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Development of E-Genius Shopping Cart Billing Estimator Using Arduino Microcontroller

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Abstract: People nowadays are fond of buying goods, most of the time they buy "one-time big-time" as old sayings to save time and money. Carts were helpful, especially when customers are up to a large number of goods to have. It provides the customer ease to carry their purchased goods from the store to their respective cars. Due to long queues, overspending, and troublesome price inquiry in the supermarkets, the researchers have been challenged to innovate a more conventional shopping cart through Shopping Cart Automation (SCAn). The main objective of this project was to design an automated shopping cart that enhances the conventional shopping cart that was capable of setting the budget, price inquiry, over the budget notification, and alarm for users to monitor the accumulated price of all items in the shopping cart. In this project, only those scanned items will be included as purchased items. The researchers have inserted a secure digital (SD) card connected to the Arduino microcontroller as a storage device for the price database; the price database comprises all of the items stored on the SD card; thus, adding any item scanned will result in a purchase. It was additionally found that notifying clients by way of monitor displays alone is insufficient; hence, a beeping alarm was used to alert customers when the customer's total price for products in the cart exceeds the pre-defined budget. The SCAn has a high demand in supermarkets, especially in the local area, based on the interviews with the target beneficiary and other small-scale grocery conducted by the researchers. Implementing this project would cut costs, save time, improve efficiency, eliminate human error, and later be developed long into the future, such as more protected casing, voice services for notification, and installing the thermal printer.

Keywords: Arduino microcontroller, bar code technology, shopping cart automation, thermal printer

1. Introduction

Shopping carts are widely used in supermarkets. It is a basket supported by wheels and used to hold goods while shopping. When it was invented, the shopping cart earned its credibility to make shopping much easier for the customers. The shopping cart has undergone many more changes as time has progressed, but those changes only focused on its capacity to hold goods. [1] stated that customers must wait in extensive lines to purchase products in a shopping center. Those lines take a long time before the customer can buy goods. According to a British academic researcher [2], the average queue time in UK retailers is 5 minutes 54 seconds long enough to miss most vital activities like flight departure.

Considering that we are now living on the 21st century where technological advances are at boost, shopping cart seems to be old fashioned and outdated. The rate of people of all ages who are attracted to electronic gadgets has altered dramatically due to technological advancements. Electronic equipment such as intelligent card readers, barcode scanners, and RFID scanners are becoming more common in many businesses. These kinds of equipment are also required in supermarkets [3].

Nowadays, since shopping carts have been outdated, innovators and other researchers conducted a case study on upgrading the conventional pushcart. This difficulty can be solved by presenting a creative alternative to typical billing techniques, which will speed up the payment process [4]. Hence, they want to study what is more beneficial to the consumers; the automated shopping cart has developed from simply installing a reading system

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up to wireless communication of database counter through RFID technology. The RFID module leverages the SPI communication technique to move or retrieve data from an RFID card or tag [5].

As part of the technological society, the researchers aimed to enhance the innovative, conventional shopping carts used in supermarkets by applying a bar code reading system and using microcontrollers to automate shopping carts. The project is called Shopping Cart Automation (SCAn). The SCAn can lessen the long queuing process, helps the customers avoid overspending, and provide convenient price inquiries.

This research study aimed to determine the functionality of the project through specific experiments and tests conducted. Specifically, the study sought to answer the following questions: (a) How will the project accept entry on the database at a given attempt? (b) What is the response and time interval of the project upon scanning an item? and (c) How will the project notify the user and show that the accumulated amount was accurate?

2. Methodology

2.1 Research Design

The researchers used an experimental approach. The project requires plenty of experiments and tests to prove every scope and improve its limitations. The researchers also set a system requirement for both software and hardware functionality. For software, it was designed to make a scanning and computing device that will display output which accuracy. For hardware, to innovate a shopping cart that was more convenient to use. Without the program flow and architectural design, the project would not obtain the desired output.

2.2 Respondents

The researcher's target client was the 27N supermarket located at Iba, Zambales. They were three (3) groups of individuals who benefited. The owner and its managers will enjoy easy management because barcodes are very useful in logistics and supply chain management. It also reduces employee training time and increases productivity since the developed device uses a hand-held scanner for reading barcodes to speed up the transaction.

2.3 Conceptual Framework

The project design aims to achieve its desired result through the input-process-output conceptual framework model, as seen in Figure 1. The inputs are the allotted budget through the 4x4 membrane keypad and scanned barcodes with the help of a barcode reader. Process, microcontroller generates the scanned barcode to the SD card and will be compared if it exists in the database then accumulate the added item else deleted items. Results will display the name, quantity, weight, and price of the scanned item using an LCD monitor, and an additional sound alarm feature was installed.

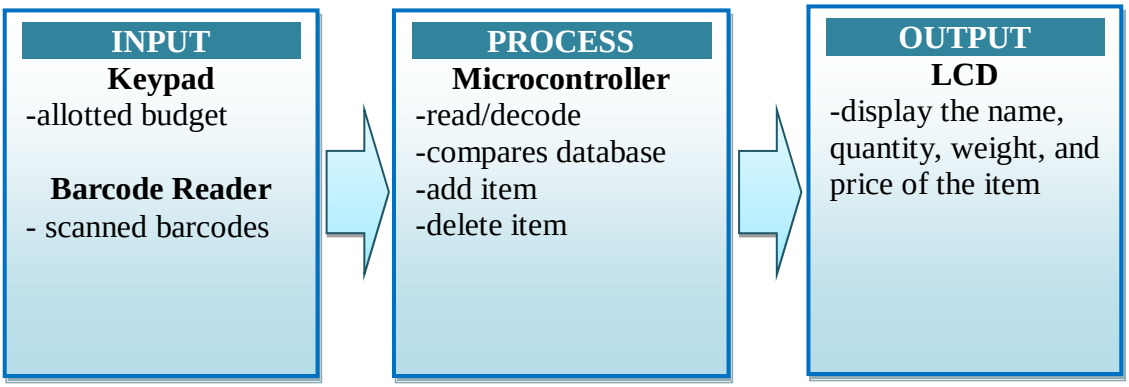

Figure 1. The Input-Process-Output framework of Shopping Cart Automation

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2.4 System Architectur

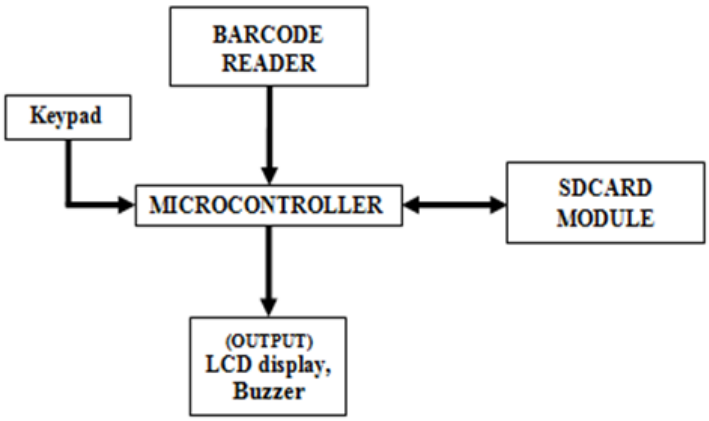

Figure 2. The block diagram of Shopping Cart Automation

Figure 2 shows that the project was designed with a keypad for the user to input their allotted budget. The barcode reader was used to scan the chosen item. Once the barcode has been scanned, the microcontroller connected to the SD card that serves as the storage of the database program compares if the scanned barcode is available. If yes, the device would accumulate and display an output else not. A sound alarm was also installed to notify the user.

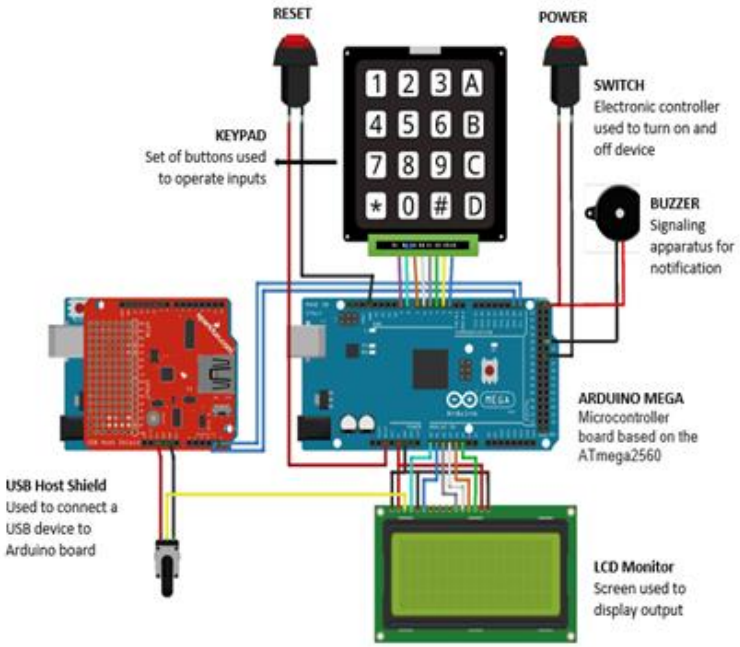

Figure 3. Hardware Design of the Project

A budget must be inputted through the 4x4 membrane-type keypad along with the configured connection to the microcontroller. The inputted value will be saved on a temporary register set on the program. The barcode reader must scan a barcode sent to the USB host shield that allows communication between the microcontroller and other components linked. The programmed Arduino UNO will then interpret the code and sends the decoded data to Arduino Mega through I2C synchronous serial protocol. The Arduino Mega search for a similar barcode on the database then displays factual information about the barcode on the 20x4 LCD. A specific function must be set through the custom buttons on the 4x4 membrane-type keypad to satisfy the device's needed action. A logic expression was set on the program to know if the total purchase was exceeded the allocated budget. Then a notification on the 20x4 LCD will be displaying the item name, prices, quantity, and

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the total amount included, and the buzzer will alarm if the accumulated amount was exceeded the allocated value. A push-to-on was set to stop the process of the device and trigger from displaying the total summary of the purchase items. Another push-to-on switch was connected to the microcontroller's ground to restart the whole process of the device.

2.2.3 Software Design / Flow chart

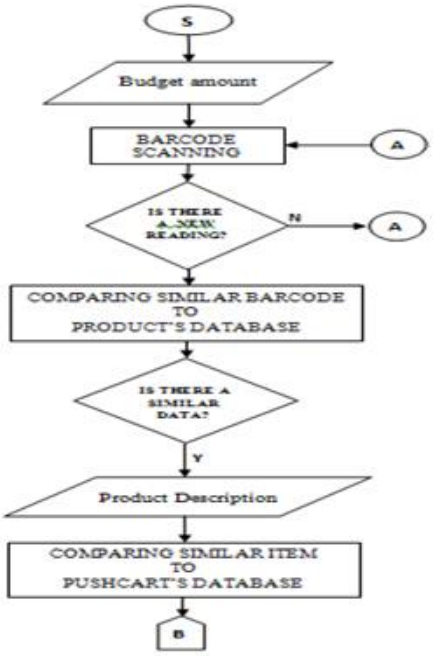

Figure 4a. The flow chart of Shopping Cart Automation

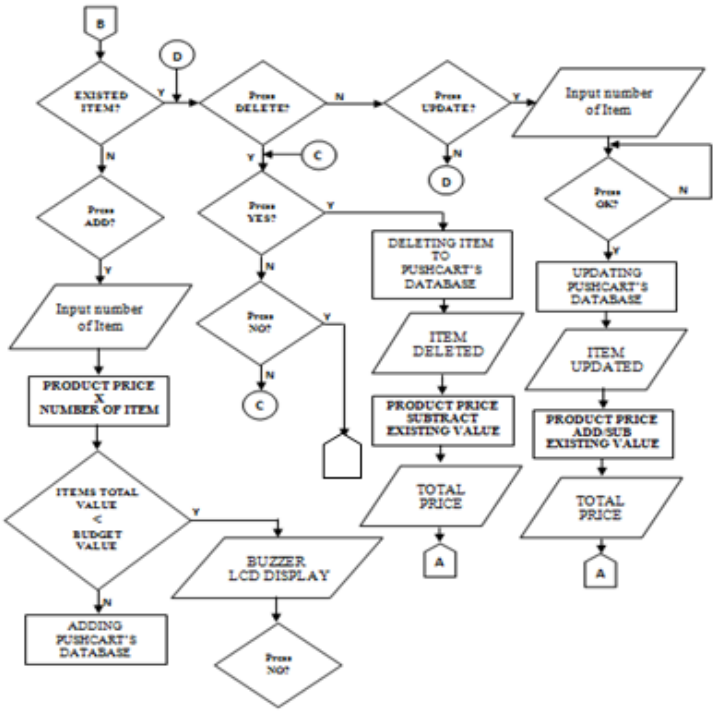

Figure 4b. The flow chart of Shopping Cart Automation

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Algorithm

For further understanding of the flow of the program, the following step by step instructions has been instructed:

1. Press the start button.
2. Enter the budget allotted.
3. Press the Add button to purchase an item.
4. Items must be read/scan by the bar code reader.
5. All recognized items will be displayed with prizes on the LCD screen.

a. Once the item has been detected, the device will automatically get the sum of the item.

b. If not recognized, the buzzer will alarm the customer and notify through the screen that the item is not detected.

c. If it detects that the total price of the purchased item on the cart is exceeded the allotted budget, the buzzer will alarm and ask the customer if he/she wants to continue else push the button to stop.

6. Press the Delete button to remove the unwanted item.
7. Confirm notification.

2.5 Data Gathering Procedures

The researcher asked for the approval of the 27N supermarket to become the target client company. Additionally, the researcher surveyed various staff and consumer populations in the region and used the internet to seek project-related ideas. Afterward, a series of tests examined the project's design and flow, resulting in the desired output.

3. Results and Discussion

3.1. How will the project accept entry on the database at a given attempt?

Table 1.Test on scanning the items through Barcode reader

Trial	Item	Result
1ST attempt	Piattos Cheese Flavored	scanned
2nd attempt	Summit Natural Drinking Water	scanned
3rd attempt	Cussons Baby Powder	scanned
4th attempt	Colgate Fluoride Toothpaste	scanned
5th attempt	Johnson's Baby Powder	scanned

Based on the experimentation performed as shown in Table 1, starting from the first attempt, the result was scanned, and the test was repeated five (5) times and outputted the same result. Therefore, the researcher concluded that the barcode reading system was correctly installed and very well-functioning within the given items to be read and scanned to register on the project's database.

3.2 What is the response and time interval of the project upon scanning an item?

Table 2. Test on the response time in scanning items

Item	Time	Response
Piattos Cheese Flavored	3 seconds	success
Summit Natural Drinking Water	3 seconds	success
Cussons Baby Powder	3 seconds	success
Colgate Fluoride Toothpaste	3 seconds	success
Johnson's Baby Powder	3 seconds	success

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Based on the experimentation performed as shown in Table 2, the barcode reading system is more convenient in terms of scanning items in the shopping cart and acceptable for the reliability of the information. The response time of the barcode reader to read the barcode was 3 seconds. However, the researcher finds out by reading some information about barcodes that the time interval of scanning may vary depending upon the barcode's visibility and scanning angle.

3.3. How will the project notify the user and show that the accumulated amount was accurate?

Table 3.Test on Overspending Notification

Item	Qty	Unit Price	Total Price Accumulated	Warning/ Notification
1.Lemon Sqr ChooChoo	3	50	150	None
150				
2.Nature's Spring	10	25	250	None
400				
3.Piattos Cheese	10	25	250	None
650				
4.Downy Parfum Cllct	8	20	160	None
810				
5.KOPIKO Blanca	60	8	240	Item exceeded P50.00 on the Budget! ADD? -Yes
1,050				
6.Lewis&Pearl Powder	19.50	9	175.50	Item exceeded P175.50 on the Budget! ADD? -Yes
1,225.50				
7.Cussons Baby Powder	28.50	5	142.50	Item exceeded P142.50 on the budget! ADD? -No
Total			*1,225.50*	*Budget Exceeded, Alarm Activated!*

Note: Budget: ₱ 1,000.00

Based on the experimentation performed as shown in Table 3, the project computed the specific of the item scanned. Looking at trial number 6 the project notifies the user that the allotted budget inputted has reached and about to exceed, the research will notify and prompt the user whether to accept the exceed good or stick with the items belong to the allotted budget. The research also has accurate computing based on the output perform in the experiments.

3.4 Screenshot of the Device

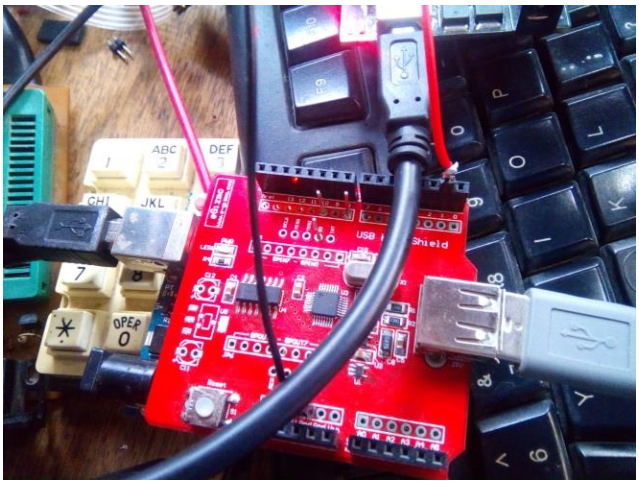

Figure 5. USB Host Shield connected to the Arduino board

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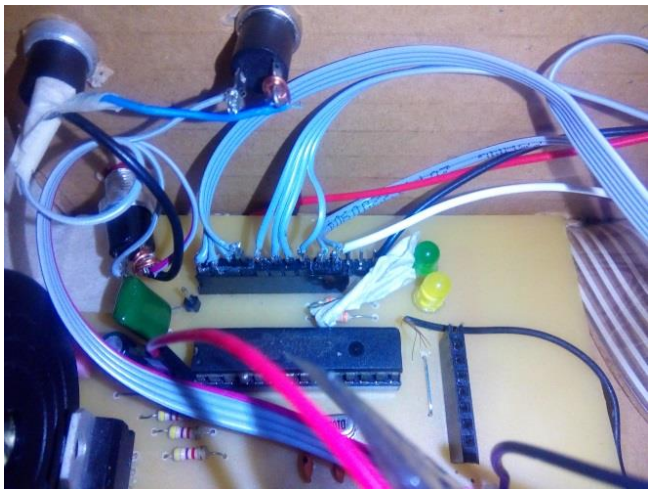

Figure 6. Arduino Microcontroller ATMega2560 with a switch and buzzer

Figure 7. E-Genius Shopping Cart Billing Estimator Prototype

4. Conclusion

This research study positively impacted reducing the long queuing process and will help the customers avoid overspending and provide convenient price inquiries. The Shopping Cart Automation met its objectives, such as scanning barcodes, accumulating prices, and displaying outputs. The developed device showed an efficient performance in avoiding overspending due to its input of budget allocation and monitoring of purchased items through notification. The device was also accepted in the supermarket, and since interviews revealed a significant demand for the project, it was a success. Based on the test results, the designed device accomplished its designated function.

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