

Hand controlled car
for disabled
individuals
engineering essay



Introduction

Definition of Car

Car was defined as a motor vehicle with four wheels and normally driven by an internal combustion engine. The main function of car was used for the transport of passengers. Nowadays, a car is the most common transportation for personal use in travelling, working and also shopping (Kameda 2009). Generally, a standard car is invented for normal person who is capable to use both their hands and legs to control the oil pedal, brake pedal, steering wheel, shift lever and also the clutch pedal for manual car in transmission control.

However, in this recent year, automatic transmission car is more popular than the manual transmission car and widely used around the world. For all knowledge, there are significant differences between an automatic transmission and a manual transmission. For example, clutch pedal and gear shift were not found in an automatic transmission car. Everything was automatic once we put the transmission of car into drive mode. However, automatic transmission only provide a narrow speed range while manual transmission can operate in a wide range of output speeds. With the automatic transmission, users can drive a car easily and no need to control the clutch pedal and also gear shift during driving journey. Therefore, the driving ability has become an important part in normal life.

Disability

Disability is generally defined as a physical or a mental impairment which can make our routine tasks more difficult or impossible. According to the

World Health Organization, there was a distinction between disability, impairment and handicap. A disability is any restriction or lack of ability that caused by impairment to perform an activity in the manner or within the range considered normal for a human being. Meanwhile, impairment is any loss or abnormality of psychological, physiological or anatomical structure or function. Handicap is a disadvantage for a given individual, resulting from impairment or a disability that prevents the fulfillment of a role that is considered normal for that individual. In other words, this “disability” term is commonly used for individual functioning which includes physical impairment, sensory impairment, cognitive impairment, intellectual impairment mental illness, and various types of chronic disease. Disability not only effects on human organs or body parts, it may be effects on an individual’s participation in life.

Type of Disability

Mobility and Physical Impairments

Spinal Cord Disability

Head injuries or Brain Disability

Vision Disability

Hearing Disability

Cognitive or Learning Disability

Psychological Disorders

Hand Controlled Car

A hand controlled car was a vehicle that uses both hands to operate the brake, accelerator and clutch. Hand controlled car was designed for the physically challenged people who cannot use both legs to operate the accelerator and brake pedals. Thus, with the assist of hand-controlled car, disabled individuals can acquire a driving license and drive safely on the road. Nowadays, there are several of hand controlled car in the market. For example, the invention of digital accelerator ring and the main hand brake in car for the driving without the use of both legs. This car's users just need to push the digital accelerator ring towards the steering wheel to accelerate and move the main hand brake downward to brake (Figure 1. 1).

Figure 1. 1 The Digital Accelerator Ring and Main Hand Brake

In addition, automatic transmissions car are strongly recommended for those disabled drivers so that they do not need to operate the clutch controller.

Another example of hand controlled car was used a portable hand controls. For example, the product of TNT portable hand controls (Figure 1. 2).

Figure 1. 2 Demonstration of using TNT portable hand controls

Figure 1. 3 Attachment of TNT portable hand controls in a car

This portable device was designed for those disabled people such as amputees, paraplegics, and quadriplegics who cannot apply and maintain the pressure that needed to operate the accelerator and the brake pedal.

With the invention of TNT portable hand controls, the user can use the left

hand to operate the both accelerator and brake pedals; the palm is used to apply the brake pedal and the thumb is used to apply the accelerator pedal while the right hand is free to control the steering wheel (Figure 1. 3).

Aims and Objectives

The main objective of this research study is to modify a car in order to enable disabled individuals drive safely on the road. In addition, the cost of hand-controlled car should low so that disabled individuals afford to owe a car. For the convenience of disabled individuals, the hand-controlled car must easy in maintenance as well.

Literature Review

A standard car was designed to be control by a normal person who is able to use their arms and legs for controlling accelerate and brake pedals, a steering wheel and also a shift lever. However operations using left and right arms and at least one leg are still needed for a car drive (Kameda 2009). This paper presented a joystick car drive system for a handicapped person using a wheelchair. With the help of this joystick drive system, a handicapped person can drive a car with his/her single hand. In this joystick drive system, there was a mechanical linkage connected to accelerate and brake pedals which is controlled by an operation lever. This lever only can be shifted in back and forward direction. Pulling the lever in the backward direction will accelerate a car whereas pushing the lever to the forward direction to brake a car.

The demographics of the disabled and aging populations who are demanding to maintain their independence and mobility tested the driver licensing

authorities to ensure that physical and cognitive difficulties are measured to an acceptable standard (Roake 2008). In order to compensate for reduced ability, servo system has been developed to enable severely disabled people to drive safely and pass the standard driving test. This development engineering interfaced with the vehicles primary and secondary controls which include electronic joystick devices to operate steering, braking and accelerator along with infra red or wireless systems to interface with vehicle electronic systems such as Multiplex and Can Bus electronic systems (Roake 2008).

Shaheen (2001) described the recent findings on the driving-related physical and cognitive impairments faced by the elderly. Two major types of vehicle design and infrastructure adaptations were proposed: (1) modifications for private vehicle and (2) intelligent technology and support services for private vehicles (Susan A. Shaheen 2001). Adaptive driving controls, such as mechanical hand controls or electromechanical contact switches, now allowed even the most severely impaired to operate a vehicle. However, these mechanical functions are usually directed toward primary controls only, such as steering, braking, and accelerating, which limits the ability of drivers to operate secondary controls such as the horn, turn signals, ignition, and headlights (Quintin 1991). Vehicle control adaptations can be effective, simple, and inexpensive. For example, the use of simple extension bars to gear levers and lever release mechanisms for hand braking.

Nowadays, there are several joystick systems available in commercial which were specifically designed for those drivers with limited strength in their arms and hands. However, (Ostlund 1999) concluded that the tested joystick <https://assignbuster.com/hand-controlled-car-for-disabled-individuals-engineering-essay/>

system had several functional limitation which includes time lags, lack of feedback and risk of interference between steering and speed control. In this journal paper, a design called uncoupled control was compared with the conventional joystick design which called as coupled control. In coupled control joystick, the original lever was replaced with a forklike grip which developed for driver with tetraplegia. In other one hands, the joystick with uncoupled control was developed by modifying the joystick in order to transform the radial speed controlling motion into a linear longitudinal motion. Nevertheless, there were sensors and actuators equipped in this joystick system to monitor the driver's control commands and provide a force feedback to the driver. Therefore, the joystick will back to neutral position if the driver released it.

All tetraplegics and most paraplegics depend on mobility aids such as wheelchairs for short-range transportation (Bjorn Peters 2001). Therefore, in order to become a licensed driver, the right adaptation is needed. The purpose of this journal paper was examined the driver performance and limitations of drivers with tetraplegia and investigate the influences adaptation designs in driver's performance and imposed workload. There are two types of hand controls installed in a car simulator, one had two separate levers and the other had one combined lever for braking and accelerating. For the system with separate levers, the braking lever was controlled by pushing it forward, while the accelerator lever was moved radially downward. The combined lever system was operated by pushing the lever to brake and pulling to accelerate. However, both systems had their pros and cons. For example, in the single lever system, the driver was impossible to

use both hands on the steering wheel, while the dual lever system will prolonged the reaction time of transfer accelerator lever to brake lever especially in critical situation.

Methodology

Before I make further research about my thesis which entitled “ Hand Controlled Car for Disabled Individuals”, I had search and read through some numbers of journal articles from database such as IEEE, Science Direct, and SpringerLink. For example the keywords that I used to search related journal articles were “ Disabled Vehicle”, “ Hand Controlled Car”, “ Handicapped Car” and so on. Next, I decided to choose car Myvi as my car model to do the car modification for the need of disabled people in Malaysia. In my research study, I will create my own design in draft with the suitable dimension as well. In addition, I also need to find out the most suitable materials that can be used for the car modification. In the future, I will conduct some experiment tests, such as tensile test and stress test for the materials that was chosen to examine the characteristic of relevant material whether the material suitable to use for car modification or not. Besides that, I will also use Solidwork software to present my own design unit in 3D.

Materials

Following are the criteria material of my design unit:

Medium to high strength

Good toughness

Good surface finish

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Excellent corrosion resistance to atmospheric conditions

Excellent joining characteristics

Good workability

Widely available

Based on the criteria material that mention above, I suggest aluminium alloy 6061 as the main material of my design unit. Aluminium alloy 6061 is a versatile heat treatable aluminium alloy. Aluminium alloy 6061 consists various of components in its chemical composition (Table 1). Besides that, it has wide range of mechanical and corrosion resistance properties (Table 2). Generally, aluminium alloy 6061 is used in many applications such as aircraft structures, truck bodies, yacht construction and so on.

Table 1 Typical Chemical Composition of Aluminium alloy 6061

Component

Amount (wt.%)

Aluminium

Balance

Magnesium

0. 8-1. 2

Silicon

0. 4 – 0. 8

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Iron

Max. 0. 7

Copper

0. 15-0. 40

Zinc

Max. 0. 25

Titanium

Max. 0. 15

Manganese

Max. 0. 15

Chromium

0. 04-0. 35

Others

0. 05

Table 2 Mechanical Properties of Aluminium Alloy 6061

Temper

Ultimate Tensile Strength (MPa)

0. 2% Proof Stress (MPa)

Brinell Hardness (500kg load, 10mm ball)

Elongation 50mm dia (%)

0

110-152

65-110

30-33

14-16

T1

180

95-96

—

16

T4

179 min

110 min

—

—

T6

260-310

240-276

95-97

9-13

Results

Figure 4. 4 First Draft Design of Hand Controlled Car Unit

Discussion

According to the result above, I just did the sketching of my design unit. This design is easy to control, push forward to accelerate and pull backward to brake a car. However, this design occupies a lot of spaces in driver seat, thus the users will face some difficulty to enter and leave the car.

For my future work, I will modify my design in order to increase the spaces for the movement of disabled people. Besides that, I will include the placement of wheelchair in consideration of my design.