

## **Automated Smart Billing System Using RFID Technology**

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**ABSTRACT:** The embedded system is the one which has a computer-hardware with software embedded in it as one of its most important component. This makes our life better and simple. This smart billing system is one of the embedded systems. An automated smart shopping system is formed using the concept of RFID. Each of the shopping cart consists of an RFID reader, RF module, AVR Microcontroller, LCD display, and load cells and the products are embedded with the RFID tags. The RFID tag will have the details of the product to which it is attached. The tag is detected by the RFID reader and an automatic invoice gets generated near the cart or the trolley itself. This paper provides us how this billing system is made easy using the RFID. The main aim of this system is that the billing is made easy for the customers from waiting in the long queues in the supermarkets.

**Keywords:** RFID Reader, RFID Tags, RF module, AVR Microcontroller, Load cells.

### **1. INTRODUCTION**

The concept of embedded systems has become common as it makes our work more efficient and quick, as the life of a common human being has become hectic and thus wants to make it as easy as possible. The embedded system is mainly based on a Microcontroller. These days most of the people aren't willing to spend their time at the shopping malls or

supermarkets and hence are trying to purchase everything online along with the household products or groceries but there are people who still go the supermarkets and buy the products. Thus, this system makes it easier for them as the time taken to scan and bill the products is reduced a lot.

The Smart Billing System is based on the concept of Radio Frequency Identification (RFID). RFID technology uses radio waves in order to track or identify the products and objects which has a great potential in making great economic impacts in the industries. This is almost similar to the barcode system, but in this system the barcode must be within the line-of-sight to the scanner, whereas in the RFID system, when the object is in the reading range of the scanner i.e., the reader (in this system) the object gets detected.

These systems consists of transceivers, transponders, readers and the tags. RFID systems are also a type of automatic identification systems.

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The strengths of RFID also make it a natural fit for grocery stores. Items can be tagged and batch-read. This means the retailers knows exactly how many items are on shelves at all times with only one scan. This reduces waste and the labour costs associated with inventory and retagging.

The microcontroller used here is the AVR Microcontroller -- ATmega328. This is used to store the data regarding the price, the quantity, the total weight that are needed to generate the invoice. It is faster than the other types of microcontroller. Thus, using the above concepts the smart billing system i.e., the smart trolley is designed. Finally one can pay the total amount to the cashier either through cash or card and can get validated at the checkout points.

## **2. PRESENT TECHNOLOGY**

The barcode technology is the existing technology and is used as means of identification. The barcode consists of white spaces and black lines which store the details of the product in a visual pattern. This is one-dimensional which is read by a scanner which can be a hand-held one.

The scanner sends out the laser which helps in detecting the details of the product to which it is attached. The scanner will read the pattern of the barcode and translates it such that our system understands it. These barcodes are widely used in the retail stores.

Barcodes help us to track, assist in accounting to generate invoices. These barcodes are sometimes not unique as two products can have a same barcode like retailer can have one barcode and the dealer can have another which can hamper the details of the product. This

helps us to bring in the new technology, the RFID technology into existence.

RFID avoids the limitations of barcode scanning, which requires line-of-sight access to each barcode and can only be used to scan one item at a time. Instead, RFID tags do not require line-of-site, and multiple RFID tags can be detected and read remotely and simultaneously.

## **3. ABOUT THE PRODUCT**

In this system, when the trolley gets initialized, the RFID reader starts to emit the radio waves continuously. When the customer starts dropping the products to which the RFID tags are embedded into the trolley and comes into the reading range of the reader, the tag gets detected and thus, the data that is related to that product gets displayed on the LCD. The price along with the count of the products gets added as the product is dropped and also gets deducted as the product is removed.

To remove a product, the process is same as for that of adding a product to the cart. The load cells used in this system help us to know whether there is a difference in the weight, which is between the total weight of the products scanned and dropped to the final weight of the products present in the trolley. A buzzer is used to indicate about the change in the weight. This process continues till the customer presses the final button.

## **4. HARDWARE COMPONENTS**

The hardware components that are used to design the smart billing system – smart trolley are ATmega328 microcontroller, RFID reader, RFID tags, RF module, Load cells, and LCD display. The RFID tags are embedded to each

product and consists the data to which it is attached.

**1) ATmega328:**

The microprocessor used in this is ATmega328 also known as Arduino Nano. This is used to store the data that is related to the product and also acts an interface for the LCD display. This has an inbuilt SPI and I2C. It consists of 23 general purpose I/O ports out which 20 can be used as the other 3 are connected to two crystal oscillators and a timer, 6 ADC ports.



ARDUINO NANO



ATmega328

The specifications of this ATmega328 are

- It is a 28 pin microcontroller.
- It has a flash program memory of 32 kb.
- It has EEPROM data memory of 1kb and it has SRAM data memory of 2kb.

- It has 23 I/O pins and it has 2 timers: two 8 bit/ one 16 bit.
- Its communication protocol is USART.

**2) RFID Reader:**

The RFID reader used in this system is EM-18. It continuously emits radio frequency waves. The RFID reader consists of mainly three parts: signal generator, a receiver, and a microcontroller. The signal generator is used to generate the radio waves and transmits it using an antenna. The receiver is used in order to receive the feedback signal from the tag.



Fig: RFID Reader

**3) RFID Tags:**

RFID tags are usually embedded or attached to the products. These tags consists of a transponder and a rectifier. The transponder receives the radio waves from the reader and sends the feedback signal back to the reader, they rely on the radio waves from the reader. The rectifier is the place where the energy is stored across the capacitor, this energy is used as the power for the controller and memory.

There are three types of RFID tags. They are: Active, Passive, and Semi-Passive.

**Active tags:** They have their own power supply, transmit the signal to reader also they rely on own supply. Hence, the range is less.

**Passive tags:** They have no power supply on their own and thus, uses RFID reader as source of the energy. Hence, it is compact. It is of low cost.

**Semi-passive:** They have their own power supply but for transmission of data to the reader, they rely on the reader.

These tags are available in any shape or size, like, a keychain, label, or as a credit card.



Internal structure of RFID tag



RFID tags

#### 4) Load cells:

A Load Cell is a type of transducer, specially a force transducer which converts one form into other such as tension, compression, pressure into electrical signal. These are mainly used

for weighing purpose in an industrial process. Load cells are also used to test monitor, and run industrial machinery, medical devices, aircraft loads and many other applications.

#### Types:

1. Pneumatic
2. Hydraulic
3. Strain gauge
4. Capacitance

#### Specifications:

1. Non-linearity
2. Hysteresis
3. Operating temperature range
4. Combined error



Fig: Load cell

#### 5) LCD Display:

A Liquid-Crystal Display is a flat panel display. LCDs are used to display preset words, digits, seven segments as in a digital clocks. The LCD is of size 16\*2. Each block has its own Id. Pneumatic liquids or crystals are present in each block of the LCD. The LCD has HD44780 microprocessor in it.

#### Applications:

- LCD televisions
- Computer monitors
- Instrument panels
- Watches

- Digital cameras
- Calculators
- Mobile telephones

**6) RF Module:**

The RF module is a new generation multi-channel wireless module. It is a wireless transceiver which uses a half-duplex mode of communication. There are 100 channels, which helps us to change the transmission frequency according to the channel used.

**Features:**

- Maximum transmission power is 100mW.
- Baud rate is of 5000bps.
- Transmits up to 1000mts.

**Applications:**

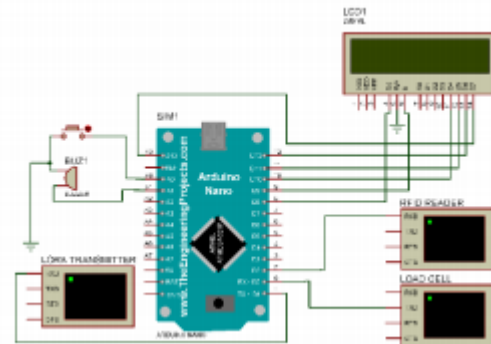
- Wireless sensor
- Robot wireless control
- PC wireless networking
- Automatic data acquisition.



Fig.: RF Module

**5. DESIGN AND WORKING OF THE CART**

The cart consists of a microcontroller which stores the data that is required to make it work. As this system is an embedded system, the software also plays a vital role. The microcontroller is connected to the RFID reader, LCD display, and RF module (LORA), Load cell and a buzzer.



The circuit diagram of the smart billing system is as shown above. The microcontroller comprises of a memory where the code is actually stored and the peripherals of it are connected to the other components of the smart billing system. The transmitter of the microcontroller is connected to receiver of the RF module, the transmitter of the load cell is connected to the receiver of the microcontroller. This helps us to make a communication path between these components.

When a product is dropped the RFID reader which continuously emits the radio waves will start detecting the product as they are embedded with the RFID tags. Once they are detected, the information is passed over the microcontroller which actually contains the name, price, weight etc., of the product and thus it gets displayed on the LCD. If there is any difference in weight between the scanned and unscanned products dropped into the cart, the buzzer helps us to know about this by turning on.

As the price gets added or deducted once the product is dropped or removed from the cart, the billing gets done at the cart itself. This helps us by reducing the time at the billing

counter from standing in the long queues and thus one can pay ones money at the counter.

## 6. ALGORITHM

Step 1: Start

Step 2: Initialize the system

Step 3: Swipe the RFID tag

Step 4: Check the RFID tag

Step 5: Read the related data from the memory

Step 6: Display data on the LCD

Step 7: Add product cost as the products are added

Step 8: Click the final button once the purchase is done

Step 9: Buzzer turns on when there is a mismatch of the weight

Step 10: Check the products and if needed re-insert them after scanning

Step 11: The total price gets displayed

Step 12: Stop

## 7. THE SMART CART – FINAL RESULT



## 8. CONCLUSION

Here, we have demonstrated a method for billing of products which is efficient, easier and faster. This smart trolley has a feature of calculating mechanically and displays the entire cost of all the products in the trolley. This makes simple for the customer to understand and also to pay amount during shopping which is displayed on LCD and also saves time without standing in the queue for hours.

In the supermarket the proposed model is easy to use, low cost and does not require any special training. This model keeps an account and uses the existing development and various types of radio frequency identification and detection technologies which are used for item recognition, billing and inventory update. As the whole system is becoming smart, the requirement of manpower will decrease. Theft in the mall will be controlled using this smart system.

Hence by using RFID based smart billing system, the shopping can be made easy for the customers as it is low cost and does not need any special training and also saves time.

## 9. FUTURE SCOPE

- In future we can look forward to implement in the shopping malls using a long range RFID reader with a range of 2 meters.
- Security can be improved by counting the number of items or placing weight sensors within the cart for tallying the weight and getting all the types of product names when cart is passed through a particular aisle using camera module.

- Multiple RFID tags can be read using a single RFID reader for more number of products which are added in the cart.
- Net banking can be included.
- Robotic ARM may be used for selecting and dropping of the product.

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