Futuristic Trolley for Intelligent billing with the Amalgamation of Barcode Reader and zigbee

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Abstract— *An innovative product with societal acceptance is one that aids comfort and efficiency in everyday life. Purchasing at big malls is becoming a daily activity in metro cities. People purchase different items in the malls and puts them in the trolley. In the conventional method, cashier uses the barcode reader to prepare the bill. This is very time consuming process which results in a long queue at billing counter. In our project, "Futuristic Trolley for Intelligent Billing with the Amalgamation of Barcode Reader and Zigbee" we are using barcodes and strain gauge. This barcodes will be on the product. Whenever the customer puts a product into trolley it will get scanned by barcode reader and the product's price and weight will be display on LCD display. Like this the process goes on. We are using Zigbee which will be at trolley and it is used to transfer data to main computer. At the main computer, Zigbee receives the data from transmitter to store the product's price and weight.*

Keywords— *Barcode Reader, Zigbee, Load cell(Strain gauge)*

1. INTRODUCTION

Shopping mall is a place where people get their daily necessities ranging from food products, clothing, electrical appliances etc. Now day's numbers of large as well as small shopping malls has increased throughout the global due to increasing public demand & spending. Sometimes customers have problems regarding the incomplete information about the product on sale and waste of unnecessary time at the billing counters. Continuous improvement is required in the traditional billing system to improve the quality of shopping experience to the customers. To overcome these problems stated above and to improve the existing system, we have designed a "Futuristic Trolley for Intelligent Billing with the Amalgamation of Barcode Reader and Zigbee". This can be done by simply attaching barcode reader and strain gauge on the shopping trolley. With this system customer will have the information about price of every item that are scanned in, total price of the item and also brief about the product. This system will save time of customers and manpower required in mall and cost associated with the product.

We propose and implement a solution that has redundancy built into it in order to reduce the probability of failure, and has three main benefits:
1) It creates a better shopping experience for the customers by saving their time.
2) It minimizes the man-power required at the shopping mall, as the checking-out process at the check-out counters is eliminated altogether.
3) It handles cases of deception if any, thereby making the system attractive not only to the customers, but also to the sellers.

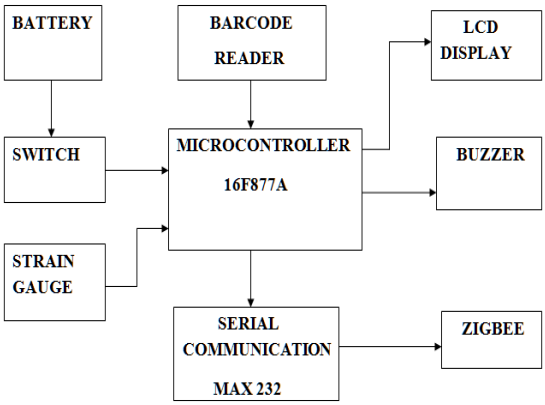
A number of attempts have been made to design a Smart Shopping Cart with various different functionalities. It describe a Smart Trolley design that concentrates on how to get the customers rid of dragging heavy trolleys and to automate billing, but it assumes all the customers to be honest and hence does not tackle cases of deception, if there are any. Further, Yew et al. [3] propose a smart shopping for future where the barcodes are completely replaced by Radio Frequency Identification (RFID) tags and scanners. This idea might take a long time to be deployed as it is expensive both in terms of money and energy. A lot of other works describe how products in a store could be tracked by customers instead of spending a lot of time searching for it.

In this paper, the system design considerably minimizes the overhead of wireless communication among the devices involved in the system as almost every processing is done locally at each cart instead of transmitting packets to another node. Hence even when there are a lot of customers present in the shopping mall, there will not be any deterioration in the performance owing to communication gridlock. Every Shopping Cart is equipped with a load-cell fitted at the base of the trolley, a barcode reader and a system for local processing and display purposes. Every customer is identified by the ID of the cart s/he picks for shopping. The Base Station at the payment counter consists of a database that stores information of all the products, and a sensor mote to communicate with all the Smart Carts in the mall. When a customer starts shopping, s/he has to scan the barcode of the product with the barcode scanner present at the cart, after which the product has to be put into the basket. The barcode of the product is wirelessly transmitted by the mote to the Base Station using the IEEE 802.15.4 (ZigBee Protocol) [4] over the ZigBee network. ZigBee is chosen along with the IEEE 802.15.4 compatible sensor motes because they are easily available and mass produced. However, any other short distance radio system will work equally well. In reply, the Base Station sends relevant

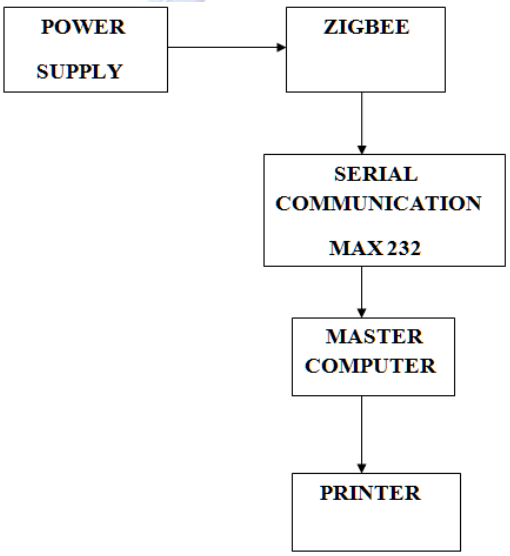
information about the product, which is used in the decision-making process at the cart. After the customer finishes shopping, s/he then proceeds to the payment counter to pay the bill amount and is assisted by an attendant only in the case the system detects discrepancy in the self check-out process of the customer.

2. BLOCK DIAGRAM

SHOPPING TROLLEY SIDE



CASH COUNTER SIDE



3. DETAILED DESCRIPTION OF THE SMART SYSTEM

The features supported by the Smart Shopping Cart and the idea behind how these features are achieved are explained in the next two sub-sections. Features of the Smart Shopping Cart

The capabilities of the Smart Shopping Cart are listed below:

1) The basic function of calculating and updating customers' bill as and when s/he places the shopped products in the cart.
2) The customer can also track the details of the purchased items as well as the current bill amount on the monitor that is attached to the cart.
3) In addition to the above features, it also includes the handling of the following special cases, which ensures that the system is fair in all respects. All the cases mentioned below are detected by the system.
a) Attempt to take away products by keeping them into the cart without scanning their barcodes.
b) When the customer scans a product, but forgets to keep it in the cart.
c) Attempt to scan one product, but place multiple products in the cart.
d) Since consumers are likely to change their mind, our implementation allows for removing any item already placed in the cart, without help from attendant. Next few sub-sections describe how these functionalities are incorporated into the Smart Shopping System.

The design has been focused to tackle all the scenarios which are mentioned above. As the goal of the Smart Shopping System is automation, the first requirement is to have a barcode scanner attached to every shopping cart. Hence, this design includes. The barcode scanner is required to identify a product so that its price can be determined from the database, which stores all the relevant information about all the products. The database in our design is stored in the Base Station, which is located at the payment counter. Some of the information per product that is stored in the database includes its barcode, its name, price and weight. The weight attribute of a product has been chosen for a way to double-check the identity of the product in order to detect deception in the system. A load-cell has been configured as a weight sensor. The output of the load-cell is used in the decision making process at the cart. If the weight of a product estimated by the load-cell is not the same as the actual weight of the product, it is interpreted as a case of discrepancy.

4. IMPLEMENTATION DETAILS

A prototype has been made based on the the same design idea. The various components that are used in the implementation along with the important considerations are explained in details.

1) Weight Sensor: A load-cell is configured as a weight sensor. A load cell is a transducer, which is used to convert a force into electrical signal, an analog output voltage. The load cell CZL601- 3kg denotes the Rated Capacity of the load cell. The load cell can be chosen based on what precision in weight is required, which in turn depends on what kinds of products are available in the Shopping Store. The cost of the load-cell depends on its precision, higher the precision, higher the price. One end of the load cell has to be fixed and force has to be applied on the other end so that the deformation in the strain gauge of the load cell is indirectly converted to an output voltage. The load cell is supplied with a DC voltage of 9 Volts with the help of a Transistor battery.

2) Barcode reader: A barcode reader also called a price scanner or point-of-sale (POS) scanner is a hand-held or stationary input device used to capture and read information contained in a bar code. A barcode reader consists of a scanner, a decoder (either built-in or external), and a cable used to connect the reader with a computer. Because a barcode reader merely captures and translates the barcode into numbers or letters, the data must be sent to a computer so that a software application can make sense of the data. Barcode scanners can be connected to a computer through a serial port, keyboard port, or an interface device called a wedge. A barcode reader works by directing a beam of light across the bar code and measuring the amount of light that is reflected back. (The dark bars on a barcode reflect less light than the white spaces between them.) The scanner converts the light energy into electrical energy, which is then converted into data by the decoder and forwarded to a computer.

There are five basic kinds of barcode readers such as pen wands, slot scanners, Charge-Couple Device (CCD) scanners, image scanners, and laser scanners.

5. RESULTS AND FEASIBILITY

The experimental set-up is tested for various test cases, with various products tested for all the possible cases mentioned above. When the system is tested with a single Shopping Cart and a Base Station, it gives the correct result for all the cases except for the case when the lighting condition is very poor, i.e., when the lighting condition in the environment is very dim/dark. This is because the object in the image cannot be recognized because of the darkness, due to which the SIFT algorithm fails to extract the key points of the object. The lighting in a store is expected to be bright. Low lighting conditions can be indicated on the smart cart by setting the attendant flag. This attendant flag is the same as the one set when weight or images do not match. Next, we observe how much time it takes for the entire process to take place with respect to the distance of a Shopping Cart from a Base Station. This is required in order to decide on the placement and the number of repeaters inside the Shopping Mall. The processing time includes the time taken by the cart to generate a decision and the time for the wireless communication between the Base Station and the Shopping Cart. This variation in the response time is mainly due to the time taken for the wireless communication, as the time taken in decision-making at the cart is approximately the same every time.

6. CONCLUSION AND FUTURE WORK

The project successfully demonstrated the possibility of using barcode for developing a Smart Shopping System which automates the entire billing procedure. The system which is developed is highly reliable, fair and cost-effective. It is reliable and fair because of the effectiveness of WSN combined with a highly reliable Image Processing technique. The system is also energy constraint as it uses a passive sensor and it reduces the communication requirement. The decision making process is done locally within the cart, thereby eliminating an overhead to the communication between the motes. Also, the application does not make use of complex routing mechanisms or unicast transmissions; our implementation makes use of the simple broadcast technique to communicate with the Base Station as each cart is associated with a unique ID. The system is cost-effective as it requires only one passive sensor (the load-cell) and a camera-based
barcode scanner (which is way cheaper than any other type of barcode scanners) per cart. In the bigger picture, it reduces the man-power requirements. The effect of multiple users operating at the same time, as well as any spectrum coexistence issues must be studied since the proposed system uses the over-used 2.4 GHz spectrum. The current implementation also does not talk about the placement of repeaters
inside a supermarket layout.

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