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A Novel Technology for Smart shopping trolley system

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Abstract. First off, humans now enjoy a higher standard of living thanks to contemporary technology. But shopping has become a world unto itself in the modern day. With its cutting-edge technology, the "Smart Shopping Trolley Using RFID and ZigBee" seeks to completely transform the shopping experience. With Radio-Frequency Identification (RFID), ZigBee communication, and a Hc-05 Bluetooth module, this cutting-edge cart makes shopping easy and productive. Customers may easily add items with RFID tags to the cart thanks to RFID technology. There is no longer a need for human scanning or checkout lines because the system automatically recognizes and records the items [9]-[10]. The ZigBee communication system monitors the items in customers' carts as they navigate the store and syncs with their mobile phone via a Bluetooth module into the app called Serial Bluetooth terminal which guarantee precise billing.

1 Introduction

For the residents, shopping at large malls and buying groceries at marts has become a daily routine. On weekends and holidays, we notice that there are more people at the malls. This audience will be more interested in purchasing the goods. This cart will be more beneficial to those who purchase different items and put them in it [1]-[3]. After making the entire transaction, payment must be made at the billing counter. Because the cashier needs to use a bar code scanner to prepare the bill, which takes time and results in a long line, customers must wait a long time at the billing counter [4-8].

Our goal is to create a mechanism that retail centre's can employ to address the aforementioned issue. Since ZIGBEE devices are Bluetooth or wireless USB devices, nodes in the network can create a mesh. Concatenation from one device to another is known as meshing. By using this technique, a single node's limited range can be replicated and extended, covering a significantly larger area.

In order to carry out this project, ZIGBEE [9] will be used for wireless connection, along with microcontrollers, RFID, and LCD (16x2). The mall trolleys will have an embedded system installed on them [5]-[6]. It will have an RFID reader in it. There will be RFID tags connected to every grocery item and merchandise at the mall. The price of every item placed in the trolley will be remembered, and its code will be recognized. As we add products, the costs will also be included to the total. Billing will therefore happen at the trolley. The item name and price are visible on the LCD. RFID reading will be utilized to identify various objects. 16X2 alphanumeric LCDs will be used [11]-[14].

The project's microcontroller is programmed in the embedding code using the C language, which offers a productive atmosphere for completing the current objective. Circuit boards are designed using PCB software.

2 Literature Survey

To the best of our knowledge, there aren't many publications in the literature about RFID-enabled automated grocery carts. Barcode technology was utilized by Sainath (2014) in their self-sustaining grocery carts for supermarket billing system. For product billing, whereby the client uses barcode technology to scan the product, where the goods is scanned by the customer utilizing barcode technology. By presenting their unique identification, the consumer will pay the charge after it is issued to the central billing system.

Barcode scanning is limited by the need for a line of sight, which should be fixed within its limit. Using RFID technology, they developed an optimization solution for cash register lines that results in an RFID shopping system. An RFID is used to scan products, and the information is stored in a database so that payments can be made online or with a single invoice. All of the shopping data is also tracked via an online application. Upkeep of web application servers is required. Products that customers inadvertently drop into the trolley are not receiving any special treatment. RFID technology was used in the shopping mall trolley by Dhavale Shraddha (2016) to bill customers during transactions, and an ESP module from IOT was utilized to manage bills.

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3 Hardware Components

3.1 PIC Microcontroller

Microchip Technologies refers to its single-chip microcontrollers as PICs, or peripheral interface controllers as shown in Fig. 1. 8-bit microcontrollers have shown great success with these devices. The primary explanation for this is that Microchip Technology has consistently improved the design of the device and added necessary peripherals to the microcontroller to meet customer needs. In the early 1980s, General Instruments released the PIC microcontroller MCU, which was a primitive processor that could execute instructions with a bit width of 12 and perform basic I/O activities. We encompass these devices as low-end architectures. They are designed for applications that need modest program and data memories along with basic interface functionalities, and they have restricted program memory.

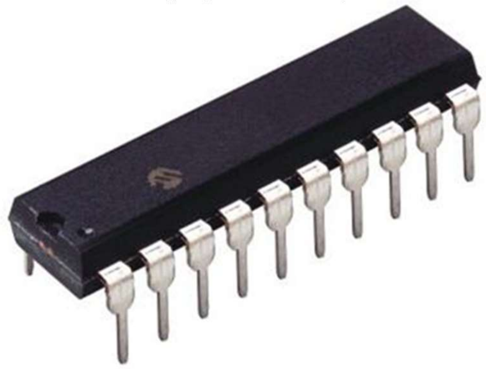

Fig .1. PIC Microcontroller

3.2 RFID Reader

Fig. 2. RFID Reader

The abbreviation for Radio Frequency Identification is RFID and it is shown in Fig. 2. In order to uniquely identify an object, animal, or human, RFID (radio frequency identification) technology uses electromagnetic or electrostatic coupling in the radio frequency (RF) region of the electromagnetic spectrum. RFID is replacing bar codes in industry and is becoming more and more common. One benefit of RFID is that it doesn't need to be scanned in line of sight or by direct touch. An antenna, transceiver, and transponder, or tag, are the three parts of an RFID system (which are often merged into a single reader).

The transponder receives an activation signal from the antenna by radio frequency waves. Data is transmitted back to the antenna by the tag when it is in use. After receiving data, a programmable logic controller uses it to decide what has to be done. A radio frequency signal is used in radio frequency identification, or RFID, to identify a person or item. Numerous things can be detected, sorted, tracked, and identified with the help of this technology. A transponder (tag) and a reader (interrogator) communicate with one another. Tags exist in a variety of shapes and sizes and can be either passive (powered by the reader field) or active (powered by a battery).

3.3 LCD Display

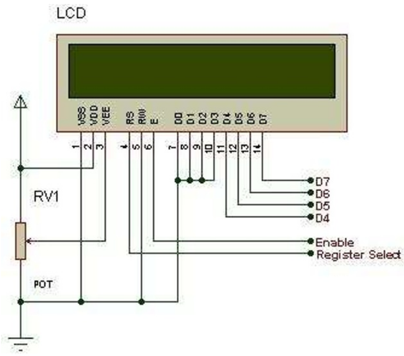

Fig. 3. LCD Display

An LCD display is among the most often used components connected to a micro controller as shown in Fig. 3. The most widely used LCDs that are linked to the various microcontrollers are 16x2 and 20x2 screens. Specifically, this translates to 16 and 20 characters per line by two lines, respectively.

A liquid crystal display (LCD) is a thin, flat electronic visual display that utilizes the light-modulating properties of liquid crystals. The liquid crystal display is a crucial component of embedded systems. Because he may show the necessary data on it, it gives the user a great deal of versatility. An LCD display is one of the most often used components connected to a micro controller. 16x2 LCDs are among the most widely used LCDs that are linked to the numerous microcontrollers.

This capacity allows sixteen characters per line by two traces across two lines, in that order. Pin1, also known as the "Ground/Source Pin," is a GND pin on the display that connects to the GND terminal of the microcontroller unit or the power source. Pin 2 (VCC/Source Pin): This pin links the voltage supply of the display to the power source. Pin 3, also known as the V0/VEE/Control Pin, is where a variable POT that controls the difference between 0 and 5V is connected.

3.4 Crystal Oscillator

PIC Microcontrollers have a maximum operating frequency of 20 MHz. Since crystal oscillators are more temperature stable than other oscillator types, they are used in this project. In digital and communications equipment, voltage-controlled crystal oscillators (VCXO) are frequently employed as clock and timing signal generators. A crystal Oscillator is Economical and Compact as shown in Fig. 4. Crystals are used in a variety of sectors due to their small size and affordable price. These oscillators are beneficial to any device that needs accurate timing and measurement. They are present in consumer electronics like PCs and cell phones.

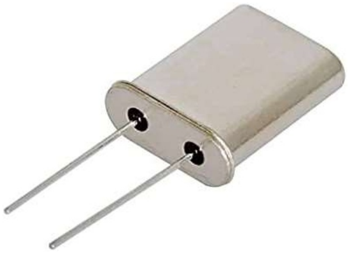

Fig. 4. Crystal Oscillator

3.5 Zigbee Transmitter and Receiver

Fig. 5. ZigBee Module

The latest generation of several integrated wireless data transmission modules is the HC-12 wireless serial port transmission module. 433.4–473.0 MHz is the wireless operational frequency range for it. It features several channels that can be modified with a 400 kHz stepping and a total of 100 channels.

The component has an extreme transmission power of 100mW, an open area communication distance of 1000m, and a reception sensitivity of -117dbm at a band rate of 4,000bps in the atmosphere. Because the module is enclosed with a stamp hole, can be patch welded, and measures 24.8 x 14.4 x 3 mm (including antenna cap, except spring antenna).The module contains a microcontroller unit (MCU), which eliminates the need for the user to program it independently. Additionally, the transparent transmission mode simplifies operation by limiting its functions to serial port data transmission and reception. The module supports a number of transparent serial port transmission modes, which the user can choose by an AT command based on their specific needs.

3.6 HC-05 Bluetooth Module

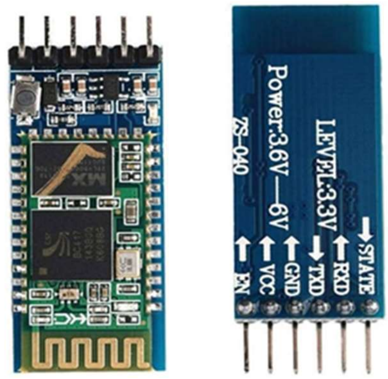

Fig. 6. HC-05 Bluetooth module

The HC-05 is a class 2 Bluetooth module for wireless serial communication that is transparent as shown in Fig. 6. It is preconfigured to operate as a Bluetooth slave device. Once it is connected to a computer, smartphone, tablet, or other master Bluetooth device, the user may quickly grasp how it functions. The consumption is less than 40 mA when pairing or device seeking is underway. If there is no communication after pairing, the current consumption is less than 8 mA. The Bluetooth device consumes roughly 20 mA when in communication.

For projects requiring wireless communication functionality, like wireless data transfer, wireless control, and wireless monitoring, the Bluetooth Module HC-05 is a great choice. It has a 30-meter Bluetooth communication range when using other devices.

4 Source Code

```
#include <16F73.h>
#use RS232(baud=9600, xmit=PIN_A1, rcv = PIN_A0, stream=RF_ID)
#use RS232(baud=9600, xmit=PIN_B0, rcv = PIN_B1, stream=zigbee)
#include <lcd.c>
#include <rfid.c>
Char ch;
Byte num1[15]={“15001FD124FF”};
Byte num2[15]={“15002BFC76B4”};
Byte num3[15]={“01006F759289”};
Byte num4[15]={“15008DBDB396”};
Void start()
 Lcd_putc(‘\f’);//Clear LCD Display
 Lcd_gotoxy(1,1);
  Printf(lcd_putc,”      RFID      based      “); lcd_gotoxy(1,2);
 Printf(lcd_putc,”Smart shopping cart”);
Void main()
Lcd_int();
Start(); //Welcome message
 Output_high(PIN_C4);
 Delays_ms(500);
 Lcd_putc,”,”(‘\f’);    //Clear LCD Display
 Lcd_gotoxy(1,2);
 Printf(lcd_putc,”Show the product”);
 While(1)
  Output_toggle(PIN_C4);
```

```
Read_rfid_data();    //read the rfid tag number from RFID Reader (live data)
  Lcd_gotoxy(1,1);
  Printf(lcd_putc,"RFID Tag Number");
 Lcd_gotoxy(1,2);
 Printf(lcd_putc,"%s",data);
 Delay_ms(700);
If(!strcmp(num1,data))
 Lcd_gotoxy(1,1);
Print(lcd_putc,"product : 1");
Lcd_gotoxy(1,2);
 Printf(lcd_putc,"Rs: 25/-");
 Delay_ms(1500);
 J = j+1;
 Count = count + 25;
 }
Else if(i1 == 1)
 Lcd_gotoxy(1,1);
 Printf(lcd_putc,"product : 1");
 Lcd_gotoxy(1,2);
  Printf(lcd_putc,"Rs:25/-(took out)");
 Delay_ms(1500);
 I1 = 0;
  Count = count – 25;
```

5 Block Diagram

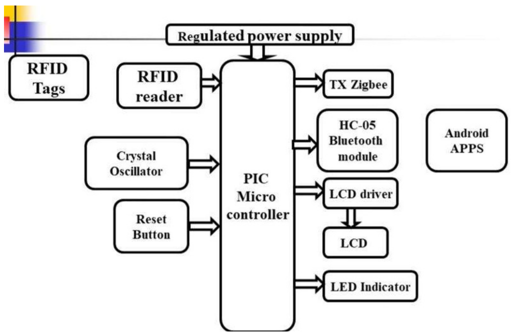

Fig. 7. Trolley Section

Every product has an RFID tag attached to it, and an RFID reader is connected to the microcontroller. When goods are placed in the trolley, an RFID reader interface to a microprocessor decodes the RFID tags attached to the objects, and the information is then recorded and displayed on an LCD [15]. Using wireless ZigBee, the system automatically uploads the chosen good number and cost to the billing counter's PC.

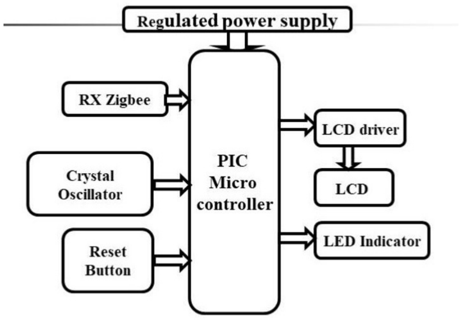

Fig. 8. Billing Section

The Trolley section includes the LCD display, microcontroller, HC-05 Bluetooth module, RFID module, and ZigBee module. The RFID reader, which serves as the input module, decodes an object's RFID tag to provide information about the items. Cost information is also shown on the LCD. The output modules are LCD and mobile phone [16]-[18]. Through the Bluetooth module via Serial Bluetooth terminal app or billing counter section, the RFID reader continuously verifies that the goods package is placed inside the trolley or removed from it using the RFID tag attached to it. These details, along with the cost, are automatically uploaded onto the customer's mobile phone through app. ZigBee and PC are the primary communication links between the billing and monitoring department and the computer at the bill counter. Using a ZigBee module, the specifics of the chosen items and their associated costs are automatically imported into the PC and shown on the monitor.

6 Results

With the use of wireless ZigBee and RFID technologies, the "Smart Shopping Trolley Using RFID and ZigBee" project aimed to create a smart shopping cart that could show billing information on an LCD. The PIC microcontroller was used to implement the RFID and ZigBee systems in the Smart Shopping Trolley. An adaptor that runs at 5 volts powers the PIC microcontroller. Using ZIGBEE wireless technology, this intelligent shopping cart will transmit all product details and the cost to the billing section.

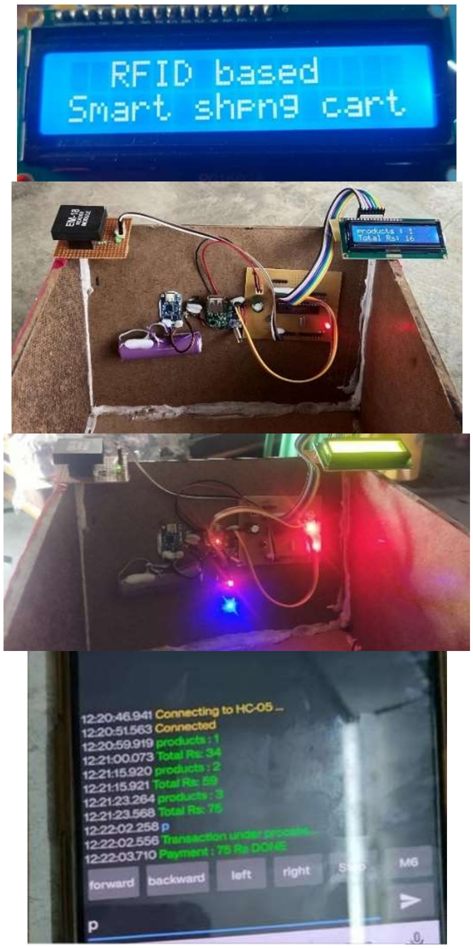

Fig. 9. Hardware implementation and Results

7 CONCLUSION

The current approach provides an integrating characteristic of every hardware feature that the PIC microcontroller has been utilized to construct. Therefore, the Embedded C device's contribution to the superbly designed Smart Shopping Trolley employing RFID and ZigBee has been executed flawlessly. Additionally, employing significantly better integrated circuits (ICs) like PIC microcontrollers to operate devices using increasing technologies. As a result, the task has been effectively created and evaluated.

Using ZigBee technology, this smart trolley can upload the entire product name and trolley bill into the billing section. This system's LCD module will be able to display the product details and total bill amount.

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