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Instantaneous Inventory Billing Based On RFID and Tracking Using Optical Sensor

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ABSTRACT

The grocery industry sector is nowadays extremely important in worldwide economy, with its recent evolution in technological, political, social and economic terms making it one of the most convenient and diverse businesses across the globe. In the journal "Consumer perceptions of privacy, security and trust in ubiquitous commerce" mentioned that the proliferation of electronic commerce technologies has utterly transformed the way business is conducted. Microcontroller based design, has acquired the status of most happening field in electronics. This is highly specialized that has the power of integrating thousands of transistors on single silicon chip. Nowadays, in mall for purchasing variety of items it requires trolley. Every time customer has to move the trolley for rack to rack for collecting items and has to do calculation of those items and need to compare with his budget in pocket. After this procedure customer has to wait in queue for billing. So, to avoid headache like waiting in billing queue and managing the budget, we are introducing a new concept called 'INSTANTANEOUS INVENTORY BILLING BASED ON RFID AND TRACKING USING OPTICAL SENSOR'.

In modern era, for automation we are developing a microcontroller based TROLLEY which uses a new trend in technology called Radio Frequency Identification (RFID). It reduces the time consumed in the process of billing their products. It follows the customer while purchasing items and it maintains a safe distance between customer and itself.

Keywords: RFID, RFID Tag, RFID Reader, Antenna, ZIGBEE, Optical Sensor.

I. INTRODUCTION

Motivation:

Reason behind choosing Microcontroller Based System:

In this paper, we have designed system by using microcontroller, because microcontroller based systems are less bulky and also easily transferable. It requires less power and so system becomes cheap. It requires less space, easy to install, so can be fitted easily in the system.

Benefits to the Customers:

Enabling customers' easy access to product information or other back-end supported functions; Providing quick and flexible checkout (the current checkout process is consistently reported as one of the most negative aspects of supermarket shopping), Enhancing management efficiency and reducing labour cost.

II. BACKGROUND OVERVIEW

A. *Existing system*

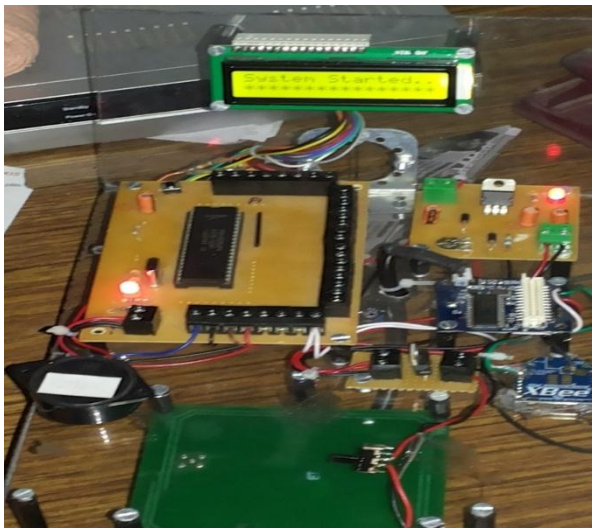
The customers are required to purchase their products using a Trolley in supermarket and then stand in long queue, for the payment of the bill. During this tedious process, the customer even has to wait for the calculation of the bill at the counter and if the bill amount exceeds his budget, he has to make corresponding changes to his requirements. There is still no provision for the bill to be made available for the customers before they stand in a long queue for the payment. The goods are scanned using Barcode Scanning Technology.

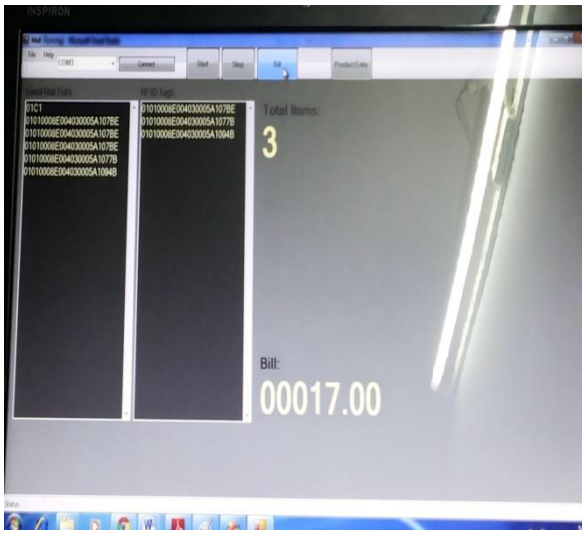
B. Drawbacks of existing system

The customer has to wait in long queue for the payment because of the bill to be calculated for each customer by scanning Barcode of his corresponding product making it a tedious process to deal with. Even customer is unaware of the bill before standing in the queue so as to make proper adjustments to his requirements.

C. Proposed system

In this new system the trolley itself will be reading a RFID tag attached on the project, which contains the cost related information of the product. The microcontroller system then calculates the bill amount for all products inserted and updates the bill of the customer, to display it on the LCD provision in the Trolley. This enables the customer to just do the payment at the counter rather than scanning the products. The optical sensor is used to drive the motor circuit, thus enabling the trolley to keep safe distance with the customer and track the customer.





RADIO FREQUENCY IDENTIFICATION (RFID)

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of cooperation of an RFID reader and an RFID tag. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader.

A basic RFID system consists of three components:

a) An antenna or coil

b) A transceiver (with decoder)

c) A transponder (RF tag)

RFID systems out in the market are categorized according to there frequency ranges. Some of the most commonly used RFID kits are as follows:

1) Low-frequency (30 KHz to 500 KHz)

2) Mid-Frequency (900KHz to 1500MHz)

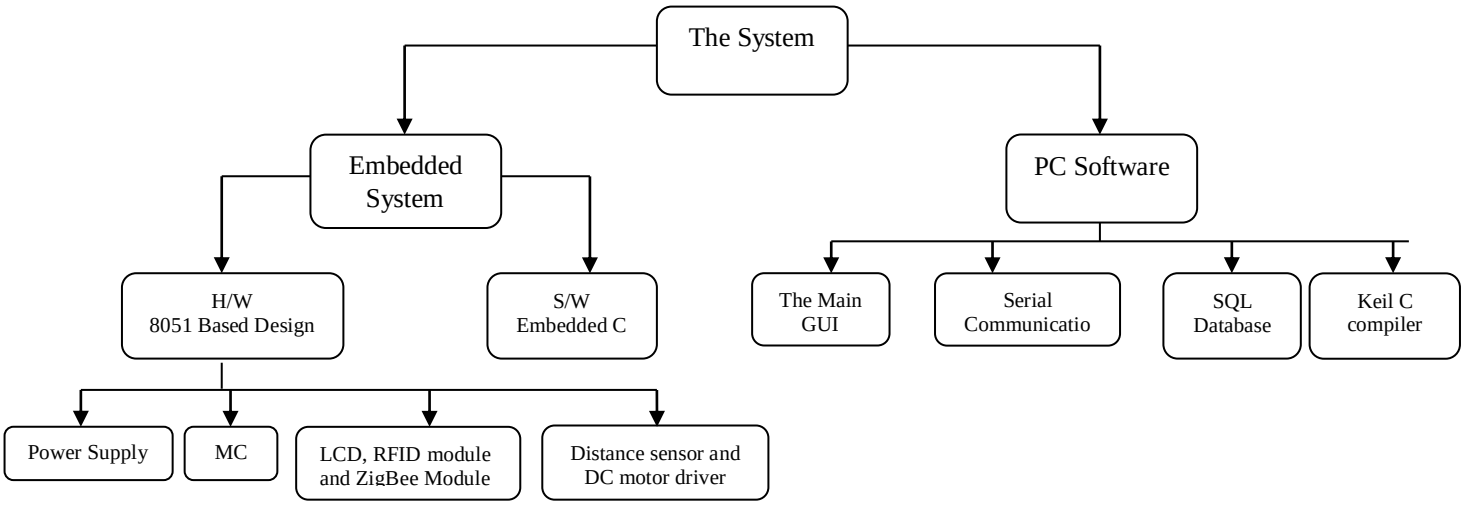
3) High Frequency (2.4GHz to 2.5GHz)

These frequency ranges mostly tell the RF ranges of the tags from low frequency tag ranging from 3m to 5m, mid-frequency ranging from 5m to 17m and high frequency ranging from 5ft to 90ft.

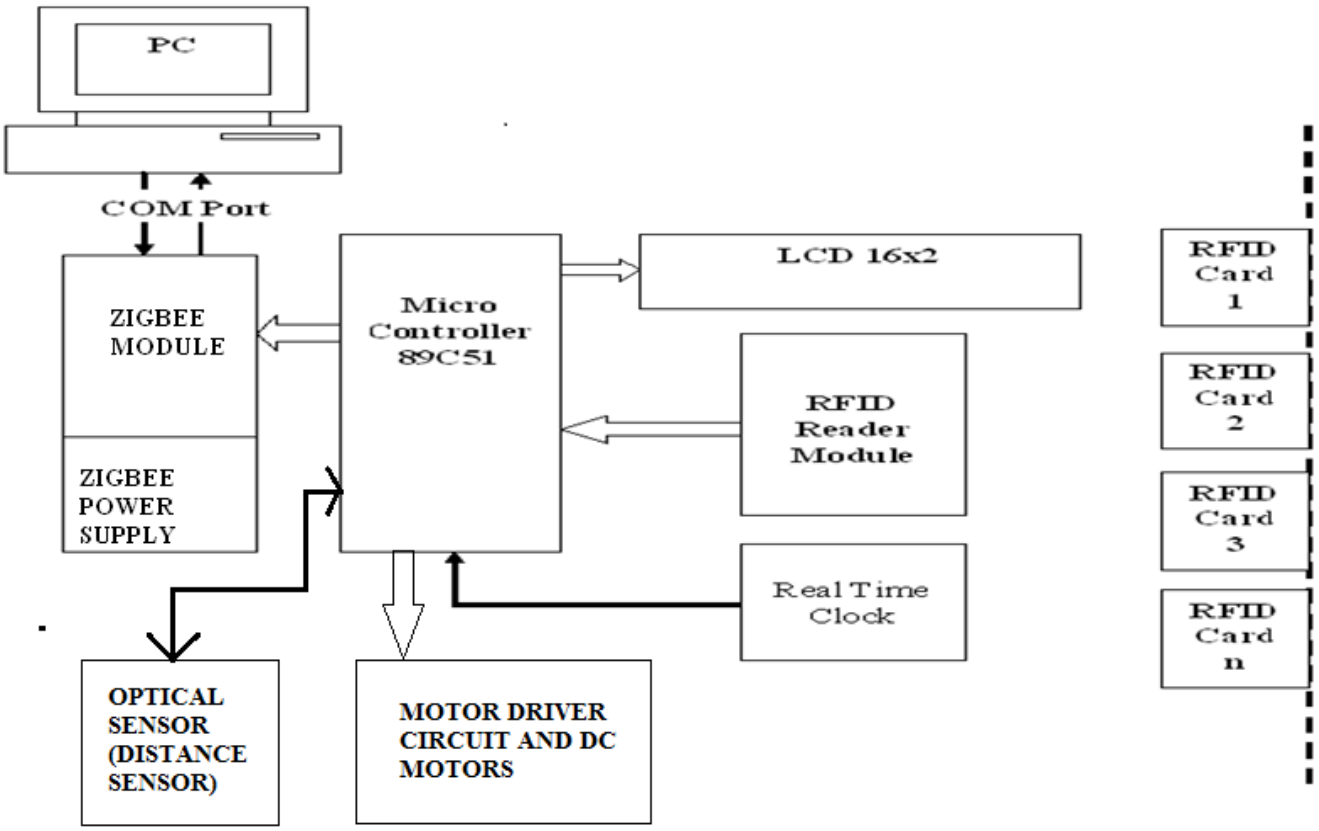
III. THE PROPOSED SYSTEM

A. System Overview

The above proposed system will be divided into the following sub modules or sections…



B. Block Diagram



C. Explanations of Blocks

The following are the brief explanations of the working principle of the various major blocks or sections used in the system…

- **Power Supply:**

  A variable regulated power supply, also called a variable bench power supply, is one where you can continuously adjust the output voltage to your requirements. Varying the output of the power supply is the recommended way to test a project. It uses a transformer, regulator, filter and a rectifier. It will convert 230V Ac to 5-12V DC.

- **Microcontrolle**r:

  This unit is the heart of complete system. It is actually responsible for all the process being executed. It will monitor and control all the peripheral devices connected in the system. The controller used here is 8051 microcontroller family. Its single serial port for communication can be used to communicate with both ZigBee and Server end.

- **LCD 16x2:**

  It is called Liquid Crystal Display. We are going to use 16x2 character display. LCD's job is to display all generated message by the system.

- **RFID Tags**:

  An RFID tag is a tiny radio device that is also referred to as a transponder, smart tag, smart label. The tag comprises a simple silicon microchip (typically less than half a millimetre in size) attached to a small flat aerial and mounted on a substrate. The finished tag can be attached to an object, typically an item, box, and read remotely to ascertain its identity, position, or state. For an active tag there will also be a battery.

- **RFID Reader Module**

  RFID readers may make use of **anti-collision algorithms** to enable a single reader to read more than one tag in the reader's field. The main purpose of the reader is to read data from the tag and transit it to the microcontroller based system for the calculation of the bill.

- **RFID Antenna**:

  The SkyeRead M1 antenna is designed for low power RFID applications that require less than 4 inches read range when using the internal antenna of the M1. Alternatively, the M1 can directly drive an external antenna to provide upto 10 inches read range. And for applications that require more than 10 inches read range a power amplifier can be used to drive an external antenna.

- **ZIGBEE:**

  ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/. Thus it is best suited for periodic transmission from a sensor.

- **Optical Sensor:**

  In this paper we have adopted Obstacle \detection methodology. It is used to keep safe distance between trolley and customer, which also indirectly enables trolley to track the customer.

  If obstacle is far away from the sensor, it does not give reflected back signal and if obstacle is in range of the sensor then it will get the reflected signal and the obstacle is detected.

D. System Implementation:

The 8051 microcontroller is the heart of our system. The Trolley itself acts as an Antenna, is used to read the RFID tags attached on the products. As soon as the products are placed on the antenna the RFID reader detects it and reads all the data to be read from the tag. The data read from the tag i.e. the unique tag ID is send to the RX pin of ZigBee module. ZigBee module then transmits that tag ID to the Server for further process. The reading of the data using M4 RFID reader is done according to the algorithm, where the microcontroller initiates the reading of the data according to the command provided

The ID is verified at the PC centre using the Inventory lookup or the database of the products corresponding to its ID, Corresponding cost of the product is send to the ZigBee module, which transfers the data to microcontroller via its TX pin for the further calculations of the bill. The transfer of data from the modules to the microcontroller is done by serial communication and UART port of 8051.

LCD is interfaced to the Microcontroller at port 1. Microcontroller calculates and displays the bill on the LCD provision in the trolley and even transfers that data to the server PC for updating the bill at the counter level.

A special provision is provided to read the removal of product and update the bill by reducing the cost of that corresponding product. This helps in the budget management of the customer. This special provision is done by updating the inventory database in the memory of the microcontroller itself, enabling the microcontroller to become the vital part of the system.

RFID uses a different range of frequencies and the antenna uses different types of antenna according to the area to be covered. Frequency is used is **mid-range** frequency. The tags are only meant to be read when placed on the trolley, so the reader field to read the tag should be limited to the boundaries of the trolley.

The optical sensor which maintains distance between trolley and the customer is connected to port 0 of the microcontroller. Distance sensor GP2D12 is used to sense the distance between

customer and the trolley. It is converted to corresponding voltage and compared with the reference voltage at LM358. According to the output level of LM358, trolley runs or stops. The motor driver circuit is interfaced to port 2 of the microcontroller. Trolley reversing facility is provided by use of a remote and RF trans-receiver section.

E. Features

The Following are the prominent features of the above discussed system…

- Lack of internal power source in the passive tags. This requires the tag reader to power-up these tags whenever it needs to communicate with them.
- Total number of tags is unknown.
- Tags cannot communicate with each other. Hence collision resolution needs to be done at the tag reader.
- Limited memory and computational capabilities at the tag.

F. Technology & Programming Languages

As microcontrollers are the core of these days digital circuit design in industry, this system uses it for the centralized operation and digital processing. The technology used here is embedded technology which is the future of today's modern electronics.

The followings are the various Programming Languages & Technologies that are going to be used in the proposed system…

For Microcontroller System:

- Embedded Technology,
- 8051 Family Based Controller,
- Embedded C - Keil Compiler,
- SPI Protocol for SD/MMC Card interfacing,
- Eagle Software for PCB Designing,

For PC System:

- VB.net 2008 Based Application Software,
- File Handling,
- Serial Communication Protocol,

G. Project Development Methodology or Steps

The following will be development steps so as to achieve the working Prototype Model of the above proposed system…

- Defining the Problem,
- Understanding the Need & Usability in industry and society (Market Analysis),
- Developing Block Diagram,
- Designing Circuits of individual blocks,
- Testing circuits in LAB & Finalizing,
- Developing PCB on PC,
- Getting the PCB printed from market,
- Soldering the components,
- Performing various Basic Experiments to test the PCBs,
- Developing Flowchart for the entire process,
- Writing actual Software Program,
- Compilation & Burning,
- Testing and Debugging,
- Developing Flowchart for PC Side Software,
- Developing Data Flow Diagram,
- Writing actual code.
- Finally Running the system and,
- Documentation.

IV. SCOPE & APPLICATIONS

Only the imagination can limit the applications of the above proposed system.

Though this may be an application of RFID and ZigBee Technologies, they can have numerous applications like:

- Inventory lookup and management
- Animal Tracking
- Serial communication of data in a small area with maximum possible speed

V. CONCLUSION

This project helps to reduce the main parameter Time. This RFID dual frequency tags can achieve higher transmission rates when communication is done at higher frequencies. The tag can always be read, even when placed in a glass of water because it can transmit at lower frequency. It increases consumer confidence.

Thus the system developed when used widely will not only help the customer to reduce time wastage in calculation of bill according to his budget, will also allow the customer to care free about the trolley. The instantaneous billing and trolley tracking the customer helps a lot in saving many parameters.

VI. ENHANCEMENTS

A. Limitations

The first problem is critical for the efficient development of the solution. It can be defined as a special case of multiple-channel-access communication problem. Anti-collision protocols that address this problem cannot be directly applied to the tag identification problem due to various constraints, which make this problem unique. The constraints are as follows:

- Lack of internal power source in the passive tags. This requires the tag reader to power-up these tags whenever it needs to communicate with them.
- Total number of tags is unknown.
- Tags cannot communicate with each other. Hence collision resolution needs to be done at the tag reader.
- Limited memory and computational capabilities at the tag.

B. Future Modifications

There is always chance to improve the any system as research & development is an endless process. Our system is no exception to this phenomenon. The following improvements can be done…

- By reusing the RFID tags one can reduce the cost of the system.

- One can maintain the database of the products available in the supermarket on mobile.
- It can also be used efficiently for inventory tracking and theft management.

REFERENCES

A. Embedded Books & Websites

[1] Myke Predko, *Programming and Customizing the 8051 Microcontroller*, Edition 1999, Tata McGraw-Hill, Page:157-167.

[2] Muhammad Ali Mazidi, Janice Gillispie Mazidi, *8051 Microcontroller and Embedded Systems*, Prentice-Hall, Page:183-193, 236, 243.

[3] Dogan Ibrahim, *Microcontroller Projects in C for the 8051*, Newnes, Page:29-161.

[4] Kenneth J. Ayala, *The 8051 Microcontroller ARCHITECTURE, PROGRAMMING and APPLICATIONS*, WEST PUBLISHING COMPANY, Page:131-197.
[5] The 8051 microcontroller and embedded systems – Ayala and Mazidi
[6] Programming Customizing 8051 microcontroller – Predko

[7] www.beyondlogic.org
[8] www.discovercircuits.com
[9] www.electronicsforu.com

B. Software Books & Websites

[1] Gary Cornell & Jonathan Marrison, *Programming VB.Net: A Guide for experienced programmers*, Second Edition 2002, ASPToday Publication, ISBN (pbk): 1-893115-99-2, 424 Pages.

[2] Dave Grundgeiger, *Programming Visual Basic.Net*, First Edition 2002, O'Reilly Publication, ISBN: 0-596-00093-6, 464 Pages.

[3] Evangelos Petroutsos, Mark Ridgeway, *Mastering Microsoft Visual Basic 2008*, First Edition, Wiley Publishing, ISBN: 978-0-4701-8742-5.

[4] Brian W. Kernighan, Dennis M. Ritchie, *The C programming Language*, First Edition 1988, Prentice-Hall, ISBN 0-13-110370-9.

C. Websites for RFID and Serial Communication

[1]. www.beyondlogic.org

[2]. *www.technovelgy.com/ct/technology-article.asp?artnum=50*

[3]. www.embeddedrelated.com

[4]. www.microchip.com

[5]. *www.intechopen.com/.../anti-collision-algorithms-for-multi-taq-rfid - For anti-collision algorithms*