International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.317

IOT Based Smart Shopping Trolley

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ABSTRACT: With the current COVID-19 pandemic scenario we all have realized that social distancing is the key measure to be taken in order to control the contagion. In this situation it is very crucial to avoid close contact among people. The area where people are most vulnerable to contract this disease are market places from where daily essentials are bought. Thus, the staff is working at these shops are very much prone to contract such diseases as they spend a major part of their day handling and managing customers. This increases the risk of infection not only for the staff but also for the customers. Hence a proper method has to be implemented in order to avoid any contact between the staff members and the customers, and implementation of technology can provide a solution for this issue.To tackle this problem,I have come up with an idea where in a model of a smart trolley will be made which will be equipped with a Raspberry pi, Camera, servo motor, Load cell and Hx711 amplifier, LCD display and I2C Module, Proximity sensor and a mobile application. Camera is used to scan the Barcodes on the products by using image processing for billing which will be reflected on the mobile application that we build.As for the security feature making use of proximity sensor and Weight sensorto keep a check on malpractices performed by the customer. This device will ensure no contact between people and also apart from being a safety device, the need for standing in queues for billing is eradicated. Here the mobile application is also being built to ease the customer experience of shopping.

Keywords: Raspberry pi, IOT, Image processing, Barcode Scanning, Mobile application, SQL Database,Automation, etc.

I. INTRODUCTION

The modern electronic technology is based on embedded system. The main aim of growing technology is to make life became easier. Nowadays, a mall is a place where people get their daily necessities. In the mall, purchasing a number of items requires a cart andtime. But time is money for today's generation. Therefore, people do not have much time is for shopping, which is necessary in every day. Although shopping in malls has the advantage of saving time.In holidays and special offers the huge crowed in malls.With the help of many advanced technologies that are applied, we can offer security to customers and retailers. It is necessary to develop a system in order to get the Product and status of the trolley which can be checked in real time. The status of the trolley is monitored using sensors such as Weight sensor and Proximity sensor.People enter in the mall; each takes the product from the cart. After the purchase is complete, that person must line up to checkout.In the invoicing process, a salesperson scans the barcode of each individual product and issues the final invoice. This process is very time consuming. To avoid this problem, we design smart trolley. In smart trolley we use different techniques. A number of smart cart methods have been developed to facilitate customer shopping in malls/stores. It reduces the time of customers by avoiding standing in long billing queues.So, thesystem is reliable and easy to use.
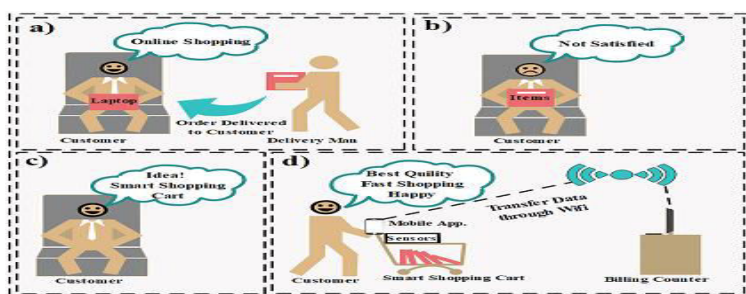

Figure 1: Online and Offline Shopping

II. LITERATURE REVIEW

Mobeen shahroz, muhammad faheem mushtaq, maqsood ahmad, saleem ullah, arif mehmood, gyu sang choi et.al., This provides the smart shopping cart based on Internet of Things (IOT), which consists of Radio Frequency Identification (RFID) sensors, Arduino, microcontroller, Bluetooth module and a mobile app.Rfid sensors are based on wireless communication. One part is the RFID tag attached to each product, and the other part is the RFID reader that reads product information efficiently. After that, all product information will be displayed in the mobile application. The customer easily manages the shopping list in the mobile app according to their preferences. Then purchase information is sent wirelessly to the server and invoices are generated automatically. This experimental prototype was designed to eliminate time-consuming purchasing processes and quality of service issues. [1]

Jayshree.M, Lakshmi prabha.K.R, Jayaprabha.S, Mohan.K., et.al., In an automated shopping cart using a Raspberry Pi tool mixed with a barcode scanner and LCD display. We look at revenue and holiday rush in supermarkets and due to this type of billing, revenue time becomes more important and customer can't stand for too much time in the billing queue, so here we can use the automatic shopping cart which contains a barcode reader, a raspberry pi device and an LCD screen. With the help of this shopping cart, the customer will personally try the product using him-self and will fill in the invoice. Therefore, there may not be a long line at the grocery store at the cash register for payment. [2]

Kowshika S, Madhu mitha S.S, Madhu Varshini G, Megha V, Lakshmi K., et.al., The smart cart proposed to generate invoices using the IOT with the mobile cart application. With the use of this mobile app and cart, the customer can pay the bill in no time. The smart cart uses the RFID tag and receiver to scan the product, the load cell to prevent theft, the LCD display and the Raspberry Pi. Moreover, the customer can also log in using the mobile app which will displaythelist of all the mentioned products and their quantity.Once done, the customer can pay the bill through the mobile application.[3]

Tapan Kumar Das, Asis Kumar Tripathy, and Kathiravan Srinivasan, et.al., proposed to design a smart shopping cart that can take care of shopping and billing. This allows the customer to enter the store directly, buy the products with the smart cart and exit the store again. Receives the e-invoice by post and can view the purchase details via the store's website. To make this happen, we need an Arduino board, radio frequency identification (RFID) reader. RFID tag, LCD screen, ESP8266 Wi-Fi module, database manager, and a website to track product and data. Client is accessible to the from anywhere in the world. It is an IOT-based system anywhere the cart can interact with the distributed network around the world. [4]

M. Kabil Dev, R. Kannan, M. Agarshan, S. Karthik, Dr. K. Lakshmi. et.al., The smart shopping cart is such an advanced device that it is more flexible and easier process to complete your shopping without any delay. Customers in the shop don't want to wait long for their bill to be paid. In the smart shopping cart, the bill can be paid at the same time without having to wait at the counter. Once the shopping is finished, the payment is made online or offline according to the customer. This flexibility is not offered by the existing cart. To overcome this, the Smart cart is preferred. The newly designed smart cart is made up of Arduino UNO, RFID reader and tag, Wi-Fi module. Apart from this checkout feature, the smart shopping cart also allows the admin to view the stock details. The stock of each product can be controlled and planned accordingly without additional manual work. [5]

Xuan Liu, Haitao Zhang, Jingxian Fang, Guan Guan, Yundi Huang, et.al., An intelligent shopping cart represents the design and implementation of a new application. This Cart can accurately track its garment by identifying the colour and shape characteristics of the specific image that the garment is wearing. it also implements fast payments to provide a more convenient way to purchase. In this paper, designed an intelligent shopping cart system architecture. Then presented automatic payment based on RFID. Finally they proposed a new system. the results of the experiment indicates that the proposed smart shopping cart system provides dynamic target tracking with more accuracy and significantly speeds up the checkout process. [6]

Sarala t., sudha y. a., sindhu k. v., et.al.,Theinnovative concept of Smart Electronic shopping Trolley used in shopping complex with many individual stores. The main purpose here is to help a person to shop to save time while purchasing a product. The electronic trolley is equipped with a Barcode reader which scans the identification of the outcome and an internet connection to the shop server. It also consists of LCD display that report the number of items and the total amount to customers, and the Barcode scanner identifies the outcome and updates the bill. A Sweeper will be provided to pay your bill via credit/debit cards. In this paper, we report the performance or management of reliable andefficient

shopping with smart shopping carts using WSN. Such trolley is acceptable for supermarkets, it can help to reduce labor and create better shopping opportunities for customers. [7]

Susila sakthy. S., ragupathy t., Kishore g., et.al., proposed an android mobile application. It developed in which the customer first creates a list of items to be purchased. Then, customers scan the QR code of the products with their smartphone and put these products in the shopping cart. At the end of the purchase, the invoice is generated and the payment is made through one of the UPI money transfer platforms. To prevent theft, Camera-based theft detection using machine learning is used to detect occurrence of theft. This approach will detect customers movements using convolutional neural networks and send an alert along with a captured image to the authorized person. [8]

Dipika D., M. M. Sardeshmukh, Sabita Mali, Swapnalini Pattnaik, Ashwini Ubale, Puja Bajirao Sindhe, et.al., proposed system helps individual customers to receive the actual invoice after a discount or deduction on their purchase. Customers must log into their account for billing and pay the bill using any digital payment method. This system is designed with security in mind to prevent theft and this system is also user friendly. It minimizes the time in purchase and deliver to the customer by standing in a long queue, ensuring customer convenience and minimizing the hassle of scanning barcodes and eliminating the hiring of billers, thus satisfying the requirements of customers and customers to be met by trades. [9]

Shailesh, Pragati Srivastava Deb, Rajan Chauhan, Vaibhav Tyagi, et.al., offers a solution for those long queues approaching the billing counter leading to long queues at the counter. For this Purpose, a barcode reader and an LCD screen are attached to the trolley. The barcode automatically recognizes the barcode on the product. When we place the item in the Basket and a screen, the details of the item are displayed. This will add the cost of the item to the invoice. This exercise trolley takes care of all the billing and solves the problem of long queues at the counters. [10]

III. PROBLEM STATEMENT

An idea of building a technology that can help in calculating the bill of all the items we wish to purchase and vanishing the system of queues for paying the bills will help in the ongoing crisis and maintaining social distancing all around. This small idea basically draws attention to "smart market place" where everything can be done with minimal human intervention. This in turn will save time and social distancing is also followed here.The main aim to carry forward this project are:

1. To build a system that will be able to ease the billing process in turn reducing human contact and long queue.
2. To prevent theft extra features to be loaded.
3. To build a mobile app to connect with the system that will help in payment methods.

IV. **IOT IN SHOPPING TROLLEY**

The system is consisting of the Raspberry pi 3 microcontroller, The HX711 amplifier, for the load cell, servo motor, 16*2 LCD display with I2C module, Proximity sensor module, and a mobile application for barcode scanning. The microcontroller contains the code for all the devices and makes the entire system function. The functioning of the entire system is as follows:The product is first scanned by the customer via the Camera through image processing. Once scanned, the product details i.e., price and type will flash on the lcd screen which is retrieved from the database containing information of all products. The product is then placed inside the trolley. The weight of the products placed inside is compared with the weight specified in the database and an alarm or warning is given if there is a difference in the readings of the two values. This ensures that the customer does not indulge in foul actions. Finally, when the products are tallied and the payment is made by the app. The user has to place his/her hand in front of the Proximity sensor for the trolley door to open by the servo motor to collect his/her commodities.In order to store all the product information and retrieve it whenever the barcode of the product is scanned, a DBMS is required. phpMyAdmin is an open-source software tool written in PHP, which handles the administration of MySQL over the Web. phpMyAdmin supports a wide range of operations on MySQL. Frequently used operations like managing databases, tables, columns, relations, indexes, users, permissions, etc can be performed via the user interface, while still having the ability to directly execute any SQL statement. Developing an application for the User interface of the customer is essential. It would provide an effortless experience and would make the customer self-reliant. The application will include the QR scanner which will be used to pay the total bill.
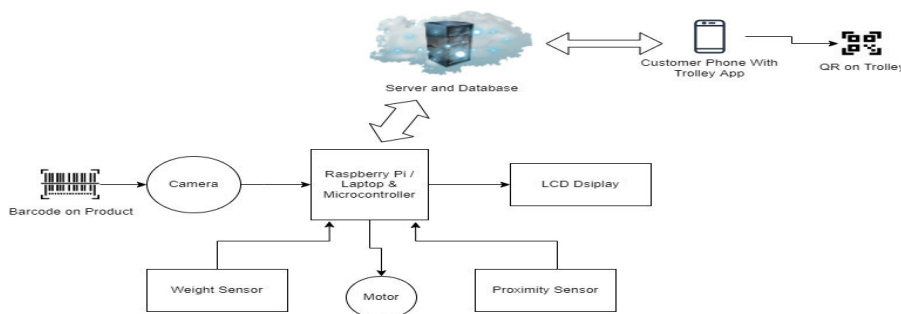
Figure2:Block Diagram of Smart Shopping Trolley

Barcode Scanning using Image Processing

A barcode scanner is a device or an implementation of image processing where in the barcode placed in front of the scanner or the camera is detected and read and all the product or details to which the barcode is linked is retrieved and displayed. There are mainly two ways of scanning barcodes. The first is a dedicated barcode scanner which scans or reads a barcode symbol and then provides an electrical output to a computer via a decoder and a cable. The decoder recognizes the type of barcode symbols and then translates the bar and space content and transmits data to a computer in a human readable format. The second method is to integrate image processing with a camera attached or built in to a computer or mobile using an application.

Figure 3: Mobile Barcode/QR Code Scanner

Application Development

Developing an application for the User interface of the customer is essential. It would provide an effortless experience and would make the customer self reliant. The application will include the camera which will be used to scan the products and retrieve the price of the commodities the customer wishes to purchase.

Android Studio

Android Studio is the official integrated development environment (IDE) for Android application development. It is based on the IntelliJ IDEA, a Java integrated development environment for software, and incorporates its code editing and developer tools.

LCD for basic Information

An LCD placed in the shopping trolley will update the customer by displaying the products scanned and the type and weight of all the commodities scanned by the customer. The Adafruit library is used for LCD in python which helps with the interface of Raspberry microcontroller. The LCD Display is mainly used for displaying the products are scanned or not and any desired message with a specific format of choice.

Security Gate

For security and to curb malpractices by the customer. A safety door has to be incorporated which would only open when the payment is made and the customer makes a gesture for the gate to open. This feature is very essential because staff numbers in an automated retail store are expected to be less and hence monitoring of customers becomes extremely difficult.The opening and closing of the security gate are to be programmed and interfaced properly to avoid any hiccups during the entire process. A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. The servo motor will drive the door to open and close. In order to do so the duty cycle for the motor has to be set.

Servo Motor

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in both the clockwise or counter-clockwise direction. The PWM sent to the motor determines the position of the shaft, and based on the duration of the pulse sent via the control wire; the rotor will turn to the desired position. The servo motor expects to see a pulse every 20 milliseconds (mms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position. Shorter than 1.5ms moves it in the counter-clockwise direction toward the 0° position, and any longer than 1.5ms will turn the servo in a clockwise direction toward the180° position.

Hand detection

A hand detection system will help the gate to open and close whenever the customer wishes after the transaction. In order to achieve this a Proximity sensor poses the best way of implementation. Whenever the hand is detected, the gate will open and when the hand is taken away, the gate automatically closes.

Weight Sensing

The weight sensor equipment consists of the Load cell and the HX711 Amplifier. A load cell is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally. A load cell is made by using an elastic member to which a number of strain gauges are attached. Usually there are a total of four strain gauges that are bonded to the upper and lower surfaces of the load cell. When the load is applied to the body of a resistive load cell, the elastic member deflects and creates a strain at those locations due to the stress applied. As a result, two of the strain gauges are in compression, whereas the other two are in tension.

The four strain gauges are configured in a Wheatstone Bridge configuration with four separate resistors connected as shown in what is called a Wheatstone Bridge Network. An excitation voltage - usually 10V is applied to one set of corners and the voltage difference is measured between the other two corners. At equilibrium with no applied load, the voltage output is zero or very close to zero when the four resistors are closely matched in value. That is why it is referred to as a balanced bridge circuit.
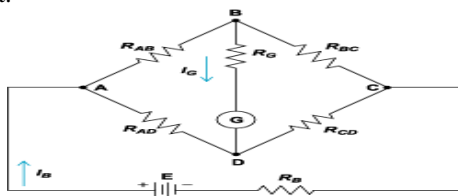

Figure4: Wheatstone Bridge

HX711 Amplifier

The load cell produces very feeble electrical signals in the range of millivolts. For the microcontroller to make use of the signals produced by the load cell, a HX711 amplifier isused. The HX711 amplifier amplifies this electric signal for the microcontroller to read the output signals of the load cell. This amplifier is designed specifically for weight scale measurements.
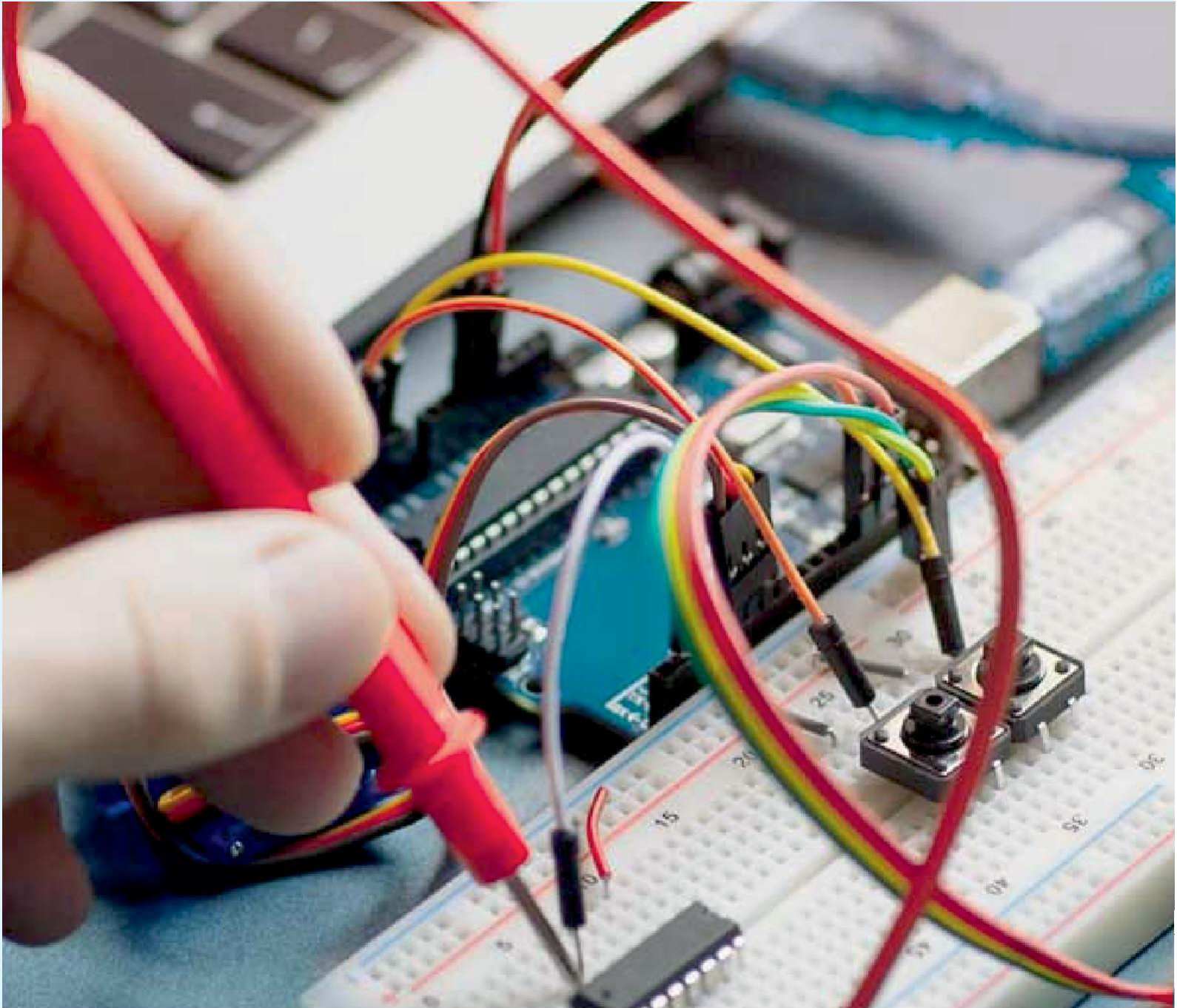
V. CONCLUSION

The Smart Shopping Trolley helps the customers in shopping, billing and payment in less time and in an easy way. By simply scanning the barcode the customer can pay the bill. Supermarket owners get benefit with respect to time saving, less manpower and space which reduces the investment. The smart shopping trolley can be used in all retail shopping malls, supermarkets, hypermarkets. This system consists of a barcode for scanning the products.Most of the all products have its own barcode so for the customers and retailers barcode is suitable to use. Here the camera is used for the scanning of products therefore it can be increasing its accuracy by using image processing technology. The advantages of this proposed system are high efficiency, total amount and other detail stored in the database.

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