Original Research Paper



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ZIGBEE BASED SUPERMARKET AUTOMATED SYSTEM FOR BULK BILLINGS: A CONCEPTUAL MODEL OF A WIRELESS SYSTEM

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ABSTRACT Large supermarkets used by billions of people for acquisition of product, represent a complicated process comprising wastage of time spent, location of products and long queues at checkout. Besides, it is becoming harder for retailers to maintain loyalty towards clients and forecast their needs, resulting from the lack of availability of tools and intense competition influence that discriminate patterns of consumption. This paper presents and proposes a solution in the form of innovative system architecture for an product acquisition and commercial development. An implementation of a proposed Zigbee based system for billing will enable consumers payoff their total purchase bill instantly at payment counter upon arrival. This will increase customer satisfaction, taking minimal time for payment and reducing manpower required at supermarkets. Moreover, it describes how a system work's in technological manner and how wireless supermarket automation can contribute in exploring quality of services provided by retailers, saving expenditure on manpower.

KEYWORDS: ZigBee technology, ARM7, LPC 2148 MC, Barcode reader

1. Introduction

Structural changes have occurred at large scale in recent years, having consequences and impact on societal and economic growth, especially on determinants such as cultural and consumption patterns, openness approach towards global markets, urbanization, family structures and occupation (Xiaodong, 2012). Innovation in information technologies and business communication has caused a change in perception, values and gained knowledge in considerable areas of human understanding, giving rise to the "Era of Advanced Information and Knowledge" (Rao B., 2015). Nowadays, grocery and retail industry sector is of extreme significance in the global economy and worldwide market; with its evolution in current economic, social and technological phases and terms, making it diverse and most essential business. Usually, present day shopping involves long-time waiting at checkout to scan each item in cart. This leads to wasting great amount of time for customers.

The emergence of new technologies might make traditional retail processes productive, efficient and more transparent escalating operational excellence. Technology exemplify an opportunity for retailers to lessen costs, enhance services and allowing to fulfill clients expectations by supplying precise personalized services. The advances in information, supply chain and manufacturing in combination with an urbanized and modernized society, gave rise to the creation of so-called "New and Advanced Consumer" (Andrews, 2014). Today's consumer has a deep and extensive understanding in comparing brands and product costs by being selective and versatile in brand preferences and more attentive towards supplied information.

In this paper, wireless billing system for big supermarkets is framed. The main objective is to reduce time taken during billing (i.e. no queues) at counter, since billing will be done wirelessly. Secondly, reducing man power required to minimize overhead cost of a system. System accounts of two main units;

- Trolley Unit
- Complete Unit

There is usage of barcode reader & Wireless Standard ZigBee (IEEE 802.15.4) (Acosta, 2018). Barcode reader is used to scan products whereas ZigBee establishes wireless connectivity and transmission protocol between trolley unit and Personal Computer (PC) available at the counter.

2. Literature Review

Various author reviews of literature in general suggest a need of exploring emerging technologies and improvement in quality of services at supermarkets, particularly in developing nations. Awati and Awati (2012) consider microcontroller based designs to be less bulky and easy for installations while introducing new concept of mall automation. Chen et al. (2015) further developed this study focusing on hardware and software integrated designs for proposing new methods of navigations and for establishing stable operations during shopping. Xiaodong (2012) researched on the support and features of comprehensive smart processing of data within supermarket for quick, reliable and personalized customer experience. And rews (2014) investigated a need of omitting routine tasks and establishing the purpose of instant payoff and increasing customer satisfaction by formulating wireless billing system. Chandrasekar and Sangeetha (2014) worked on proposing a contemporary model of embedded systems and Radio Frequency and Identification (RFID) to avoid gueues in supermarket. Rao et al. (2017) examined large supermarkets and their infrastructure which needs more human resource for maintaining queues and generating bills and subsequently suggested decentralization of a billing process along with an advancements in technology. Even Singhi and Jayavel (2017) revealed the importance of user-friendly automated systems and urgency of developing smart cart in big grocery stores through detailed analysis of limitations beared by existing systems. Kulkarni et al. (2017) addressed the implementation and manageability of electronic hardware system and wireless link for a payment of bills in supermarket using RFID. Aaron et al. (2017) suggests necessity of efficient counter systems at checkout in order to decrease manpower and possibility of marginal errors of wrong price, unreliable goods loss etc. Gurule and Gulve (2018) put forth an idea of an analytical model of IoT based automized billing system to lessen overall management expenses.

The review of engineering publications disclosed crisis and severe shortcomings to carry out billings at supermarkets. It described current flaws, suggesting ideas and solution to cultivate innovation in communication. Early publications recommended and researched on conceptualized models of automation in billings at supermarket. Later on, recent publications discussed feasibility of implementing automation in reality. This has provided major insights for developing application model for automation in billings. The major research questions essential to be answered are suggesting appropriate system architecture and building technological model associated with the architecture to achieve intended outcomes explained below.

3. Methodology

3.1 Empirical and Proposed System Architecture

The architectural implementation of a wireless system allows and introduce a new and unique method of shopping. After the arrival at supermarket, a consumer heads for shopping, following the

operations of technological system elaborated further. Technological system consists of:

Trolley unit constituting:

LPC 2148 controller, peripherals such as LCD module, buzzer, keypad, serial memory Interface using I2C bus, barcode reader and ZigBee interface using MAX232

Complete unit constituting:

PC unit, MAX232 interface to PC unit of ZigBee transceiver

Figure 1 specifies a proposed architecture for this system. Figure 2 specifies the complete technological model of Figure 1.



Figure 1. A proposed System Architecture



Figure 2. Technological model comprising of the Trolley and Complete unit

3.2 Working of a proposed system architecture

The key objective of a technological model in the form of offered solution is the utilization of ZigbBee transceiver for the identification of products in which firstly, user initialize Controller, Liquid Crystal Display (LCD), Universal Asynchronous Receiver/Transmitter (UART) for barcode, ZigBee and shopping buffer. Next, barcode reader waits for an item to be brought in its vicinity to scan and if barcode is valid, it would send command to the controller to extracts the product name & information from a look up table memory to display it on the LCD module interfaced with a controller. Controller would wait for a key to be pressed (either add, reject, delete, end) i.e. read keypad. After displaying an information on the LCD customer can decide to add, delete or reject the product item. If user is willing to add product, then add subroutine is followed with a search of the product in shopping list. After that, if available in the list, value is incremented adding with pervious product and displaying on LCD. At the same time, product code is sent via ZigBee transceiver present on the onboard hardware to PC unit present at the counter which consist of ZigBee transceiver interface to pc and it is within the overall wide range of an mall. With a possibility of deleting item, user should follow delete subroutine. To discard product, delete key is to be pressed and user must descan intended product via barcode reader. Controller would search product from a shopping list, and will subtract value and display it on the LCD and as well transmit it to counter PC unit using ZigBee wireless connectivity. After finalizing shopping items, user has to press end key so that the person on the counter would know that user is ready for billing. When user would arrive at counter, would not wait in a queue and can directly receive bill in hands with no longer verification and scan. Thus, paying a bill amount, a consumer can take quick exit from the supermarket. Also, there is less man power and energy expenditure for a person at the counter PC unit.

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The complete work flow diagram for an above explanation has been shown in the Figure 3 of Appendix A.

4. Future Scope

Inclusive study and research can be conducted for the following listings, which can offer new directions for future analysis:

- 1. Study and implementation of user interface & SQL for database storage and maintenance
- 2. Burning of the programming code on ARM7 LPC 2148 controller
- 3. Testing of power supply & correction of errors if any
- Verifying entire on-board circuitry and its components, to examine their functionality and working

5. Conclusion and Discussion

This paper recommend and exploit latest developments, interpreting types of radio transmission and wireless technologies for billing and identifying product at supermarket. Also, it studies and surveys research insights evaluating application of ZigBee wireless system that can make supermarket billing process easier. Comprehensive study about a technological and business model for supermarkets and for its all future schemes is carried out. Learning of a system architecture used in intelligent shopping to save energy, capital and time of the consumers is manifested. Therefore, supply chain management has wider scope for ZigBee protocol. In near future, if testing and implementation is favorable and feasible, we can run the developed and proposed prototype architecture in real as wireless billing has potential to improvise our lies to a great extent.

Appendix

Appendix A



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