ABSTRACT

The standard structure of a manual transmission vehicle consists of the driver-operated accelerator, brake and clutch that are engaged or disengaged with the aid of foot pedal. In the case of specially abled people, it is not possible for them to drive a manual transmission vehicle as some of them may be physically born-handicapped, victims of several accidents like an injury in factories, bus or train accidents, warfare, bomb-explosions, loss of limbs due to diseases such as polio, etc. This project aims to develop a detachable hand control interface to assist the specially abled people to effectively drive a manual transmission vehicle and provide with necessary assistive systems for effective maneuvering. The interface operates such that the base frame remains fixed centrally on the floor of the vehicle which is fastened adequately. The brake pedal and the accelerator pedal are respectively operated by pushing and pulling an operating rod by hand. The clutch is actuated by a rock lever provided with a locking mechanism. The project also facilitates responsive gear shift assist encompassing a mechanism mounted to the gear lever controlled by push buttons on the steering wheel and assistive systems to aid people disabled due to hearing inability. The team conducts research in several areas and performs several design iterations which lead to the design of minimally invasive hand control interface with good driver ergonomics.

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LIST OF ABBREVIATIONS

Abbreviation	Description
SAUV	Specially Abled Utility Vehicle
FOS	Factor Of Safety
MS	Mild Steel
SFD	Shear Force Diagram

LIST OF SYMBOLS

Symbol	Description
ϕ	Diameter

π	Pi = 3.141592654...
H	Hole
R	Radius
µ	Coefficient of friction
T	Tension
M	Moment
L	Length
F	Force
d	Distance
+	Addition
-	Subtraction
x	Multiplication
/	Division
>	Greater than
<	Smaller than
%	percentage
ө	(Theta) angle
σ	(Sigma) stress
I	The area moment of inertia
Z	The section modulus
y	Distance
R	Reaction
τ	Shear stress
()	Parenthesis
[]	Bracket
{}	Flower bracket
e	Euler's number = 2.718281828...
$\sqrt{a}$	Square root
°	Degree
a^b	Power exponent

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Globally there are more than one billion people with some kind of disability and it is estimated that nearly 200 million experience considerable difficulties in functioning. People affected by disabilities have limited educational achievements, poorer health outcomes, higher rates of poverty and smaller economic participation in comparison to people without disability. The inspirations for the project was specially abled people experience difficulties in accessing the services that are easily accessible by people without disability, including employment, education, transport and health inclusive of information. These barriers are increasing in less advanced communities [1]. Nearly everyone will be permanently or temporarily disabled at some point in life and disability is a part of the human condition. The inspirations for this project also include those who desire the ability to drive a manual transmission vehicle because of their interest in recreational driving or because they own one of a kind cars. The population of India is 1.21 billion out of which 26.8 million people are disabled and accounts to 2.21% of the total population. Amongst the specially abled people, 44% are females and 56% are males [2].

Currently available systems require the use of one leg or are designed in such a fashion that the driver occasionally must sacrifice steering wheel control. The project aims to mitigate the inability of specially abled people and create an ergonomic, minimally invasive hand control interface to effectively control manual transmission vehicle which allows full coordinated actuation of the inputs of a standard transmission vehicle with zero-leg input from the driver and provides assistive features to the people affected by hearing inability while driving the vehicle. Also, the project facilitates responsive gear shift assist controlled by push buttons on the steering wheel for effectively changing the gear. Additionally, assistive systems consisting of the 170-degree fisheye camera and ultrasonic sensors are provided at the rear for the safety of the driver. It is recognized that the device does not interfere with the structure of standard service accelerator, brake and clutch, therefore, foot assembly is fully possible after disassembly of the interface.

Chapter 2 describes the literature review for this project. The team researched and reviewed various available systems and studied several research papers for a better understanding of the mechanisms implemented in the market and to determine the drawbacks which will assist in manufacturing a competitive hand control interface and aid the specially abled people to drive the manual transmission vehicle with greater ease. Chapter 3 illustrates the prior art search performed by the project team. Chapter 4 covers the current problems encountered by the specially abled people to drive a manual transmission vehicle. It also covers design iterations carried out by the team in order to develop a final design for manufacturing the interface and the design calculations performed. Chapter 5 discusses obtained through the various calculations performed. The final chapter incorporates recommendations that can be implemented in the future.

1.2 OBJECTIVES

The main objective of the project is to design an ergonomic, non-invasive hand control interface which allows full coordinated actuation of the inputs of a standard transmission vehicle with zero-leg input from the driver which will be able to assist people affected by locomotor disability to fully control a manual transmission vehicle. Additionally, the project aims to provide assistive systems to the people disabled due to hearing inability.

In India, there are about 26.8 million people who are disabled and out of which majority of the people have a disability in movement and 5.1 million people have a disability in hearing. The project aims to create employment opportunities for the people will disabilities up to a certain extent. Thus the specially abled people can be employed for material handling, gardening, airports, loading and unloading, etc.

The other prime objectives that the project strives to achieve are mentioned below:

- Establishing minimum response time between controls and pedal actuation.
- Manufacturing a compact hand control interface installable in small vehicles or tight spaces where other controls would not fit.
- Providing driving experience to the specially abled people they have been longing for.
- The interface must be minimally invasive and not cause any permanent damage to the vehicle
- The interface must be ergonomically designed for safe and efficient interaction with the user.
- The interface should not hinder the normal functioning of the standard structure of accelerator, brake and clutch pedals.
- The interface should facilitate the driver to operate throttle, brake, and clutch independently.
- The interface inputs must always be located in a consistent, easy to reach location.
- The hand control interface provided will be compact in nature and can be operated adopting a single hand.
- The interface allows no compromise on the safety of the driver or the surrounding.
- This interface can be employed by normal people wherever traffic congestion is a major concern.

1.3 METHODOLOGY

The methodology is not an algorithm that provides a formula to the various problems. It is a system consisting of various rules and principles through which several procedures and specific methods are derived in order to solve many problems within the limits of a particular discipline. Additionally, it encompasses qualitative and quantitative techniques, phases and theoretical model. Moreover, it provides a theoretical approach for understanding the best practice and set of methods.

The methodology consists of several defined steps, takes engineers through the process of problem formulation and background research, into the development and iteration of design concepts, and finally to the into the design concepts, and finally to the realization of a solution. The ten step process is outlined below

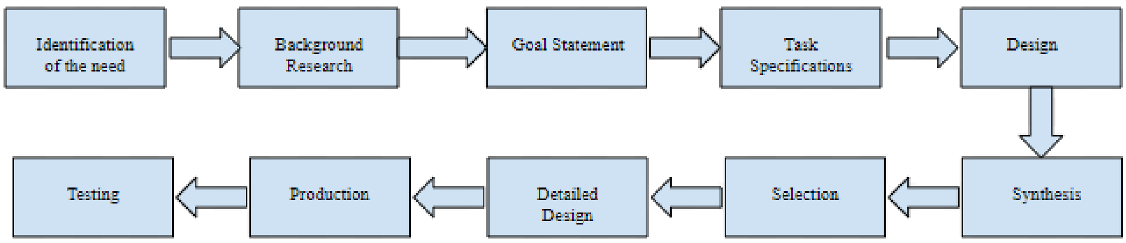

Fig. 1 Design Process

Firstly, projects starts with identifying the need for the project and was discovered that the currently available systems require the use of one leg or are designed in such a fashion that the driver occasionally must sacrifice steering wheel control. Secondly, the background research was necessary to estimate the people specially abled in India and the technical specifications of the vehicle cockpit and so on. Thirdly, the main objective of the project was to develop a noninvasive hand control interface without interfering with the standard accelerator, brake and clutch pedal. The further steps have been explained in detail in the forthcoming chapters.

CHAPTER 2

LITERATURE REVIEW AND RESEARCH GAP

2.1 LITERATURE REVIEW

Out of 1.21 billion population in India, 26.8 million people are disabled which accounts for 2.21% of the total population. Amongst these, 56% (15 million) are males and 44% (11.8 million) are females. In the total population, the percentage of male to female is 51% and 49%.

Among the specially abled non –workers with disability in seeing, 42.7% are dependents and amongst those with disability in hearing 38.7% are dependents. Similarly, in the case of specially abled non–workers, with disability in speech, 33.5% are dependents while among those with disability in movement 49.8% are dependents.

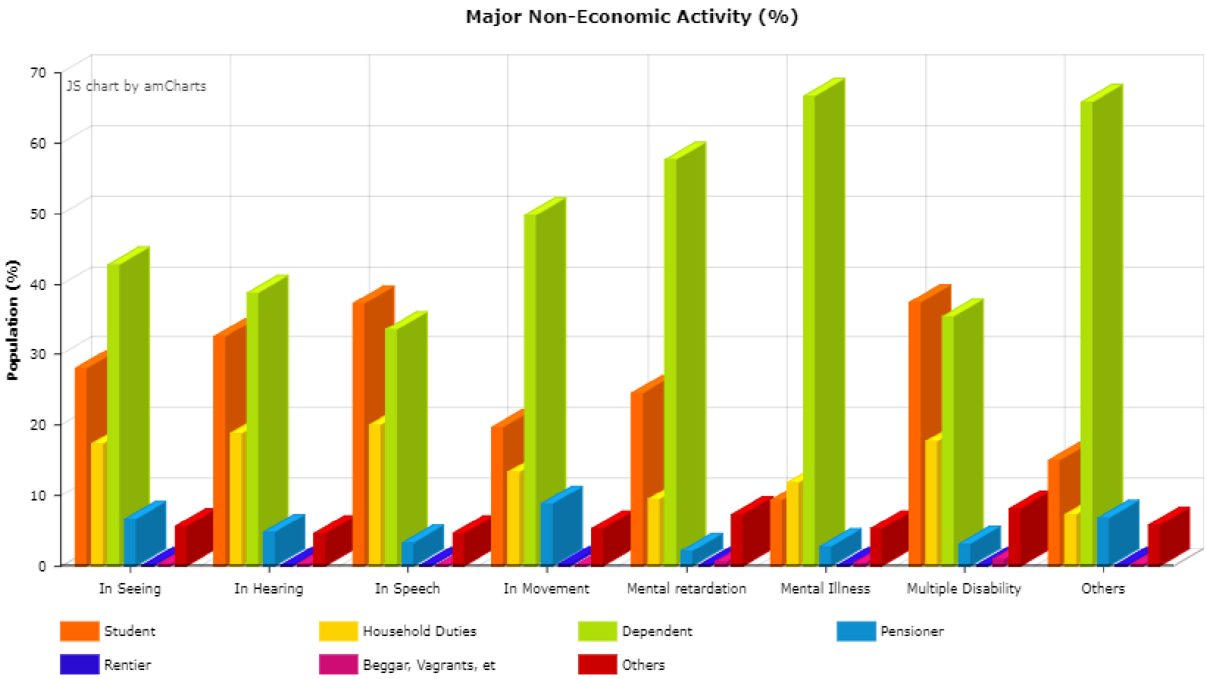

Fig. 2.1 Major Non-Economic Activity

The literature review was performed in order to gain some scientific knowledge, study various reports and research papers including technical papers apart from only studying only the existing systems available in the market. Few are listed below.

The first paper referred was about ‘Development of Hand Control Interface for Manual Transmission Vehicle.’ The paper was published by Worcester Polytechnic Institute by the Department of Mechanical Engineering.

The accelerator ring is located on the steering wheel for actuating the gas controls. In case of brake control, there consists of two rings, a fixed ring and a shell rotating freely on the outer shell engaged together in translational fashion. The shell is connected by steel cables to the brakes. As the driver engages the hand brake control the shell comes in contact with the fixed ring which results in engaging the brakes [3].

Fig. 2.2 Double Rail System

The clutch control for the device was provided on the shifting knob as actuation of clutch and shifting gears involved independent systems to be used concurrently. Bicycle cable was used in actuating the clutch.

Fig. 2.3 Hand Control Interface for Manual Transmission Vehicle

The following observations were identified. Firstly, enclosure of all the moving part is an important aspect to consider for safety purpose. Secondly, due to the incorporation of side rails in the steering installing becomes tedious. Hence, further modifications of the model should be considered.

The second paper referred was about ‘Fabrication of Hand operated clutch in four-wheelers’, published by the Department of Automobile Engineering from Christ The King Engineering College Coimbatore, India

The operation of clutch is done by implementing a button or switch on the top of the gear lever. The working of the clutch is electronic done using various components such as motor, control unit, electromagnetic hand clutch, belt and pulley [4].

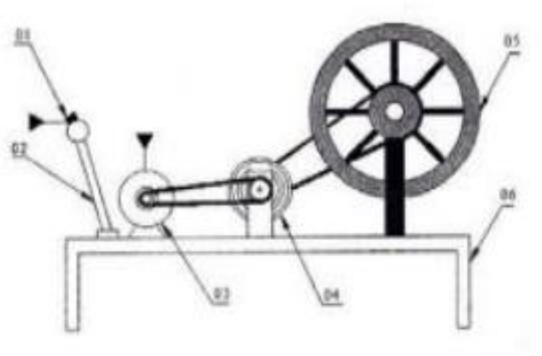

Fig. 2.4 Arrangement of Hand Clutch

This hand operated Clutch acts economical, electromagnetic care performance is good and mechanical properties and physical properties of the material are safe. The vehicle is capable of running in smooth operation and can be used in traffic congestion.

2.2 PRODUCT REVIEW

2.2.1 MPS PUSH PULL HAND CONTROL

Fig. 2.5 MPS Push Pull Hand Control

The MPS push/pull hand control is operated by pushing down against the floor for brake and vice verse for acceleration provided with an upright handle or standard handle to custom fit the driving style.

2.2.2 MPS PUSH / ROCK HAND CONTROL

Fig. 2.6 MPS Push / Rock Hand Control

The control enables the driver to accelerate and brake with the use of a single hand. As the upright handle is pushed against the driver, brakes are applied. Conversely when the handle is rocked rearward towards the driver accelerator is applied. Additionally, it consists of an accelerator lockout feature for more safety.

2.2.3 SURE GRIP PUSH/ROCK HAND CONTROL

Fig. 2.7 Sure Grip Push/Rock Hand Control

Unlike other hand control styles, in push/rock system the upright handle is in the vertical position, the driver pulls the handle back to accelerate and pushes the upright handle forward to brake. The different motion of the handle control the interface allows for full range acceleration and braking with minimal hand travel keeping the hand in a natural position.

2.2.4 MONARCH MARK IA RIGHT ANGLE HAND CONTROL WITH ACCELERATOR LOCK OUT

Fig. 2.8 Monarch Mark IA Right Angle Hand Control with Accelerator Lock Out

It consists of mechanical linkages, brakes are applied by moving the linkage in the forward direction towards the dashboard. Also, the accelerator is applied by moving the linkage in the direction away from the dashboard. The interface is provided with easy to use accelerator lockout which on engaging locks out the accelerator function [5].

2.2.5 GUIDOSIMPLEX DETACHABLE ELECTRONIC OVER RING ACCELERATOR

The electronic accelerator is composed of three components namely an over/under ring, the ECU and a motor reducer or interface depending on the type of ring opted. The motor reducer is usually installed when the vehicle is mounted with a mechanical accelerator. Similarly, the interface is installed when the vehicle is mounted with an electronic accelerator. The motor reducer and the interface are operated with the aid of switches situated at the reachable position. On using an interface for the electronic accelerator, the dashboard is fitted with two switches ‘A’ and ‘B’. A switch, when positioned to on/off, will activate and deactivate the manual acceleration device. B switch when positioned to ‘I’ position the 50% mode is activated, hence the performance optimization is possible by reducing acceleration and sensibility whenever needed by 50% [6].

Fig. 2.9 Guidosimplex Detachable Electronic Over Ring Accelerator

CHAPTER 3
PRIOR ART SEARCH

3.1 PATENTS

3.1.1MOBILE DEVICE FOR CONTROLLING A CAR WITHOUT USING LEGS, ENABLING FOOT PEDALS TO BE USED WITHOUT DRASTIC ALTERATION TO THE CAR (PATENT 1).

Abstract

This paper discusses about a device which can be firmly installed for legless guidance of the car. This device facilitates the disabled person to quickly assemble and disassemble from his vehicle and also provides the use of this device in a large number of vehicles with different adjustments. It can be inferred that the device is constructed using a lever, which sets the driving condition via train and the pedal is attached via a plate. The mobile device has a handle with a working connection to the accelerator and brake pedal.

Specifications

This invention was done to operate the accelerator and brake in the automobile manually. It consists of a handle which is connected to the pedals through a linkage or cable operated. This device offers paraplegics, leg amputees or people suffering from muscle diseases an alternative to the conventional foot operation. The device is such that it can be fitted and removed by the disabled people itself without the need any external help. It is also possible to use a conventional vehicle. The mobile device for manual operation of the accelerator and brake pedals in a motor vehicle is described by the features of the protection claim 1. The mobile manual operation for the acceleration and braking in a motor vehicle is mentioned such that both vertically and horizontally, a slidable mounted carrier for manual operation, as well as for the connecting elements are provided to drive and brake pedal. According to the invention the mobile device for manual operation of the driving and brake pedal, both by means of a connection to the driver's seat as well as with a connection to the vehicle floor can be fixed.

3.1.2 VEHICLE WITH HAND CONTROL SYSTEM(PATENT 2).

Abstract

An embodiment contemplates a vehicle comprising an electronically controlled propulsion system, an electronically controlled brake system having at least one brake, at least one controller operatively engaging the propulsion system to control a vehicle propulsion and operatively engaging the brake system to control actuation of the at least one brake, an accelerator pedal and a brake pedal configured to be moved by the foot of the vehicle operator and communicate a position to the at least one controller. An embodiment of the vehicle also includes a hand control connector system including a hand controls connector configured to be accessible in a passenger compartment of the vehicle and an electrical connection from the hand controls connector to the at least one controller.

Specifications

An advantage of an embodiment is that automotive vehicles may be more easily equipped with hand controls allowing disabled drivers to operate a vehicle without the use of foot pedals. Such a system may be more cost effective and easier to install in a vehicle. Moreover, the hand controls may be more ergonomic for the disabled vehicle operator while not interfering with conventional operation of the vehicle by a non-disabled operator. In addition, the hand control system may be employed to assist a driver training instructor to control a vehicle while riding in a passenger seat.

3.1.3 COMBINED ACCELERATOR AND BRAKE ASSEMBLY(PATENT 3).

Abstract

A combined accelerator and brake assembly is adapted to be used on self-propelled rubber tired vehicles which have accelerator and brake actuating means either side-by-side or on opposite sides of the vehicle operator. The self-propelled rubber tired vehicle or tractor is often used in underground mining operations. The combined accelerator and brake assembly means is comprised of a mounting plate which holds the assembly and can be bolted onto the tractor or vehicle chassis. Two bearing supports with accompanying bearings are attached to the mounting plate through which a shaft is supported. A coaxial member extends the length of the shaft between the bearing supports and has bearings at the opposing ends thereof for engaging the shaft. Depending on the location of the actuating means for the brake and accelerator relative to the operator's position, an accelerator pedal right-brake pedal left arrangement can be provided by mounting the brake activator on the end of the coaxial member proximate to the brake actuating means and the accelerator activator on the end of the shaft proximate to the accelerator actuating means.

Specifications

Self-propelled mine vehicles for the transportation of coal, and ores are necessary for the collection and removal of the materials to be mined from shafts within the earth. Further, when such materials are collected by the self-propelled rubber tired mine vehicles, a maximum versatility and maneuverability of the vehicle is necessary which causes the operator to use the brake and accelerator pedals of the mine vehicle in rapid succession. Because of this rapid alteration of brake and accelerator use, mining companies desire uniformity in self-propelled mine vehicles such as having the brake and accelerator pedals in the same relative position to each other to prevent accidental misuse of the wrong pedal which may cause an accident. In accordance with the present invention, a combination brake-accelerator assembly is provided which can adapt the positioning of the accelerator and brake pedals to be the same, no matter where the location of the accelerator and brake actuating means are located in relation to the mine vehicle operator.

3.1.4 CONTROL PEDAL APPARATUS FOR MOTOR VEHICLE (PATENT 4).

Abstract

The mechanism includes a pedal arm, an adjustor member, and a bracket secured to the fire wall of the vehicle. The mechanism allows the position of the pedal pad to be adjusted slidably on the adjustor member without disturbing the position of the particular control element actuated by the pedal assembly, and selectively moves the pivot axis of the pedal assembly to maintain a fixed mechanical advantage of the pedal assembly irrespective of the position of adjustment of the pedal arm on the adjustor member. Additionally, intersecting slots in the adjustor member and pedal arm allow the pivot axis to selectively move during adjustment of the assembly and fix the position of the pivot axis in any adjusted position of the pedal arm so that the pedal assembly pivots positively about the instantaneous assembly axis in any adjusted position of the pedal arm. One disclosed embodiment is intended for control of the push rod of the brake master cylinder and another disclosed embodiment is intended to control the throttle cable of the throttle mechanism.

Specifications

This invention is directed to a control pedal mechanism in which the pedal position is readily adjusted without disturbing the essential dimensional relationships in the control environment. The invention control pedal apparatus comprises a mounting bracket adapted to be mounted on the fire wall of the vehicle; a pedal assembly; pivot means mounting the upper end of the pedal assembly for pivotal movement on the bracket; a pedal pad mounted on the lower end of the pedal assembly; attachment means on the pedal assembly defining an attachment point for attachment of a control member for operation of a control system of the vehicle in response to pivotal movement of the pedal assembly upon the application of operator pressure to the pedal pad; and pedal adjustment means operative to selectively move the pedal pad relative to the bracket without moving the attachment point relative to the bracket. This arrangement allows the pedal to be selectively adjusted to suit the individual driver without disturbing the operative relationship of the control pedal assembly to the involved control member of the vehicle.

3.1.5 BRAKE AND ACCELERATOR CONTROLS FOR THE HANDICAPPED (PATENT 5).

Abstract

A hand operated automobile brake and accelerator operation assembly for the handicapped is adaptable to various models of cars. It is installed by clamping onto the brake pedal shaft with manually operable wing nuts. The brake pedal and accelerator pedal are respectively operated by pushing and pulling by hand an operating rod to move an operating lever fulcrum on a pivot axis fixed relative to the brake pedal shaft. This operating lever moves an accelerator operating shaft into contact with the accelerator pedal to depress it as the hand operated rod is pulled. Conversely when pushed the hand operated rod depresses the brake pedal and release the accelerator. To accommodate different car models an accelerator operating shaft has a manually operated lock to fix its length, and the accelerator assembly distance from the brake is adjustable.

Specifications

A pantograph type mechanism transforms a nearly linear back and forth motion of a hand held manipulating handle positioned near the automobile steering wheel, and preferably in the operators lap, into corresponding respective application of braking and accelerating forces.

The entire control mechanism is mountable upon the brake pedal shaft as the sole bracketed coupling to the car by means of a simple manually applied wing nut clamp assembly permitting quick installation and removal to reposition in another automobile. Simple manually adjustable means is provided to adjust to the relative stroke lengths of brake and accelerator pedals of various models of automobiles.

CHAPTER 4
PROBLEM DEFINITION AND DESIGN THINKING APPROACH

4.1 PROBLEM DEFINITION

The manual transmission vehicles are a driver-operated accelerator, brake and clutch actuated with the aid of foot pedal. Hence, specially abled people having locomotor disability face difficulty in operating the manual transmission vehicle. There exist various unique and adaptive systems to serve the specially abled people to comfortably drive an automatic transmission vehicle. In contrary, there exist only a few solutions in case of manual transmission vehicle. Moreover, the existing hand control interface for specially abled people involves an operative connection between manual operation and pedal providing multiple leverages which obstructs the standard structure of accelerator, brake and clutch as well as occupies space. Additionally, the installation of the current interface requires permanent damage to the vehicle.

The manual transmission vehicles facilitated with hand control interface requires one hand of the driver to be positioned on the steering wheel while the other hand to be simultaneously operating the interface and the gear lever. The interface usually consists of a locking mechanism which disengages the clutch followed by changing the gear. In order to perform the above action, the driver must often switch his hand between the interface and the gear lever. Sometimes lag in responsive action may lead to a mishap. Moreover, the vehicles were only dedicated to a particular kind of specially abled people i.e. people affected by locomotor disability.

4.2. INITIAL DESIGN USING DESIGN THINKING APPROACH

4.2.1 ACCELERATOR, BRAKE AND CLUTCH CONTROLS

The design of a hand control interface initially began with an empathic understanding the need for the hand control interface. This phase involved consulting various disabled people around the city seeking insights on existing systems and the improvements they were lasting for. The next stage involved gathering the information obtained from the various people and classifying the common problems in the existing systems. This stage involved gathering of numerous ideas to build features, functions or any other elements that are wanting in the current systems.

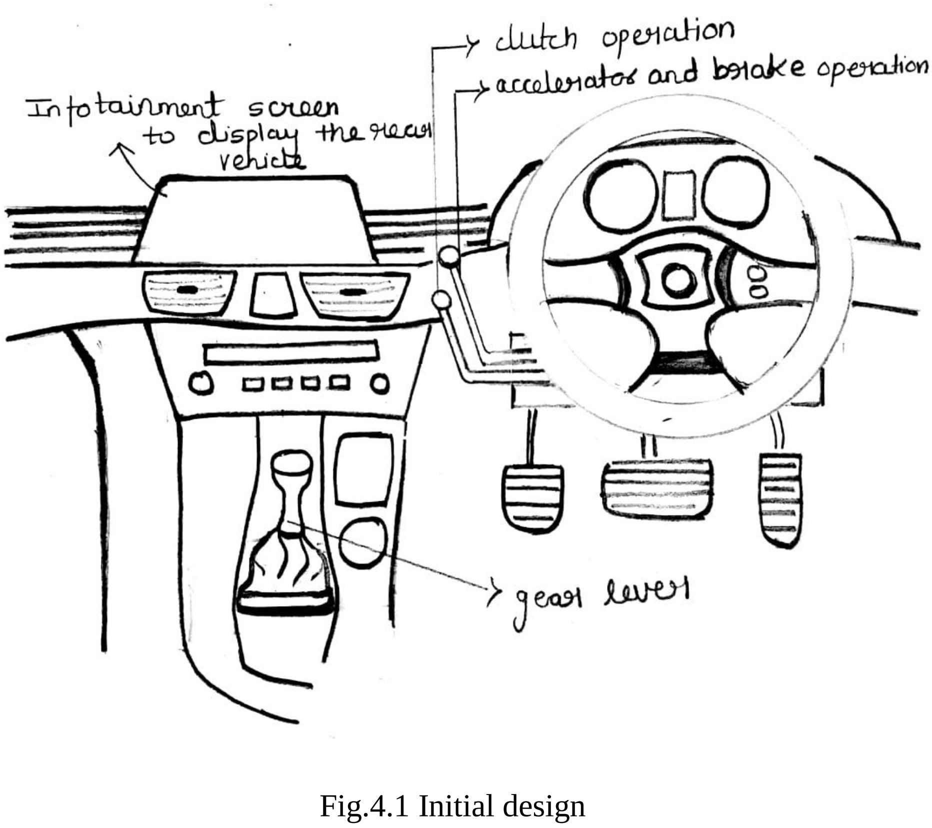

Fig.4.1 Initial design

The figure above was the first design sketched using the various ideas that popped up during the initial phase of research and survey. The basic idea was to develop a mechanism that could be easily operated and easily accessible to the human hand. In the above design the mechanism provides the accelerator brake and clutch to be effectively actuated by hands. In this initial design the specially abled person can operate the accelerator, brake and clutch independently using his hands. The lever behind the steering wheel would operate the clutch and another lever when moved forward would accelerate the vehicle and when moved in counter direction would apply the brakes. The driver can accelerate or decelerate the vehicle using his left hand while his right hand is on the steering wheel. He can also easily operate the clutch using his left hand making use of the second lever while he steers the vehicle. In addition, the left hand can be used to change the gear withoutremoving his hand from the steering wheel. These mechanisms were operated using rigid linkages.. This was the initial basic design which we thought off during the initial phase.

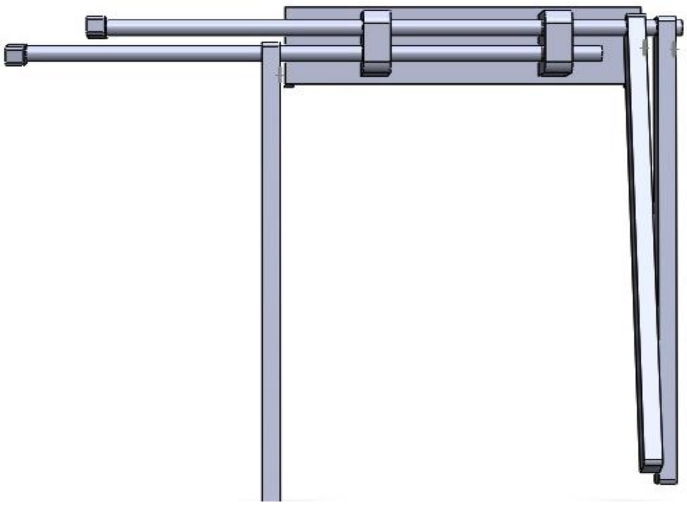

Fig.4.2 Front View of the linkage mechanism

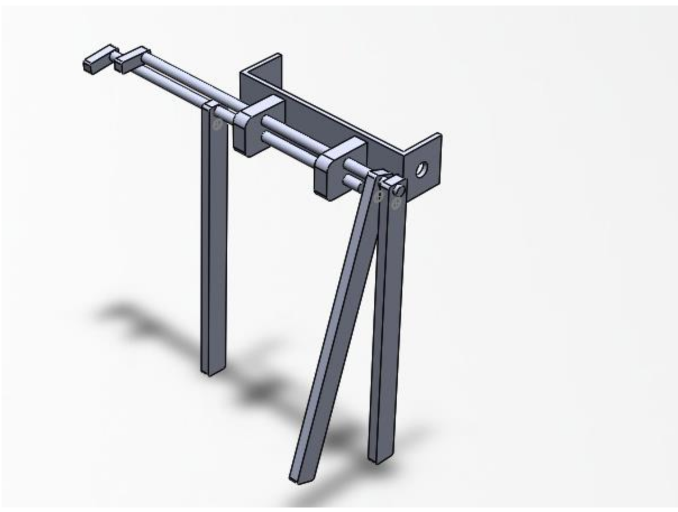

Fig.4.3 Isometric view of the linkage mechanism

The figures 4.2 and 4.3 demonstrate the rigid link connections of the mechanism. The initial raw idea was further developed and modelled to get a realistic idea.

On further exploring other options to operate the mechanism, the second design phase was carried out where the mechanism design included a clutch operating ring behind the steering wheel. This provision would simplify the process of application of clutch and would also help easy gear changing, as the driver can simultaneously steer the vehicle and apply the clutch using his right hand. In this design the left hand would be used to operate the accelerate, brakes and gear changing. This mechanism was much simpler to operate then the previous one. Thus there was an upgrade in the product design. The figures 4.4, 4.5, and 4.6 demonstrate the above mentioned design idea. The mechanisms were modelled using Solidworks software.

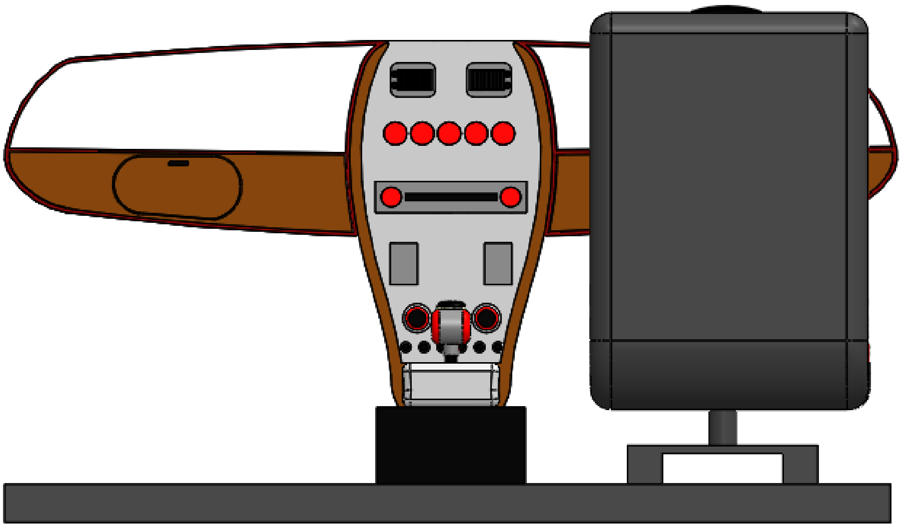

Fig.4.4 Front view(Hand clutch)

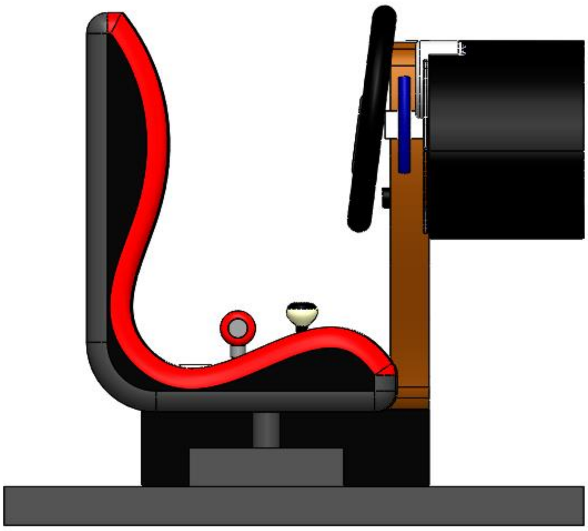

Fig.4.5 Side view(Hand clutch)

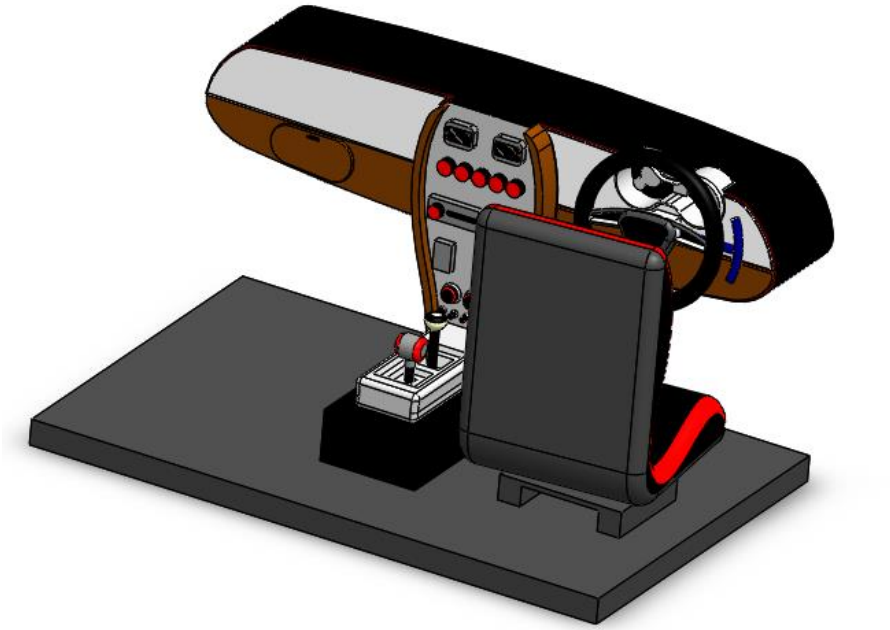

Fig.4.6 Isometric view(Hand clutch)

After performing numerous iterations in the designing process the final mechanism was decided. In the final mechanism the acceleration and braking in an automobile are controlled by an operating lever mounted on the hand control interface. The operating lever works on the principle of the push-pull interface. The Push-pull interfaces are very straightforward, with the pushing of a lever actuating one pedal, and pulling controlling another. The interface operates such that the base frame remains fixed centrally on the floor of the vehicle which is fastened adequately. This is done to avoid displacement or rotation of the base frame, by the forces resulting from pedal operation The brake pedal and the accelerator pedal are respectively operated by pushing and pulling an operating rod by hand. The operating lever moves an accelerator pedal to depress it as the lever is pulled. In contrary, when pushed the hand-operated rod depresses the brake pedal and release the accelerator. While the clutch is actuated by a rock lever which works on the principle of push rock lever interface and is provided with a locking mechanism. Push-lock interfaces include a hinged lever mated to two pushrods. Rocking the hinged lever actuates one input while pushing the whole assembly downward activates another.

Fig.4.7 Accelerator Actuated

Fig.4.8 Brakes Operated

Fig.4.9 Clutch Actuated

Fig.4.10 Isometric view

4.2.2 GEAR SHIFT ASSIST

The project facilitates responsive gear shift assist encompassing a mechanism mounted to the gear lever controlled by push buttons on the steering wheel and assistive systems to aid people disabled due to hearing inability. The responsive gear shift works on the principle of XY plotter. XY Plotter consists of two-axis control and a separate mechanism for lowering and raising. The blocks of the plotter are provided with two servo motors which serve as outputs to an Arduino Uno R3 USB microcontroller. The push buttons provided steering assist as inputs to the microprocessor. The microprocessor is programmed such that on switching the appropriate push button on the steering will result in responsive gear change on the mechanism.

The gear shift assist system was initially designed with a four leg structure to guide the gear slider. After further study of the ergonomics within the vehicle, a compact structure needed to be designed. The designed was then improved and the gear slider was supported by just two leg supports and a cantilever support. The guide rods were also reduced to two from four.

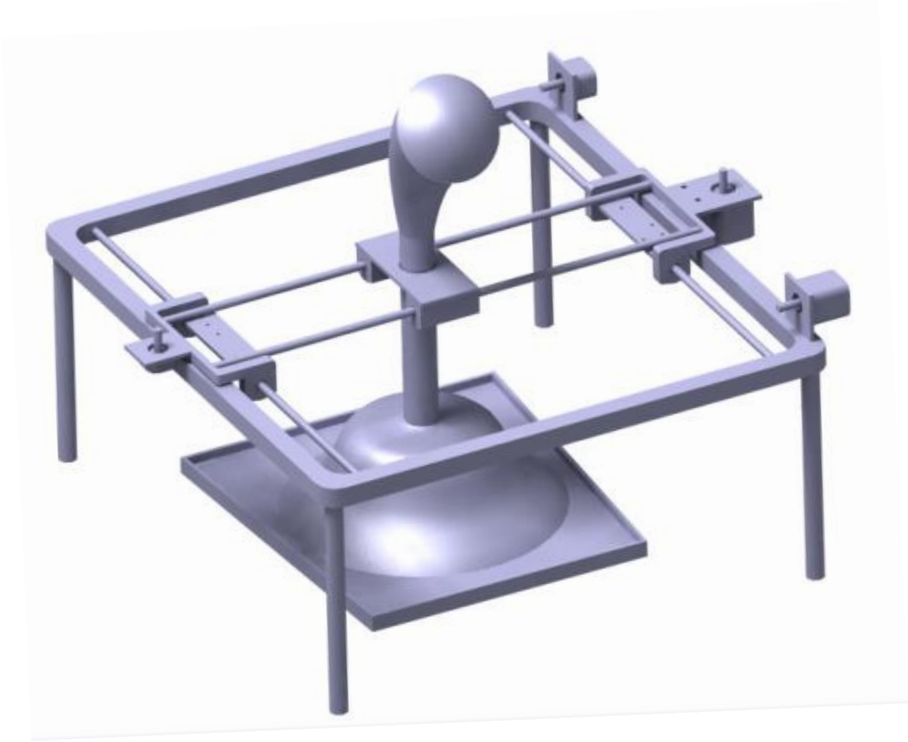

Fig.4.11Initial Design

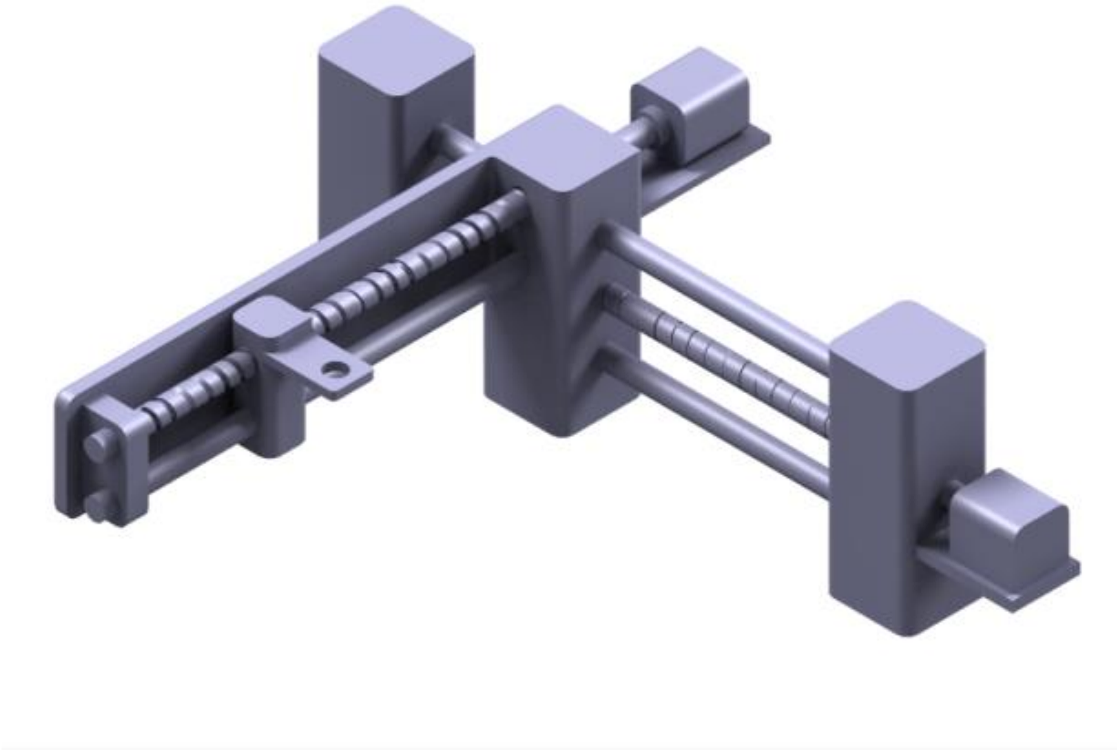

Fig.4.12Final Design

6.2.3 SWIVEL SEAT

A swivel seat for a vehicle that provides a fixed seating platform surrounding a swivel seating platform and a smooth transition from the edge of the vehicle seat to the seating platform. The swivel seat includes a rotatable inner portion and a fixed outer portion surrounding the inner portion. Preferably, the inner portion is elevated above the surrounding outer portion only enough to allow the inner portion to rotate freely. That is, the inner and outer portions are nearly flush with one another. In a second version, the seat includes a rotatable seating platform and a curved lip disposed adjacent to and extending away from the seating platform. The lip is configured to conform generally to the edge of a vehicle seat to provide a smooth transition from the edge of the vehicle seat to the seating platform. These two novel features may be combined in a swivel seat that includes the two piece seating platform and the lip. In this third version of the invention, the seating platform has a rotatable, preferably round, inner portion and a fixed, preferably rectangular, outer portion surrounding the inner portion. The curved lip extends away from one side of the outer portion of the seating platform.

4.2.4 ADDITIONAL SAFETY ASSISTIVE FEATURES

The ultrasonic parking sensors work on the principle of high-frequency sound waves to detect the objects nearby. The ultrasonic sensors emit sound pulses possessing a frequency undetectable by human ears which reflect off the nearby objects and calculate the distance of the vehicle from the object. There are two separate sensors mounted on the left and right of the car which individually measure the distance of an object and display the distances on the either sides independently. Ultrasonic proximity sensors are paired to an alert/alarm system which warns the person driving the vehicle of nearby obstacles. Also, the ultrasonic sensor translates to a pictograph on a vehicle infotainment screen.

Fig.4.13 Assistive features display

4.3. DESIGN AND COMPONENT DRAWINGS

The designing process was initiated through the selection of material to be used to fabricate the mechanism Mild steel, Aluminum and various other materials were considered. Due to its relative ease of machining and its easy availability in various sizes and shapes Mild steel was considered most suitable for use. Moreover, the working forces were small and found to be well within the safe limits for operation. Due to space constraints near the foot pedals the use of flexible push-pull cables to transmit the forces to the controls was most desirable. The following parts were designed using CATIA software and manufactured in the workshop and final assembly of the below-shown parts led to the development of our retrofit mechanism.

4.3.1 BOX

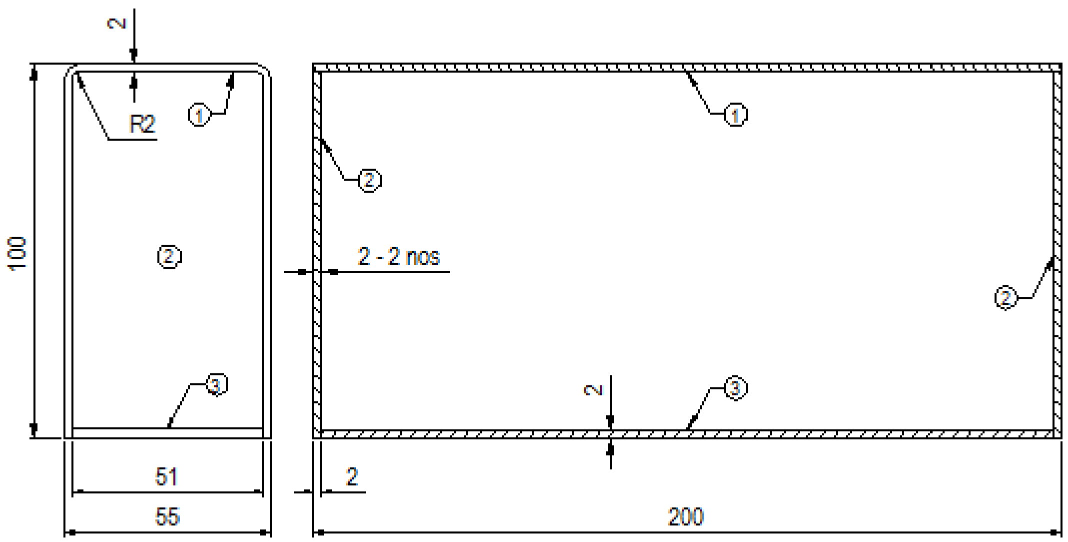

Fig.4.14Box

4.3.2BOTTOM COVER WITH OPERATING LEVER MOUNTING BRACKET

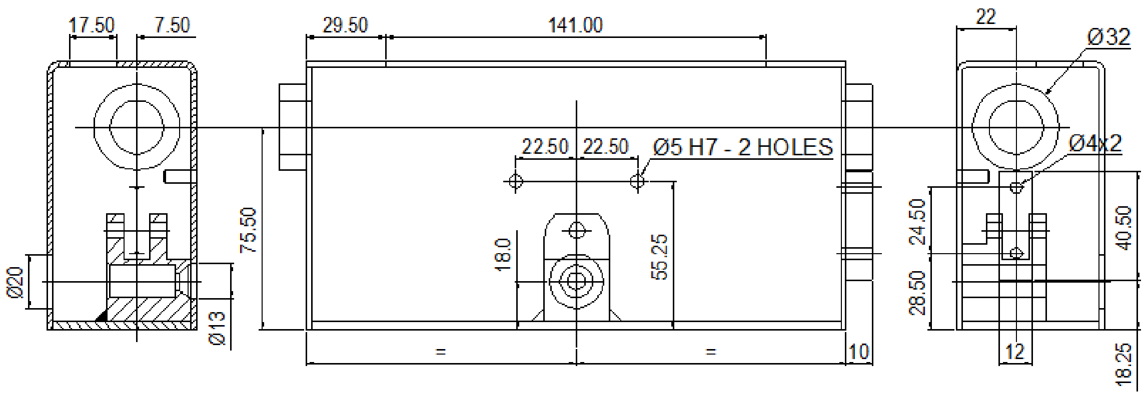

Fig.4.15 Bottom Cover with Operating Lever Mounting Bracket

4.3.3 OPERATING HANDLE

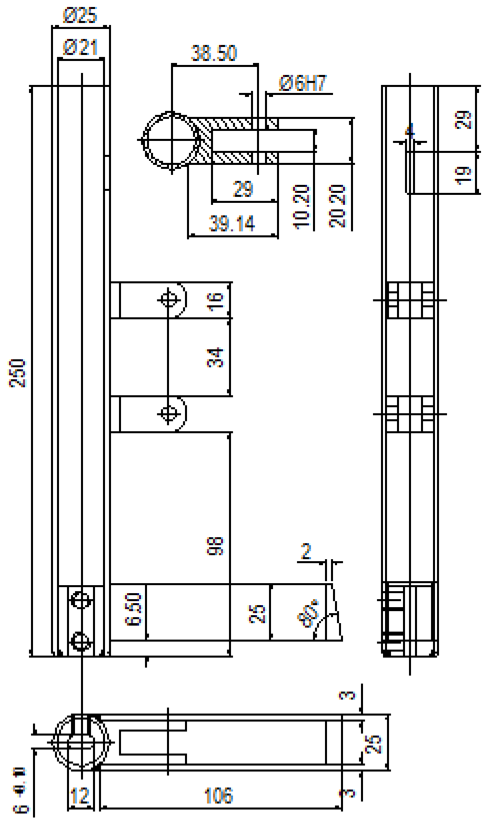

Fig.4.16 Operating Handle

4.3.4 OPERATING LEVER

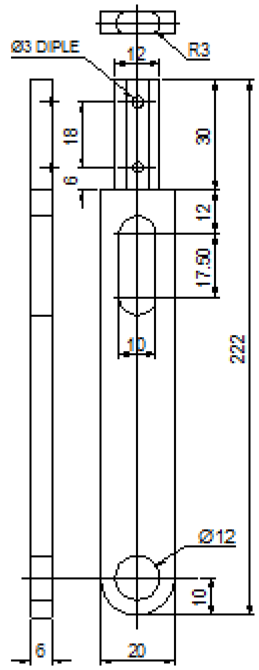

Fig.4.17 Operating Lever

4.3.5 CLUTCH LEVER MOUNTING BRACKETS AND CLUTCH LEVER

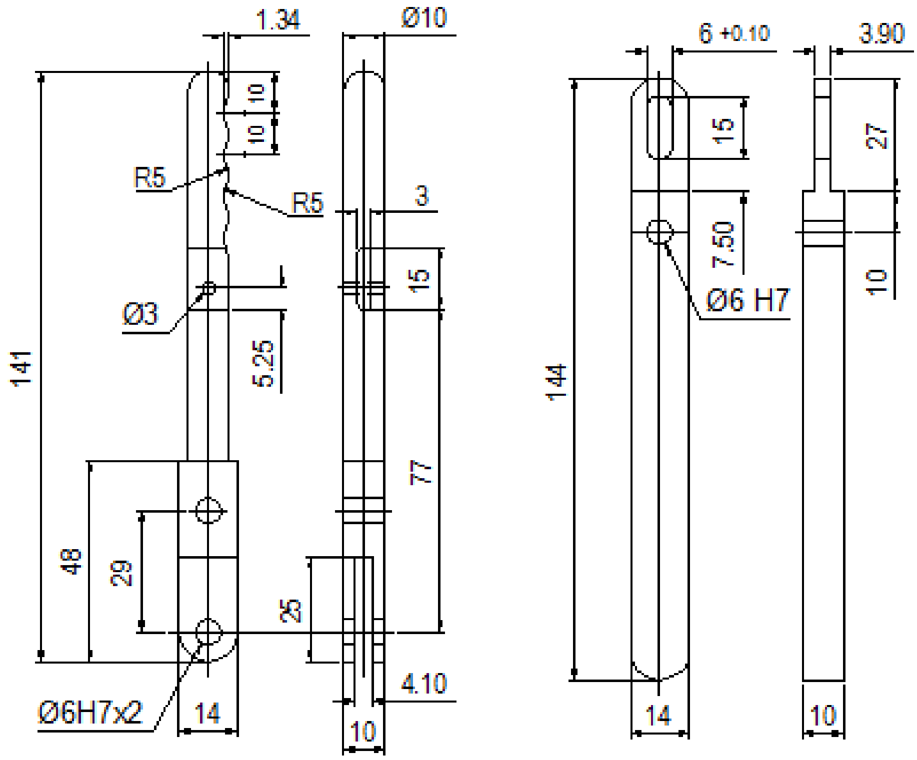

Fig.4.18Clutch Lever Mounting Brackets And Clutch Lever

4.3.6 PUSHER

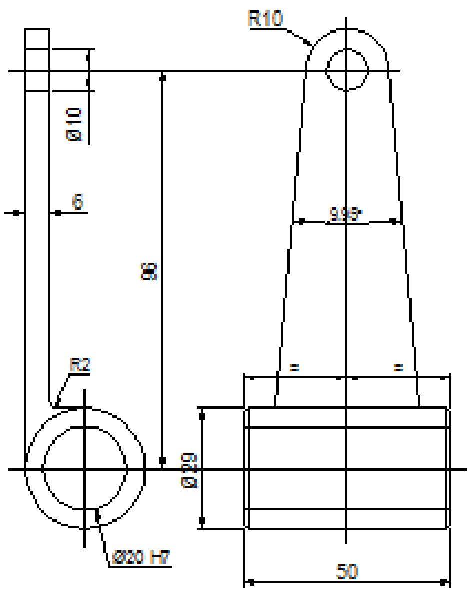

Fig.4.19Pusher

4.3.7 ACCELERATOR SLIDER

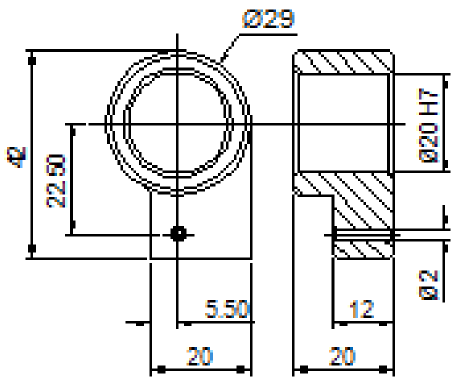

Fig.4.20Accelerator Slider

4.3.8 BRAKE SLIDER

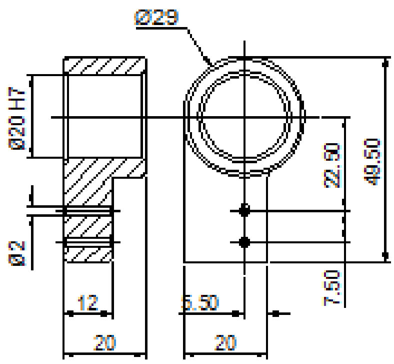

Fig.4.21Brake Slider

4.3.9 PIN

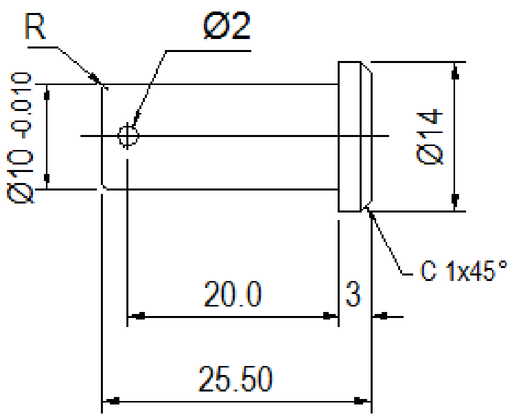

Fig.4.22 Pin

4.3.10 WASHERS

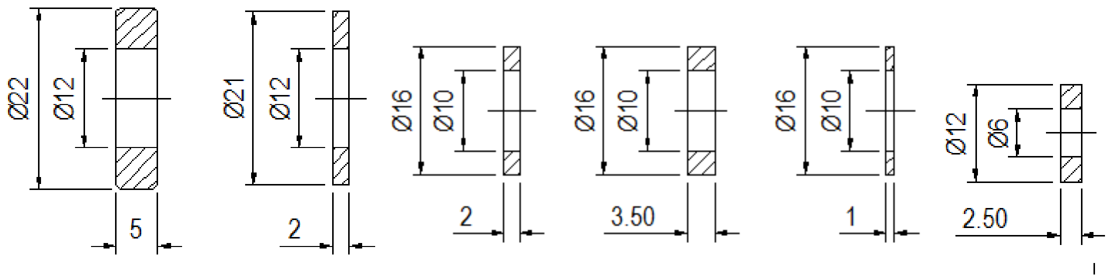

Fig.4.23Washers

4.3.11 PULLEY

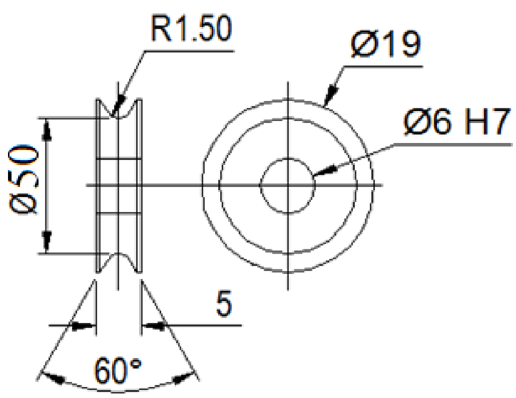

Fig.4.24Pulley

4.4. DESIGN CALCULATIONS

4.4.1 CALCULATION FOR FORCE REQUIRED TO OPERATE THE ACCELERATOR LEVER

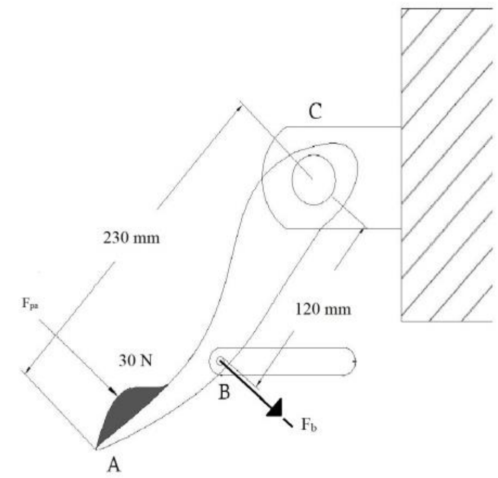

Fig.4.25 Accelerator Pedal

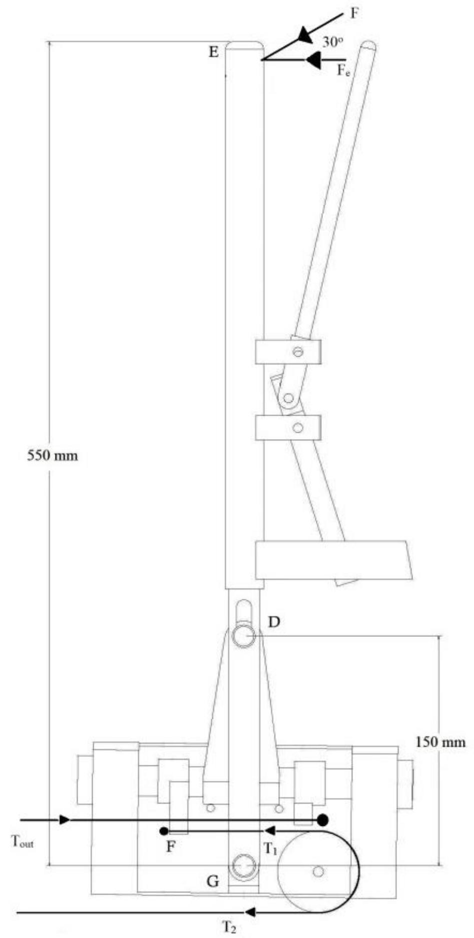

Fig.4.26 Accelerator Mechanism

The average pedal force required to operate the accelerator pedal is equal to 30 N.

From the figure 4.26 we observe that the link (pedal) AC of length 230 mm is pivoted at point C, and a moment is produced at point C due to the force exerted on the pedal. The force from the pedal is transmitted to the mechanism using flexible inextensible push-pull cable. The cable is connected to the accelerator pedal at point B which is at a distance of 120mm form the pivot point C. The force transmitted through the cable is calculated using the moment equation

The moment equation is given by

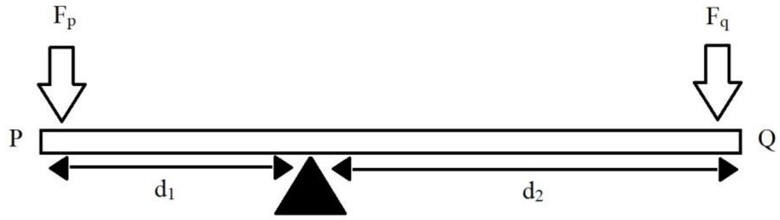

Fig.4.27 Moment Diagram

For a link PQ pivoted at point R the moment equation is given as:

$M_p = M_q$

$F_p \times d_1 = F_q \times d_2$

Similarly,

$M_a = F_{pa} \times d_1$ .... (4.1)

Where, $M_a$is the moment at point A due to the force $F_{pa,}$

$F_{pa}$is the pedal force acting at point A,

d_1 is the perpendiculardistance from the pivot point C to the point A as shown in Fig 4.25

$M_a = 30 \times 230$

$M_a = 6900$ N-mm

From the moment equation $M_a = M_b$

Where, M_b is the moment at point B due to the force F_b,

F_b is the force acting at point B,

d_2 is the perpendiculardistance from the pivot point C to the point B as shown in Fig 4.25

.

$F_{pa} \times d_1 = F_b \times d_2$ .... (4.2)

$6900 = F_b \times 120$

$F_b = 6900 / 120$

$F_b = 57.5$ N

This force is transmitted through the push-pull cable, as there is friction loss which takes place in the cable due to friction between the inner and the outer, the tension at the exit of the cable is calculated as

$T_{out} = T_{in} + LW\mu$... (4.3)

Where, L = length of the straight section

W= weight per unit length

T_{out} = Tension at the pedal side of the cable

T_{in} = Tension at the lever side of the cable

$T_{in} = F_b = 46$ N.

$L \times W = 0.2 \times 9.81 = 1.962$ N

$T_{out} = 57.5 + (1.962 \times 0.1)$

$T_{out} = 57.5 + 0.6867$

$T_{out} = 58.18$ N.

This force acts at the brake slider at point F as shown is figure 4.26, and as the member FD is rigid the same force acts at point D therefore

$F_f = F_d = 58.18$ N.

Where, F_f is the force acting at point F and F_d is the force acting at point D.

The operating handle EDG is pivoted at point G. The moment produced by the force of 58.18 N at point D is

$M_d = F_d \times d_3$... (4.4)

Where, M_d is the moment at point D due to the force F_d,

F_d is the force acting at point D,

d_3 is the perpendicular distance from the pivot point G to the point D as shown in Fig 4.26

$M_d = 58.18 \times 150$

$M_d = 8728.02$ N-mm.

The force at E required to produce the same moment is calculated using the moment equation

$M_e = M_d$

$F_e \times d_4 = F_d \times d_3$ .... (4.5)

Where, M_e is the moment at point E due to the force F_e,

F_e is the force acting at point E,

d_4 is the perpendicular distance from the pivot point G to the point E as shown in Fig 4.26

$F_e \times 550 = 8728.02$

$F_e = 8728.02 / 550$

$F_e = 15.86$ N.

This force acts normal to the lever, but when we observe the normal operating position of the lever the angle made by the human arm with reference to the horizontal is 30^o in the anticlockwise direction as shown in the figure 4.28

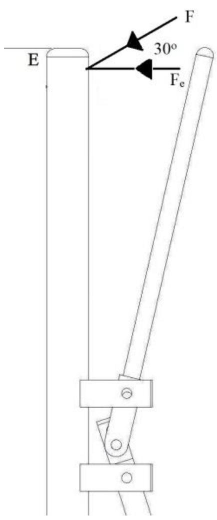

Fig.4.28 Accelerator Mechanism

Hence the force required to operate the brake lever using human arm is given by

$F = F_e / \cos\theta$.. (4.6)

Where, F_e is the force acting at point E normal to the accelerator handle and Fis the force acting at point E atand angle of 30^o.

$F = 15.86 / \cos 30^o$

$F = 18.32$ N.

Therefore the force required to depress the brake pedal using the human hand is equal to **18 N** which is less than that required by the human leg.

4.4.2 CALCULATION FOR FORCE REQUIRED TO OPERATE THE BRAKE LEVER

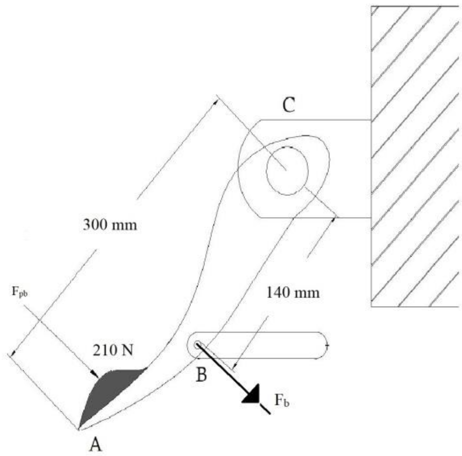

Fig.4.29 Brake pedal

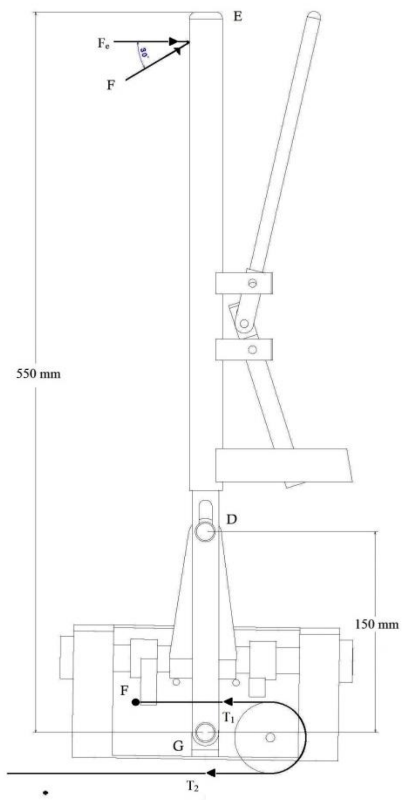

Fig.4.30 Brake mechanism

The average pedal force required to operate the brake pedal is equal to 210 N.

From the figure 4.30 we observe that the link (pedal) AC of length 300 mm is pivoted at point C, the moment produced at point C due to the force exerted on the pedal. The force from the pedal is transmitted to the mechanism using flexible inextensible push-pull cable.

The cable is connected to the brake lever at point B which is at a distance of 140mm form the pivot point C. The force transmitted to the cable is calculated using the moment equation

The moment equation is given by

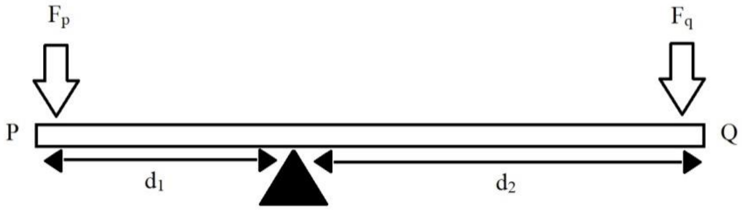

Fig.4.31 Moment diagram

For a link PQ pivoted at point R the moment equation is given as:

$M_p = M_q$

$F_p \times d_1 = F_q \times d_2$

Similarly,

$M_a = F_a \times d_1$…………………………………………..……………………………… (4.7)

Where, M_a is the moment at point A due to the force F_a,

F_a is the force acting at point A,

d_1 is the perpendiculardistance from the pivot point C to the point A as shown in Fig 4.31

$M_a = 210 \times 300$

$M_a = 63000$ N-mm

From the moment equation $M_a = M_b$

$F_{pb} \times d_1 = F_b \times d_2$.. (4.8)

Where, M_b is the moment at point B due to the force F_b,

F_{pb} is the pedal force acting at point B,

d_2 is the perpendiculardistance from the pivot point C to the point B as shown in Fig 4.31

$63000 = F_b \times 140$

$F_b = 63000/140$

$F_b = 450$ N

This force is transmitted through the push-pull cable, as there is friction loss which takes place in the cable due to friction between the inner and the outer, the tension at the exit of the cable is calculated as

$T_{out} = T_{in} + LW\mu$... (4.3)

Where L = length of the straight section

W= weight per unit length

T_{out} = Tension at the pedal side of the cable

T_{in} = Tension at the lever side of the cable

$T_{in} = F_b = 450$ N.

$L \times W = 0.2 \times 9.81 = 1.962$ N

$T_{out} = 450 + (1.962 \times 0.1)$

$T_{out} = 450 + 0.6867$

$T_{out} = 450.68$ N.

The tension is then transmitted through the pulley. The pulley is considered to be massless hence the tension on both sides of the pulley is the same as shown is the figure 4.32

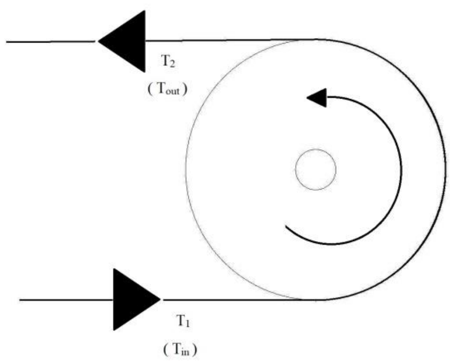

Fig.4.32 Pulley Tension

$T_{out} = T_2 = T_1 = 450.68$ N

This is the force acting at the brake slider at point F as shown is figure 4.30 the member FD is rigid the same force acts at point D therefore

$F_d = F_f = 450.68$ N.

The operating handle EDG is pivoted at point G with a force of 450.68 N acting at point D, the moment produced by this force is

$M_d = F_d \times d_3$. ....(4.10)

Where, M_d is the moment at point D due to the force F_d,

F_d is the force acting at point D,

d_3 is the perpendicular distance from the pivot point G to the point D as shown in Fig 4.30

$M_d = 450.68 \times 150$

$M_d = 67602.3$ N-mm.

The force at E required to produce the same moment is calculated using the moment equation

$M_e = M_d$

$F_e \times d_4 = F_d \times d_3$ .... (4.11)

Where, M_e is the moment at point E due to the force F_e,

F_e is the force acting at point E,

d_4 is the perpendicular distance from the pivot point G to the point E as shown in Fig 4.30

$F_e \times 550 = 67602.3$

$F_e = 122.91$ N.

This force acts normal to the lever, but when we observe the normal operating position of the lever the angle made by the human arm with reference to the horizontal is 30^o in the anticlockwise direction as shown in the figure 4.33

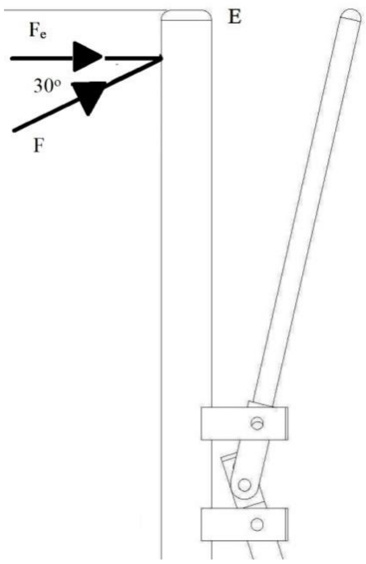

Fig.4.33 Brake mechanism

Hence the force required to operate the brake lever using human arm is given by

$F = F_e / \cos\theta$... (4.12)

$F = 122.91 / \cos 30^o$

Where, F_e is the force acting at point E normal to the accelerator handle and Fis the force acting at point E atand angle of 30^o as shown in Fig 4.33.

F = 141.92 N.

Therefore the force required to depress the brake pedal using the human hand is equal to **142 N** which is less than that required by the human leg.

4.4.3 DESIGN OF BRAKE OPERATING HANDLE

The brake operating Handle EG of length 550 mm has the possibility of bending due to the moment acting on it. The bending stress induced is calculated as

The outer diameter of the rod (D) = 25 mm

The inner diameter of the rod (d) = 21 mm

The area moment of inertia (I)

$I = \pi(D^4 - d^4) / 64$ .... (4.13)

$I = \pi(25^4 - 21^4) / 64$

$I = 9628.19\ mm^4$

The section modulus (Z) = I/y, ... (4.14)

Where, y = D/2

Z = 9628.19 / 12.5

$Z = 770.255\ mm^2$

The bending stress $\sigma_b = M / Z$ .... (4.15)

Where, M is the moment acting on the brake handle

$\sigma_b = 60672.3 / 770.255$

$\sigma_b = 78.76$ MPa

The yield strength of mild steel is 330 MPa

Factor of Safety (FOS) = 2

The permissible stress = σ_{yld}/ FOS .... (4.16)

$\sigma_{per} = 330 / 2$

$\sigma_{per} = 165$ MPa

$\sigma_b < \sigma_{per}$

The bending stress is less than the permissible stress hence the design is safe

4.4.4 CALCULATION FOR FORCE REQUIRED TO OPERATE THE CLUTCH LEVER

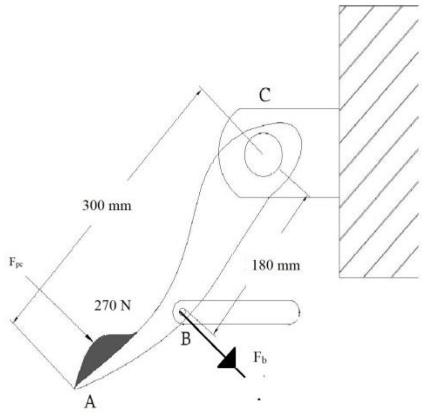

Fig.4.34Clutch lever

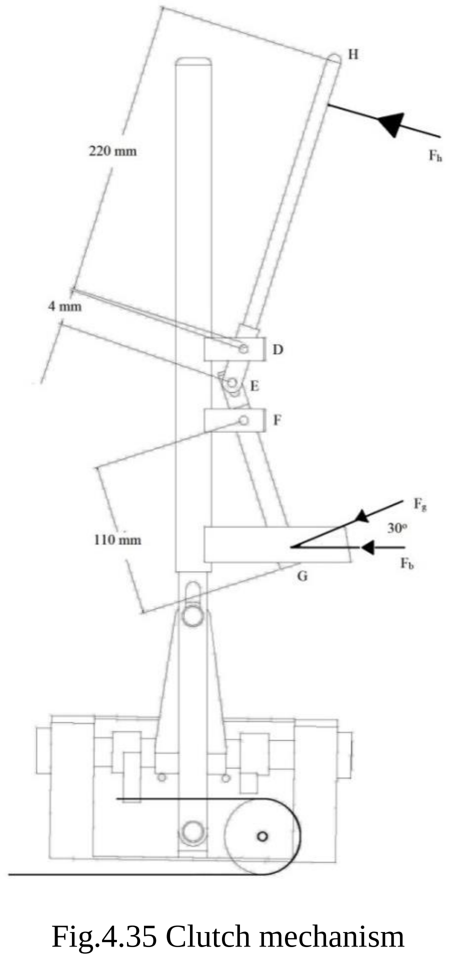

Fig.4.35 Clutch mechanism

The average pedal force required to operate the brake pedal is equal to 270N.

From the figure 4.35 we observe that the link (pedal) AC of length 300 mm is pivoted at point C, the moment produced at point C due to the force exerted on the pedal. The force from the pedal is transmitted to the mechanism using flexible inextensible push-pull cable. The cable is connected to the clutch lever at point B which is at a distance of 180mm form the pivot point C. The force transmitted to the cable is calculated using the moment equation

The moment equation is given by

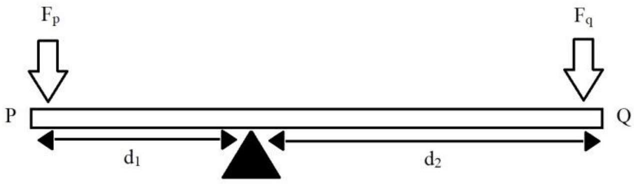

Fig.4.36 Moment diagram

For a link PQ pivoted at point R the moment equation is given as:

$M_p = M_q$

$F_{pc} \times d_1 = F_q \times d_2$

Similarly,

$M_a = F_a \times d_1$.. (4.17)

Where, M_a is the moment at point A due to the force F_a,

F_{pc} is the pedal force acting at point A,

d_1 is the perpendiculardistance from the pivot point C to the point A as shown in Fig 4.36

$M_a = 270 \times 300$

$M_a = 81000$ N-mm

From the moment equation $M_a = M_b$

$F_{pc} \times d_1 = F_b \times d_2$.. (4.18)

Where, M_b is the moment at point B due to the force F_b,

F_b is the force acting at point B,

d_2 is the perpendiculardistance from the pivot point C to the point B as shown in Fig 4.36

$81000 = F_b \times 160$

$F_b = 81000 / 160$

$F_b = 506.25$ N

This force is transmitted through the push-pull cable, as there is friction loss which takes place in the cable due to friction between the inner and the outer, the tension at the exit of the cable is calculated as

$T_{out} = T_{in} + LW\mu$.. (4.3)

Where, L = length of the straight section

W= weight per unit length

T_{out} = Tension at the pedal side of the cable

T_{in} = Tension at the lever side of the cable

$T_{in} = F_b = 506.25$ N.

$L \times W = 0.18 \times 9.81$

$= 1.7658$ N

$T_{out} = 506.25 + (1.7658 \times 0.1)$

$T_{out} = 506.25 + 0.6867$

$T_{out} = 507.05$ N.

This is the force acting at the point G in the mechanism as shown in the figure 3.5

$T_{out} = 507.05$ N

But the force at point F is not perpendicular to the link EG but makes an angle of 30^o with reference to the horizontal measured anticlockwise as shown in figure 4.37. The force acting perpendicular to the link is calculated as

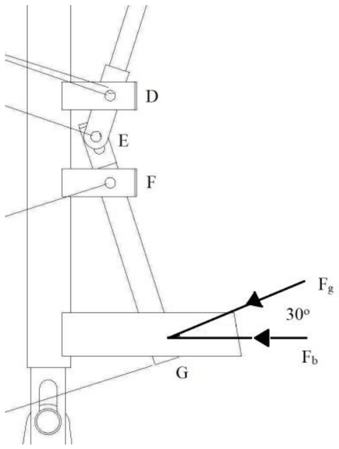

Fig.4.37 Clutch mechanism

F_b= 507.05 N

F_g= F_b×cosϴ .... (4.20)

Where, $F_b$is the force acting at point G normal to the accelerator handle$F_g$is the force acting at point G at and angle of 30° as shown in Fig 4.37.

Here ϴ = 30°

F_g= 507.05 cos 30°

F_g= 439.11 N.

The links EG and EH are pivoted at point F and D respectively

The force acting at point G is equal to

F_g= 439.11 N

The moment produced by $F_g$at F is calculated using the moment equation

M_g = F_g× d_3.. (4.21)

Where, $M_g$is the moment at point F due to the force F_g,

$F_g$is the force acting at point G,

$d_3$is the perpendiculardistance from the pivot point F to the point G as shown in Fig 4.37

M_g = 439.11 × 110

M_g = 48302.1 N-mm

As EG is a rigid single link the same moment is produced at E due to the force acting at that point.

$M_g = M_e$

Hence the force acting at point E is calculated as

$F_e \times d_4 = F_g \times d_3$... (4.22)

Where, $M_e$is the moment at point E due to the force F_e,

F_e is the force acting at point E,

$d_4$is the perpendiculardistance from the pivot point F to the point E as shown in Fig 4.37

$F_e \times 40 = 48302.1$

$F_e = 48302.1 / 40$

$F_e = 1207.5525$ N

The links HE is connected to the link GE hence the moment produced at point E due to the force F_e

$M_e = F_e \times d_5$.. (4.23)

Where, $M_e$is the moment at point E due to the force F_e,

F_e is the force acting at point E,

$d_5$is the perpendiculardistance from the pivot point E to the point D as shown in Fig 4.36

$M_e = 1207.5525 \times 40$

$M_e = 48302.1$ N

The quantity of force at point H required to produce the same moment about the pivot point D is calculated using the moment equation

$M_h = M_e$

$F_h \times d_6 = Fe \times d_5$... (4.24)

Where, M_h is the moment at point H due to the force F_h,

F_h is the force acting at point H,

d_5 is the perpendiculardistance from the pivot point D to the point H as shown in Fig 4.36

$F_h \times 220 = 48302.1$

$F_h = 48302.1/220$

$F_h = 219.55$ N

Therefore the force required to depress the clutch pedal using the human hand is equal to **220 N** which is less than that required by the human leg.

4.4.5 DESIGN OF THE CLUTCH OPERATING LEVER

The clutch operating lever EH of length 220 mm has the possibility of bending due to the moment acting on it. The bending stress induced is calculated as

The diameter of the rod (D) = 15 mm

The area moment of inertia (I)

$I = (\pi \times D^4) / 64$ .... (4.25)

$I = \pi(15^4) / 64$

$I = 2485.04$ mm^4

The section modulus (Z) = I/y, where y = D/2

$Z = 2485.04 / 7.5$

$Z = 331.33$ mm^2

The bending stress $\sigma_b = M / Z$ .... (4.26)

$\sigma_b = 48302.1 / 331.33$

$\sigma_b = 145.78$ MPa

The yield strength of mild steel is 330 MPa

Factor of Safety (FOS) = 2

The permissible stress = σ_{yld} / FOS .... (4.27)

σ_{per}= 330 / 2

σ_{per}= 165 MPa

$\sigma_b < \sigma_{per}$

The bending stress is less than the permissible stress hence the design is safe

4.4.6 DESIGN OF THE SHAFT

The shaft is simply supported at both the ends and is acted upon by a moment

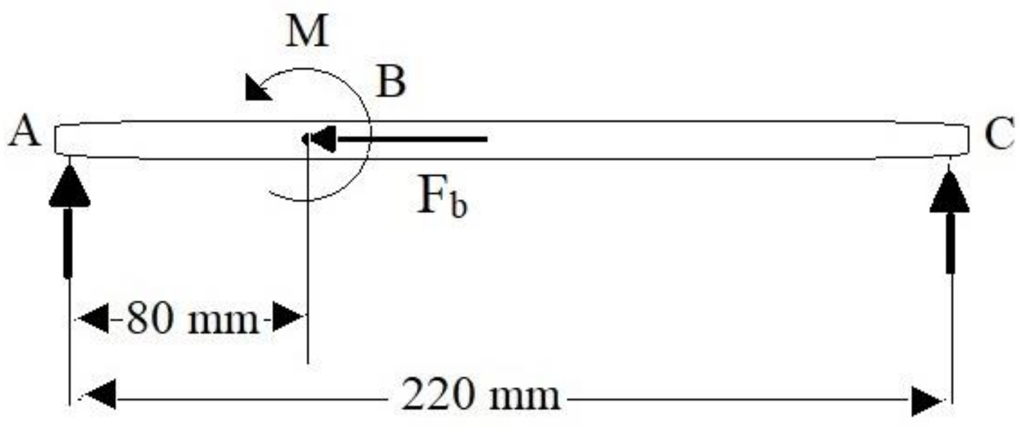

Fig.4.38 Shaft subjected to moment

The support reactions are calculated as

ΣM_a= 0

$R_c \times L + M = 0$ .... (4.28)

R_c= - M / L

Where, R_c is the reaction force at point C.

M is the moment acting on the shaft

L is the length of the shaft

The moment acting on the shaft is equal to M = 60672.3 N-mm

The length of the shaft is L = 220 mm

R_c= - 60672.3 / 220

$R_c = -275.78$ N

The reaction at point C is acting upwards as the sign is negative

$\Sigma F_y = 0$

$R_a + R_c = 0$.. (4.29)

Where, R_a is the reaction force at point A.

$R_a = - R_c = M/L$

Therefore $R_a = 275.78$ N

The shear force for the shaft is

$F_x = R_a = M / L$ .... (4.30)

$F_{ab} = R_a = M / L = 275.78$ N

$F_{bc} = M / L = 275.78$ N

Shear force is not induced due to the couple.

The bending moment for the shaft is

$M_a = 0$

$M_x = R_a \times = M \times /L$ .... (4.31)

$M_b = R_a \times L^1$

Where M_b is the bending moment at point B

$M_b = 275.78 \times 80$

$M_b = 22062.65$ N-mm

M_b (on portion BC) = 22062.65 - 60672.3

$M_b = - 38609.64$ N-mm

$M_c = 0$

The shear force and bending moment diagram are as shown in figure 4.39

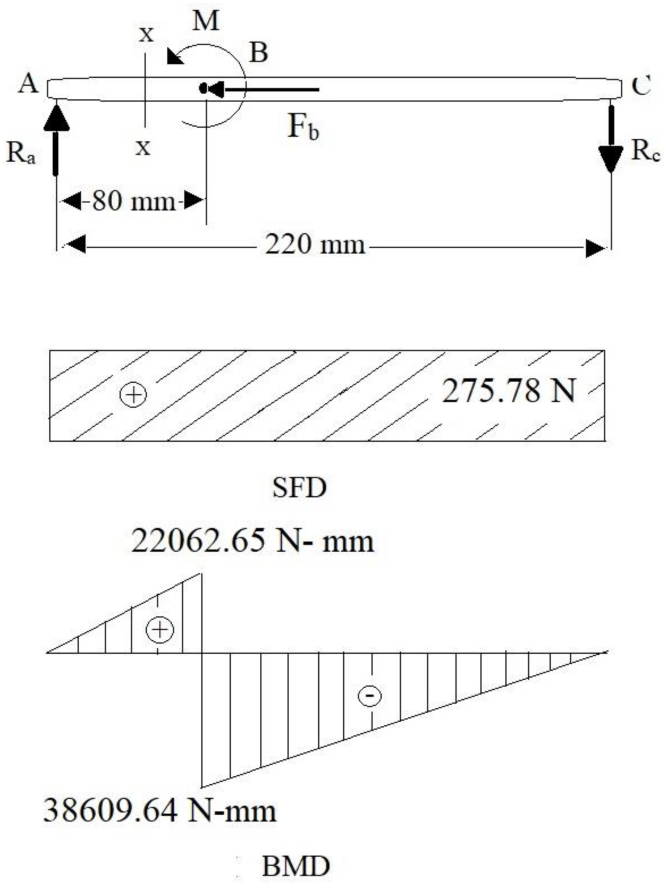

Fig.4.39 SFD and BMD

The maximum bending moment is equal to 38609.64 N-mm and the force of 122.91 N acts at point B

The bending stress is given by

σ_b= 32M / π d^3.. (4.32)

where M is the ma× bending moment

d is the diameter of the shaft

$\sigma_{b} =$ 32 × 38609.64 / π× 20^3

σ_b= 49.15 MPa

The direst stress acting at the point B due to the force of F_b122.91 N is calculated as

$\sigma_{d} =$ F_b×π× d^2 / 4

σ_d = 0.31MPa

The resultant stress developed is calculated as

$\sigma_r = \sigma_d + \sigma_b$

$\sigma_r = 49.15 + 0.31$

$\sigma_r = 49.56$ MPa

The material of the shaft used is mild steel. The yield strength for mild steel is 330 MPa, the permissible strength is calculated by

$\sigma_{yld} = 330$ MPa

FOS = 2

$\sigma_{per} = \sigma_{yld}$ / FOS .... (4.33)

Where, σ_{per} is the permissible stress

σ_{yld} is the yield stress

FOS is the Factor of safety

$\sigma_{per} = 330/2$

$\sigma_{per} = 165$ MPa

$\sigma_r = 49.56$ MPa

$\sigma_r < \sigma_{per}$

The resultant stress is less than the permissible strength hence the design is safe.

4.4.7 DESIGN OF PIN

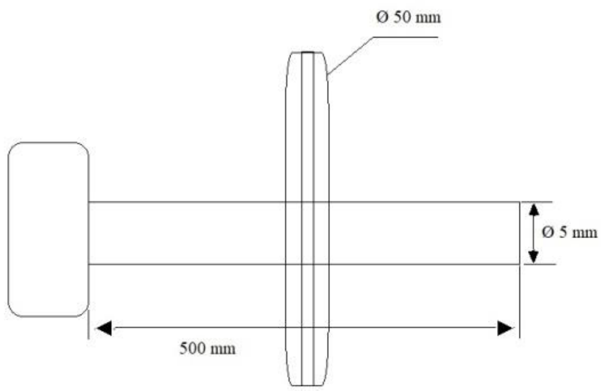

Fig.4.40 Pin with the pulley

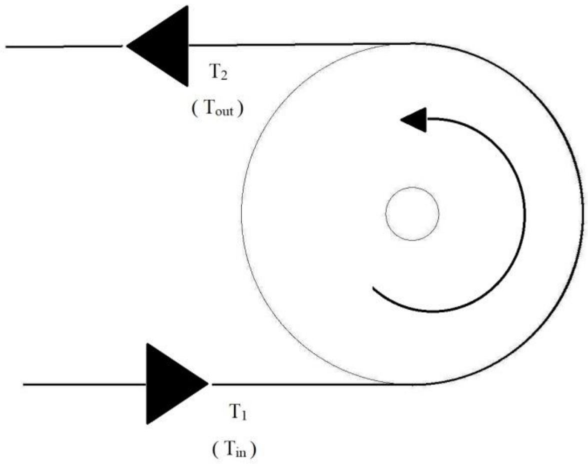

Fig.4.41 Pulley tension

The diameter of the pin is d= 5 mm

The length of the pin is L = 500 mm

The tension acting on the either sides of the pulley $T_1 = T_2 = 450.68$ N

The total load on the pulley $W = (T_1 + T_2) = 450.68 + 450.68$

W = 901.36 N

The moment produced due to the load is M = W × L /4 .... (4.34)

M = 901.36 × 500 / 4

M = 112670 N-mm

The torque acting is $T = (T_1)\ r$ .... (4.35)

Where r is the radius of the pulley r = 60 mm

T = 450.68 × 30

T = 13520.4 N-mm

The diameter D of the shaft is 25 mm

The diameter of the shaft subjected to combined bending and torsion, according to the maximum shear stress theory is

τ_d = [16/ (π D^3) { (M $)^2$ + (T $)^2$ $\}^{1/2}$] .... (4.36)

$\tau_{d\,=}$ 36.98 MPa

The allowable sheer stress value is $\tau_{da\,=}$ 50 MPa.

$\tau_d < \tau_{da}$

Hence the shear stress developed is less than the allowable stress and the design is safe.

CHAPTER 5
RESULTS AND DISCUSSION

In order to create a minimally invasive hand control interface that will accomplish our goal, benefit the end user, the mechanism is successfully designed to actuate the accelerator, brake and clutch controls using minimal hand force. Taking into consideration the average upper body strength in humans, the hand operations of the mechanism is designed for a lighter hand force. Below is a table which demonstrates the actual forces required to actuate the pedals and forced developed on the interface.

	Pedal force (Newton)	Hand force (Newton)	Percentage reduction (%)
ACCELERATOR	30	18	40
BRAKES	210	142	33
CLUTCH	270	220	19

Table 5 Results

From the above table, we observe that the mechanism is successful in reducing the actuating forces from the pedal to the hand operations. The maximum reduction in the force application is observed for the accelerator operation with 40% reduction in the force applied at the pedal. Additionally, there is a 33% reduction in the force required for actuating the brakes using the hand control interface. We can also infer from the above table that the amount of forces required for actuating the accelerator, brake and clutch controls using the hand interface is minimal in comparison to the forces required to operate by foot.

The project literature review substantiates that 2.21% of the population in India are specially abled. We identified that 20% of the specially abled people are having disability in movement and another 19 % are with disability in hearing. The project was able to meet its goal of developing a hand control interface targeting the specially abled people and in particular, the people affected by locomotor disability and inability in hearing. The results obtained interpret that the interface can actuate the accelerator, brake and clutch with minimal force in terms of the forces required by a normal driver to operate the pedal. Additionally, there exist benefits of using the hand control interface. Firstly, the hand control interface has minimal responsive time between control and pedal operation and allows no compromise on the safety of the driver or the surrounding. Secondly, the interface aids the driver to operate the accelerator, brake and clutch one at a time. Thirdly the installation of the interface does not require any permanent damage to the vehicle and can easily be utilized by normal people during traffic congestion with no hassle. Moreover, the assistive systems enable the driver to view the vehicle approaching the driver's car. Lastly, the ultrasonic sensors are capable of detecting the vehicle within the range of 2.5 meters and have an accuracy of 0.1m, ensures consistent measurement and accordingly depending on the position of the vehicle, the LED screen actuates followed by a human voice warning.

CHAPTER 6
CONCLUSION AND SCOPE FOR FUTURE WORK

6.1 CONCLUSION

People affected by disabilities have limited educational achievements, poorer health outcomes, higher rates of poverty and smaller economic participation in comparison to people without disability. In some or the other way, it is not possible for them to enjoy a normal life. So they must not consider them as social burdens. Instead, they must be encouraged to live boldly and overcome all the odds in their life. Hence this project aims to ameliorate the inability of specially-abled people to effectively control manual transmission vehicle through the creation of a minimally invasive hand control interface and providing the necessary assistive systems in a conventional vehicle.

Firstly, the project started hunting down the need in the market. This resulted in determining that globally there are more than one billion people who are specially abled and particularly in India there are 26.8 million people specially abled and contribute of 2.21% of the total population. Secondly, while concentrating on the existing systems available in the market partly satisfy the objectives of the project. However, the existing systems are particularly meant for an automatic transmission. Also, the systems when installed in a manual transmission vehicle are inconvenient from the driver's point of view.

Our hand control interface provides a comfortable driving condition incorporating the accelerator, brake and clutch in a single mechanism without interfering the conventional pedal controls of the vehicle. The project also provides assistive features for the ease of the vehicle driven by people disabled due to hearing or hard to hear. Furthermore, the project aims to provide a gear shift assist in a manual transmission vehicle along with controls mounted on the steering wheel.

The project was successful in meeting the desired objectives and developing a minimally invasive hand control interface facilitating the specially abled people to effectively control a manual transmission vehicle. As intended the project is also provided with assistive features such as a camera for constant vision and a better understanding of the vehicle approaching from the back and ultrasonic sensors for determining the distance of the other vehicles from the driver’s vehicle. This project mitigates the difficulties experienced by specially abled people in accessing the services which include employment, education, health and information as a result of immobility or lack of transport facilities. The team has made an attempt to create job opportunities for specially abled people and bring hope in their life and create social equality in society.

6.2 SCOPE FOR FUTURE WORK

6.2.1 SATELLITE ACCELERATOR

The innovative satellite accelerator is designed to assist any driving condition. Additionally, it provides precise acceleration and freedom of movement.

Fig 6.1 Satellite Accelerator

The satellite accelerator can be worn as a glove and is made convenient on the left and right hand. The changeable brackets, hand locator and padding are adjustable to ensure proper fitment for various hand sizes. There is no interference when turning or holding the steering wheel. Acceleration is actuated by softly pushing the thumb on a small lever that is connected to an original vehicle electronic system. Dedicated software enables smooth progressive acceleration through precise programming done to suit vehicle and driver characteristics.

In order to avoid interference with the steering wheel, the cord is mounted at distance close to the elbow. Both the hands are placed on the steering wheel, upon wearing the satellite accelerator and allow reaching the gear lever, brake lever, various commands on the steering wheel and the dashboard.

6.2.2 DUCK CLUTCH

A recent development in assistive driving devices is the electronic actuation of clutch in manual transmission cars .The system is called as the “Duck clutch”. The Duck clutch consists of an electrically powered actuator system which can be installed on any vehicle in order to give fingertip Control clutch pedal.

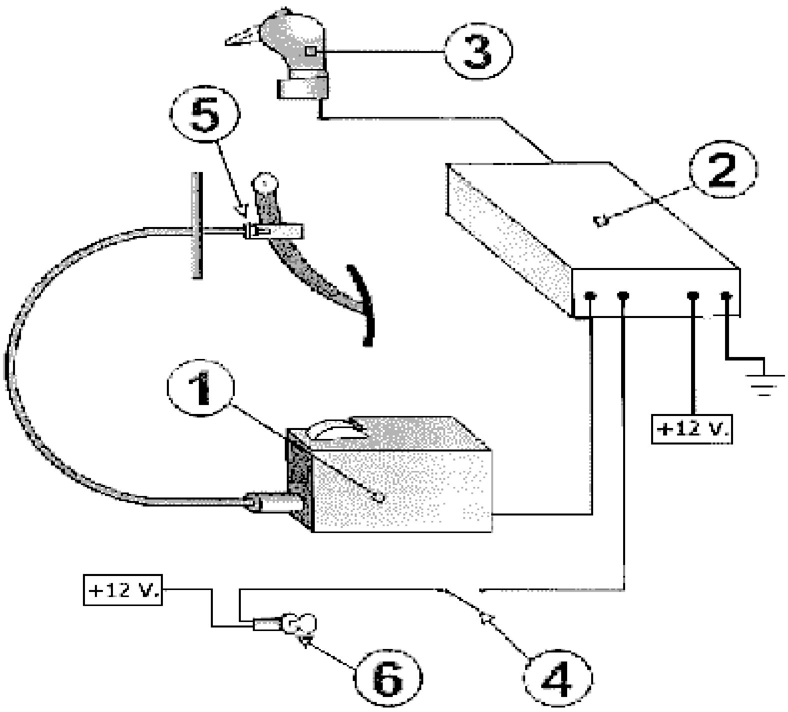

Fig 6.2Automatic Duck Clutch system principle

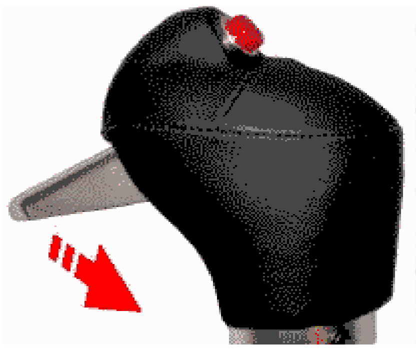

Fig 6.3 Duck Clutch

The servo motor (1) which is installed in the engine compartment, receives signals from the control unit (2), which is installed in the passenger compartment under the dashboard. The control unit's function is to interpret and amplify the signals it in turn receives from the head of the gear lever (3), which is a treated wood or leather clad, unit that replaces the original gear knob and incorporates a hand operated lever and a single button. The system can be enabled or disabled at any time by a switch on the dashboard (4). The system connects to the car's original clutch pedal (5) with a strong mechanical linkage and pulls the on pedal from behind so as not to interfere with the normal operation of the clutch pedal by an able bodied driver. All power is removed from the system when the car is switched off at the ignition switch (6) so as to avoid any current drain from the battery when the vehicle is not in use.

6.2.3 ELECTRONIC HANDBRAKE

The manual handbrake in a conventional vehicle requires the handbrake lever to be pulled. The electronic handbrake converts the handbrake lever in the form of an electronic system and implements the handbrake to be controlled by the push of a button.

Fig. 6.4 Electronic Brake

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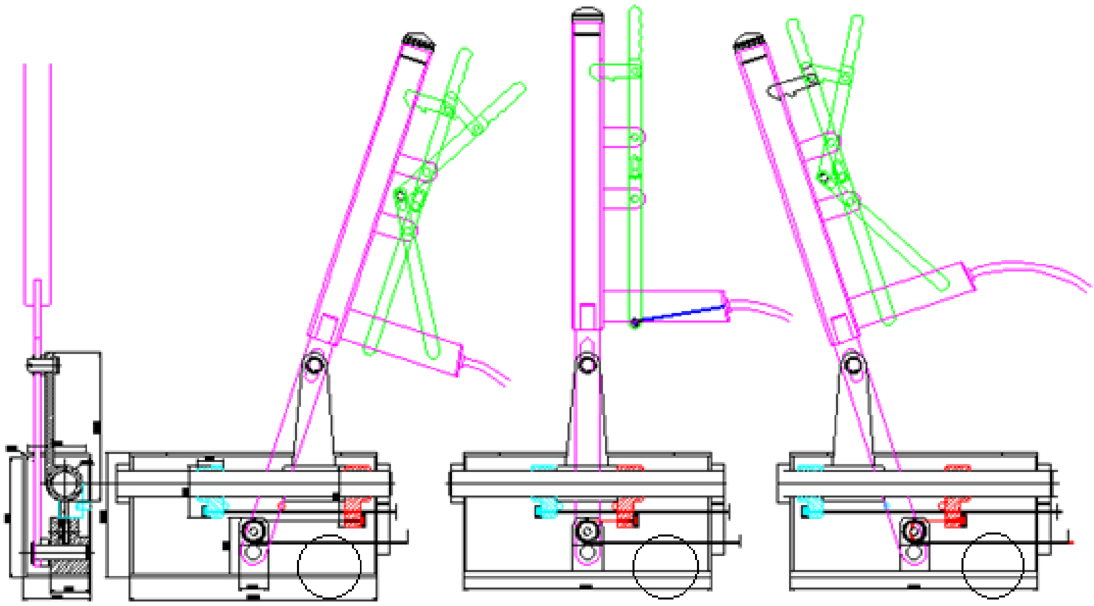
APPENDIX A PHOTOGRAPHS



Mechanism operations

Steering wheel fitted with steering wheel knob.

Hand operated mechanism fitted in the car.

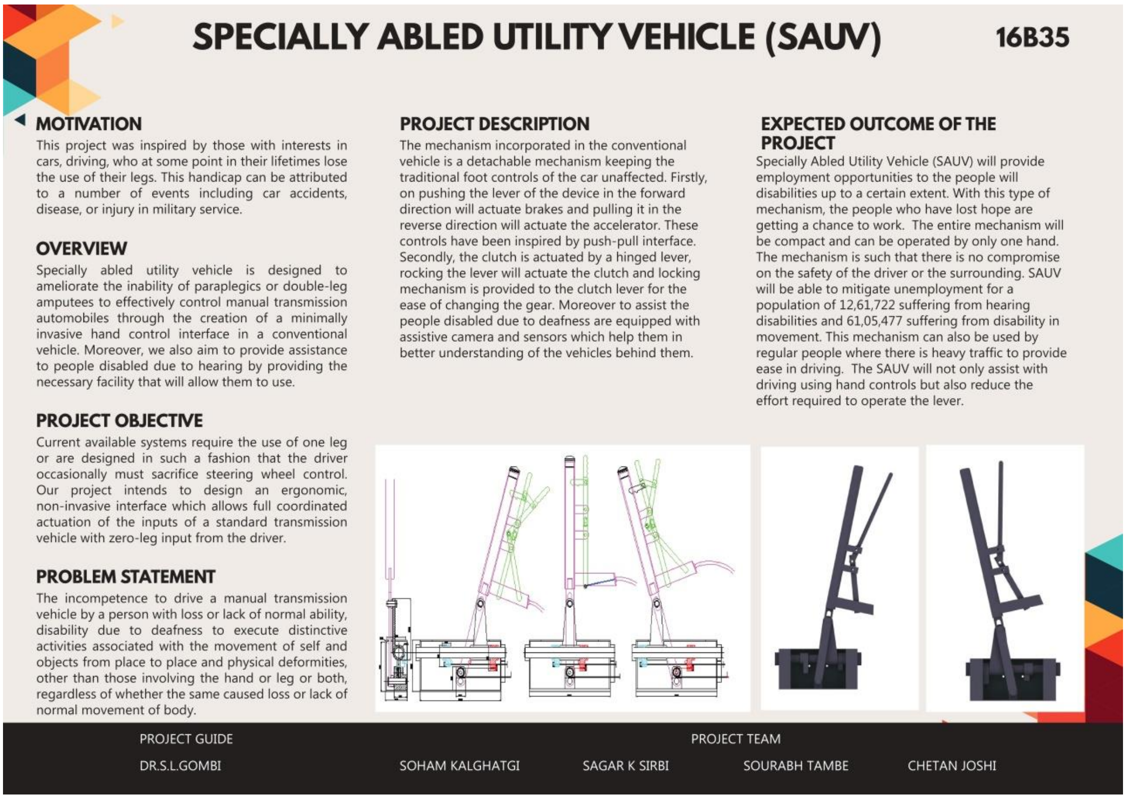
Rear camera display and sensor.

Inside view of the vehicle.

Vehicle Front View

Rear view of SAUV.

SAUV exterior view



SAUV Poster 1

SAUV Poster 2