JOYSTICK OPERATED STEERING SYSTEM

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Abstract - *In recent decades the modification is done only for ordinary people in the car but not for the people who has some disability or are physically handicapped. The only modification is done in the area of wheel chair for handicapped person. The only modification done in wheel chair is that the physically challenged person can operate wheel chair with less effort by himself. But yet there are no modification implemented in car for handicapped person. So that they can easily drive the car and complete their dream of driving the car and also reduce their dependency on other people.*

Key Words: **Joystick, steering system, Joystick operated steering system, Joystick operated car, joystick operated steering for handicap person, controlling steering of car by joystick.**

1.INTRODUCTION

The aim of this project is to reduce the effort of driving for handicapped person. In this the steering motion of the wheel is replaced by a joystick, which is easy and require less effort.

In this project the steering wheel is replaced by the assembly of joystick, control unit, electric motor and gear box. Joystick is operated on resistance phenomenon. It gives signal to control unit which is forwarded to motor. The torque of motor is magnified by using the gear box. The output of the gear box is connected to the steering column.

Fig. 1.1 :- Block Diagram

1.1 Problem Statement

Due to disability of handicapped persons they cannot drive cars. So the problem of reducing hand effort required for steering should be solved.

1.2 Objectives

1. To reduce the effort of steering.
2. General steering system is converted into power steering system.
3. Dependency of handicapped persons is no more and he can also drive this car effectively.

1.3 Scope

1. It is useful for handicapped persons
2. It provides comfort for the driver as it reduced steering effort.
3. With ordinary steering system this can also be installed as secondary system.

1.4 Methodology:

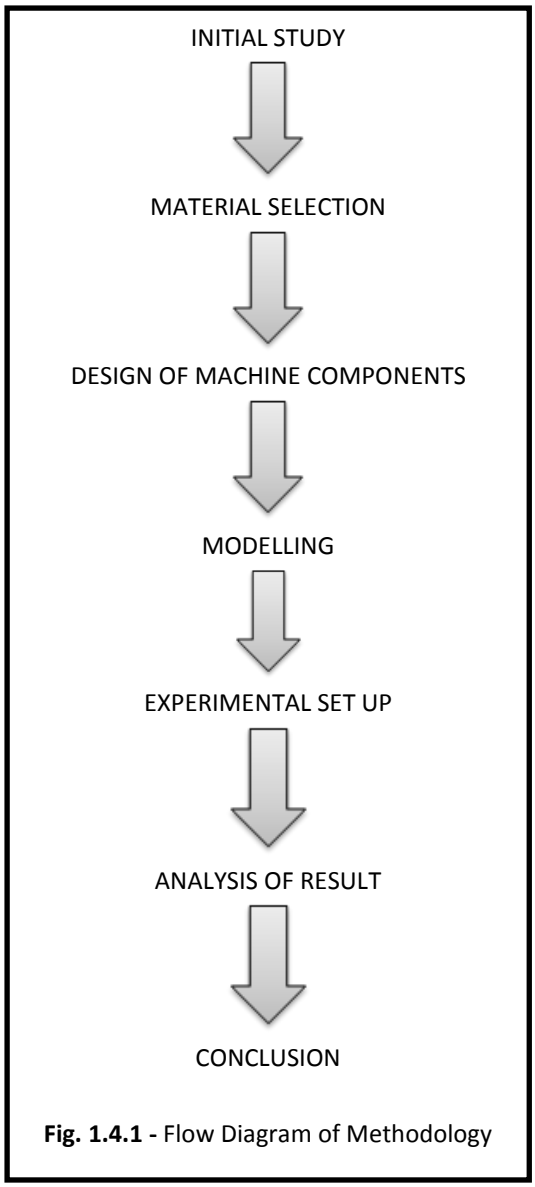


Fig. 1.4.1 - Flow Diagram of Methodology

Steps In Methodology:

1. Study and analysis of working of conventional steering mechanism of automobile steering system.
2. Study the various research papers published in this field.
3. Based upon this design and model a unit of easy and with minimum effort steering system for an automobile.
4. Select the appropriate materials of unit components and study various properties of it.
5. Manufacturing of the components of the system.
6. Perform trial and analyze it.
7. Compare the conventional steering system and developed steering system.

2. LITERETURE REVIEW

[1] Mateusz Kukla et al, (2016) Motor is a device used for converting electrical energy into mechanical energy i.e. rotation of shaft at output. Various types of motors are available as per requirement. A stepper motor converts electrical signals in form of impulses into the angle of rotation. This relation is proportional so the speed of motor is dependent on frequency of impulse. The higher value of rotational speed results in lower torque of stepper motor – this value is connected with the value of current intensity.

[2] Tatyaso A. Garande et al, (2013) described that there are many people who cannot do their day to day activity on their own due to their disability. So they can use wheel chair which are automated and require less effort. This can be done by providing joystick or by Deictic approach. Joystick is displaced by user in the direction he wants to go. The joystick used is of resistance type. Another way is Deictic approach in this vision of environment is used for controlling. If user wants to move from one place to another, he points the location where he wants to move and wheel chair goes to the pointed location automatically.

[3] Robin Burgess-Limerick et al, (2013) described that the joystick controls the rate of change of steering angle instead of directly changing the steering angle. By displacing the joystick at constant rate the steering angle also increases constantly. Until the joystick is bring to origin that is center position, the steering angle changes. To get maximum steering deviation we must hold joystick away from center for long time. Its main advantage is that we can achieve sensitivity for control over a large range of the displacement of joystick.

3. SIMULATION WORK

3.1 Selection of Joystick

There are two types of joystick:-

1. Analog Joystick :
   The directional interface required to map specific directions of movement on to specific buttons on the controller. In this type of joystick we do not get variable output. It means when we press the button we get maximum output.

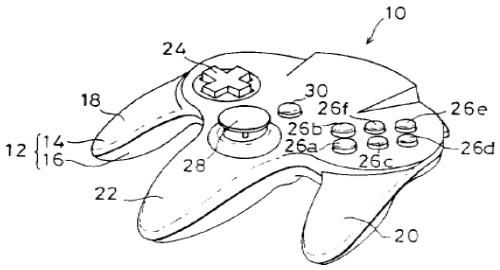


Fig. 3.1.1 :- Analog Joystick[4]

2. Resistance Joystick :
The lever is fixed at a single point, normally in accordance with the principle of a ball-and-socket joint, which gives the lever its two degrees of freedom. This type of joystick work on resistance phenomenon. As the resistance is varied we get variable output.

Fig. 3.1.2 :- Resistance Joystick[2]

From studying the above two types of joystick we see that resistance joystick is more compatible with our system. So we select the resistance type joystick.

3.2 Design of Gear Box

Material Selection:-
Gear material :- EN18.
Pinion material :- EN18.
Input Parameters :-
$(s_{ut})_g = (s_{ut})_p = 930$ N/mm^2
$(s_{yt})_g = (s_{yt})_p = 735$ N/mm^2
$Z_p = 32$
$Z_g = 96$
G = 3
Hardness = 207 BHN

From PSG design data book, page number 8.50 and 8.51.

We get values of spur gear and pinion pair for gear ratio 3.

we can find ,

Beam strength calculations:-

$$\sigma_b = (s_{ut}) / 3, \quad = (930)/3 , = 310 \text{ N/mm}^2$$

For 20^0 involute gear,

$$Y_p = 0.154 - (0.192/ Z_p)$$

$$Y_p = 0.154 - (0.192/ 32)$$

$$Y_p = 0.1255.$$

$$\sigma_b * Y_p = 310*0.1255 = 44.795 \text{ N/mm}^2$$

$$Y_g = 0.154 - (0.192/ Z_g)$$

$$Y_g = 0.154 - (0.192/ 96)$$

$$Y_g = 0.1445.$$

$$\sigma_b * Y_g = 310*0.1445 = 38.905 \text{ N/mm}^2$$

As $(\sigma_b * Y_p) < (\sigma_b * Y_g)$, we will design the gear pair for pinion

$$F_b = \sigma_b * b * m * Y_p$$

$$F_b = 310*12*m*m*0.1255$$

$$F_b = 466.86*m^2 \text{ N} \quad \ldots\ldots\ldots (1)$$

Wear strength calculations:-

$$d_p = m* Z_p = 32*m$$

For external gear pair,

$$Q = (2* Z_g) / (Z_g + Z_p)$$

$$Q = (2* 96) / (96 + 32)$$

$$Q = 1.5$$

$$K = 0.16 *(BHN / 100)^2$$

$$K = 0.16 *(207/ 100)^2$$

$$K = 0.16 *(BHN / 100)^2$$

$$K = 0.6855$$

Wear strength :-

$$F_w = d_p * b * Q * K$$

$$F_w = 32*m*12*m*1.5*0.6855$$

$$F_w = 394.848*m^2 \text{ N} \quad \text{.....(2)}$$

$$V = (\pi * d_p * n) / (60000)$$

$$V = (\pi * m*32 * 114) / (60000)$$

$$V = 0.191*m, \text{ m/s}$$

For velocity < 10 m/s

$$C_v = (3+v) / 3$$

$$C_v = (3+0.191*m) / 3$$

$$F_t = P/V$$

$$F_t = 25/(0.191*m)$$

$$F_{eff.} = (K_a * K_m * F_t) / C_v$$

$$F_{eff.} = (1*1*(25/(0.191*m))) /((3+0.191*m)/3)$$

From (1) and (2) we see that,

$$F_{eff} * N_f = F_w$$

$$3*(25/(0.191*m)) /(3+0.191*m) = 394.848*m^2$$

$$m = 0.68 \text{ mm}$$

By taking standard value,

$$m = 1.00 \text{ mm.}$$

Dimensions of gear pair are as obtained :

$$d_p = m * Z_p = 1*32 = 32 \text{ mm}$$

$$D_g = m * Z_g = 1*96 = 96 \text{ mm}$$

$$b = 12*m = 12*1 = 12 \text{ mm}$$

$$a = (m*(Z_g + Z_p)) /2 = (1*(96 + 32)) /2 = 64 \text{ mm}$$

$$h_a = m = 1 \text{ mm}$$

$$h_f = 1.25*m = 1.25*1 = 1.25 \text{ mm}$$

$$\text{clearance} = 0.25*m = 0.25*1 = 0.25 \text{ mm}$$

Selected standard diameters of gear pair is –

d_p = 34 mm.

D_g = 98 mm.

Torque calculation :-

$$P = (2 * \pi * n * T)/60$$

$$25 = (2 * \pi * 114 * T)/60$$

$$T = 2.09 \text{ Nm.}$$

$$T = 21.33 \text{ Kg.cm}$$

$$T = 22 \text{ Kg.cm}$$

3.3 Selection of Motor

From above calculation we saw that we require a motor with specification of :-

Power = 25 watt
Torque = 22 kg cm.

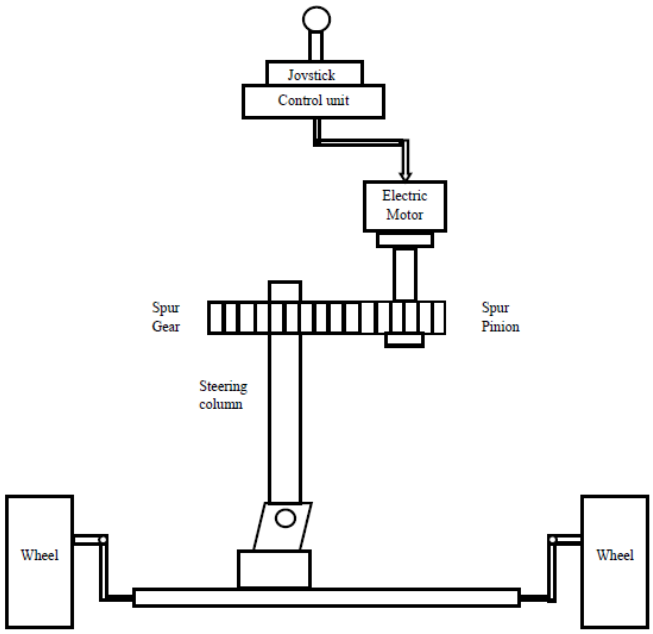
3.4 Selection of Bearing

With reference to diameter we select the following bearing:-
From PSG D.D.B. PG. NO. 4.12

1. Deep Groove Ball Bearing :-

Bearing designation – 6002
No. of quantities - 02
Inner diameter of bearing = 15 mm.
Outer diameter of bearing = 32 mm.
Dynamic capacity = 440 kgf.
Static capacity = 255 kgf.
Maximum permissible speed-rpm = 20000

4. OUTLINE DIAGRAM



5. CONCLUSION

By this the person who are handicapped or have less strength in their hand can drive this car. The conventional steering system performs as power steering system. The effort required by common man for steering the wheel is also eliminated. This system can also be installed as secondary system in cars. The dependency of handicapped person on other persons reduces.

6. REFRENCES

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