Auto-following Cart

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Project overview:
Nowadays, supermarkets are pervasive in our lives, if we want to buy drinks, snacks, food or other necessities, supermarkets are suitable places. However, the experience of using shopping carts may be inconvenient. It can be difficult to select the things we want while handling a bulky cart. The current shopping carts in most supermarkets are moved by human power. Many people use them because they can help us to handle the things we want to buy with ease. However, they have limitations because it is sometimes too tedious for us to control a cart while shopping or chatting with someone nearby.

As there is a high demand for using shopping cart in supermarkets, these unsolved problems have inspired us to improve the current technology of using carts and therefore create a niche for our innovation to address. In this project, an “Auto-following Cart”, containing a sensing and turning system, which is a combination of an xbee (receiver mode), xbee (emitter mode), ultrasonic sensor on a turntable and Omni wheels is introduced to overcome the paramount disadvantage of existing carts by following the user's step instead of being moved manually.

Aim and Objectives:
The objective of this project is to solve the major problem of existing shopping carts, which is that they rely on human power to move. It diminishes the availability of users’ hands and will tire users easily. Also, when we need to transport a huge number of heavy things by cart, it will be very hard for us to move the cart.

The ultimate goal of this project is to make an auto-following cart that can search and follow one and only one user during shopping, keeping a safety distance from the user to prevent crashing and avoid messing up with another auto-following cart. It is moved by using sensing (xbee radio modules act as receiver and emitter, ultrasonic sensors), processing (Arduino) and turning (Omni wheel) systems.

Therefore, “Auto-following Cart” will aim to be a good solution to solve this problem and facilitate the process of buying in supermarket. It does not only provide a comfortable way for shopping or transporting baggage, but is also cost-effective as most of the components are simple and easy to find. So for those who go to supermarket to buy a lot of things for storage at home, the shopping time can be more enjoyable.

Methodology:
Sensing system: Using ultrasonic sensors with xbee (receiver and emitter mode)
The cart uses one ultrasonic sensor to check if there is anything in front of it within a certain short distance. If there is an object in front of it, it will bounce back the sound to the sensor to indicate for the cart to move forward.

The xbee (receiver mode) is located on the bottom part of the cart, and it works with a portable xbee (emitter mode), which will be carried by the user. This pairing uses to measure the distance between the emitter and sensor, which is the distance between user and cart.

We set the cart to follow an object only when a specific signal is sent to the sensor of the cart. This makes the cart only follow one object which emits a unique signal. We use a portable xbee (emitter mode) to be a signal generator, and we wrote a program to make the cart only start the following function when the control signal toggled. Therefore, when the xbee (emitter mode) continuously emits a signal, the cart will only follow the right object.

Turning system: Turning by Omni wheel
 Omni Wheel contains wheels that are placed in a circle shape. This placement of wheels can improve the range of movable direction and mobility of the cart as with Omni Wheel the cart can move in any direction without turning.

In hopes of enabling the cart to follow the user when the user is turning left or right, we sought to make the cart search for the user when the ultrasonic sensors in the cart could not detect the user. So we installed a turntable to hold the ultrasonic sensor that can be used to detect the position of the user and assigned a program to allow the turntable to keep turning in three directions (left, middle, right) periodically when there is no user in front of the sensors.

Processing system: Using Arduino mainboard
Arduino as the cart’s mainboard as it is cost-effective and has many embedded software libraries online, which enable us to implement a number of intrinsic programs. It is good for people who are not majoring in computer science as it has a big community and forum which provides help for users.

Results:
Appearance of the cart
Our cart basically can be divided into the upper, middle and bottom parts. The upper part is just an ordinary basket we see in supermarkets, the middle part is a turntable with ultrasonic sensors (located between the wheels and basket) and the bottom part is a metal fame which combines three Omni wheels (located in a triangular shape to have wider range of mobility), an xbee (receiver mode) (located on the upper right of the wheels), three motor driver boards for each Omni wheel (located on the upper right of the wheels) and two more ultrasonic sensors for safe distance checking (located on the bottom side of the cart).

Functions of the cart
In this project, we have successfully implemented the sensing, following, turning and stopping functions. All of these are accomplished to our aim of this project as planned.

Firstly, one of our project aims is to make the cart follow only one unique user without any interruption made by others. Our cart can start following a specific user once that user enables the portable xbee (emitter mode) which is carried by him or her. This is completed by using the unique xbee emitted signal as an enable signal to the xbee (receiver mode).

Secondly, we aim to have a cart which can search and follow the user all the time. In our cart, during following, when the user is moving or turning his or her direction, the cart can detect where the user is and then start to follow the movement of the user. This is achieved by measuring the distance between xbee (receiver mode) and xbee (emitter mode), and the angle of direction from the ultrasonic sensor with turntable.

Thirdly, avoiding crashing is also one aim of the project. Once the cart we made starts working, at any time, the cart can keep a safety distance from any obstacles around it. This is done by two ultrasonic sensors placed on the two sides of the cart body.

Finally, the cart we made also satisfies the purpose of minimizing the production cost and occupied space. Our cart is made from a simple metal fame with a plastic basket. This simple structure leads to minimizing the material used and therefore reduces the cost of fabrication and cart size.