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Smart Shopping Trolley (E-Cart)

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Abstract: This project aims to design and develop a prototype of an automated motorized shopping cart, capable of trailing shoppers along with the extensive ability to avoid obstacles with its built-in intelligence.

This feature has enabled the study of embedding the extensive ability of trailing shoppers in a shopping complex. Given a situation with obstacles in a complex mall, the shopping cart would have the ability to evade them. This can be done because of the system is governed by a simple micro-controller (Arduino Mega 2560), with ultrasonic positioning system (Transmitter and Receiver based approach) for identifying and locating the target person, and infrared sensors system to measure the direction of obstacles. In hope of adding intelligence values the shopping cart would be design in such a way that, the purpose of extending convenience service and safety to the customer can be delivered.

Index Terms - RFID tag, IoT, Smart Shopping, Smart Cart, Grocery Shop, Smart Trolley System for Automated Billing using RFID and IoT.

INTRODUCTION

The pace of technological progress is exponential in this era of unanticipated conversion. Many companies are investing in features that provide a particular level of satisfaction for customers at all levels. One of the most obvious developments is the use of technology in customer service, which ensures that customers will receive modern, reliable structures.

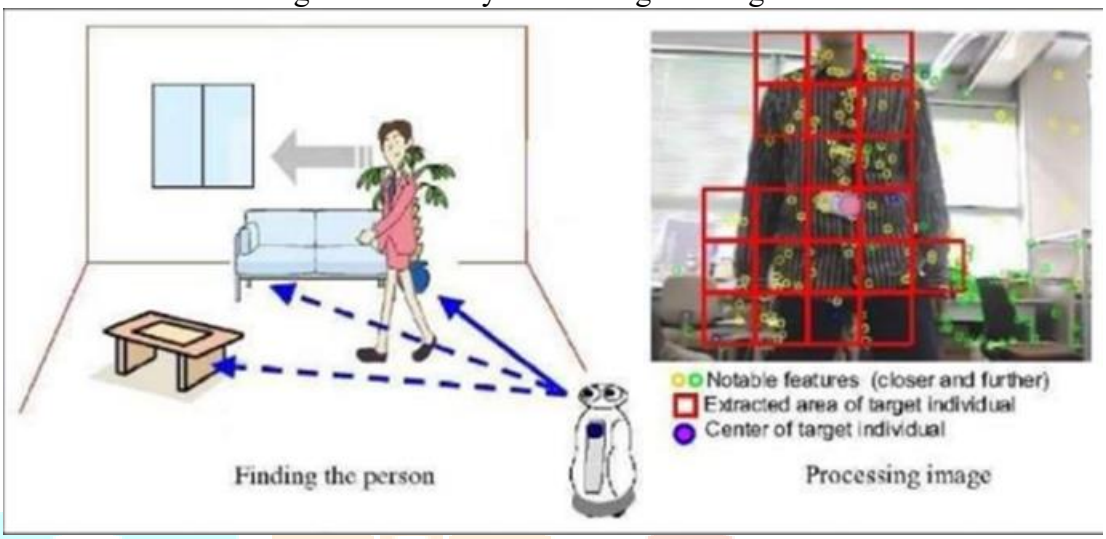
Shopping carts, sometimes known as purchasing trolleys, are a way to move goods around a store temporarily before purchasing something. Since its creation, shopping carts have seen little alterations. The majority of the enhancements were made to modify its weight and capacity. But as technology has improved, several of the company's investigations have led to the development of a convenient purchase machine for customers. For example, the purchasing trolley may have a bar code scanner and hint panel linked. The customer may be able to learn about the products' location and promotion by consulting the contact panel.

As mentioned, the creation of the shopping cart can maintain the customer's purchasing time; nonetheless, it necessitates manual navigation with the help of the client. Thus, the goal of this mission is to give the customer hands-free shopping such that shopping carts with artificial intelligence and self-propulsion are unavoidably needed.

LITERATURE

To the best of our knowledge, there aren't many publications in the literature about RFID-enabled automated grocery carts. Sainath (2014) used barcode technology to bill customers for purchases through an automated shopping trolley for supermarkets. The customer scans the product barcode. The customer will pay the payment by presenting their unique ID to the central billing system, where the bill will be sent.

Figure 1: Visually-Based Target Recognition



Barcode scanning is limited by the need for a line of sight, which should be set within its bounds.Budic (2014) created a cash register lines optimization solution that leverages RFID technology to create an RFID shopping system. Products are scanned using RFID technology, and the data is saved in a database where it may be paid for online or through a single bill. The online application is also used to keep track of all the buying information. It calls for web application server maintenance. When a customer inadvertently drops things into the cart, no appropriate action has been taken.

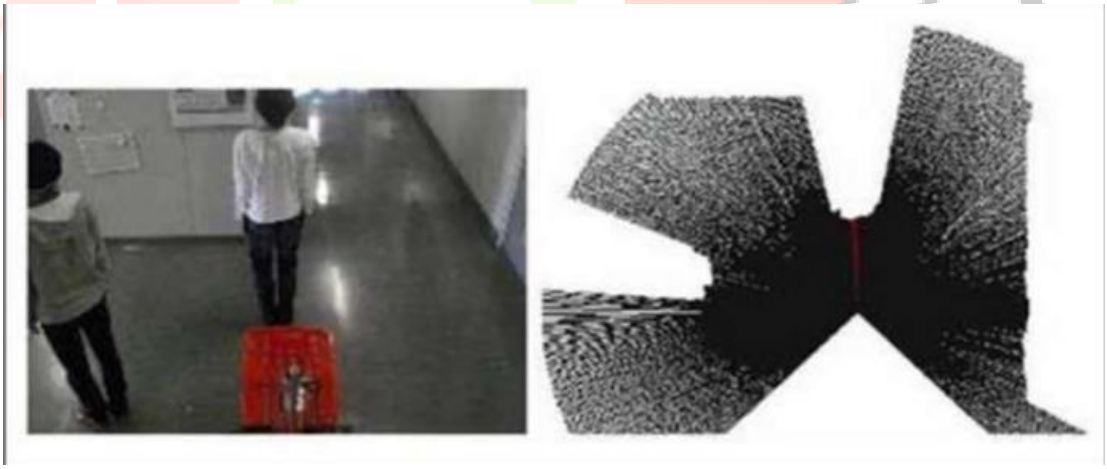


Figure 2: Example of Data Obtained from the Laser Range Sensor

Narayana Swamy (2016) developed a smart RFID-based interactive kiosk cart that uses a wireless sensor node to enable automated shopping. For user contact and billing maintenance, they used a dedicated website. Every user who has a unique ID can visit the web server to pay bills and view invoice details. With this kind of service, internet access is required. Thus, high load may also lead to server error issues and the process failing as a result of unstable internet. Vinutha (2014) uses RFID technology to enable shopping and automatic billing, which integrates with the server end. Using radio frequency identification, products are scanned, and a bill is generated at the server end and sent to the customer. Both internet access and server upkeep are necessary for this for both the buyer and the retailer.

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Not every consumer may have a mobile device running Android. Billing is delayed as a result of network difficulties. Vanitha Sheeba and Brindha Rajkumari (2015) developed an RFID-enabled smart billing system concept model that uses ZigBee and RFID to communicate generated bills to a server, where workers at the bill counter identify consumers to collect the bills. However, since only the creation of bills is automated through RFID scanning, this will once more result in a billing line. Our proposed system of billing payments in the trolley itself is reliable and easy to use. Because it does not require the ESP module, Wi-Fi, ZigBee, or other technologies that are mentioned above. Payment options include consumer card and the card from ATM. The aforementioned ideas do not guarantee product security against intentional or unintentional theft.

METHODOLOGY

The feasibility study was the first step in the approach, intended to be a first assessment of the data to see whether it warrants moving further to the analysis stage. The main reason for this is because the feasibility analysis is what determines whether to move on to the next stage of the project or to end it altogether.

Automation is the process of controlling processes with the use of control systems to minimize the need for human interaction. An incident occurs as a result of customer negligence or human error when using a trolley. Therefore, using automated machinery and robots is a good approach to reduce injury rates.

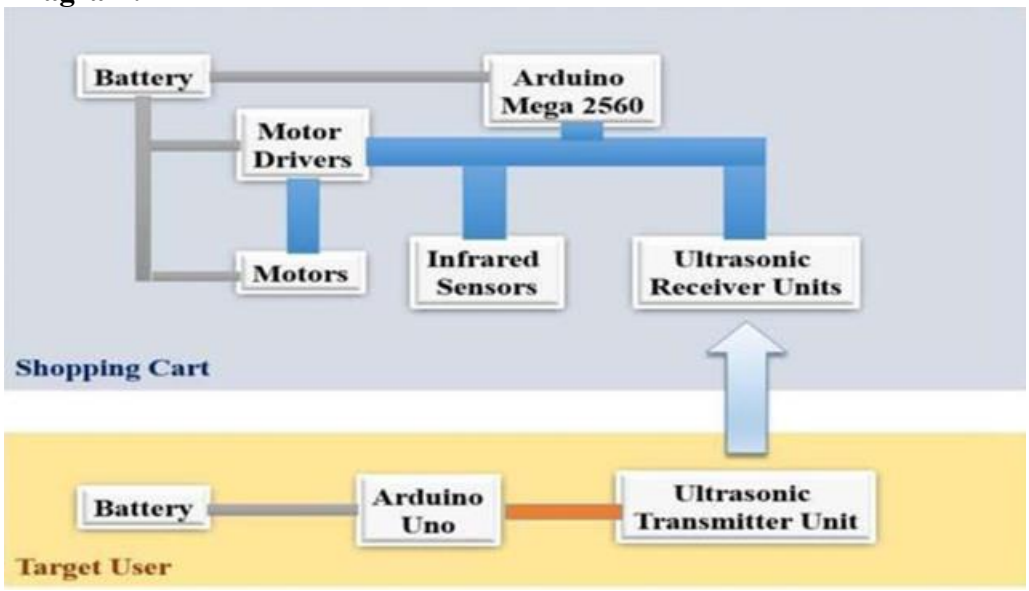
An Arduino Uno, a battery, and an ultrasonic transmitter unit make up the ultrasonic transmitter circuit in the target user portion. The Arduino Uno controller, which is attached to the ultrasonic transmitter unit, will run on the battery during operation. As a result, when the power is on, the ultrasonic transmitter unit will send out a signal at the frequency that is configured in the controller.

The necessary parts are the power unit (battery), Arduino Mega 2560, motor drivers, motors, infrared sensors, and circuits for ultrasonic receivers. The Arduino Mega 2560 controller, motor drivers, and motors will all be powered by the battery. The purpose of the ultrasonic receiver circuit is to receive the signal that the intended user has transmitted. The purpose of the infrared sensor is to locate the obstruction. The controller is responsible for analyzing the signals and data from the ultrasonic receiver circuits and infrared sensors. It then sends a signal to the motor drivers, which controls the motors, to feedback the movement of the shopping cart. The "Ultrasonic Transmitter Receiver Circuit Ideas", which was created by the HobbyTronixStore EBAY STORE, is the source for ultrasonic sensor circuit designs (both transmitter and receiver circuits). It is recommended to employ marketed sensory circuits with greater precision readings and appropriate functionality in addition to this prototype ultrasonic sensory circuit to improve the performance of the smart shopping cart's sensing capability.

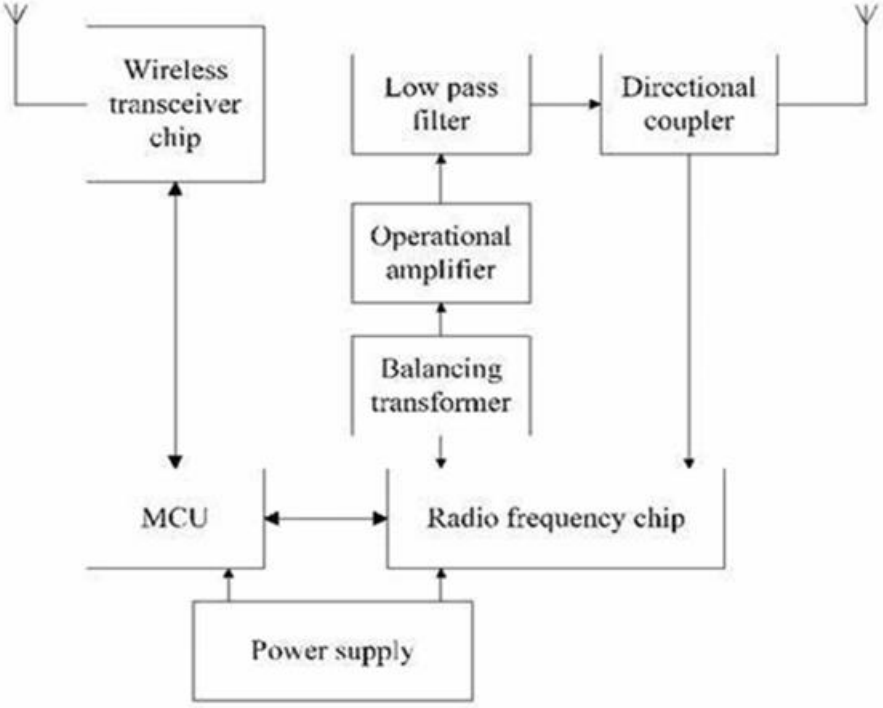
Currently, the process is carried out in malls utilizing barcode scanners, where the vendor scans the merchandise. Customers must wait in lengthy lines for what is thought to be a slow process. The Arduino-powered smart cart uses a security mechanism to prevent theft and does away with labor-intensive tasks like self-packaging and cart storage .The majority of the literature on trolleys addresses the creation of RFID in conjunction with ZigBee technology to enable wireless communication between individual RFID tags (916–924 MHz) and the primary server. Low-power Bluetooth is used by shopping devices to communicate, which requires just 1/4 of the power of Zigbee and increases battery life for the same price.

Establish a maintenance plan to address software updates, hardware issues, and system improvements. This methodology provides a general framework for developing an RFID-based shopping trolley with automated billing. Depending on specific requirements and constraints, you may need to customize certain aspects of the system.

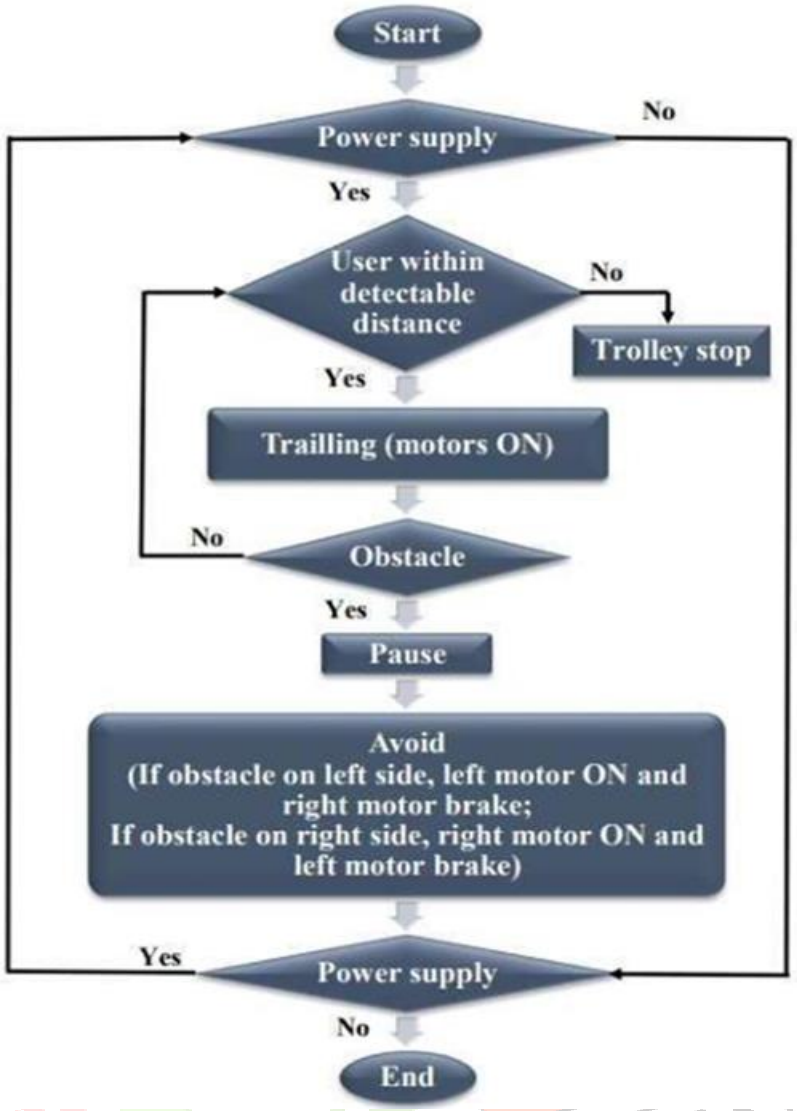
System Block Diagram:



RFID Receiver Circuit Diagram:



FLOW CHART:



RESULTS

Every retail center, whether old or new, has a unique billing system. For instance, a bill may be generated manually or with the use of a billing machine. Customers pay the billing amount with cash or credit cards once the bill is prepared. However, this procedure is more time-consuming, which irritates the line of clients. From the perspective of the customer, the billing system is used in super markets the majority of the time.

Thus, in "Smart Trolley System".To accomplish the goals, EM-18 reader, HC-12 transmitter, RFID tag, trolley, and LCD display are employed.

CONCLUSION

The primary goal of this project is to build and construct a working prototype of an automated motorized shopping cart that can follow customers and has the intelligence to steer clear of obstructions.

The following objectives have been met in this project in order to fulfill this goal:

1. Designed the operating program's interface between the control system and the ultrasonic positioning system.
2. Created a system that could follow the intended user and avoid barriers at the same time.
3. Completed the human tracking experiment in which the target user and the shopping cart are not separated by any obstacles.
4. Completed the trial of tracking people while there is a barrier separating the target user and the shopping cart.

The objectives have been met, based on the findings of multiple experiments in the preceding chapter (Chapter 7). The project's main idea—that the smart shopping cart may simultaneously execute tasks like human tracking and obstacle avoidance—was proved to be feasible as all of the goals have been met.

We have created the operating program's interface so that the control system and the ultrasonic positioning system can be simply integrated. The resulting system can simultaneously observe a selected individual and negotiate barriers, demonstrating its flexibility in real-world scenarios. In human tracking trials, the system followed a target individual and a shopping cart successfully, demonstrating its capacity to operate in scenarios where there are no obstacles in the way of the tracking process. Trials with obstacles between the intended receiver and the shopping cart were also completed, showing how adaptable the system is to overcome challenges and maintain good tracking performance in challenging environments.

FUTURE WORK

Despite the fact that it is feasible to use an ultrasonic positioning system to construct a human tracking system, this shopping cart has a number of drawbacks.

Although the circuitry using the transmitter and receiver as a smart shopping cart sensory system is a simple approach for tracking people, it is inevitably limited. In situations when there are significant barriers between the intended user from the shopping cart, this circuitry might not be the best choice. This may be because the obstruction will completely block the transmitted signal.

Furthermore, the system's ability to identify the target signal is restricted by the effective target bearing. Therefore, if the target deliberately leaves this range, the system might not be able to monitor them. Put otherwise, the shopping cart loses its ability to receive the signal whenever the intended user moves out of its line of sight. The assessment of swapping out inferior ultrasonic sensors for better ones or other kinds of sensors is the next stage in making this project more efficient.

Numerous methods exist to increase the effectiveness of the human tracking system, including vision-based methods, Bluetooth, radio frequency (RF), and others. Maybe the combination of these human tracking systems can produce more effective results in recommendation efforts.Aside from that, the smart shopping cart must be equipped with the "Automated User Finding" program or feature in order to automatically locate the intended user when they round a corner or become blocked by a large object and are no longer within the detectable range.

The shopping cart can have additional features or functionalities added to it to make it more intelligent. For instance, the system will have a new "items finder" capability that will enable the shopping cart to assist customers in finding the things they want in the mall.

In addition, after the consumer places the items in the shopping cart, the queue-less payment system can be included so that it can compute the bill of goods. This can improve both the shopping experience and the smart shopping cart's functionality. The shopping cart will be "smarter" and easier for customers to use with the addition of these features.

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