easily manageable that are implemented with latest technologies. This model can be mounted on all shopping trolley. However further enhancement can be made by adding dc motors for developing automatic moving trolley. But one of the biggest challenge hidden here is it has to follow the specific person (customer) without any interruption even in the crowded areas in supermarkets.

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