Automatic Retail Store System Using RFID and ZigBee

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Abstract: As a vital and integrated part of the radio frequency identification (RFID) system, RFID antennas have been received much attention over years, and their design is very urgent and significant. In fact, the development of RFID antenna is of theoretical significance and practical value for the RFID system. This paper presents the design of micro strip rectangular patch antenna, using inset line feeding, with center frequency at2.45 GHz for RFID applications. The patch antenna is fabricated on the substrate type FR-4, with dielectric constant of 4.4 and thickness of 1.58 mm respectively and fed by a 50- micro strip line. Initially, we set our antenna as a single patch and after evaluating the outcomes of antenna features (S11, VSWR, antenna gain and directivity), then we transformed it to 2*1linear antenna array. Finally, we analyzed the 4*1 linear antenna array to increase directivity, gain and have better radiation patterns.

Keywords*:* Adaptation; Micro Strip Antenna; Radiation Pattern, Return Loss, Voltage Standing Wave Ratio, Gain, Directivity, HFSS,CST.

I. INTRODUCTION

Radio frequency identification, known as RFID, is a smart technology that is highly efficient, flexible and well suited for automatic operations. It is a growing technology which replaces barcodes [1,2]. It uses radio waves to read data contained in devices called labels or RFID tags [3]. RFID technology is also used to monitor, identify and follow objects, animals and people using radio waves [4,5]. The principle of RFID system consists of a reader and transponder (tag). The communication between these two components is accomplished by the air [6]. The tag, associated to the identifier element, contains all data relating to the object that uniquely identifies it. The data stored in an electronic chip can be read by an antenna that receives and transmits radio signals to and from the reader [7]. The reader, fixed or held by hand, is the device that is in charge of reading the RFID tags located in its reading field and capable of converting the radio waves coming from the tag into a digital signal which can be transferred to a PC [8].Antennas, which are a component of RFID system, have a very important role [9]. The whole system depends on their performances like return loss, gain, directivity and bandwidth. Fig.1 shows the various components of an RFID system. This part provides the simulation results of the proposed Antenna using the electromagnetic simulators CST microwave studio and HFSS. The first one employs the Finite Integration Method and the second one is based on the Finite Element Method (FEM)[14,15].The simulation has been performed to achieve the desired results at the resonance frequency (2.45 GHz), particularly: the return loss, voltage standing wave ratio, input impedance, radiation pattern.

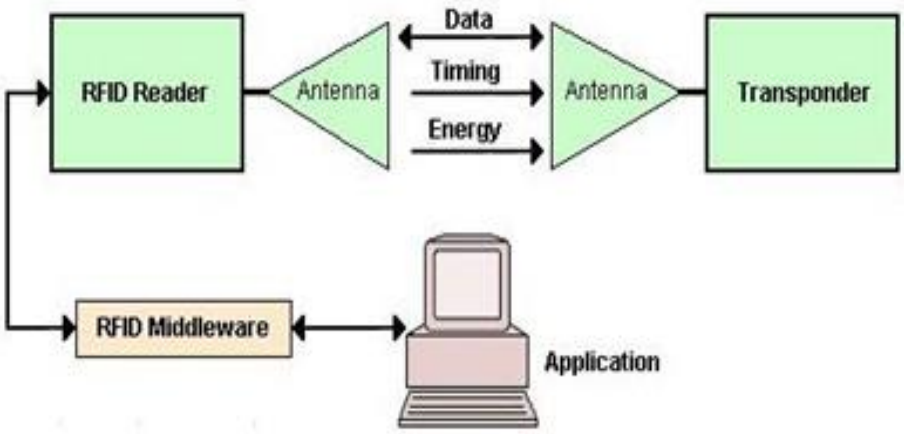

Fig.1. Principle of an RFID system operation.

II. INTERFACING BLOCK DIAGRAM AND DISCUSSION

Embedded systems are designed to do some specific task rather than be a general purpose computer for multiple tasks. Some also have real time performance constraints that must met, for reason such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. An embedded system is not always a separate block very often it is physically built in to the device it is controlling. The software written for embedded systems is often called firmware, and is stored in read only memory or flash convector chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen and little memory. To perform any application in the embedded system we require microprocessor and microcontroller. In the microprocessor an external memory is connected which increases the size of the microprocessor and multiple operations are being performed by the microprocessor but whereas in the microprocessor the memory is inbuilt and also we can use this controller only for the specific applications where the speed is

increased so most probably microcontrollers are used in the different applications in the embedded systems rather than microprocessor**.** An embedded system can be defined as a computing device that does a specific focused job. Appliances such as the air-conditioner, VCD player, DVD player, printer, fax machine, mobile phone etc. are examples of embedded systems. Each of these appliances will have a processor and special hardware to meet the specific requirement of the application along with the embedded software that is executed by the processor for meeting that specific requirement. The embedded software is also called "firm ware". The desktop/laptop computer is a general purpose computer as shown in Figs.2 and 3. You can use it for a variety of applications such as playing games, word processing, accounting, software development and so on.

Block Diagram:

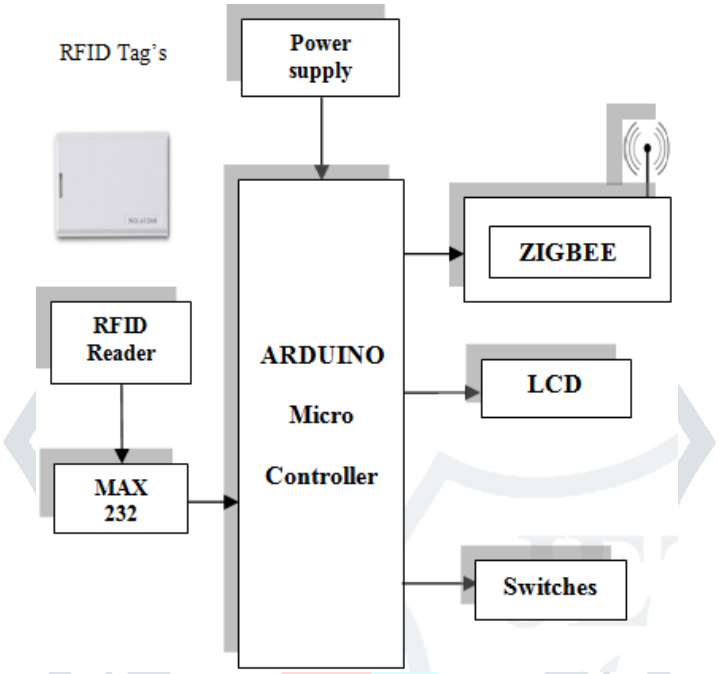

Fig.2. Block Diagram.

Receiver Section:

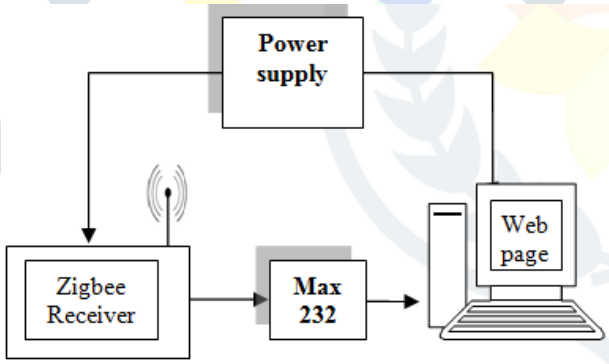

Fig.3. Receiver Section.

A. Power Supply

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output as shown in Fig.4. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

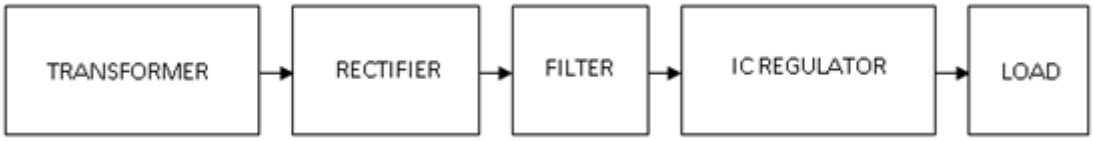

Fig.4. Block Diagram of Power supply.

B. Arduino Uno

Arduino/genuinouno is a microcontroller board based on the atmega328p (datasheet). It has 14 digital input/output pins (of which 6 can be used as pwm outputs), 6 analog inputs, a 16 mhz quartz crystal, a usb connection, a power jack, an icsp header and

a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a usb cable or power it with a ac-to-dc adapter or battery to get started.. You can tinker with your uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in italian and was chosen to mark the release of arduino software (ide) 1.0. The uno board and version 1.0 of arduino software (ide) were the reference versions of arduino, now evolved to newer releases. The uno board is the first in a series of usbarduino boards, and the reference model for the arduino platform; for an extensive list of current, past or outdated boards see the arduino index of boards as shown in Fig.5.

Fig.5. Arduino Uno board.

C. LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data as shown in Fig.6.

Fig.6.LCD.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

D. MAX232 IC

The MAX232 is an IC, first created by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 VTTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

E. Radio Frequency Identification

RFID, short for Radio Frequency Identification, is a technology that enables identification of a tag by using electromagnetic waves. RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz as shown in Fig.7.

Features:

- Reading Distance: 6-10 cm
- Dimension: 40mmx20mmx8mm (LxHxW)
- Frequency:125kHz
- Compatible Card codes:Manchester64-bit,modules64
- Current Rating: 35mA (Max)
- Operating Voltage:4.6V - 5.4VDC

Fig.7. RFID Reader.

Specifications:

It is an ADC (Automated Data Collection) technology that:

- Uses radiofrequency waves to transfer data between a reader and a movable item to identify, categorize, track..
- Is fast and does not require physical sight or contact between reader/scanner and the tagged item.
- Performs the operation using low cost components.
- Attempts to provide unique identification and backend integration that allows for wide range of applications.

F. ZigBee

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard as shown in Fig.8. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.

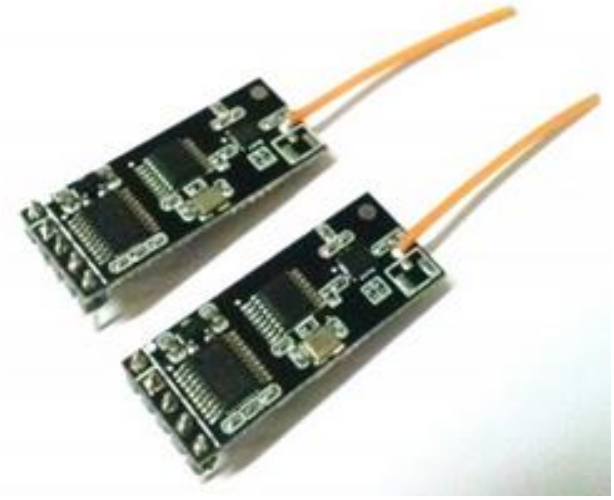

Fig.8. ZigBee.

Zigbee/IEEE 802.15.4 - General Characteristics:

- Dual PHY (2.4GHz and 868/915 MHz)
- Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz)

- Optimized for low duty-cycle applications (<0.1%)
- CSMA-CA channel access Yields high throughput and low latency for low duty cycle devices like sensors and controls
- Multiple topologies: star, peer-to-peer, mesh
- Addressing space of up to:
- 18,450,000,000,000,000,000 devices (64 bit IEEE address) 65,535 networks
- Range: 50m typical (5-500m based on environment)

III. SCHEMATIC DIAGRAM AND RESULTS

Results of this paper is as shown in bellow Figs.9 to 14.

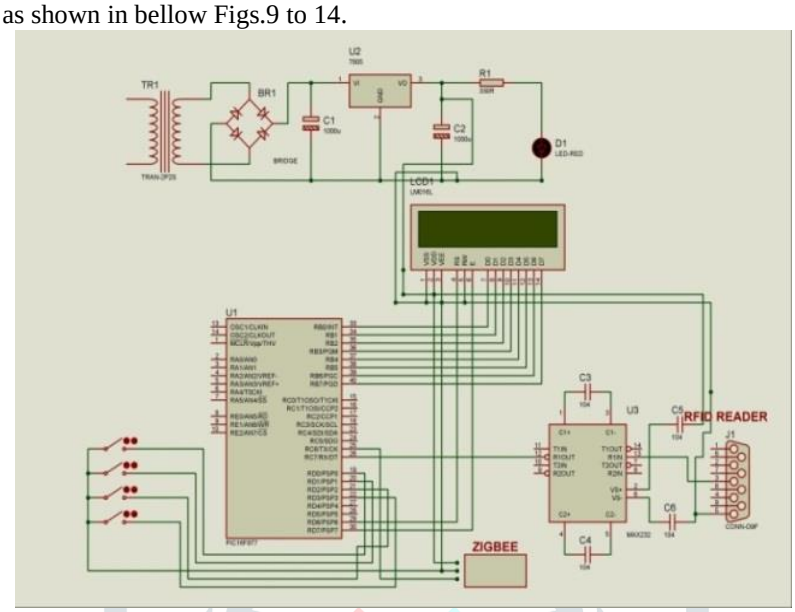

Fig.9. Schematic Diagram.

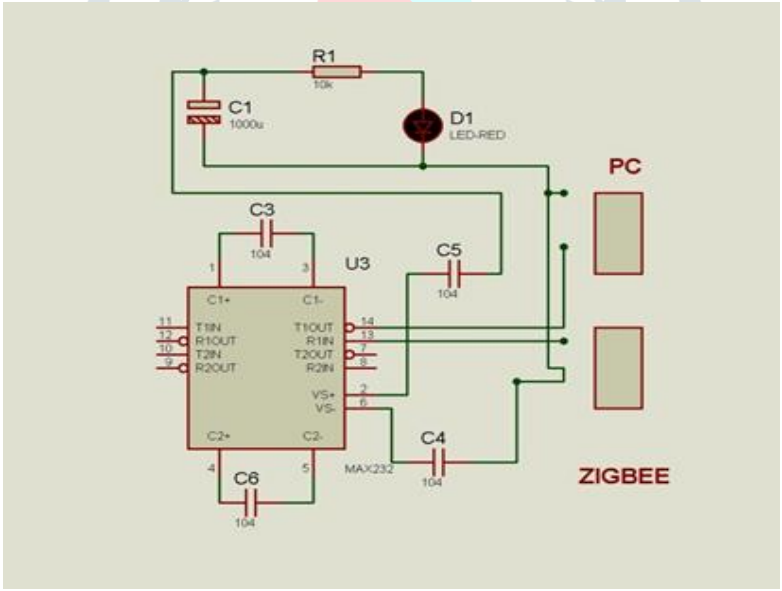

Fig.10. Schematic Diagram of Receiver section.

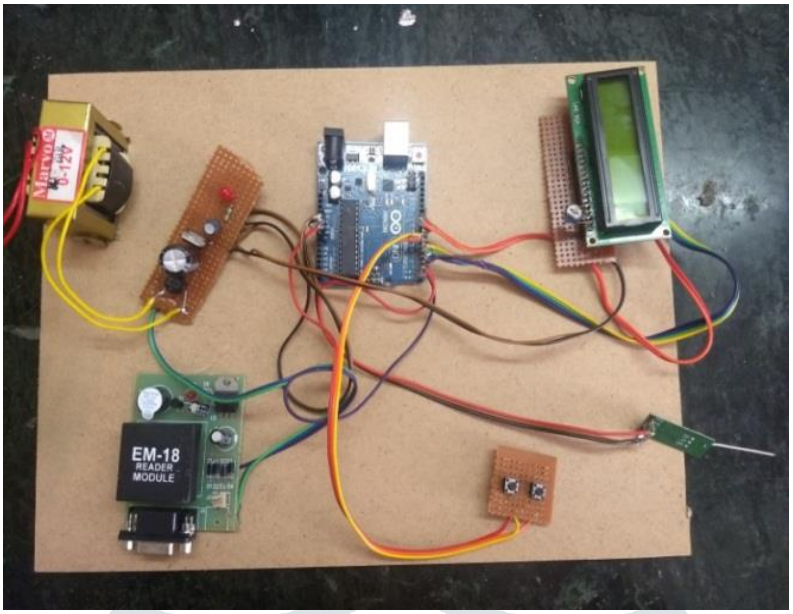

Fig.11. Hard ware kit.

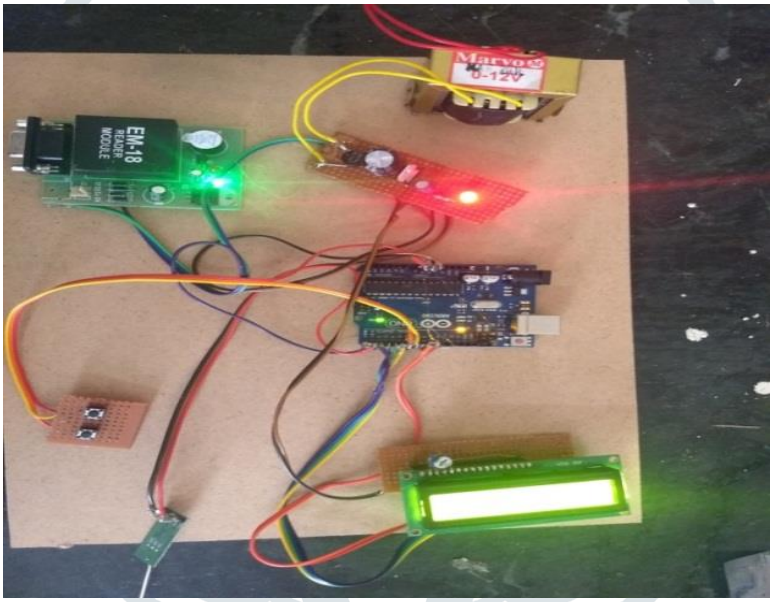

Fig.12. Hard ware kit with power supply.

Fig.13. LCD Acknowledgement.

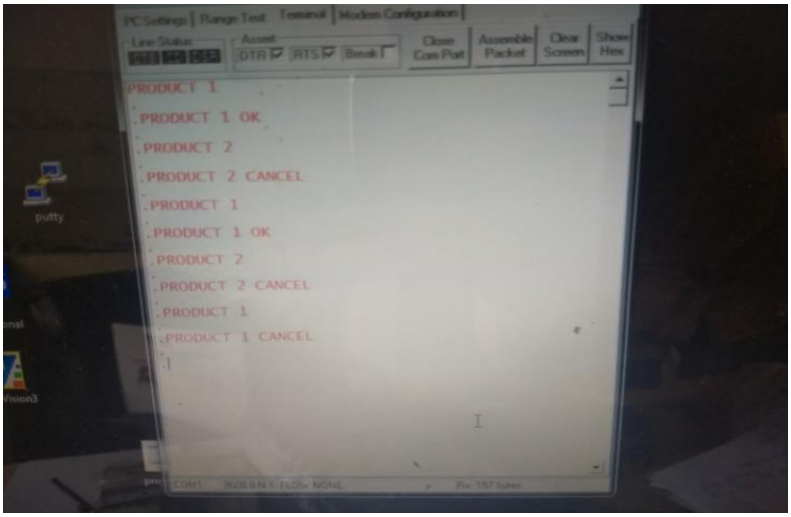

Fig.14. Output Result.

IV. CONCLUSION

This project mainly focuses on design of the RFID based product collection system working with frequency. According to customer's point of view our project has redefined the way of purchasing. Evidently RFID has outsmarted barcodes by its accuracy, fast response and durability. Our concept has erased the tradition of customer Relying on the shopkeeper for acquiring information about products. Billing is completely avoided which in turn saves time for the customer and makes process easy for shopkeeper. It avoids queue for customer since billing is completed in the trolley. It reduces one third of the overall investment of the shopkeeper for billing department. Thus The model allows better shopping experience using improved technology which can be handled by any common man who just knows to read and write things.

V. REFERENCES

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