Development of Smart Carry Trolley for Library

(Pembangunan Troli Pintar untuk Perpustakaan)

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Abstract

The Smart Carry Trolley is a library-specific unit. There have been some studies done on ordinary trolleys but not focused on trolleys used in the library. During the pandemic time, this will help in minimizing contact with the trolley. The main goal of this trolley is to make it easier for library staff to carry, transport, and organize books in the library. The libraries that still use the ordinary trolley had to drive themselves off the trolley, which caused negative effects such as body ache and may have taken them a long time to complete because they had to return to move books many times. This makes it impossible for library staff to get around. Some even used their bare hands and did not use the trolley to carry and transport the books, this causes difficulties for library staff because by the end of the day they might experience hand, shoulder, and back pain. This will also take longer for them to finish their job as they must keep going back and forth to transport the books to the bookshelf. Therefore, the smart carry book trolley is a self-propelled Arduino Uno microcontroller used in this project, as well as an ultrasonic sensor for detecting humans and a DC motor to help move the trolley. The ultrasonic sensors will detect human movement and aid library staff in transferring books from one location to another. The test results on the ultrasonic sensor used show the operation of the smart carry book trolley. As a result, the library staff can enjoy their work without having to push the trolley.

Keywords: Smart carry trolley, book, library

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INTRODUCTION

Ordinary trolleys used nowadays are very much a hassle for the users. The trolley is mainly used because of its low cost, easy maintenance, easy operation and light weight which is very convenient to transport things in short distances. The trolley uses human biological energy into kinetic energy. Therefore, when the loads are heavier, it becomes more difficult for users to just rely on their energy, thus the efficiency is relatively low, and it is also a waste of time. During the post-Covid-19 era, technology has become more crucial than ever before where it is used in almost every aspect of life to make it more productive and safer. There have been a few innovations of trolley that aids in human shopping experience using low-cost passive Ultrahigh Frequency Radio Frequency Identification (UHF RFID). This innovation allows tracing and processing data in real time. Shopping trolleys equipped with a UHF antenna are referred to as "Smart Trolleys," and things are identified using UHF RFID tags with unique identification codes. Besides the application of UHF RFID technology, vision-based robots have gained growing interest for navigation (Athauda, Marin, Lee, & Karmakar, 2018). Research using a portable robot with human, and line following functions was developed. According to Ng, Danapalasingam, Tan, and Tan (2015), the robot was designed to assist customers to carry a heavy load while shopping in the supermarket.

The Smart Carry Book Trolley is a machine that results from the innovation of supermarket shopping carts. It is designed for library staff to facilitate them in carrying and organizing books in the library. Generally, the trolley uses an Arduino Uno as the ultimate heart in controlling the trolley while transmitter and receiver are used to navigate the trolley. The Smart Carry Book Trolley is designed as a self-propelled trolley with the help of ultrasonic sensors where it detects human movement in order to assist the library staff in transporting books from one place to another. This is very useful for the library as it reduces their energy in carrying the books.

The trolley's aim is to create an ultrasonic sensor that can detect human movement and reduce library staff workload. With the help from the trolley, they can carry the books without having to push the trolley manually. The Smart Carry Book Trolley will carry the loads of books and help save the library staff time in transporting and organizing books. Besides that, other problems faced by the library staff when they use the ordinary trolley is having to experience hand, shoulder and back pain when it comes to carrying loads of books. The library staff are expected to stop a while in between and this will cause delay in organizing the books since it might take time for them to get back to work. With the Smart Carry Book Trolley, it can help in reducing the pain experienced by the library staff.

This project is a trolley made from a variety of materials, including an iron frame and four wheels. Only books can be carried in this smart carry trolley, which can only load less than 20kg. The trolley can identify persons at a range of 100 cm and does not follow the user too closely. The ultrasonic sensors can only identify humans within a 1-meter range. The length, width, and height of the vehicle's frame are as follows: 50 cm in length, 50 cm in width, and 30 cm in height. Therefore, this paper aims to ease the library staff with their work where the Smart Carry Book Trolley helps to carry, transport and organize the books in the library by adopting the current technology available in the market today.

METHODOLOGY

The Smart Carry Book Trolley is designed to reduce the efforts of the library staff so that they can finish their job without wasting their valuable time and can reduce the manpower. Figure 1 depicts a block diagram of the trolley.

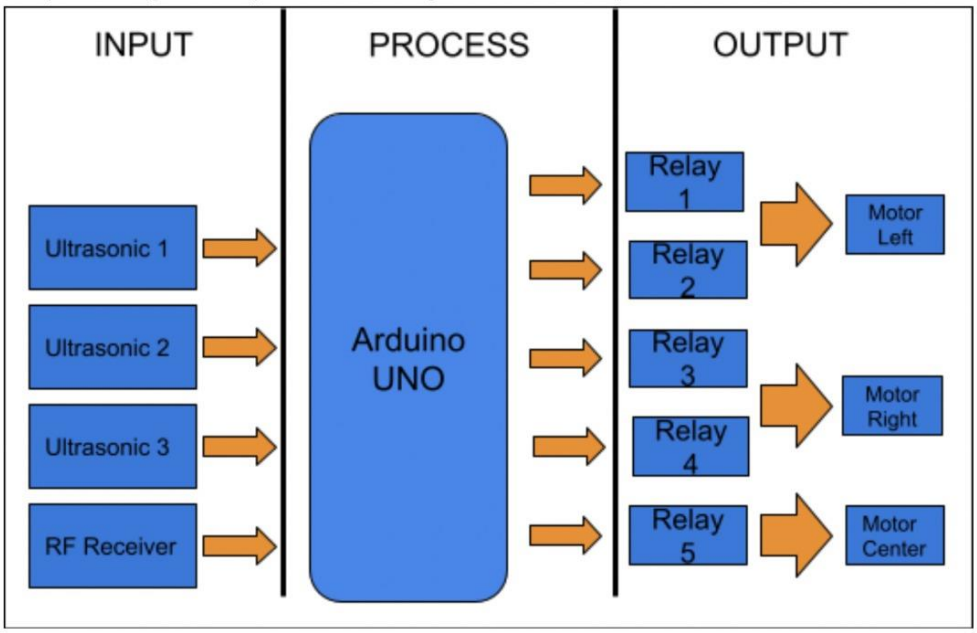

Figure 1. Block diagram of Smart Carry Book Trolley

From the Figure 1 above, the Smart Carry Book Trolley consists of three ultrasonic sensors as input, Arduino Uno as the controller and five relays to control the left, right and center motor as the output. Arduino Uno is the heart for the trolley therefore Arduino Uno need to be supplied with a battery with power of 12 volts, 7.2 AH to turn in on for it to act as a controller to 'Left Motor', 'Right Motor', 'Left Sensor', 'Center Sensor' and 'Right Sensor'. The Arduino Uno will give a signal to the relay circuit where Relay 1 will act either 'Yes' or 'No'. When it is in 'No' condition, the left motor will stop while if it is 'Yes' condition, the left motor will move. Then, Arduino Uno will give a signal to Relay 2 where Relay 2 controls the right motor. The same as Relay 1, when it is in 'No' condition, the right motor will stop and when it is in 'Yes' condition, the right motor will move. Relay 3 will control the left sensor. Relay 4 will control the right sensor while Relay 5 will control the center sensor. When the relay is in 'Yes' condition, it will activate the sensor whereas when it is in 'No' condition, the sensor is inactive (Jaiswal et al., 2018). The flowchart of the trolley can be seen in the figure below.

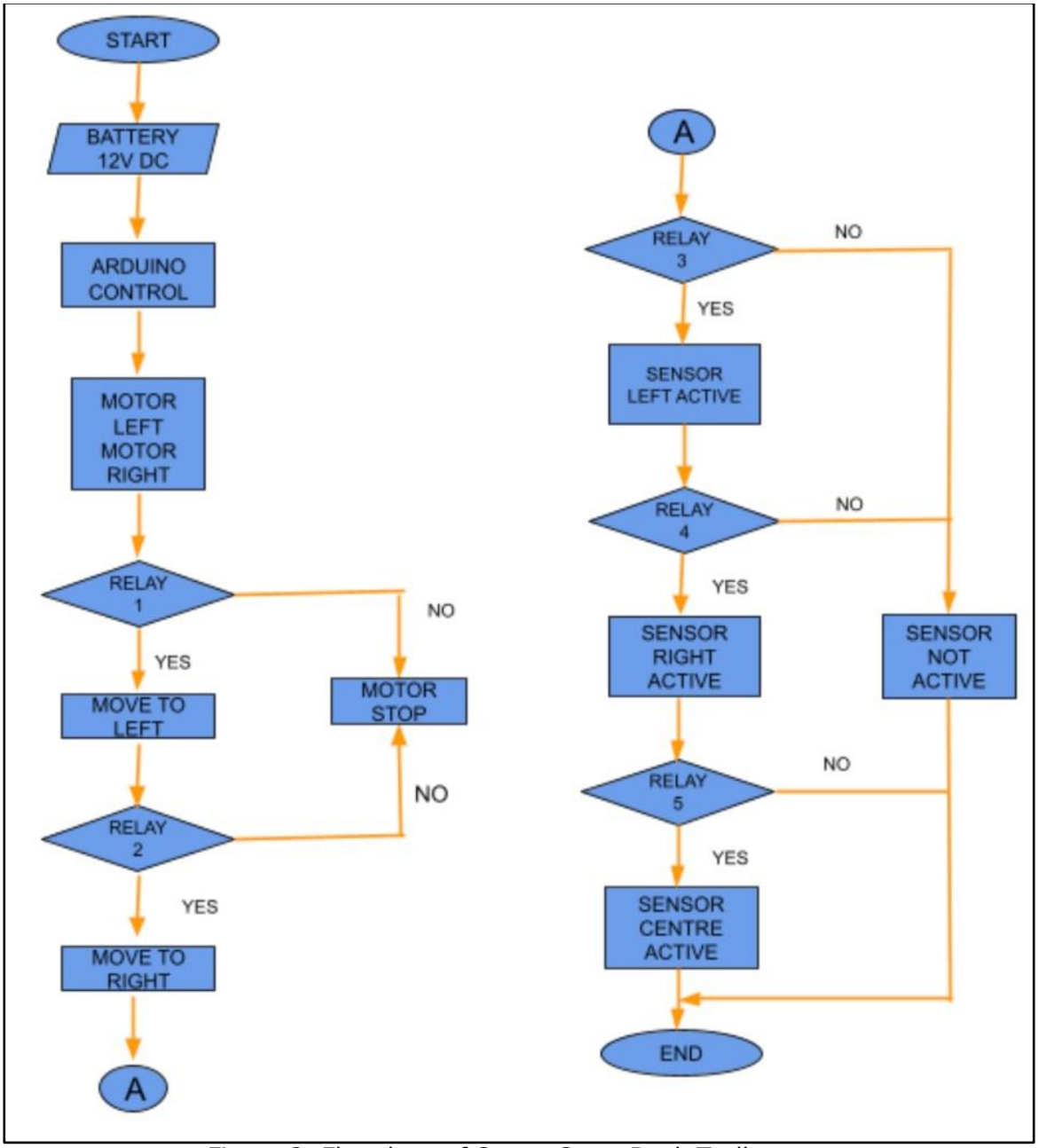

Figure 2. Flowchart of Smart Carry Book Trolley

At the beginning of the circuit, it needs to be supplied with a power of 12-volt 7.2 AH battery. This battery power comes in the Arduino section to turn on the Arduino, so Arduino acts as a controller to the left motor, the right motor, the left sensor, the center sensor, and the right sensor. The Arduino uno will transmit data to the relay circuit, which will cause relay 1 to operate either 'yes' or 'no,' with the left motor stop in the 'No' state and moving in the 'Yes' condition. The relay 2 will then receive instructions from Arduino. Relay 2 is the relay that controls the right-hand motor, and it can be in two states, either 'Yes' and 'No.' When relay 2 is turned to 'No,' the right motor stops, and when it is set to 'Yes,' the right motor moves (Jaiswal et al., 2018). Next, the relay that controls the sensor on the left is Relay 3. The first state of the relay 3 will be 'No,' in which case the sensor on the left will be inactive.

When relay 3 is turned to 'Yes,' the left sensor is activated. The sensor in the middle side is controlled by Relay 4. Relay 4 will be in two states, the first of which is 'No.' When relay 4 is in this state, the sensor in the middle will be inactive. Finally, relay number five. The

sensor on the right side of the cart is controlled by Relay 5. When relay 5 is in the 'No' position, the sensor on the right will not be functioning. When relay 5 is set to 'Yes,' the sensor on the center is activated.

RESULTS

The results from the study will be presented and analyzed in this chapter. The research to gather information on the project is classified and analyzed. The outcomes and assessments of the analysis conducted in this project will be described in this chapter. Following the creation of the Smart Carry Book Trolley, the project will be evaluated to determine its efficacy and assure its success. The Smart Carry Book Trolley's strengths and shortcomings were determined during the analysis stage. In summary, three elements of the Smart Carry Book Trolley's behavior, capabilities, and limitations are highlighted in the analysis.

Figure 3. Smart Carry Book Trolley

The completed trolley is shown in the diagram above, complete with all of the trolley frame construction and the insertion of the irons to make it look like a real trolley. The trolley used in this project differs from the last trolley discussed in this chapter not only in terms of design, but also in terms of how it is used and the human detector that is installed on it.

ANALYSIS OF THE TROLLEY'S BEHAVIOR

The function of the Smart Carry Book Trolley, like other trolleys, is to transfer heavy products to make it easier for workers or users to transport. The size and capability of the goods to be conveyed by the trolley determines their acceptability. Our concept, the Smart Carry Book Trolley, is intended solely for use in libraries. A book is one of the items that is appropriate for our project. This project has developed a trolley with a length of 50 cm, a width of 50 cm, and a height of 30 cm that is suited for usage in a library. This size is appropriate for a library that is neither too big nor too tiny, since it is based on the library's state-of-the-art storage shelves and the distance between shelves near to our project's trolley. As a result, our project is solely suitable for books. The Smart Carry Book Trolley is powered by a 12VDC battery. It interacts with the Arduino Uno, which makes the development easier. The Smart Carry Book Trolley operates using ultrasonic sensors that

deliver signals to a 5-channel relay system.

Figure 4. Body of Trolley

The visual abstract of a trolley is shown in Figure 4, where all the hardware components are mounted on it according to the library staff's convenience, making it much simpler and more convenient for the librarian to load and unload books in the library. It's a brilliant idea that will help librarians save time and resources. Trolleys are often used in commercial settings, and this smart carry book trolley helps to save time and effort (Sarala T., 2018). Using these smart trolleys, the librarian staff are not required to carry the heavy book, because it can automatically follow the librarians. Ultrasonic sensor is connected to the Arduino Uno as a main circuit to store all information in Arduino memory. Arduino will give instructions to move the trolley after detecting the movement of humans.

ANALYSIS OF THE TROLLEY'S CAPABILITY

The advantage of using our project trolley is that it allows you to transfer large books without having to push the cart or manage it with your hands. Ultrasonic sensors are used to identify humans with the goal of tracking the back of the human, making it easier for staff to transport books from one location to another. Furthermore, our small-scale trolley project is suitable for use in libraries with many shelves. Our project also has the advantage of simply requiring a battery to switch on the trolley, which can then be recharged and utilized at any time. Workers can also save energy by not having to carry as many heavy books.

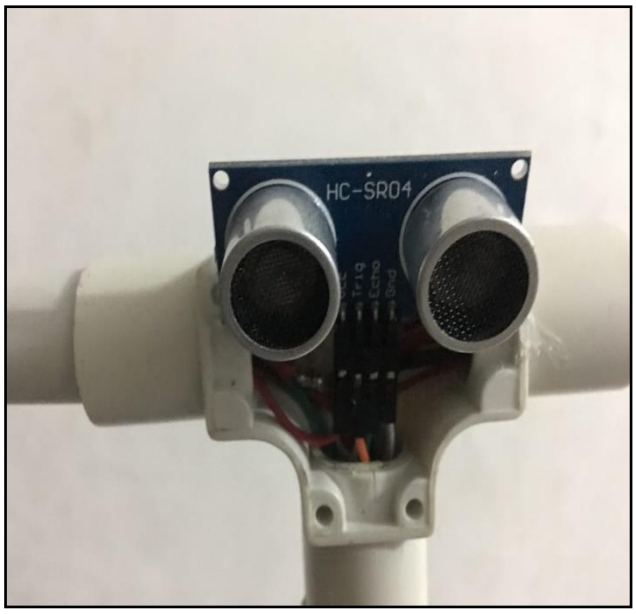

Figure 5. Ultrasonic sensor

The Ultrasonic sensor range provides a 2cm-400cm non-contact measurement function. This sensor will automatically send information to Arduino Uno when it detects the human. For measuring, this sensor trigger must receive a high (5V) pulse for at least 10us, during which the sensor will send an 8-cycle ultrasonic burst at 40kHz and wait for the reflected burst (Ng et al., 2015). When the sensor detects ultrasonic from the receiver, it raises the Echo pin to 5V and delays the signal for a time (width) proportional to the distance. Measure the width (Ton) of the Echo pin to get the size.

ANALYSIS OF THE TROLLEY'S LIMITATION

This project is a trolley designed by using materials, such as an iron frame, and four wheels. This compact carry cart is only capable of carrying fewer than 20kg of books. The trolley may follow the user within that range, around 100 cm, and it does not follow the user too closely. The ultrasonic sensors can only detect people within 1 meter. The frame dimensions of this vehicle for length, width and height are as follows: 50 cm long, 50 cm wide and 30 cm height.

CONCLUSION

Each project has its own set of goals and interests. The same goes for the Smart Carry Book Trolley. The aim of this project is to make it easier and faster to organize books on the bookshelves in the library. The library staff would have their own way of using this trolley. Since they are not able to carry loads of books while moving the trolley, this is a mechanism for them. Library staff will be able to carry these books without having to control the trolley as the Smart Carry Book Trolley is designed to follow human movement. Based on different researchers and observations of the situation, this led to the design of the Smart Carry Book Trolley.

In this project, the best technique is to have the trolley follow a human using sensors. It uses less energy than a trolley that does not move automatically. The effectiveness of the trolley in this study is more focused on time-shifting and allowing staff to bring books without having to carry them themselves and without becoming exhausted. Librarians that do not carry books with their hands to compile books in the library can become fatigued and waste a lot of time transporting and transferring books, as there were also workers who were tired from carrying out and assembling books. According to the overall evaluation of the 'Smart Carry Book Trolley,' it assists library workers in transferring and

carrying books without becoming fatigued, carrying their own hands, or generating physical problems.

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