Smart Shopping Trolley Using RFID

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Abstract— the purchasing various items in malls or supermarkets require a trolley. Product procurement represents a complex process. On each occasion customer items has to pull the trolley from rack to rack for collecting and simultaneously customer has to perform estimated expense computation. At the end, customer has to wait in queue for billing and payment. To overcome that we have been developed a smart way for shopping. Each and every product has RFID tag instead of barcode scanner. The smart trolley will consists of a RFID reader, LCD display and ZigBee transmitter. When a person puts any product in the trolley it will scan the product and the cost and the name of the product will be displayed. The sum total cost of all the products will be added to the final bill. This will be stored in the micro controller memory. It will wirelessly transfer the product information of the items placed in the trolley using a ZigBee transmitter to the main computer. So, to avoid waiting in billing queue while constantly thinking about the budget, a new concept has been introduced which is the "SMART-TROLLEY".

Keywords: RFID, IoT

I. INTRODUCTION

In the era of the internet of thing (IoT), interactions among physical objects have become a reality. Everyday objects can now be equipped with computing power and communication functionalities, allowing objects everywhere to be connected. This has brought a new revolution in industrial, financial and environmental systems and triggered great challenges in data management, wireless communications, and real-time decision making. Additionally, many security and privacy issues have emerged and lightweight cryptographic methods are in high demand to fit in with IoT application. There has been a great deal of IoT research on different applications, has as smart shopping system based on Radio frequency Identification (RFID) technology, which has not been well-studied in the past. In such a system, all items for sale are attached with an RFID tag, so that they can be tracked by any device equipped with an RFID reader in the store- for example, a smart shelf. Intuitively this brings the following benefits:

Items put into a smart shopping card (with RFID reader capability) can be automatically read and the billing information can also be generated on the smart card. As a result, customer does not need to wait in long queue at checkout. 2) Smart shelves that are also equipped with RFID readers are able to monitor all stocked items and send items status update to the server. When items become sold out, the server can notify employee to restock. 3) It becomes easy for the store to do inventory management as all items can be automatically read and easily logged.

We propose the use of ultra-high frequency (UHF) RFID technology in the smart shopping system, as UHF passive tags have a longer range, from 1 to 12 meters, Previous research on the design of smart shopping systems mainly

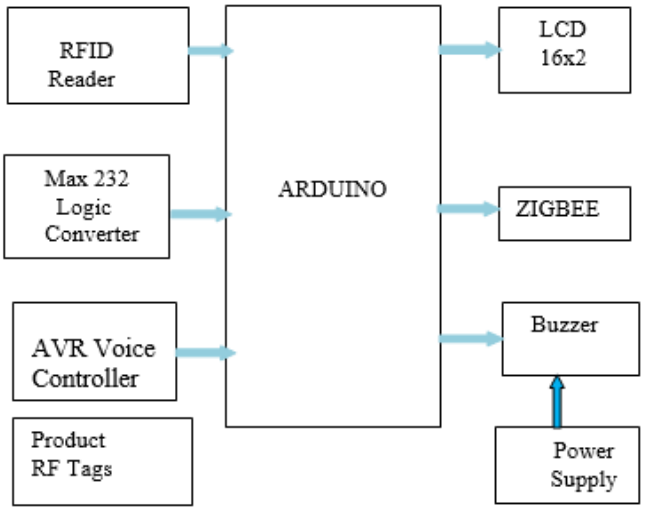


Fig. 1: Block Diagram

focused on using low/high frequency RIFD, which have inadequate ranges, and leave customers to manually scan items with a RFID scanner. In our proposed system, each smart cart is equipped with a UHF RFID reader, a micro controller, an LCD touch screen, a Zig-Bee adapter, and a weight sensor. The smart cart is able to automatically read the items put into a cart via the RFID reader. In order for the smart cart to communicate with the server, we have chosen Zig-Bee technology as it is low-power and inexpensive. The weight scanner can also help do a security check, for example, if a malicious user peels off one item's RFID tags and puts it into the cart, extra unaccounted weight will be added. When a customer finishes shopping they pay at the checkout point using the generated billing information on the smart cart, We also set a RIFD reader before the exit door to check that all the items in the cart have been paid for.

We consider security and privacy issues related to smart shopping systems as no previous research has tackled it. In such a system, wireless communications among the server, smart carts, and items are vulnerable to attacks; an adversary is able to interface with the communications if no proper security method is applied. Privacy issues also exist in such a system: the competitor of a store might get easy access to the circulation of commodities for financial strategy; and customer preferences can be inferred by easily collecting the product Information in shopper's shopping carts. There are a few restrictions in choosing a practical security method for a smart shopping system. If the smart cart needs to send a message to the server after reading an item in the cart, it needs a lightweight, asymmetric scheme for singing and encrypting, in order to protect confidentiality and integrity. At this step we choose to use ECC-based cryptosystems, as the key size is much smaller compared to other cryptosystems, such as RCA. ECC system With 163-bit key can achieve the same security level. To do this, before communication with the

server begins; the smart cart prepares a pair of symmetric keys as session keys and appends them to the message. The sever will use one of the two keys for encryption, and the other for creating a message authentication code (MAC). Therefore, computational overhead is greatly reduced as symmetric encryption/decryption and MAC is more computationally efficient than asymmetric encryption/decryption.

We have built a prototype to test the functions of the smart cart. We also give a security analysis and performance evaluation to prove this system is practical. Finally, we take into consideration the cost of the required components and we find the cheapest RFID reader are at 150 USD and UHF passive tags are at 2 cents in the current market. We believe in the future, grocery store will be IoT-based with RFID technology.

II. RELATED WORK

Items put into a smart shopping cart (with RFID reading capability) can be automatically read and the billing information can also be generated on smart cart. As a result, customers do not need to waiting long queues at checkout. Smart shelves that are also equipped with RFID readers are able to monitorial stocked items and send item status updates to the server. When items become sold out, the server can notify employee store stock. It becomes easy for the store to do inventory management as all items can be automatically read and easily logged.

This using Arduino, RFID, MAX232, AVR Control, Zig-Bee, Buzzer, LCD.

A. Power Supply

The present chapter introduces the operation of the power supply circuit built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the dc voltage, then filtering to a dc level, and finally, regulating to obtain a desire fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the even if the input dc voltage varies, or the output load connected to the dc voltage changes. A block diagram containing the parts of a typical power supply and the voltage and at various points in the unit. The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then provides 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 are ac voltage variation.

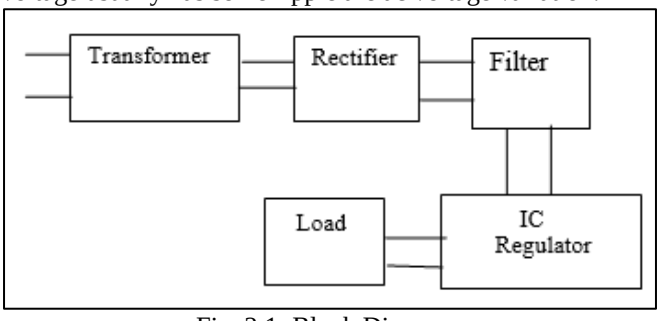


Fig. 2.1: Block Diagram

A regulator can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, are the load connected to the output dc changes. This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

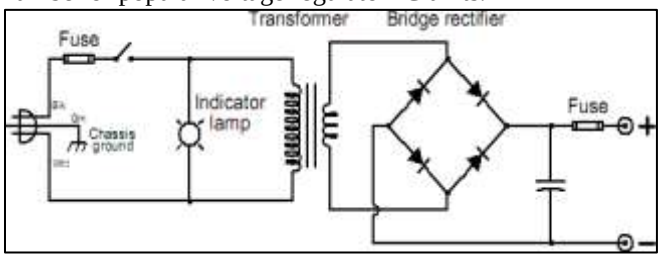


Fig. 2.2: Circuit Diagram

B. LCD

Liquid Crystal Display (LCD) has materials which combine the propointperties of both liquids and crystal. Rather than having a melting , 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 from similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material and switched 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. One each polarizer's are pasted outside the two glass panels. This polarizer's would rotate the light ray passing through them to a definite angle, in the particular direction. The LCD does generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relativity simple which makes the LCD's more customer friendly. The LCDs used exclusively in watches, calculator and measuring instruments are the simple seven-segments displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

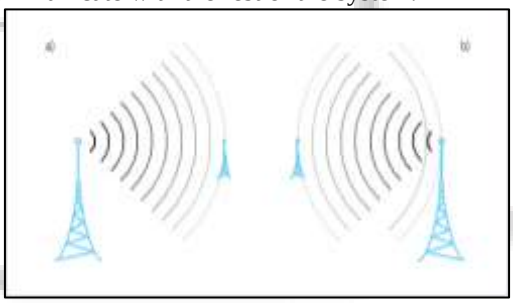
C. BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Piezoelectric buzzers, or piezo buzzers, as they are sometimes called, were invented by Japanese manufactures and fitted into a wide array of products during the 1970s to 1980s. This advancement mainly came about because of cooperative efforts by Japanese manufacturing companies. In 1951, they established the Barium Titan ate Application Research Committee, which allowed the companies to be "competitively cooperative" and bring about several

piezoelectric innovations and invention. The word "buzzer" comes from the rasping noise that electromechanical buzzer made. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. Interior of a readymade buzzer, showing a piezoelectric-disk-beeper (with 3 electrodes) including 1 feedback-electrode the central, small electrode joined with red wire in this photo), and an oscillator to self-drive the buzzer.

D. ZIGBEE

ZigBee is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee, a specification for communication in a wireless personal area network (WPAN), has been called the "Internet of things ". Theoretically, your ZigBee-enabled coffee maker can communicate with your ZigBee-enabled toaster. ZigBee is an open, global, packet-based protocol designed to provide an easy-to-use architecture for secure, reliable, low power wireless networks. ZigBee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications. Flowor process control equipment can be place anywhere and still communicate with the rest of the system.



Low power wireless networks. ZigBee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications. Flower process control equipment can be place anywhere and still communicate with the rest of the system. It can also be moved, since the network doesn't care about the physical location of a sensor, pump or value.

The ZigBee RF4CE standard enhance the IEEE 802.15.4 standard by providing a simple networking layer and standard application profiles that can be used to create interoperable multi-venter customer electronic solutions.

NRF24L01 is a single chip radio transceiver for the world wide 2.4 - 2.5 GHz ISMband. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0mA at an output power of -6dBm and 12.3mA in RX mode. Built-in power down and standby modes make power saving easily realizable.

E. RFID

Radio frequency identification (commonly abbreviated to RFID) is so named because it relates to the identification of objects using EM radiation at radio frequencies. A large range of frequencies within the EM spectrum are referred to as radio Frequencies (RF),which results in a number of different forms of RFID. Once again, RFID systems may be categorized based on the band of the EM spectrum that they operate in. RFID systems in the same band will generally display similar characteristics; those in other bands may well operate very differently and therefore be more or less suitable for a given application. An RFID system comprises two components – an RFID reader and an RFID tag.

Despite its name, the RFID reader is really the transmitter in an RFID system. The electronics in the reader uses an external power source to generate the signal that drives the reader's antenna and which in turn creates the appropriate radio wave. This radio wave may be received by an RFID tag, which in turn 'reflects' some of the energy it receives in a particular way (based on the identity of the tag).Whilst this reflection is going on, the RFID reader is also acting as a radio receiver, so that it can detect and decode the reflected signal in order to identify the tag.

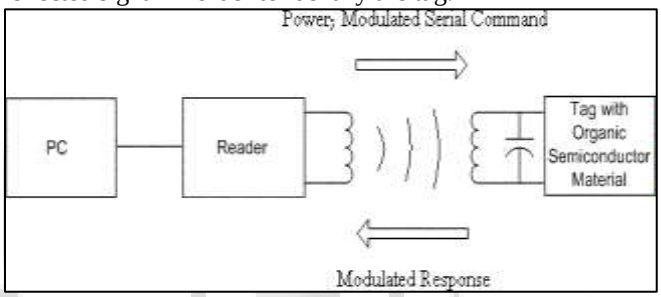


Fig. 2.3. RFID System

An RFID system is specifically designed to be asymmetric - the reader is big, expensive and power hungry compared to the RFID tag. There are a number of different types of RFID system, but one basic categorization is based on the power source used by the tag.

1) Passive tag RFID systems require no power source at the tag there is any battery. Instead, the tag uses the energy of the radio wave to power its operation, much like a crystal radio. This results in the lowest tag cost, but at the expense of performance.
2) Semi-passive tag RFID systems rely on a battery built into the tag in order to achieve better performance (typically in terms of operating range). The battery powers the internal circuitry of the tag during communication, but is not used to generate radio waves.
3) Active tag systems use batteries for their entire operation, and can therefore generate radio waves proactively, even in the absence of an RFID reader. Passive tag RFID systems are the most common type, and are often referred to simply as 'RFID systems'.

F. ARDUINO

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME

2011, or student's anywhere who is confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. The Arduino project was started in Italy to develop low cost hardware for interaction design. An overview is on the Wikipedia entry for Arduino. The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino that you can create a control program on the host PC, downloads it to the Arduino and will run automatically. Remove the USB cable connection to the PC and the program will still run from the top each time you push the reset button. Remove the battery and puttheArduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) powers can co either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center- positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and V_{in} pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

G. MAX232

Max232 is designed by Maxim Integrated Products. This IC is widely used in RS232Communication systems in which the conversion of voltage level is required to make TTL devices to be compatible with PC serial port and vice versa. This chip contains charge pumps which pumps the voltage to the Desired Level. It can be powered by a single +5 volt power supply and its output can reach +_7.5 volts.MAX232 comes in 16 Pin Dip and many other packages and it contains Dual Drivers. It can be used as a hardware layer convertor for 2 systems to communicate simultaneously. Max232 is one of the versatile IC to use in most of the signal voltage level conversion problems. Mostly MAX232 used in 16-pin DIP package. It consists of 3 major blocks. It can only be powered by 5 volts to make supply compatible with most of the embedded systems. First block is the voltage doubles in this IC switched capacitor techniques is used to make the voltage double .Once the voltage is doubled second block will converts that voltage to +10 and -10. The third block consists of 2 transmitters and 2 receivers which actually convert the voltage levels.

III. CONCLUSION

The smart shopping trolley application creates an automated central billing system (ACBS) for Supermarkets and malls. Using Arduino (product identification), customers will not have to wait near cash counters for their bill payment. Since their purchased product information is transferred to central billing system. Customers can pay their bill through credit/debit cards as well. The system proposed is highly dependable, authentic, trustworthy and time- effective. There will be reduction in salary amount given to employees, reduction in theft also; the system is very time-efficient. The proposed Smart Shopping Trolley System intends to assist shopping in- person which will minimize the considerable amount of time spent in shopping as well as to time required in locating the desired product with ease. The customer just needs to type the name of the product he wants to search on the Android device, and the cart will automatically guide him/her to the product/s locations.

REFERENCES

[1] F. Xia, L. T. Yang, L. Wang, and A. Vinel, "Internet of things,"International Journal of Communication Systems, vol. 25, no. 9, p. 1101, 2012.
[2] P. Castillejo, J.-F.Martinez, J. Rodriguez-Molina, and A. Cuerva,"Integration of wearable devices in a wireless sensor network for an e- health application," IEEE Wireless Communications, vol. 20, no. 4, pp. 38–49, 2013.
[3] N. Mutton , S. Papavassiliou, A. Puliafito, and K. S. Trivedi, "Combiningcloud and sensors in a smart city environment,"EURASIP journal on Wireless Communication and Networking,vol. 2012, no. 1, p.1,2012.
[4] D. Klabjan and J. Pei, "In-store one-to-one marketing," Journal of Retailing and Consumer Services, vol. 18, no. 1, pp.64–73,2011.
[5] T. Shanmugapriyan, "Smart cart to recognize objects based on userintention,"International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 5,2013.
[6] S Gupta., A. Kaur, A. Garg,A. Verma, A. Bansal, and A. Singh,"Arduino based smart cart,"International Journal of Advanced Research in Computer Engineering & Technology, vol. 2, no. 12,2013.
[7] Z. Ali and R. Sonkusare,"Rfid based smart shopping and billing," International Journalof Advanced Research in Computer andCommunication Engineering, vol. 2, no. 12, pp. 4696–4699,2013.
[8] M. R. Sawant, K. Krishnan, S. Bhokre, and P. Bhosale, "The rfid basedsmart shopping cart,"International Journal of Engineering Research and General Science, vol. 3, no. 2, pp. 275–280,2015.

