Smart Shopping System By Using Li-Fi Technology In Supermarkets

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In large super markets, customers feel uncomfortable to stand in long queue for billing the purchased products. This will get even worse at the time of festival or seasonal sale. This paper provides a great solution to all these problems using Li-Fi technology. Li-Fi is a new emerging technology in trend which uses light waves to transfer data. In this paper, we propose an automatic billing system which is not only time effective but also reduces human effort. This system uses Li-Fi technology to transfer data quickly. The free accessible android application is deployed in mobile using which we get the product details and the payment is processed in the mobile itself. For security, the products are verified in the gate section by checking the products in the trolley. The main objective of this paper is to avoid queues in supermarkets and malls.

Keywords: Li-Fi technology, android application, payment.

I. INTRODUCTION

Li-Fi technology, proposed by the German physicist—Harald Haas, provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi comprises a wide range of frequencies and wavelengths, from the infrared through visible and down to the ultraviolet spectrum. It includes sub-gigabit and gigabit-class communication speeds for short, medium and long ranges. The logic is very simple. If the LED is on, a digital 1 is transmitted. If the LED is off, a digital 0 is transmitted. These high brightness LEDs can be switched on and off very quickly which is fast for transmitting data through light. The working of Li-Fi is very simple. There is a light emitter on one end, for example, an LED, and a photo detector (light sensor) on the other. The photo detector registers a binary one when the LED is on; and a binary zero if the LED is off. Li-Fi is an important component of the Internet of Things (IoT), in which everything is connected to the internet. It enhances energy-efficiency by combining data communication and illumination. Li-Fi promotes a wide range of application. This project, presents a new application using Li-Fi technology which is helpful to the customers at supermarket. Li-Fi module is attached with mobile, trolley and cart. It is interfaced with the microcontroller which is programmed using Embedded C language. Payment is carried out in android mobile. Purchased product details are passed to the server and further verification is done in gate section.

II. RELATED WORKS

The main drawback of supermarket system is that the customers have to stand in a long queue for billing the product. In large supermarkets, many stalls are available for billing. But even at the time of seasonal sale or festival, crowd will be increased and the shopper cant able to maintain the customers. To avoid these problems, many new technologies are introduced in the shopping malls to get a customer's satisfaction. RFID tag is used instead of barcode. It will be directly read by the trolley. Serial communication is used to transfer the data from the trolley to the shopping server. Each trolley need to be interfaced separately via wired connection to the billing system. It still consumes more time. Therefore, Zigbee module is added to the trolley to send the information of the product to the server.

After purchasing the product, customer has to stand in a queue to pay the bill. Smart trolley system is used to locate the items in the shopping mall and it automatically carries the goods to the specified location when the product list is entered. The information of shopping mall is shared among the customers using android application. It deviates from the objective of reducing the billing time. Hence we proposed an automated billing system using Li-Fi. Li-Fi technology is proposed by the German physicist—Harald Haas, provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi comprises a wide range of frequencies and wavelengths, from the infrared through visible and down to the ultraviolet spectrum. The working principle of Li-Fi is very simple. If the LED is on, a digital 1 is transmitted. If the LED is off, a digital 0 is transmitted. These high brightness LEDs can be switched on and off very quickly which is fast for transmitting data through light.

III. SYSTEM ARCHITECTURE

Li-Fi is a new emerging technology in trend. It provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues. Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved blisteringly high speed. In our system, Li-Fi technology is used to reduce the shopping time of customers in shopping centers.

A. PRODUCT MODULE

Fig. 1 Block diagram of Product Module

As shown in Fig. 1 every product consists of a Li-Fi transmitter. It is interfaced with PIC microcontroller.PIC microcontroller is based on Harvard architecture. PIC microcontrollers are widely used for industrial purpose due to its high performance ability at low power consumption. It is also very famous due to moderate cost and easy availability of its supporting software and hardware tools like compilers, simulators, debuggers. Here it is used to store the product ID. Using the product ID, product details are extracted from the server database. The Li-Fi transmitter contains a LED light which is switched on and off quickly to transfer data. The IR detector is used to read the data at the receiver end. Li-Fi transmits the details of the product to the mobile and the trolley. These details will be transmitted in the form of encoded digital data.

B. MOBILE MODULE:

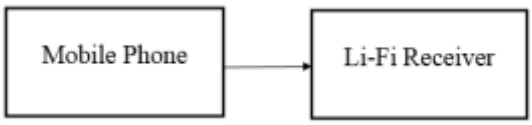

Fig. 2 Block diagram of Mobile module.

Mobile Shopping Application is created and installed in user mobile. It is developed using advance Java concepts like JSP and Servlet. After launching the application, it is connected to the shopping mall server using IP address to retrieve the product information and to send the billing details. Mobile contains a Li-Fi receiver which is connected through OTG cable. It is shown in Fig 2. Fig 3 shows final circuit for mobile module. A Li-Fi receiver contains the IR detector which reads the product ID and transmits it to the mobile. OTG cable is connected to the UART port of the Li-Fi receiver.

C. TROLLEY MODULE

The Trolley contains a Li-Fi Transceiver integrated with PIC Microcontroller as shown in Fig 3. When a product is dropped into the trolley, Li-Fi module automatically reads the product information. It will maintain a record of all the products which are inside the trolley. LCD screen displays the product ID. The LCD screen is connected to the D port of the microcontroller. The signal is passed in the form of encoded digital data. The product ID is displayed on the LCD screen. When the product is removed from the trolley, it will be automatically updated.

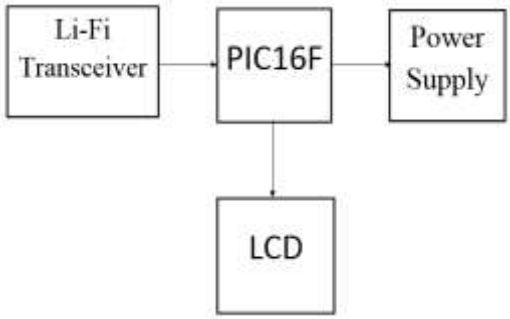

Fig. 3 Block Diagram of Trolley Module

D. GATE SECTION:

Mobile will send the purchased product information to the server. Then server will transmit it to the gate section. Li-Fi receiver also gets the product details which are inside the trolley. Cross verification is carried out. DC Motor which is connected to the B port of microcontroller runs when all the products are billed. It is a commonly used actuator for producing continuous movement. When the mismatch happens, buzzer sound will be produced to indicate that there is some unbilled product inside the trolley. The block diagram and final design of gate section is shown in Fig.4

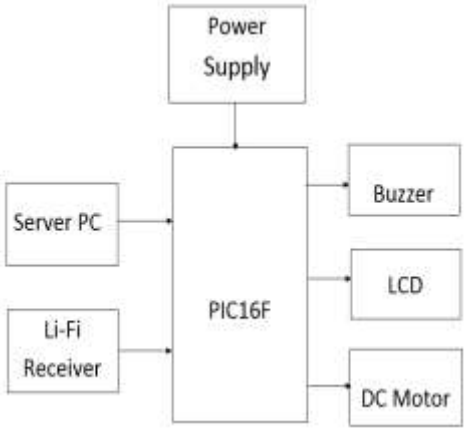

Fig. 4: Block diagram of Gate Module

IV.SYSTEM WORKFLOW

Li-Fi technology is used to reduce the shopping time of customers in large supermarkets. Li-Fi module is attached to mobile, trolley and gate section. Every product has a Li-Fi module which contains a unique ID. Using these ID's, product details are extracted from the database of the server. When the product is shown to the mobile, Li-Fi module reads the product ID. The product details will be extracted from the database and displayed in the mobile phone. The trolley section will also store the product ID when the shopper drops them into the cart. If the customer wants to remove any product, he/she has to show the product again to the mobile and trolley. Then the details of the product will be removed from both the sections. Once the customer finishes shopping, the payment is done in mobile itself using mobile banking system. After payment, the billed product details will be updated in the server. The server sends the information to the gate section. It will cross verify with the products billed and the products in the trolley. If any product is found to be not billed, then the alarm sound will be produced. The main aim of this project is to provide an automatic billing system to avoid queue in malls and super markets. The Fig. 9 shows the overall working of the Automated Billing System and demonstrates how the data is transferred between the modules.

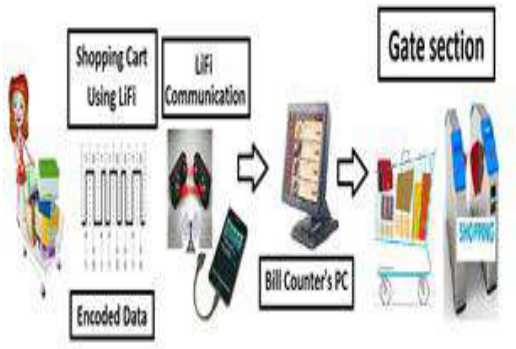

Fig. 5 Workflow diagram of system

Server login & adding products to the database

Administrator has to login to the shopping mall server to add the product details such as product ID, product name, price and discount. The product details will be stored in the database using MYSQL. This is shown in Fig. 6

Connecting mobile to the server

Mobile is connected to the shopping mall server using the IP address as shown in Fig 10. The server host will accept the mobile request and the database will be connected to the mobile.

Fig. 7 Connecting mobile

GETTING THE PRODUCT DETAILS FROM DATABASE

The Fig.8 shows the details of the product in the trolley obtained from the database

Fig. 8 Product details

Adding The Product To Trolley

When the product is dropped into the trolley, the product ID will be read by the Li-Fi receiver and displayed on the LCD screen as shown in Fig. 9

Fig. 9 Product ID displayed

Android payment

After purchasing the product, the total amount is calculated. The bank database is connected to the mobile. The customer has to enter their card and pin number. Authentication is carried out and the amount will be transacted to the shopping mall database. This is shown in Fig. 10

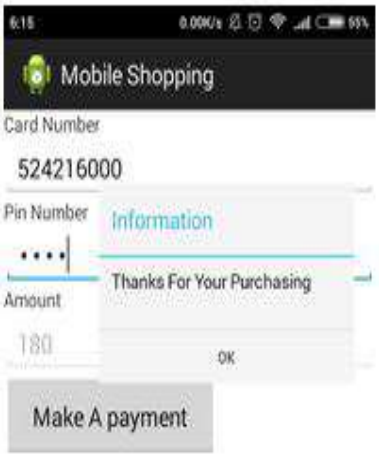

Fig. 10Making payment

Gate section verification

After payment, the purchased product details will be sent to the gate section. The gate section cross verify with the products inside the trolley. If there is any mismatch, the buzzer sound will be produced. Otherwise, the gate will open. The Fig. 11 shows the final hardware of the Automated billing system with all modules and important parts.

Fig. 11 Final Hardware of Automated Billing System

CONCLUSION AND FUTURE SCOPE

The main objective of this system is to avoid standing in queues while billing and reduce the time taken for shopping. With the usage of Li-Fi technology, the billing process takes place automatically and payment is also enhanced using mobile banking. Security is also managed by checking products in trolley and verifying it with billed products. If any product is unbilled, a buzzer sound will be produced. There are many useful ideas for further enhancement. Automatic billing system with a credit/debit card facility in the trolley itself will further reduce the human effort. Indoor mapping technology along with IoT can be used to locate the commodities in large Supermarkets. Continuous development in this area will lead to a revolutionary change in shopping experience.

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