Automated Billing System in Supermarkets

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Abstract—Super market is a place where people get their daily necessities and the major problem faced by users is that they have to wait in long queues for billing. Some improvement is required in the traditional billing system to improve the quality of shopping experience to the customers. The proposed system helps to eliminate all such difficulties by using RFID. This system makes use of a microcontroller which controls the overall process. Once the purchase is completed the total amount will be calculated and the customer can pay their bills using a Smart Card.

Keywords---RFID Reader, RFID Tags, Microcontroller, Buzzer, LCD Display.

I. INTRODUCTION

Supermarket is a place where people get their daily needs such as food products, clothing, electrical appliances etc. Now a days, super markets have increased throughout the globe due to increasing public demand. Sometimes customers have problems regarding the information about the product on sale and waste of time at the billing counters. Most shoppers buy groceries on a budget, and it is only at the end of purchase shoppers they come to know that the overall purchase amount is greater than their budget after which they spend much time in searching for their desired products and finally overall shopping process becomes more time consuming. Another major problem faced by users is that they have to wait in long queues for billing. Some changes is required in the traditional billing system to improve the quality of shopping experience to the customers. The proposed system helps to eliminate all which can be placed on trolleys. The RFID tags are placed on each and every product of the super market. During their purchase the customers have to hold the RFID tag near to the scanner. With this unique code on the product, the name, price and the number of the product purchased are automatically displayed on a LCD display. This system makes use of a microcontroller which controls the overall process. The microcontroller stores all the data and it sends the information to the users with the help of serial data transfer protocol. Keys are used for the purpose of increment/decrement of the products purchased. After the purchase a key is pressed to indicate the completion of process only after which the payment process starts. Finally the total amount will be calculated and the customer can pay their bills using a Smart Card. When this card is inserted for payment it displays the amount in the particular card and also displays the remaining amount after the payment of bill.

Fig1. Bock Diagram

The concept is to design a trolley with a user interface screen (LCD), RFID Scanner along with a Smart Card, in order to make automatic billing system. The products will be tagged with the RFID tag containing the codes for the desired data of the product. Once the purchased products are scanned through the RFID scanner with the RFID tag, the data of the product will be displayed on the LCD. After purchasing, the total amount of the purchased products will be calculated and will be displayed for the customer’s perception. Once purchased, the payment can be done using the Smart Card which will be owned by every customer for the smart-payment. This can skip the time consumption of the customers by standing in the queue for a period of time during rush hours. The Smart Trolley comes with all the basic services including scanning an item to check for price and details. This also allows the user to pay their bill using a Smart Card.

II. HARDWARE DESIGN

A. LCD Display:

A Liquid Crystal Display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of Liquid Crystals (LCS) as they do not emit light directly. Liquid Crystal Displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which
define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

B. Liquid Crystal Display

They are usually more compact, light weight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are more energy efficient and offer safer disposal. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. Once the product is scanned using the RFID scanner the LCD will display the name, quantity and price of the product. This also displays the total amount to be paid and the amount remaining in the smart card after the payment of bill. This also displays the notifications to the customers such as insertion of card and regarding the payment of bills.

C. Microcontroller:

Here we make use of the microcontroller PIC 16F877A. It has a program memory of 8kb, a data memory of 368 bytes and an inbuilt analog to digital converter. It has 33 I/O pins which can be effectively used for the connection of peripheral devices such as the LCD, alarm circuits etc.

1) Busy flag:

When the busy flag is, the controller is in the internal operation mode, and the next instruction will not be accepted. When RS = 0 and R/W = 1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

2) Address Counter:

The address counter allocates the address for the DD RAM and CG RAM read/write operation when the instruction code for DD RAM address or CG RAM address setting is input to IR, the address code is transferred from IR to the address counter. After writing/reading the display data to/from the DD RAM or CG RAM, the address counter increments/decrements by one the address, as an internal operation. The data of the address counter is output to DB0 to DB6 while R/W = 1 and RS = 0.

D. Display Data RAM (DD RAM):

The characters to be displayed are written into the display data RAM (DD RAM), in the form of 8 bit character codes present in the character font table. The extended capacity of the DD RAM is 80 x 8 bits i.e. 80 characters.

E. Character Generator ROM (CG ROM):

The character generator ROM generates 5 x 8 dot 5 x 10 dot character patterns from 8 bit character codes. It generates 208, 5 x 8 dot character patterns and 32, 5 x 10 dot character patterns.

F. Character Generator RAM (CG RAM):

In the character generator RAM, the user can rewrite character patterns by program. For 5 x 8 dots, eight character patterns can be written, and for 5 x 10 dots, four character patterns can be written.

Interfacing the microprocessor controller:

The module, interfaced to the system, can be treated as RAM input/output, expanded or parallel I/O. The module is selected by gating a decoded module – address with the host – processor’s read/write strobe. The resultant signal, applied to the LCDs enable (E) input, clocks in the data. The ‘E’ signal must be a positive going digital strobe, which is active while data and control information are stable and true. The falling edge of the enable signal enables the display / instruction register of the controller. All module timings are referenced to specific edges of the ‘E’ signal. The ‘E’ signal is applied only when a specific module transaction is desired. The read and write strobes of the host, which provides the ‘E’ signals, should not be linked to the module’s R/W line. An address bit which sets up earlier in the host’s machine cycle can be used as R/W. When the host processor is so fast that the strobes are too narrow to serve as the ‘E’ pulse

- Prolong these pulses by using the hosts ‘Ready’ input
- Prolong the host by adding wait states
- Decrease the Hosts Crystal frequency

When the controller is performing an internal operation the Busy Flag (BF) will set and will not accept any instruction. The user should check the busy flag or should provide a delay of approximately 2ms after each instruction. The module presents no difficulties while interfacing slower MPU. The liquid crystal display module can be interfaced, either to 4-bit or 8-bit MPU. For 4-bit data interface, the bus lines DB4 to DB7 are used for data transfer, while DB0 to DB3 lines are disabled. The data transfer is complete when the 4-bit data has been transferred twice. The busy flag must be checked after the 4-bit data has been transferred twice. Two more 4-bit operations then transfer the busy flag and address counter data. For 8-bit data interface, all eight-bus lines (DB0 to DB7) are used.

III. Transponder

The Transponder or tag is fixed on to the baggage to be tracked in the airport. When this tag comes within the range of the reader or integrator, the tag is energized. Now, this tag transmits the data to the reader. This data is automatically sent to the micro-controller for further processing. The time at which the tag is sensed is sent to the micro-controller from the
RTC (Real Time Clock). These details are displayed on LCD (Liquid Crystal Display). The same is sent to the EEPROM (Electrically Erasable and Programmable Read Only Memory), which is used as a backup. It can be stored, and retrieved.

IV. PASSIVE TAG AND READER

Passive tags are those energized by the reader itself; they contain no power source, typically have very long lifetimes (near indefinite) a drawback over active tags is the read range, typically 2cm (1in) to 1.5m (4.5 ft), a strong positive is individual tag cost. RFID Passive tag is composed of a integrated electronic chip and a antenna coil that includes basic modulation circuitry and non-volatile memory.

For most general applications passive tags are usually the most cost effective. These are made in a wide variety of sizes and materials: there are durable plastic tags for discouraging retail theft, wafer thin tags for use within "smart" paper labels, tiny tracking tags which are inserted beneath an animal’s skin and credit card sized tags for access control. In most cases the amount of data storage on a passive tag is fairly limited - capacity often being measured in bits as opposed to bytes.

A. Interaction Between Tag and Reader

The reader powers the tag (transponder), by emitting a radio frequency wave. The tag then responds by modulating the energizing field. This modulation can be decoded to yield the tags unique code, inherent in the tag. The resultant data can be the passed to a computer from processing. Tags have various salient features apart from their physical size: Other available features are: Read Only, Read Write, Anti-Collision.

B. Operating Principles of RFID Systems:

There are a huge variety of different operating principles for RFID systems. The most important principle is inductive coupling, which is described in detail below.

Inductive coupling: An inductively coupled transponder comprises of an electronic data-carrying device, usually a single microchip and a large area coil that functions as an antenna.

C. Inductive Coupling

Inductively coupled transponders are almost always operated passively. This means that all the energy needed for the operation of the microchip has to be provided by the reader. For this purpose, the reader's antenna coil generates a strong, high frequency electro-magnetic field, which penetrates the cross-section of the coil area and the area around the coil. Because the wavelength of the frequency range used (< 135 kHz: 2400 m, 13.56 MHz: 22.1 m) is several times greater than the distance between the reader's antenna and the transponder, the electro-magnetic field may be treated as a simple magnetic alternating field with regard to the distance between transponder and antenna.

A small part of the emitted field penetrates the antenna coil of the transponder, which is some distance away from the coil of the reader. By induction, a voltage $V_i$ is generated in the transponder's antenna coil. This voltage is rectified and serves as the power supply for the data-carrying device (microchip). A capacitor $C_1$ is connected in parallel with the reader's antenna coil, the capacitance of which is selected such that it combines with the coil inductance of the antenna coil to form a parallel resonant circuit, with a resonant frequency that corresponds with the transmission frequency of the reader. Very high currents are generated in the antenna coil of the reader by resonance step-up in the parallel resonant circuit, which can be used to generate the required field strengths for the operation of the remote transponder.

The antenna coil of the transponder and the capacitor $C_1$ to form a resonant circuit tuned to the transmission frequency of the reader. The voltage $V$ at the transponder coil reaches a maximum due to resonance step-up in the parallel resonant circuit. As described above, inductively coupled systems are based upon a transformer-type coupling between the primary coil in the reader and the secondary coil in the transponder. This is true when the distance between the coils does not exceed 0.16 times the wavelength, so that the transponder is located in the near field of the transmitter antenna.

The advantages of a passive tag are:

- The tag functions without a battery; these tags have a useful life of twenty years or more.
- The tag is typically much less expensive to manufacture.
- The tag is much smaller (some tags are the size of a grain of rice).
- These tags have almost unlimited applications in consumer goods and other areas.
- Tags can be read through a variety of substances such as snow, fog, ice, paint, crusted grime, and other visually and environmentally challenging conditions, where barcodes or other optically read technologies would be useless.
- RFID tags can also be read in challenging circumstances at remarkable speeds, in most cases responding in less than 100 millisecond
D. **Smart Card**

A smart card, chip card, or integrated circuit card (ICC), is any pocket-sized card with embedded integrated circuits. There are two broad categories of ICCs. Memory cards contain only non-volatile memory storage components, and perhaps dedicated security logic. Microprocessor cards contain volatile memory and microprocessor components. The card is made of plastic, generally polyvinyl chloride, but sometimes acrylonitrile butadiene styrene or polycarbonate. Smart cards may also provide strong security authentication for single sign-on within large organizations.

![Diagram of a smart card circuit](image)

V. **DRIVER CIRCUIT**

In electronics, a driver is an electrical circuit or other electronic component used to control another circuit or other component, such as a high-power transistor. The term is used, for example, for a specialized computer chip that controls the high-power transistors in AC-to-DC voltage converters. An amplifier can also be considered the driver for loudspeakers, or a constant voltage circuit that keeps an attached component operating within a broad range of input voltages.

The following circuit will allow you to drive a 12V relay using logic voltage (an input of 4V or greater will trip the relay). The circuit has its own 12V power supply making itself contained but the power supply portion can be left out if an external supply will be used. The circuit shows an output from the power supply that can be used to power other devices but it should be noted that the supply is unregulated and not particularly powerful with the parts stated. The 12V DC output is suitable for powering a few LEDs or low voltage lights but should not be used to power other electronic boards or motors. An alarm gives an audible or visual warning about a problem or condition. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

VI. **SIMULATION**

- The software used for simulation is PROTEUS 7.8 and MPLAB
- The microcontroller used here is PIC 16F877A
- Four push buttons are used for the purpose of,
  1) Increment
  2) Decrement
  3) Enter- for confirmation
  4) Payment

![Simulation diagram](image)

VII. **ADVANTAGES**

- This system is,
- Time saving
- Portable
- Affordable
- Consumes less power
- User friendly

VIII. **CONCLUSION AND RESULT**

The introduction of this electronic product to the supermarkets will be a boon for off-line purchase as it would make shopping easier.

The device records the data of the different products with the help of RFID Tags

The recorded data helps the shop owner with detailed analysis of shopping by the customer and their preferences through the computer and the printout of the same can be obtained

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