Semi-Autonomous Trolley Cart

Teoh Thean Hin\textsuperscript{1*}, Tan Wee Choon\textsuperscript{2}, Siva Prabhu a/l Suthra Sakaran\textsuperscript{1}, Alif Mikhail Ahmad Asha’ari\textsuperscript{1}, Muhammad Syahrul Izwan Shamsul Azhar\textsuperscript{1}, Indiran Manimaran\textsuperscript{1}, Yaalinthiran Kumaran\textsuperscript{1}

\textsuperscript{1}Department of Aircraft Maintenance, Politeknik Banting Selangor, Selangor, Malaysia  
\textsuperscript{2}Faculty of Mechanical Engineering Technology, Universiti Malaysia Perlis, Perlis, Malaysia  
\textsuperscript{*}teoh@plibingan.edu.my

Abstract: Semi-Autonomous Trolley Cart is designed to reduce the chances of flight attendants from getting injuries while performing their duties. This project will help flight attendants to move the trolley cart comfortably and smoothly. The weight of this trolley including its loads weighs at approximately 25KG. It can move by itself using a rocker switch as this trolley is equipped with a line following sensor underneath it. This trolley is also equipped with some electrical components. There is a line following sensor underneath the trolley. This sensor will follow a straight line that will be placed along the aisle using a black tape. This project primarily focused on the trolley being a semi-autonomous and it will be controlled by switch.

1. Introduction

Engineering in the aviation field normally assigns with multiplex machines and most of the aviation companies such as airliners use trolley in this ever increasing and unlimited field of aviation.

In this moment in time, trolley evolves from a dining trolley to a big slight trolley just to fit in the trolley inside the plane. All of these trolleys provide a place to store food and beverages, blankets, pillows and some needs for the passengers inside the airplane.

2. Problem Statement

Trolley can be one of the biggest problems in an airline, especially for cabin crews. It turns out that cabin crew constantly and frequently pushing and pulling the trolley every time when they are on duty. This complication can last for a long time and it can be one of the reasons why some cabin crews complain of back pain problems. This also leads to work-related musculoskeletal disorder risk factor and symptoms [1].

As being reported by Flight Safety Foundation on July-August 2002, of the 49 cabin crew with back injuries, 36 (73\%) received injuries to the lower back, and 23 received injuries (47\%) to the upper back [2]. (The report said that injury reports that did not specify either the upper back or lower back were considered to have involved both areas.) The factors cited the most frequently for lower back injuries were turbulence (11 injuries, 31\%), overhead bin (seven injuries, 19\%), and service trolley (six injuries, 17\%).

This shows the injuries occur on cabin crews and one of the problems are service trolley. In regard to safety measurement, the source and root of the injuries on service trolley must be fixed and sort out effectively.
3. Project Purpose
With an aim to reduce back pain issues among the cabin crews as well as to make them work more efficient. This semi-autonomous trolley cart will ease the cabin crew in performing their duties even for long haul flights.

The cabin crew will be able to control the trolley easily with the help of the electronic design of the trolley which makes it move by its own smoothly and smartly. With this, it can reduce the amount of time taken for the crews to serve food and beverages for the passengers in time.

4. Project Design
This Semi-Autonomous Trolley Cart is an addition and improve version of the older trolley carts used currently in the aviation industry. There are some features being added to improve the trolley.

This trolley is powered by electrical power in order to move. There is a line sensor which is to avoid collision and bumping the aisle seats and also passengers. The DC motor will rotate the trolley cart wheels and control the speed movement of the trolley.

![Figure 1. Project dimension (0.3m width x 0.81m length x 1.03m height)](image)

5. Project Functionality
The outcome of the project which is mostly design for flight attendants who will be serving food to the passengers while facing difficulties especially during turbulence which might cause back pain and difficulty to push the trolley. The reason why this trolley is semi-autonomous is because, it can be move on its own but it is still in human control, which there is a switch to move it forward and backwards including stopping it. Therefore, this trolley is easy for manoeuvring and can easily move with human control with the help of a switch. Besides that, this can help flight attendants in reducing time taken to serve food.
Table 1. List of Materials and Functions

| Materials                     | Function                                                                 |
|-------------------------------|---------------------------------------------------------------------------|
| Line following sensor         | It detects the line in order to move in a straight line.                   |
| DC Motor with one wheel pair  | A wheel that moves the trolley forward and backward                        |
| Arduino Nano Board            | To setup coding and programming                                            |
| Rocker switch 6 pin           | The use of it is for the trolley to move forward and backward including stopping it. |
| Component                  | Description                                      |
|----------------------------|--------------------------------------------------|
| Rocker switch 3 pin        | To help the linear actuator extend and retract.   |
| Motor driver               | To transmit or relay signals from Arduino board to every electronic component. |
| SLB Battery 7.2AH 12V      | To generate electrical power in order to use all the electronic component. |
| Linear actuator            | To extend and retract the DC motor wheel when using and not using it. |
6. Project Operation
This product will be operated semi-autonomously, which means it can be controlled by 
humans using a switch. All of the electrical and electronic parts will be powered by a 
battery with the capacity of 12 volts. This can give full capacity to all of the components 
with ease. Besides that, there are 4 rollers under each edge of the trolley. The rollers can 
also help the DC motor move as well, which means it will support the movement of the 
DC motor. The movement of the trolley is in a straight line position, according to the line 
following sensor. The line itself will be place inside the cabin of the airplane in the 
middle of the aisle. The sensors will follow the line in a straight movement.

On top of that, during the use of the DC motor, the linear actuator will extend the DC 
motor until its wheel touches the ground. When the DC motor is not in use, it will retract 
allowing the DC motor to be pulled upwards. The operation is controlled by a rocker 3 
way pin switch. Lastly, the movement of the trolley is within human control. The reason 
is, flight attendants can control the movement trolley using a rocker 6 way pin switch, 
that allows moving forward, backward and stop. Most of the operation of the trolley is 
self-dependent. Which means the flight attendants will control the trolley, which is an 
easier way of handling it and not by pushing it.
7. Conclusion
This piece of work is hopefully can be a reliable reference for further improvement to fully understand and appreciate the mechanism of this Semi-Autonomous Trolley Cart such as pneumatic, electrical and electronic parts. In addition, the movement of the trolley was made easier with just a push of a switch and this will help flight attendants to travel with the trolley effortlessly.

By adding electronic components, this moving mechanism will help flight attendants reduce their back pain while serving food and beverages to the passengers. With the help of some electronic components, this will advance and progress the use of trolley in an aircraft. This can help the advance stage of the aviation business from time to time. This semi-autonomous trolley is not just to focus on reducing back pain problems occurring with flight attendants, but as well to make it easier to serve and reducing the time taken for flight attendants to perform their duties.

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