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Smart Shopping Trolley

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Abstract - *This paper targeted to reduce the Queue at a billing counter in a shopping complex. The system does the same by displaying the price of the product inside the cart. In this way the customer can directly pay the amount at the billing counter and leave with the commodities he/she has bought. It eliminates the traditional scanning of products at the counter and in turn speeds up the entire process of shopping, also with this system the customer shall know the total amount to be paid and hence can accordingly plan his shopping by only buying the essential commodities resulting in enhanced savings. Since the entire process of billing is automated it reduces the possibility of human error substantially. Also the system has a feature to delete the scanned products to further optimize the shopping experience of the customer. The hardware for the test run is based on the Arduino platform and zigbee modules, as both are very popular in small-scale research and wireless automation solution. Also the amount can be paid through online using QR code scanner.*

***Key Words*: Microcontroller, RFID Reader, Zigbee, ESP8266, LCD Display.**

1. INTRODUCTION

People tend to overshoot their budget when they are shopping at a big shopping center. Moreover they end up in long queues at the end of their shopping waiting for the products to be scanned and billed. The Smart Shopping Cart addresses the above problems with ease. It helps the customer in ensuring that he does not overshoot his pre decided budget and only buys the essential commodities actually needed by him, also the system aids in eliminating the long queues at the billing counter as the products are already scanned and the customer just has to pay the bill and bag the items purchased. The system is profitable for the shopping centers as it can help in reducing the number of billing counters and in turn will help in reducing employee costs significantly. The aim is to design a microcontroller-based shopping cart aiding the customers in their shopping and reducing the queue at the billing counter. The device must be user friendly and have an interface via which the customer can scan the products he/she intends to buy, also the system must have a LCD display so that the customer can know the total cost of the commodities purchased. The system must also have a feature to delete a purchased product in case the customer changes his/her mind. The system should also contain a buzzer system which initiates automatically whenever a product is scanned. There is also a need of a centralized database which contains the cost of all the products in the shopping market. It is very common that people tend to overshoot their expenditure at large shopping centers due to a simple fact that they are not able to anticipate the cost of the products they have placed in their shopping cart. Also on weekends and during festive seasons the customers have to wait in long queues just to get their products scanned at the counter and get them billed.

This paper helps in eliminating or reducing the above mentioned problems substantially. The Smart Shopping Cart not only displays the total cost of the commodities in the cart it also has a feature to remove any product if the customer wishes to do so. The Smart cart also eliminates the tedious process of scanning the products at the counter as this process is already done by the customer during the shopping itself. This shall substantially reduce the long queues at the billing counters as now the customers only need to pay the bill of the commodities purchased and bag them .The product is also beneficial for the shopping centers as it helps them in optimizing the total workforce at their place resulting in profits in the long run. The traditional shopping carts which are available in shopping markets are nothing but carts with a steel frame moving on wheels. Till now there has been no incorporation of electronics in order to aid the customers and enhance their shopping experience. Though there have been a lot of attempts to modernize the shopping carts all of these attempts are aimed at finding the products in the shopping market in lesser time using web servers and other utilities. The most common problems faced by the customers are overshooting their expenditure and wasting time in the queues for billing rather than not being able to

find the product of their choice. Hence there is a need to address the most common problems before approaching the more complex ones. This product is aimed at doing the above in a cost effective manner so that it is feasible to implement it in real- time. The product is first of its kind and a lot of changes have been incorporated in the traditional shopping cart in order to aid the customers. The novelty of the work also makes it open to many improvements which can be later incorporated.

2. EXISTING SYSTEM

Using the barcode scanner, we are already using the device in malls. Seller scans the product via the barcode scanner. This is going to be a slow process and the customer has to wait for long queues. So, this is one of the reasons most people want to leave the store to wait a long queue to buy a couple of items. Realistically, these days, markets are being used by a large number of individuals to obtain most products. Product procurement speaks of an uncertain process involving time spent on routes, products and checkout lines. Consumers also face certain challenges and difficulties when shopping. Such concerns include worrying about the money they carried would be inadequate for all the things they bought and also dissipating a lot of time at the cashier. And it is also becoming a growing problem for merchants to consign their customers and predict their demands due to the impact of dispute and also due to the lack of equipment to separate application designs. In some cases consumers have issues with the insufficient discount item data and thereby abuse of superfluous counter time. We will end this problem by supplanting uniform labeling of the omnipresent Universal Product Code (UPC) with sensitive names such as the RFID tag. To solve the above issues, in the field of retail stock we introduce the extensive notion of RFID-based keen shopping cart.

3. PROPOSED SYSTEM

Future system's key objective is to deliver a relevant expertise, low-cost, easily accessible, and even shopping support system. The RFID power-driven electronic shopping trolley is designed to improve the full understanding of shopping for consumers in the computer electronics stores. When enlisting something in the shopping trolley, buyers can have a range of item information accepted. A consumer enters a shopping center and takes a trolley first. Every last trolley will be joined by an RFID reader per user. The background research is the concept whereby the buyer buys an object, the buyer must first inspect the item using the RFID per user with the aid of the same tag present in each item. It can be fastened into the cart at that point the accomplished stuff. Initially Arduino checks the system status whether the contact is online or offline. When checking the item's RF tag, the consumer takes a cost of the purchasing item and secures it in the memory of the system. The RFID reader will offer Arduino identical number of RFID cards through serial communication when the customer punchs RFID card to RFID reader. Arduino will get the database ID information to be displayed on the LCD. The LCD will display details of the recent product along with the total cart amount. It will help the client not to exceed the budget limit. As soon as we press the key put on it, this will automatically send the data in offline contact to the billing counter. If the controller interacts electronically, the final amount will be posted on the corresponding website. User will clear the final amount before the products are packed.

4. CIRCUIT DIAGRAM

The entire process of working is described in the circuit diagram.

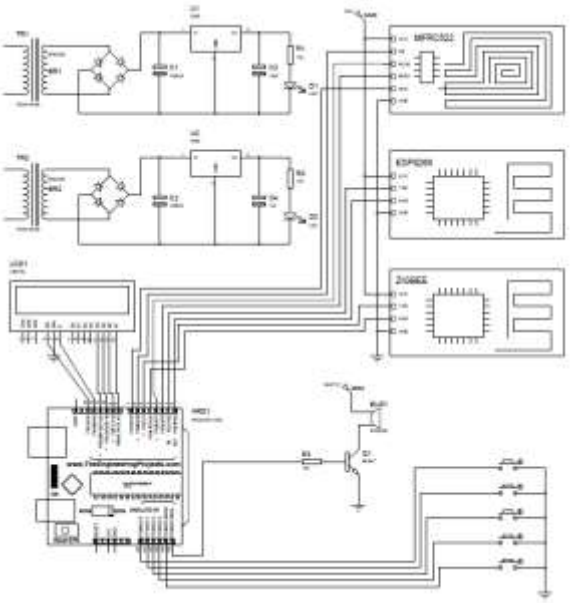

Fig -1: overall circuit diagram

5. HARDWARE AND SOFTWARE REQUIREMENTS

To implement this solution, we are using hardware components and software. The following are used in this idea implementation.

5.1 HARDWARE REQUIREMENTS

5.1.1 MICROCONTROLLER

The ATmega328 microcontroller is the MCU which is used as a main controller in Arduino UNO R3. ATmega328 is an AVR-family MCU; it is an 8-bit device, meaning its data bus architecture and internal registers are designed to handle eight parallel signals. ATmega328 contains three memory types:

Flash memory: Non-volatile Memory 32 KB. This is used for device storage and explains why you do not need to upload your application every time you unplug arduino from its power source.

SRAM memory: volatile memory 2 KB. This is used whilst running to store variables used by the application.

EEPROM memory: 1 KB of non-volatile memories. This can be used to store data that even after the board is powered down and powered up again.

The MCU allows supply voltages from 1.8 to 5.5 V. However, the operating frequency is restricted; for example, if you want to use the highest clock frequency (20 MHz) you will need a supply voltage of at least 4.5V. Serial device is a UART (Universal Asynchronous Receiver / Transmitter). There is only one UART module to the ATmega328. The UART pins (RX, TX) are attached to a USB-to-UART converter circuit and the physical header also attaches to pin0 and pin1. If you are already using the UART to send / receive data over a USB, you will stop using it. The serial interface is the SPI (Serial Peripheral Interfaces). There is only one SPI module to the ATmega328. It can also be used to customize the MCU using a standalone programmer in addition to using it as a serial interface.

5.1.2 ZIGBEE

The Zigbee stated technology is intended to be easier and less costly than other WPANs, such as Bluetooth. Zigbee is aimed at RF applications requiring low data rate, long battery life and safe networking. Zigbee is a proprietary standard for low-cost, low-power, wireless mesh networking. The low cost allows the system to be widely deployed in wireless control and monitoring applications, the low power consumption allows longer battery life, and mesh networking provides high reliability and wider range. The Zigbee protocols in general decrease the time the radio is on in order to reduce the power consumption. Nodes will only need to be participating in beaconing networks while a beacon is being transmitted. The power consumption in non-beacon-enabled networks is distinctly asymmetrical: some devices are always involved, while others spend most of their time sleeping. The software is designed for easy development on lightweight, low cost microprocessors.

Zigbee's radio architecture has been carefully optimized in large-scale production for the low cost. It has few analog phases, and wherever possible uses digital circuits. Although the radios themselves are inexpensive, the Zigbee Qualification Process requires a full validation of physical layer specifications. This amount of concern about the Physical Layer has many advantages, as all radios derived from that set of semiconductor masks will enjoy the same RF features. On the other hand, an uncertified physical layer might cripple the battery life of other devices on a Zigbee network with malfunctions. Where other protocols in a fade compensation response can mask poor sensitivity or other technical problems, the Zigbee radios have very tight engineering constraints: both power and bandwidth are limited. Consequently, radios are tested according to the ISO 17025 standard with guidance provided in Clause 6 of the 802.15.4-2006 standard. Many vendors aim to combine the microcontroller and the radio into a single chip.

5.1.3 RFID READER

The detection of radio frequencies has become a hot topic all over the world. RFID system provides what bar codes can not: information on the precise location and status of the products in a process flow in real time. It does so by wireless data transfer between the RFID reader and the RFID tags. The aim of the RFID system is to allow the transmission of data through a portable device called a tag, which is read by an RFID reader and processed according to the needs of a particular application. An active RFID system's read / write capability is also a considerable advantage in collaborative applications such as work-in-process or maintenance monitoring. Though costlier (compared to barcode) technology, RFID has become indispensable for a wide range of automated data collection and identification applications that would otherwise not be possible. RFID devices are also characterized by their frequency ranges. Low frequency systems (30 KHz to 500 KHz)have short read ranges and lower system costs. They are mostly used in applications for security access, asset tracking, and animal identification. High-frequency systems (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) with long reading ranges (greater than 90 feet) and high reading speeds are used for applications such as railway car tracking and automatic toll collection. The notable benefit of all forms of RFID systems is the technology's non-contact, non-line-of-sight nature.

5.1.4 ESP8266

For internet access the ESP-01 Wifi module is used to connect to a Wi-Fi network. The ESP01 is chip based on ESP8266. The ESP-01 is used on the GISMO board as a Wifi adapter to give the microcontroller wireless Internet access. The Microcontroller andESP-01 hardware interface is a serial interface. The RX and TX pins of the ESP-01 module are attached to pin 9 and 8 (arduino nomenclature) on the GISMO board. Since these pins are not UART hardware pins, a soft serial port is created using the Software Serial library.

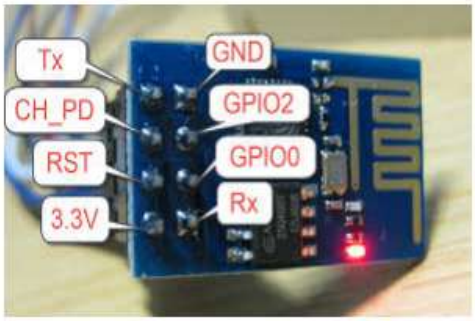

Fig -2: ESP8266 pin

The ESP8266 comes loaded with firmware that can accept AT commands to do various functions over the serial interface. The microcontroller sends these AT commands to the serial interface. The microcontroller will issue those AT commands over the serial interface. A Spark Fun Arduino library provides library functions for issuing the AT commands, receiving and passing / interpreting the answer, thus providing a convenient way to call such functions.

5.1.5 LCD DISPLAY

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. The LCD consists of two glass panels, witched in between by the liquid crystal substance air. The inner surface of the glass plates is filled with transparent electrodes that determine the character, symbols or patterns of polymeric layers to be shown between the electrodes and the liquid crystal, allowing the liquid crystal molecules to maintain a given angle of orientation. Outside the two glass panels one of each polarizers is pasted. Both polarizers will move the light rays passing through them to a certain angle, in a particular direction. When the LCD is in the off state, the two polarizers and the liquid crystal rotate light rays, so that the light rays come out of the LCD without any orientation, and thus the LCD appears transparent. When the electrodes receive appropriate voltage, the liquid crystal molecules would be aligned in a specific direction. The polarizers would rotate the light rays that pass through the LCD, which would trigger / highlight the desired characters. The LCDs are lightweight with a thickness of just a few millimetres. Because the LCD's consume less power, they are compatible with electronic low-power circuits and can be powered for long durations.

The LCD's do produce light and so the show requires light. Reading is possible in the dark by using backlighting. The LCDs have a long service life and a wide range of operating temperatures. It is relatively simple to change the monitor size or screen size, which makes the LCD more customer friendly. The LCDs used exclusively in watches, calculators and measuring instruments are the simple displays of seven lines, with minimal numerical data. Recent technological advancements have resulted in improved legibility, expanded capability for displaying information and a wider temperature range. These have contributed to widespread use of the LCDs in telecommunications and entertainment electronics. The LCDs have even started to replace the cathode ray tubes (CRTs) used for text and graphic display, as well as in small TV applications.

Fig -3: LCD display

5.1.6 POWER SUPPLY

The power supply should be+ 5V, with maximum acceptable 10mv transients. The voltage (VL) at pin 3 should be calibrated appropriately to achieve a better / appropriate contrast for the show. Neither should a module be added or removed from a live circuit. The ground terminal of the power supply must be adequately sealed so that there is no induced voltage in it. The module should be separated from the other circuits, so that there is no induction of stray voltages which may cause a flickering show.

5.2 SOFTWARE REQUIREMENTS

5.2.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform framework, written in the Java programming language (for Windows, macOS, Linux). It is used to write and upload programs to boards which are compatible with Arduino, but also other vendor development boards with the support of 3rd party cores. Under GNU General Public License, version 2 the source code for the IDE is released. The Arduino IDE supports the C and C++ languages using special code structuring rules. The Arduino IDE provides a Wiring project software library which provides many common procedures for input and output. User-written code requires only two basic functions that are compiled and connected to a software stub main() to start the sketch and the main program loop into an executable cyclic executive program with the GNU toolchain, which is also included with the IDE distribution. The Arduino IDE uses the avrdude software to translate the executable code into a hexadecimal text file that is loaded by a loader program in the firmware of the device into the Arduino system.

5.2.2 GCC

GCC stands for "Set of GNU compilers" GCC is an optimized compiler distribution for several important programming languages. Currently such languages include C, C++, Objective-C, Objective-C++, Fortran, Ada, D, Go and BRIG (HSAIL). The abbreviation GCC has many common-use meanings. The current official definition is "GNU Compiler Set," usually referring to the entire tool suite. Finally, when speaking of the language-independent component of GCC, the name is also used: code shared among the compilers for all supported languages.

GCC's language-independent portion includes most optimizers, as well as the "back ends" which generate machine code for different processors. The compiler part specific to a given language is called the "front end." Besides the front ends which are integrated components of GCC, there are several other front ends which are kept separately. These languages like Mercury, and COBOL, support these. They need to be installed together with GCC proper to use those. In languages other than C most compilers have their own names. The compiler in C++ is G++, the compiler for Ada is GNAT etc. When we're talking about compiling one of those languages, we might refer to that compiler by their own name, or as GCC. Any way it is real. Historically compilers have been implemented as "preprocessors" for many languages, including C++ and Fortran, which emit another high-level language such as C. None of the compilers included in GCC are implemented in this way; they all directly generate machine code. Do not confuse this kind of preprocessor with the C preprocessor, which is an integral feature of the languages C, C++, Objective-C and Objective-C++.

6. WORKING PRINCIPLE

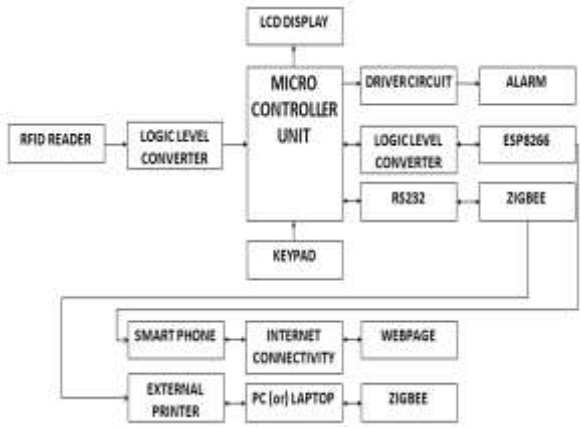

Fig -4: Overall Block Diagram

The main unit of this process is the microcontroller. The only tool that can monitor and control the entire process that we proposed in this framework. Comparing the simple one commonly known as 8051 the device has quite features. The arduino module has internal analog registers for digital communication, electrically erasable programmable memory, and generation of pulse widths. Because of its programmable memory the user friendly module is easy to develop advance code.

Fig -5: Power ON Mode

Driven controller can take a few seconds to turn on when power switches on. Once the controller has operated the coding conditions will be executed. In our phase, when it is driven the controller initializes liquid crystal display. After the liquid crystal display controller is initialized, the project title will be printed and some seconds will sleep. Picture above showing the project title that is captured after the microcontroller is powered. Here we run our project in online and offline mode. When the trolley is being taken over by the customer, the controller tests the online communication status.

Fig -6: Online Communication

Fig -7: Offline Communication

If the controller fails to connect to the user, the contact is disabled offline. Online communication consists of RFID Reader and ESP Unit, while offline communication with the billing portion includes Zigbee. At the end of selected contact mode, the controller asks the user the amount of the shopping. User need to store the amount of the purchase in the controller. Five channel keypads are used in this process to make respective adjustments such as increment and decrement. Once the amount is entered, controller store the amount locally in the variable and conduct the next shopping operation.

Fig -8: Amount Status

Here we use ten RFID Card numbers in this process. Data from the RFID card are programmed in controller. The product data are reader through RFID Reader. When the user purchases some products he / she has to show the reader the card. The device has RFID Tag that has specific digits to transmit when the reader attempts to read data. In LCD Display, the controller processes the data and displays product details such as name, weight, and price.

Fig -9: Product Status

We are groundbreaking in this process with an existing system that includes RFID readers to detect items in and out of status. Controller stores the data of the RFID here. Once controller senses multiple single product entries it considers both in and out. Consumer need to press bill button at the end of shopping. If the controller is operating in online mode, the total cost submit to the webpage.

Fig -10: Online Payment

Otherwise data are sent via zigbee communication to the billing area.

Fig -11: Offline Payment

Finally, the payment can be checked by scanning the QR code attached in the trolley and the goods are packed and delivered to the customer within short time. Hence, it enhances the customer's shopping experience.

Fig -12: QR Code

Fig -13: Overall Hardware Development

7. ADVANTAGES

1. **Speed** – High speed communication 1us per instruction execution for controller.
2. **Accuracy** - Automation systems are more accurate and consistent than their human counterparts.
3. **Production** - Work cells create more because they perform applications with more accuracy, speed and tirelessness.
4. **Reliability** – The system can work 24 hours a day, seven days a week without stopping or tiring.
5. **Flexibility** – The system can be reprogrammable and possible to apply additional sensor parameters**.**

8. DISADVANTAGES

1. Power requirement is more.
2. High Cost

9. CONCLUSION

In this paper, we have implemented smart shopping trolley using RFID reader and zigbee module. By using this, the product information is directly sent to the billing system. The total sum of the shopping is sent directly to the website by using the ESP module. And no need to wait in a long line

for customers. It is reliable, highly dependable, and time-efficient.

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