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IOT Based Smart Cart System

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***Abstract*:** *The use of trolleys in the shopping industry has always been very popular, especially among customers who frequently stop by the mall or supermarket to shop for their necessities. People need trolleys to make it easier for them to carry their groceries and other luggage. There are various types of trolleys according to their respective uses. Still, the trolleys in the shopping industry commonly used today can only help users carry goods from one place to another. However, this traditional type of trolley is still lacking in being a perfect fit in the shopping industry. It does not help reduce the crowds and the enormous queue in terms of inconvenience. In metro cities purchasing and shopping at super shops, big malls is a daily activity. At the billing counter the customer will prepare the bill using bar code reader which is a time-consuming process and will creates the long queues at billing counters. By implementing this smart machine, it will minimize human efforts and also automate the billing procedure. So, in our prototype we are using RFID technology for identification of the purchased product and it reduces the scanning time of the consumer.*

Key Word: *Customers, Billing, Time Consuming, Smart Machine, Scanning Time.*

I.INTRODUCTION

In the past, people used to write a list when they go shopping for groceries, while today, they use their smart phones to do it. In addition, the advent of smart phones has significantly changed the experience of retail shopping. Retailers are continually working to enhance their shopping experience to ensure that their customers are delighted with their overall shopping experience. Various efforts have been made to eliminate long shopping lines in department stores in the past. One popular method is implementing self-checkouts, where consumer convenience has been significantly improved. Since then, self-checking has been expected due to low overhead costs; however, shoplifting and lower operational efficiencies are considered significant disadvantages in the retail world There are some key causes of client stress or frustration in shopping centers or supermarkets in Malaysia. For example, no tagged goods price in some shopping malls and supermarkets could confuse consumers. Most people nowadays give customers a unique way of paying by using a bar code scanner attached to specific locations. Despite the severity of the COVID-19 outbreak in Malaysia, the affected customers nevertheless continued to visit supermarkets and shopping malls to buy groceries and other products and causing the long queueing for the cashier to check each product, which may affect their social distancing. The choice of one single technology to improve the shopping experience is challenging. The customers have also found that knowledge at the item level is preferable to buy decisions. Increased customer loyalty also affects the criteria for visual technology and privacy. Therefore, it is necessary to assess ways of enhancing the shopping experience when considering factors such as investment returns, anticipated revenue growth, and consumer expectations.

Recently Amazon has introduced a smart "Amazon Go" store concept, in which the customer picks and self-checked a product. The Amazon Go system utilizes image recognition, neural networks, and profound learning algorithms to forecast customers' product selection. The accuracy of the forecasts primarily depends on consumers' previous purchases. Amazon uses facial recognition process images from cameras to correlate products being purchased. Finally, the Japanese had made an RFID based shopping basket where each object is tagged using UHF RFID. This smart basket is part of the supermarket's 'cashier-free convenient store model,' enabling the customers to simply deposit items directly into the shopping basket from the shelf. Just a handful of UHF RFID applications to monitor containers in progress are currently deployed worldwide. There is a technology called RFID (radio frequency identification) which helps to make our shopping much easier. Even though bar code system is widely prevailed, RFID has few advantages over the bar code system. In order to make this RFID to be operational, Node MCU board, helps to interact with the RFID reader and send data to the online database through wi-fi module. Actually, shopping is something that people love to do. They always wanted to buy new stuffs to satisfy their needs and also others. However, some people hate it mainly because of the crowd, long queues in the shop, billing etc. In addition to this, they will be having a tough problem in searching for the products. Sometimes, they happen to lose the bill, since it is a physical entity. There must be a fine solution for this. In concern with the struggle of people during shopping and for the shop owner to adopt the emerging technology to attract more customers. This is mainly to ease the shopping, to invite more customers, to make shopping a fun and mainly to save time. Moreover, customers manage their shopping details online and remain connected with the shop owners for any queries or suggestions and also make the billing perfectly online. The main aim of this project is to ease the shopping for customers and to reduce the number of workers in the shop to save money to the shop keeper. The requirement is to stick the RFID labels to all the products in the store instead of barcode sticker Thus RFID reader is being employed to scan the products for billing, to send the data online to store it in the transaction database for future reference for

the shop-owner and for providing customers the e-bill. Essence of this approach involves using the RFID system to keep the details of each product. Each label in the products are stored with its name, id, and price. So when it comes in contact with the RFID reader, the reader reads out all those information and add it to the cart. Once the products are selected, the customer can proceed to the billing part. Each customer is given with their smart cards, which contain their id and their balance amount in the card.

II.LITERATURE REVIEW

1. Title:
A Novel Video Processing based Cost Effective Smart Trolley System for Supermarkets using FPGA

Authors:
Sudhir Rao Rupanagudi, Fathima Jabeen, Vaishnav Ram Savarni K R, Varsha G.Bhat

Year:
2015

Literature Overview:

One of the major problems faced by consumers while shopping at a supermarket is the inability to locate items and also to carry goods to the billing counter. In this paper, we describe a novel cost-effective method to overcome these issues by creating a smart trolley using a web camera along with video processing to complete the tasks. In comparison with previous methods which utilize RFID transceivers, our solution costs 10 times lesser than its predecessors and is environment friendly as well.

Drawbacks:

FPGA method camera interface is required for implementation and device cost and circuit implementation will be complicated and facing connection issues.

Overcome:

In this proposed system, we set the circuit as smaller and this will be easy to install In the small trolley setups.

2. Title:
Human-Robot Interaction with Smart Shopping Trolley using Sign Language: Data Collection

Authors:
Dmitry Ryumin, Denis Ivanko, AlexandrAxyonov, IldarKagirov

Year:
2019

Literature Overview:

The paper presents a concept of a smart robotic trolley for supermarkets with a multimodal user interface, including sign language and acoustic speech recognition, and equipped with a touch screen. Considerable progress in hand gesture recognition and automatic speech recognition within the last years has brought to life many human-computer interaction systems. At the moment the level of voiced speech and isolated/ static hand gesture automatic recognition quality is quite high. However, continuous or dynamic sign language recognition still remains an unresolved challenge. There exists no automatic recognition system for Russian sign language nowadays. There are also no relevant data for model training. In the present research, we try to fill in this gap for the Russian sign language. We present a Kinect 2.0 based software-hardware complex for collection of multimodal sign language databases with an optical video camera, infrared camera and depth sensor. We describe the architecture of the developed software as well as some details of the collected database. The collected corpus is meant for further development of a Russian sign language recognition system, which will be embedded into a robotic trolley for supermarkets with gestural and speech interfaces. The architecture of the developed system is also presented in the paper.

Drawbacks:

In speech recognition method customer need to give their voice command of the product for billing and due to surrounding noise proper billing was not possible and many of them will don't know the exact product name.

Overcome:

Here we use RFID Reader and tag for the easy and simple scanning method and anyone can access the system without any shopkeeper help.

3. Title:

Towards A Sustainable Development Cities Through Smart Shopping Trolly: A Response to the Covid-19 Pandemic

Authors:
Aileen Anak Bita, Safaa Najah Saud Al-Humair, Adzliza Salmi Binti Mohamad Azlan

Year:
2021

Literature Overview:

The use of trolleys in the shopping industry has always been very popular, especially among customers who frequently stop by the mall or supermarket to shop for their necessities. People need trolleys to make it easier for them to carry their groceries and other luggage. There are various types of trolleys according to their respective uses. Still, the trolleys in the shopping industry commonly used today can only help users carry goods from one place to another. However, this traditional type of trolley is still lacking in being a perfect fit in the shopping industry. It does not help reduce the crowds and the enormous queue in terms of inconvenience. Therefore, this project aims to design a smart trolley equipped with an Arduino NANO, RFID, and a barcode scanner. It can also be synchronized with the mobile application via a WIFI module. This new technology will replace the traditional one, which will help consumers maintain social distancing during the age of the COVID-19 pandemic.

Drawbacks:

This trolley system is only used to alert the customers to keep social distancing with use of ultrasonic sensor. Here they follow old billing methods.

Overcome:

Billing systems will be automatically done with our proposed one and send to the IOT for quick access and also avoid the crowds in malls and super market.

4. Title:
Smart Payment and Billing Management System

Authors:
Susila Sakthy.S, Ragupathy.T, Kishore.G

Year:
2020

Literature Overview:

The proposal puts forward a unique solution to reduce the average time a customer spends at a supermarket. The billing section has a cash counter in which the process is done using a bar code scanner and it is a very time-consuming process. To overcome this problem we are developing a system which we called as “Smart payment and billing management system”. In this proposal, an android mobile application is developed in which the customer creates an item list to be purchased firstly. Then, customers scan the QR code of the products through their smartphones and keep those products into the trolley. At the end of shopping, their bill will be generated and payment will be done through any of the UPI money transfer platforms. To prevent theft, Camera footage based theft detection will be used with the help of machine learning to detect theft occurrence. This approach will identify the motion of customers with the help of convolutional neural networks and a warning message will be notified to the authorized person along with a captured image.

Drawbacks:

Barcode system will be used here it is widely a old method for scanning and shopkeeper needs to stick the barcode sticker in every product.

Overcome:

RFID reader will detect the product automatically when the product enters into the trolley and no need to scan separately.

III.WORKING FLOW

When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5v, with maximum allowable transients of 10mv. To achieve a better/suitable contrast for the display the voltage (VL) at pin 3 should be adjusted properly. A module should not be removed from a live circuit.

The ground terminal of the power supply must be isolated properly so that voltage is induced in it. The module should be isolated properly so that stray voltages are not induced, which could cause a flicking display. LCD is lightweight with only a few, millimeters thickness since the LCD consumes less power, they are compatible with low power electronic circuits, and can be powered for long durations. LCD does not generate light and so light is needed to read the display. By using

backlighting, reading is possible in the dark. LCDs have long life and a wide operating temperature range. Before LCD is used for displaying proper initialization should be done.

LCDs with a small number of segments, such as those used in digital watches and pocket calculators, have individual electrical contacts for each segment. An external dedicated circuit supplies an electric charge to control each segment. This display structure is unwieldy for more than a few display elements. Small monochrome displays such as those found in personal organizers, or older laptop screens have a passive-matrix structure employing super-twisted nematic (STN) or double-layer STN (DSTN) technology—the latter of which addresses a color-shifting problem with the former—and color-STN (CSTN)— wherein color is added by using an internal filter. Each row or column of the display has a single electrical circuit.

The pixels are addressed one at a time by row and column addresses. This type of display is called passive-matrix addressed because the pixel must retain its state between refreshes without the benefit of a steady electrical charge. As the number of pixels (and, correspondingly, columns and rows) increases, this type of display becomes less feasible.

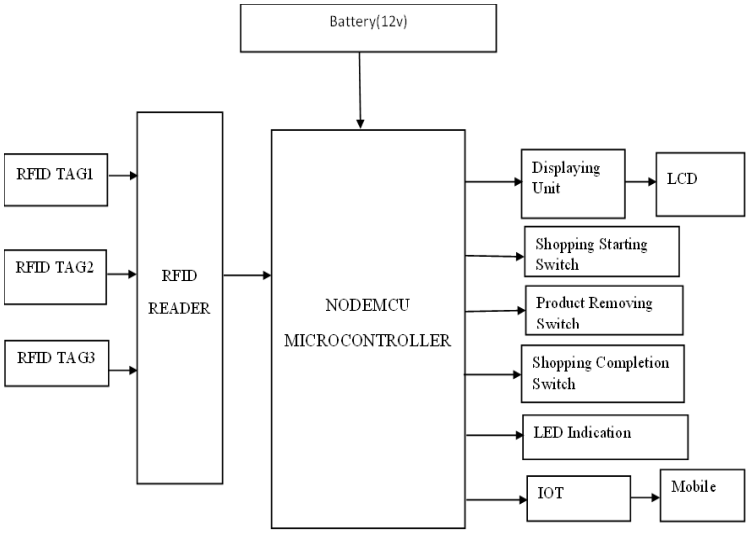


Figure 1 Working Flow

IV.PROPOSED WORK

- Automatic reading of RFID tag from product. RFID can be placed inside the product. RFID tags are not affected by the conditions such as moisture abrasion, dirt or packing contours. RFID has long read distance. RFID tag having READ & WRITE capability.
- Each and every product in the shop will have an RFID tag attached to it. RFID TAGs act a transmitter part.
- Each RFID tag contains a unique number, these number are link with project cost details.
- RFID Reader is fit in the trolly, when you take the product should show the RFID tag to the RFID Reader. The gets the value and updated to the LCD and IOT.
- LCD Display act as displaying unit.
- Switch act as a completion of Purchasing. After completion of selecting the project should click the switch.

Protocols:

In telecommunications, a communications protocol is a system of rules that allow two or more entities of a communications system to transmit information via any kind of variation of a physical quantity. These are the rules or standard that defines the syntax, semantics and synchronization of communication and possible error recovery methods. Protocols may be implemented by hardware, software, or a combination of both.

Communicating systems use well-defined formats (protocol) for exchanging messages. Each message has an exact meaning intended to elicit a response from a range of possible responses pre-determined for that particular situation. The specified behavior is typically independent of how it is to be implemented. Communications protocols have to be agreed upon by the parties involved. To reach agreement, a protocol may be developed into a technical standard. A programming language describes the same for computations, so there is a close analogy between protocols and programming languages: protocols are to communications as programming languages are to computations.

Communicating systems

The information exchanged between devices—through a network, or other media—is governed by rules and conventions that can be set out in technical specifications called communications protocol standards. The nature of a communication, the actual data exchanged and any state-dependent behaviours, is defined by its specification.

In digital computing systems, the rules can be expressed by algorithms and data structures. Expressing the algorithms in a portable programming language makes the protocol software operating system independent.

Operating systems usually contain of a set of cooperating processes that manipulate shared data to communicate with each other. This communication is governed by well-understood protocols, which can be embedded in the process code itself.

In contrast, because there is no common memory, communicating systems have to communicate with each other using a shared

transmission medium. Transmission is not necessarily reliable, and individual systems may use different hardware and/or operating systems.

To implement a networking protocol, the protocol software modules are interfaced with a framework implemented on the machine's operating system. This framework implements the networking functionality of the operating system. The best known frameworks are the TCP/IP model and the OSI model. At the time the Internet was developed, layering had proven to be a successful design approach for both compiler and operating system design and, given the similarities between programming languages and communications protocols, layering was applied to the protocols as well. This gave rise to the concept of layered protocols which nowadays forms the basis of protocol design.

Systems typically do not use a single protocol to handle a transmission. Instead they use a set of cooperating protocols, sometimes called a protocol family or protocol suite. Some of the best known protocol suites include: IPX/SPX, X.25, AX.25, AppleTalk and TCP/IP.

The protocols can be arranged based on functionality in groups, for instance there is a group of transport protocols. The functionalities are mapped onto the layers, each layer solving a distinct class of problems relating to, for instance: application-, transport-, internet- and network interface-functions. To transmit a message, a protocol has to be selected from each layer, so some sort of multiplexing/demultiplexing takes place. The selection of the next protocol is accomplished by extending the message with a protocol selector for each layer.

Data formats for data exchange

Digital message bitstrings are exchanged. The bitstrings are divided in fields and each field carries information relevant to the protocol. Conceptually the bitstring is divided into two parts called the *header area* and the *data area*. The actual message is stored in the data area, so the header area contains the fields with more relevance to the protocol. Bitstrings longer than the maximum transmission unit (MTU) are divided in pieces of appropriate size.

Address formats for data exchange.

Addresses are used to identify both the sender and the intended receiver(s). The addresses are stored in the header area of the bitstrings, allowing the receivers to determine whether the bitstrings are intended for themselves and should be processed or should be ignored. A connection between a sender and a receiver can be identified using an address pair (sender address, receiver address). Usually some address values have special meanings. An all-1s address could be taken to mean an addressing of all stations on the network, so sending to this address would result in a broadcast on the local network. The rules describing the meanings of the address value are collectively called an addressing scheme.

Address mapping.

Sometimes protocols need to map addresses of one scheme on addresses of another scheme. For instance to translate a logical IP address specified by the application to an Ethernet hardware address. This is referred to as address mapping.[15]

Routing. When systems are not directly connected, intermediary systems along the route to the intended receiver(s) need to forward messages on behalf of the sender. On the Internet, the networks are connected using routers. This way of connecting networks is called internetworking.

Detection of transmission errors

is necessary on networks which cannot guarantee error-free operation. In a common approach, CRCs of the data area are added to the end of packets, making it possible for the receiver to detect differences caused by errors. The receiver rejects the packets on CRC differences and arranges somehow for retransmission.

Acknowledgements of correct reception of packets is required for connection-oriented communication. Acknowledgements are sent from receivers back to their respective senders.

Loss of information - timeouts and retries.

Packets may be lost on the network or suffer from long delays. To cope with this, under some protocols, a sender may expect an acknowledgement of correct reception from the receiver within a certain amount of time. On timeouts, the sender must assume the packet was not received and retransmit it. In case of a permanently broken link, the retransmission has no effect so the number of retransmissions is limited. Exceeding the retry limit is considered an error.

Direction of information flow needs to be addressed if transmissions can only occur in one direction at a time as on half-duplex links. This is known as Media Access Control.

In communications, message values are transferred using transmission media. By analogy, the equivalent of a store would be a collection of transmission media, instead of a collection of memory locations. A valid assignment in a protocol (as an analog of programming language) could be Ethernet:='message' , meaning a message is to be broadcast on the local ethernet.On a transmission medium there can be many receivers. For instance a mac-address identifies an ether network card on the transmission medium (the 'ether'). In our imaginary protocol, the assignment ethernet[mac-address]:=message value could therefore make sense.

Protocol design

Communicating systems operate in parallel. The programming tools and techniques for dealing with parallel processes

are collectively called concurrent programming. Concurrent programming only deals with the synchronization of communication. The syntax and semantics of the communication governed by a low-level protocol usually have modest complexity, so they can be coded with relative ease. High-level protocols with relatively large complexity could however merit the implementation of language interpreters. An example of the latter case is the HTML language. Concurrent programming has traditionally been a topic in operating systems theory texts. Formal verification seems indispensable, because concurrent programs are notorious for the hidden and sophisticated bugs they contain. A mathematical approach to the study of concurrency and communication is referred to as Communicating Sequential Processes (CSP). Concurrency can also be modelled using finite state machines like Mealy and Moore machines. Mealy and Moore machines are in use as design tools in digital electronics systems, which we encounter in the form of hardware used in telecommunications or electronic devices in general.

This kind of design can be a bit of a challenge to say the least, so it is important to keep things simple. For the Internet protocols, in particular and in retrospect, this meant a basis for protocol design was needed to allow decomposition of protocols into much simpler, cooperating protocols.

A basics for protocol design

Systems do not use a single protocol to handle a transmission. Instead they use a set of cooperating protocols, sometimes called a protocol family or protocol suite.[9] To cooperate the protocols have to communicate with each other, so some kind of conceptual framework is needed to make this communication possible. Also note that software is needed to implement both the 'xfer-mechanism' and a protocol (no protocol, no communication).

In literature there are numerous references to the analogies between computer communication and programming. By analogy we could say that the aforementioned 'xfer-mechanism' is comparable to a *cpu*; a 'xfer-mechanism' performs communications and a *cpu*performs computations and the 'framework' introduces something that allows the protocols to be designed independent of one another by providing separate execution environments for them.

Layering

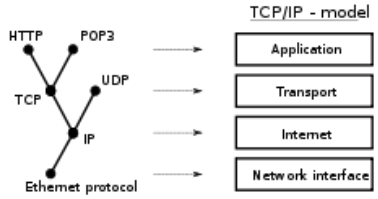


Figure 2 layering scheme protocols

The communications protocols in use on the Internet are designed to function in very diverse and complex settings. To ease design, communications protocols are structured using a layering scheme as a basis. Instead of using a single universal protocol to handle all transmission tasks, a set of cooperating protocols fitting the layering scheme is used. The layering scheme in use on the Internet is called the TCP/IP model. The actual protocols are collectively called the Internet protocol suite. The group responsible for this design is called the Internet Engineering Task Force (IETF).

The vertical protocols need not be the same protocols on both systems, but they have to satisfy some minimal assumptions to ensure the protocol layering principle holds for the layered protocols. This can be achieved using a technique called Encapsulation.

Usually, a message or a stream of data is divided into small pieces, called messages or streams, packets, IP datagrams or network frames depending on the layer in which the pieces are to be transmitted. The pieces contain a header area and a data area. The data in the header area identifies the source and the destination on the network of the packet, the protocol, and other data meaningful to the protocol like CRC's of the data to be sent, data length, and a timestamp.

Software layering

Having established the protocol layering and the protocols, the protocol designer can now resume with the software design. The software has a layered organization and its relationship with protocol layering is visualized in figure 5.

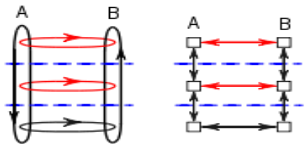


Figure 3 Protocol and software layering

The software modules implementing the protocols are represented by cubes. The information flow between the modules is represented by arrows. The (top two horizontal) red arrows are virtual. The blue lines mark the layer boundaries.

To send a message on system A, the top module interacts with the module directly below it and hands over the message to be encapsulated. This module reacts by encapsulating the message in its own data area and filling in its header data in accordance with the protocol it implements and interacts with the module below it by handing over this newly formed

message whenever appropriate. The bottom module directly interacts with the bottom module of system B, so the message is sent across. On the receiving system B the reverse happens, so ultimately (and assuming there were no transmission errors or protocol violations etc.) the message gets delivered in its original form to the top module of system B.

Examples of protocols

The Internet Protocol is used in concert with other protocols within the Internet Protocol Suite. Prominent members of which include:

- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)
- Internet Control Message Protocol (ICMP)
- Hypertext Transfer Protocol (HTTP)
- Post Office Protocol (POP)
- File Transfer Protocol (FTP)
- Internet Message Access Protocol (IMAP)
- Other instances of high level interaction protocols are:
- General Inter-ORB Protocol (GIOP)
- Java remote method invocation (RMI)
- Distributed Component Object Model (DCOM)
- Dynamic Data Exchange (DDE)

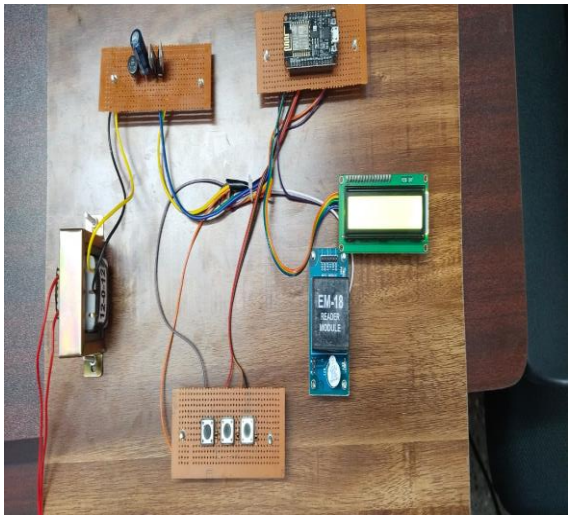
Advantages:

- The system has the provision of sending the billing details to the customer by mail, which lessen the worries about losing the bill.
- The task of waiting in queues for scanning and billing the products is alleviated.
- The customer can check their buying details online. x The shop owner can reduce the number of employees in the shop.
- The shop owner can attract quite a many number of customers to the shop.

Disadvantages:

- Person is required to read barcode on product.
- Barcode must be visible on the surface of product.
- The readability of barcodes can be impaired by dirt, moisture, abrasion, or packaging contours

V.RESULT



VI.CONCLUSION

This Project implementation will assist all those who are purchasing with inside the wonderful marketplace and trouble of standing in a lengthy queue for very last billing. The tool is very easy to perform and no need of any assistance. The assignment implementation may be very easy, reasonably priced and could lessen the amount of time need in billing area. It is designed to do a function of self accessible process providing clients to be flexible to transfer the amount through online payment or hard cash.It is designed to be more green and completely synchronized with the shopkeeper's present system. The data will be stored in the database through IOT.

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