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Auto Following Trolley

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Abstract : Supermarkets are practically fully developed nowadays, thanks to several technology breakthroughs. People buy various things from supermarkets and place them on a trolley since this is the most convenient way to transport goods in supermarkets or shopping malls. When shopping at supermarkets or food stores, a shopping trolley is a must-have item. Customers, on the other hand, must manually push the trolley during the whole purchasing procedure. To circumvent these issues, the study team devised a sophisticated and successful approach. As a result, the major goal of this project is to develop and produce a trolley that is user-friendly for humans, decreasing their load and increasing their productivity, as well as creating an autonomous trolley capable of transferring objects from one point to another. This paper proposes an auto following trolley where the ultrasonic sensors in the trolley used to determine the user and the trolley and move appropriately. The trolley's connectivity is also maintained via the remote controller which can operate the trolley using both the RF receiver and the RF transmitter. A microcontroller module unit controls the trolley. It has the ability to stop, turn right, turn left, go ahead and move backward. It can track them everywhere they go when in range. The created model was constrained with a barrier, similar to supermarkets and retail malls in order to move according to the wishes of the user and are controlled by the remote controller that they have.

Keywords: Auto Following Trolley, Shopping Malls, Arduino UNO

1. Introduction

As living in an era where technology is improving every day, people come up with new ideas now and then to upgrade or create certain technologies. With the help of robots and modern technologies, doing things on a daily basis gets easier [1]. This project focuses on upgrading a trolley used in supermarkets or shopping malls called Auto Following Trolley. In this hectic world, such new technology is needed as activities using trolleys are done on a daily basis. People will come to supermarkets or shopping malls everyday to get their daily necessities and use trolleys to help carry

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their things to certain places [2]. The not upgraded trolley uses human labour as it needs to be pushed for it to move. This brings many disadvantages to the person pushing the trolley.

The goal of this project is to design and manufacture a trolley that is user-friendly for people, reducing their everyday burden and increasing their productivity [3]. Hence, to create an autonomous trolley capable of transporting objects from one location to another. There are also disable people and also pregnant women that use trolleys in the supermarkets as well as in the shopping malls [4]. It becomes a real burden to them as well as endagers them in many ways. With the help of this Auto Following Trolley, people in a different group of circles will not be bothered by the hassle of manually pushed trolleys anymore as their preffered items can be carried automatically without any human labor used.

After doing some observations, the decision to work on a project upgrading a trolley to an Auto Following Trolley has been made. It is a combination of a general trolley with a concept of a human following robot. The trolley is a multifunctional automated trolley where heavy things can be carried and moved from one place to another following a specific person [5,6]. This project will be expected to be a user-friendly trolley that lessens the burden of users and increase their productivity and also can be utilized to transporting objects from one point to another.

1.1 User-friendly Trolley system

Most individuals from all walks of life will purchase their daily necessities at a shopping mall, including food, clothing, toiletries, gardening equipment, electrical appliances, and other items. Remember that both pregnant women and individuals with disabilities use the trolleys at supermarkets and shopping centers. It becomes a significant load for them and endangers them in several ways [7,8]. People in various groups of circles will no longer be inconvenienced by the problem of pushing manual trolleys since their preferred things may be transported automatically without the requirement of human labor thanks to the Auto Following Trolley.

1.2 Easy-to-control technology

This new Auto Following Trolley uses technology to operate DC motors that are mounted on the trolley, namely Arduino. The L298N motor driver with the Arduino Board may be used to control DC motors in a few simple ways. By simply adjusting the motor's input voltage, which is done most frequently by utilizing PWM signals, we may regulate the speed of a DC motor. A potentiometer will be used to regulate the motor's speed, and a push button will be used to alter the motor's rotational direction. The push button will work as toggle button and each time we press it, it will change the rotation direction of the motor [9]. Therefore, a DC motor, a potentiometer, a push button, an Arduino board, and an L298N motor driver are required.

2. Materials and Methods

2.1 Materials

Table 1: Hardware and Software requirements

NAME	FUNCTION
Arduino Mega	This board has 54 digital I/O connections, including 15 pins for PWM output and 16 analog pins, making it a fantastic choice for applications that need more GPIO pins and memory.
Ultrasonic Sensor	To determine our distance from an object, it uses sound waves (echolocation).
IR Sensor	To asses if an object is there, IR sensors employ infrared light.

RF Module (Transmitter & Receiver)	We utilized a remote control to control the speed of the motor driver and to change the direction of the tyre movement, therefore RF module used to receivr signal from two devices.
Buzzer	Typically used as alarm and warning tones. It is an integrated structure that produces sound and provides electricity using DC volts.
LCD	Because of anti-glare technology, it works better in brighter environments. Lighter in comparison to screen size. Energy-efficient because it uses less electricity. Due to the excessively wide brightness range and high peak intensity, exceptionally brilliant pictures are produced.

The following of **Table 1** are the hardware and software requirements for this Auto Following Trolley project:

2.2 Methods

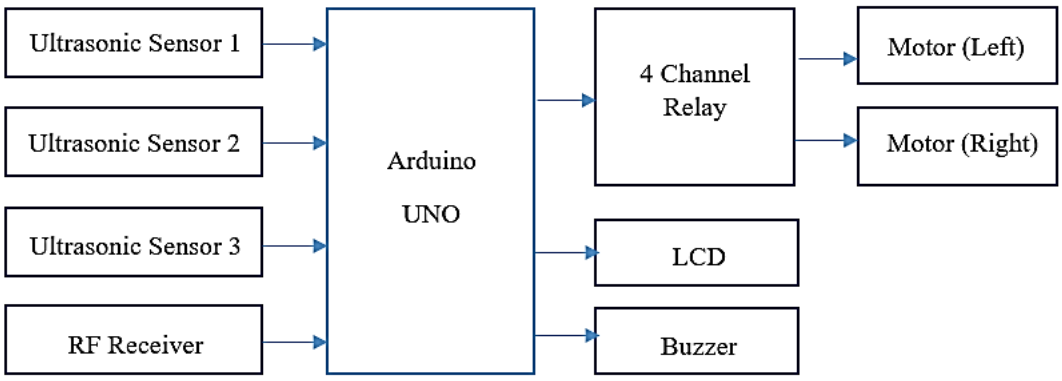

Figure 2: Block Diagram of Auto Following Trolley

The hardware in the system is diverse as shown in **Figure 2**. Three HC-SR04 ultrasonic sensors, two DC motors, an L289N Dual H Bridge Motor Controller for controlling the motors, and the Arduino Uno, an open-source microcontroller board built on the Microchip ATmega328P microprocessor, are all included in this device. While other parts are kept within the hardware box, three ultrasonic sensors are installed on the trolley. The two wheels are attached to two engines. The Arduino UNO is coupled to a motor controller and ultrasonic sensors. The motor controller is powered by a 12V battery, while the Arduino Mega receives 5V current. Through the motor controller, the speed and direction of the motors are also managed. Ultrasonic sensors are utilized to detect and gauge the distance between the device and the user's leg once it has been powered up.

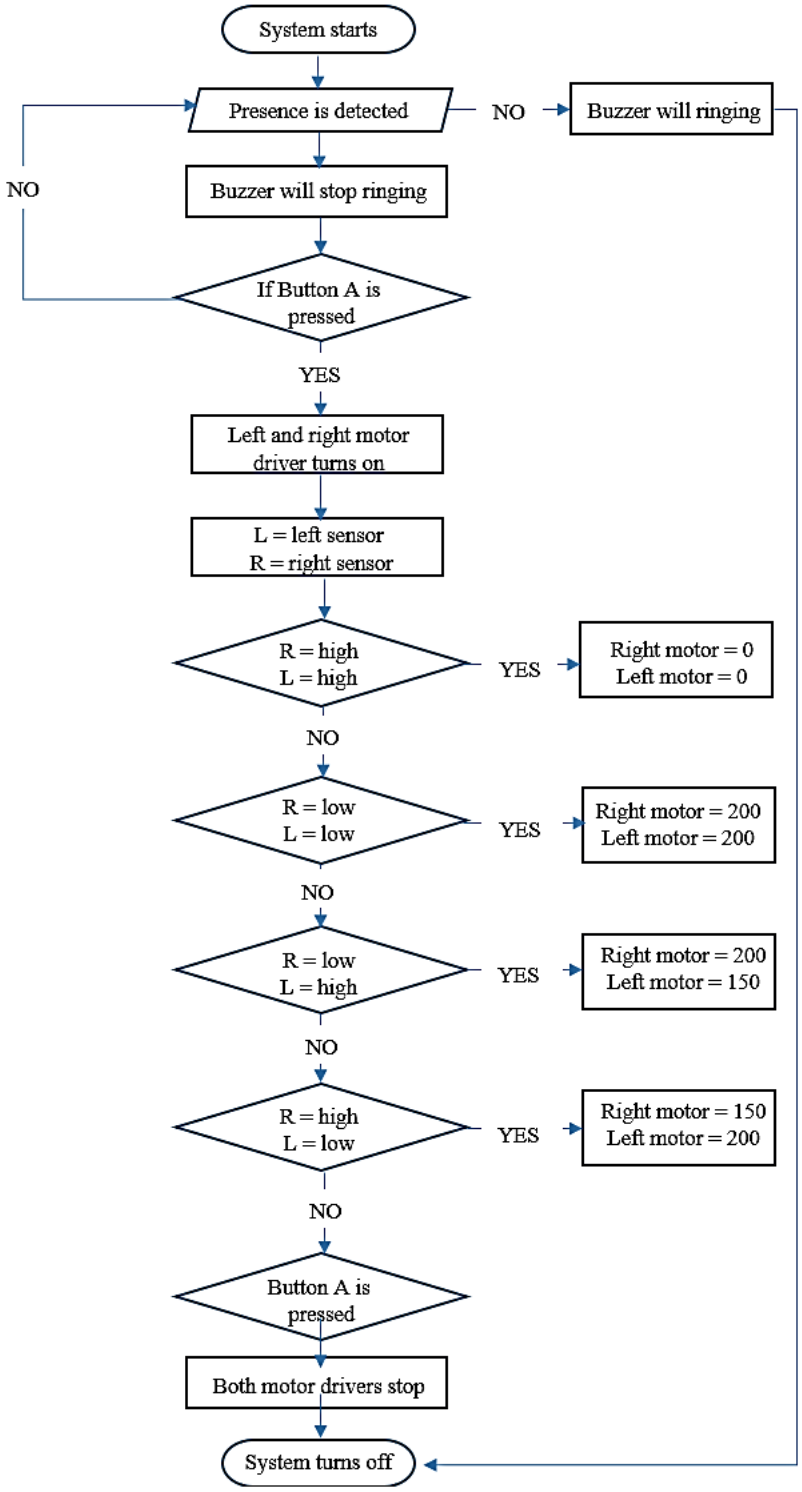

Figure 3: Flowchart of Auto Following Trolley

Additionally, the system's front-facing obstructions are detected by these ultrasonic sensors, which then transmit signals to the Arduino UNO. Two sensors are linked to the right and left sides of the trolley, while one sensor is mounted to the front of the trolley. The front middle sensor's job is to tell the Arduino UNO how far away from the user's leg the trolley is, while the other two sensors monitor the user's movements to determine whether they are to the left or right so that the trolley may follow their lead. We could see the simple block diagram of automatic trolley working principle in **Figure 2** and flowchart of automatic trolley in **Figure 3.** The hardware in the system is diverse. Three HC-SR04

ultrasonic sensors, two DC motors, an L289N Dual H Bridge Motor Controller for controlling the motors, and the Arduino Uno, an open-source microcontroller board built on the Microchip ATmega328P microprocessor, are all included in this device. 66

2.3 Implementation

The Auto Following Trolley system will be installed and tested beginning with the circuit. The intended Auto Following Trolley will be modeled using fritizing software. After the circuit diagram has been sketched up, it will be transferred into TinkerCAD, where the encoding will be checked and utilized in the program. This attempts to assess the functioning of the current system. If the Auto Following Trolley works properly, the error-free encoding will be uploaded to the Arduino.cc program and downloaded to the connected Arduino UNO.

2.4 Testing

This Auto Following Trolley will be used as a prototype after the simulation system that has been tested functions successfully. Physical connections of all components are shown in **Figure 4**. A variety of supervisory suggestions will be looked at in order to enhance the Auto Following Trolley prototype. The poll results showed a positive reaction to the adjustments because this project offers so many advantages. As a result, until the prototype Auto Following Trolley is complete, work will be done on it.

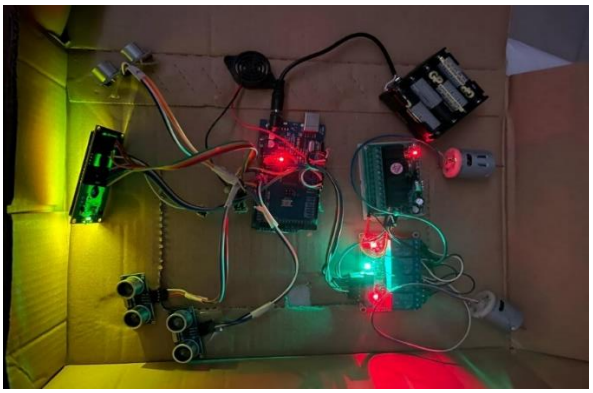

Figure 4: The connection of the components of the trolley

3. Results and Discussion

3.1 Results

The follower trolley’s goal is to locate and adhere to the acquired individual. The ultrasonic sensor and L298N Motor Driver - Arduino Interface are used to do this. The motor driver identifies and follows the person while also avoiding obstructions, and the Arduino UNO then conducts further controlling operations as necessary. The primary microcontroller in the system has programs for all of the hardware and components. To identify the user's legs and avoid obstructions in front of it, three ultrasonic sensors have been installed on the front, right, and left sides of the shopping cart. The push button that serves as a toggle button and changes the rotation direction of the motor each time it is pressed is used to regulate the movement of the shopping cart.

3.2 Discussions

The main microcontroller for this project's hardware interface is an Arduino mega UNO. To regulate the motors that are attached to the two wheels, it features two DC motors and an L289N Dual H Bridge Motor Controller. Each time we press the push button, it will function as a toggle switch and alter the motor's rotational direction. Ultrasonic sensors are used to prevent collisions between the shopping cart and other shoppers or other objects in the grocery store.

When developing the movable trolley base, it is necessary to consider all potential hardware installations, which presents a challenge in hardware creation. It has been determined via testing with ultrasonic sensors that the distance between the trolley and the reader must not be greater than 20 cm upwards.

3.3 Ultrasonic Test and Test Trolley

Testing for sensor sensitivity level was done by measuring the distance between ultrasonic sensors with the actual distance of the object using a measuring tape. The results could be seen in **Table 2**:

Table 2: Comparison between ruler and sensor

No.	Position of the Ultrasonic Sensors	Maximum Distance (cm)
1	Centre	50
2	Left	30
3	Right	52

From **Table 2**, this test was run to see if the ping sensor had been successful in detecting the distance. Testing was carried out by including a new ping library in the Arduino Idea program. The first sensor was designated as US1, the second as US2, and the third as US3. The results of the measurement were given in centimeters. To determine the distance, a test was conducted. To determine the sensitivity when presented with a barrier item, the sensor was closed and the object's location was maintained in front of the sensor. For the same distance, several tests were conducted.

Table 3: Trolley Test Result

No.	Logical	Trolley Design	Result
1	Forward	All motor forward	80%
2	Turn Left	Left motor slow down and right motor speed up	70%
3	Turn Right	Right motor slow down and left motor speed up	70%
4	Stop	All motor stop	80%

The trolley test results were shown in **Table 3**. In general, the trolley testing was conducted in the initial condition when the trolley was activated. The trolley would measure the distance to the object in front of the middle, front left, and front right trolley by using ultrasonic sensors located on the center of the front right and left trolley body. Then, using an Arduino module unit, the distance would be shown on the computer monitor via serial programming. **Table 2** displayed the outcomes of the trolley test.

3.4 Figures

Figure 5 illustrates the distance between the trolley and user in actual arrangement.

Figure 5: Distance between the trolley and the user

Curved line on a distance-time graph indicate that distance is changing. The length of time the buzzer beeps will alter depending on how far away an object is. The ultrasonic sensor on the right side of the trolley requires more time than the other sensors, which are placed at the left and the front of the trolley, in order to detect an object at a considerable distance. **Figure 6** shown that testing for sensor sensitivity level was done between ultrasonic sensors with the actual distance of the object and the time taken for the buzzer to beep as presented in the following:

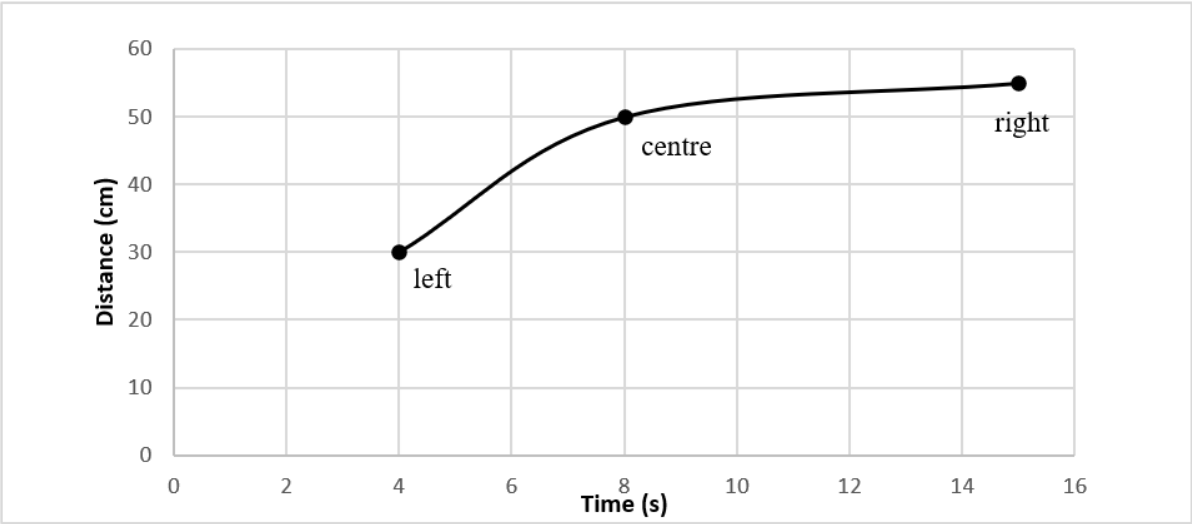

Figure 6: Distance – Time Graph

4. Conclusion

Technology is ushering us into a new era on a daily basis. The growth of technology is causing remarkable and unexpected changes throughout the planet. Our proposed technology may be further evolved into a smart trolley that uses interior navigation to track and identify the distance of user's precise location. The trolley could be controlled by an Arduino Mega module unit which could move the trolley forward, backward, turn right, turn left and stop. Users may then go shopping without having to push their shopping carts. The issue with hardware development is that because the trolley runs on batteries, a battery indicator can be developed to alert the user when the battery is low and the trolley must return to its original position when the battery is low.

The project system might be extended further into a smart trolley with features such as weight measurement, bill computation, number of things purchased calculation and credit card bill payment. Indoor navigation can be used to pinpoint the user's exact location. This suggested technology may also be used in wheelchairs, luggage and golf carrying equipment among other things. A hover board can be used in can be used in conjuction with a trolley to make purchase easier.

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