A PROJECT REPORT

ON

"DESIGN AND INSTALLATION OF ADDITIONAL CONTROL SYSTEM OF SIDE-CAR SCOOTER AND CHASSIS MODIFICATION FOR STABILITY IMPROVEMENT"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

BAIRAGDAR HASNAIN	**16DME130**
KAZI SAUD	**16DME143**
KHAN ABDULAHAD	**16DME144**
KHAN FAIZURREHMAN	**16DME149**

UNDER THE GUIDANCE OF
PROF. ZIA MOMIN

DEPARTMENT OF MECHANICAL ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
SCHOOL OF ENGINEERING & TECHNOLOGY
Plot No. 2 & 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

AFFILIATED TO

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CERTIFICATE

This is certify that the project entitled

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submitted by

BAIRAGDAR HASNAIN	**16DME130**
KAZI SAUD	**16DME143**
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KHAN FAIZURREHMAN	**16DME149**

is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

Date: / /

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Project Supervisor

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Acknowledgements

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I am grateful to him for his timely feedback which helped me track and schedule the process effectively. His time, ideas and encouragement that he gave has helped me to complete my project efficiently.

We would like to express deepest appreciation towards **DR. ABDUL RAZZAK HONNUTAGI**, Director, AIKTC, Navi Mumbai, **Prof. ZAKIR ANSARI**, Head of Department of Mechanical Engineering and **Prof. RIZWAN SHAIKH**, Project Coordinator whose invaluable guidance supported us in completing this project.

I take this opportunity to give sincere thanks to **Mr. MILIND GAWAND** for sponcer us.

At last we must express our sincere heartfelt gratitude to all the staff members of Mechanical Engineering Department who helped me directly or indirectly during this course of work.

BAIRAGDAR HASNAIN
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Project I Approval for Bachelor of Engineering

This project entitled ¨ ***Design and Installation of Additional Control System of Side-Car Scooter and Chassis Modification for Stability Improvement*** ¨by ***Bairagdar Hasnain, Kazi Saud, Khan Abdulahad, Khan Faizurrehman (Group No 10)*** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. .....
2. .....

Supervisors

1. .....
2. .....

Chairman

.....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

According to census made in 2011 there were approximately 5,436,604 patient suffering from movement disability. Our aim is to design and install additional control system of side-car scooter which was designed by previous batch students and chassis modification for stability improvement which will be driven by both escort as well as the handicap person. This vehicle will help to increase the travelling range of handicap persons by increasing their mobility.Additional Steering system is mounted in side-car compartment along with a lever to accelerate and decelerate the vehicle.The side-car will be coupled to the aprilia sr150. This vehicle will be driven by handicap person using electric power steering (EPS) mounted in side-car compartment which will reduce the effort to steer to a greater extent. In case of emergency separate kill switch arrangement is given which will avoid any mis-happening while driving. .

Our project will change the travelling sense of handicap people to live a better and in-dependency life and help them to travel across the society with ease.

Keywords: side-car, chassis, electric power steering (*EPS*)

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Chapter 1

Introduction

Mr **Milind sir** contacted our *Prof. Mr. Zia Momin* after watching the video on YouTube, a Car made by our seniors for the Physically challenged person. He wanted us to make a car for himself so that he can independently drive from one place to another. Unfortunately, he is suffering from a disease known as `Muscular Dystrophy` in which he loses his muscle power from time to time. His hands movement is also limited to a very close distance from his chest. He nearly lost all his leg power so he uses an electric wheelchair to move around. All these reasons made him choose to contact us to make a car for him. Seeing his will to move independently all by himself, his motivation and always smiling face made us wonder how weak we actually are.

Figure 1.1: Milind Sir

He wish to have a car which is dual controlled which would be driven by himself as well as by an escort. This dual control system part was a big challenge for us because a normal car for him with an control system for steering acceleration and brake can be easily made but the challenge here was to make a dual control system at same time in the same vehicle. He asked us to make him this kind of car because his muscle can lose his strength that is he may get tired. A person driving with such a disease is risky so we were not sure if we should proceed with this idea, but he made us sure and promised us that 85 percent of the time there will be someone or the other from his family with him to drive him around, that is the reason for a dual control system car.

1.1 Purpose

Nowadays, mobility of physically disabled persons is a concerning social issue. Various hand driven tricycles, wheelchairs, retrofitted vehicles etc. are commonly available for disabled people as a mode of transportation. Existing means of transportation for disabled people require a disabled person to dismount from the wheelchair and get into the vehicle. A side-car scooter is designed to overcome this problem by allowing the disabled person to wheel up or down his wheelchair onto or down the side-car scooter. This is achieved using a specially designed platform that allows the wheelchair to be wheeled up or down. Additional control system is provided to steer the vehicle and accelerate and decelerate it.

1.2 Project Scope

We have designed this scooter for customized purpose that is to be used by a specified person only.But this scooter can also be incorporated in mass production since there are 54 lacs of people in India itself suffering from muscular dystrophy according to census report 2011 and by some research and advanced technology; performance, aesthetics and ergonomics can be increased to a greater extent. The ramp which is manually operated can be automated by incorporating motor in future.

1.3 Project Goals and Objectives

1.3.1 Goals

- To Install additional control system to side-car scooter.
- Stability Improvement of side-car scooter.

1.3.2 Objectives

The objective of this project is to provide mobility to physically challenged person (movement disability). By manufacturing such type of side-car scooter adds new dimension to the world of automobile. These side-car scooter will give a sort of relief to physically challenged person and make them independent
The main objective of our project is to :-

- To provide ease of travel with independency.
- Provide proper steering control.
- Provide stability to side-car scooter.
- Design and mounting of control levers (i.e Accelerator and Brake).
- Provide easy and comfortable access to physically challenged person.

1.4 Organization of Report

The rest of this dissertation is organized as follows:-In the next chapter we review some of previous works done by the scholars on different side-car scooter and wheelchairs for disabled person. Chapter five includes the measures taken to improve stability and suspension used on side-car scooter, chapter six indicates the additional steering system implemented into the side-car scooter and additional parts fabricated to install the steering unit.Chapter seven includes the arrangement made for acceleration, chapter eight includes the measures taken to install braking unit into the side-car scooter, chapter nine includes various test done from initial to final stage, chapter ten includes guidelines todrive side-car scooter.

Chapter 2

Literature Survey

A chassis consists of an internal framework that supports a man–made object and its construction and use. It is analogous to an animal's skeleton. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). The chassis takes a load of the operator, Engine, brake system, and steering mechanism, so chassis should have adequate strength to protect the operator in the event of an impact. The driver cabin must have the capacity to resist all the forces exerted upon it. This can be achieved either by using high strength material or better cross section against the applied load.

2.1 Design of Innovative Motorized Tricycle for Disabled Person

Tatyaso Garande, et al. [1] discussed different modes of transport available and suitable for physically handicapped persons for long and short distance travel. The modes are classified as per the maneuvering, ease, automation and comfort. Various machines used for travelling of disabled persons include wheelchair, automatic wheelchair, Smart wheelchair, retrofitted vehicles, tricycles, modified cars. Systematic comparison of all these vehicles is carried out in this paper. Also considering advantages and drawbacks of each type, suggestions are made for use of proper vehicles as per the handicapped person's requirement. It shows that vehicles like Tricycle or Wheelchair needs more physical exertion for operation. To overcome this automatic wheelchairs are developed but their travelling range is limited due to sophistication of the machinery. For long distance travelling and comfort of the handicapped person, retrofitted moped bikes and modified cars are developed. The main drawback with this was, the person making use of cars needs to get out of wheelchair from time to time making it a difficult task. Also such vehicles are not affordable for every person. Thus, it discusses the need to develop a mode of transport for handicapped person, which does not include a person to come out from the wheelchair.
There are various solutions available for travelling for the disabled persons like wheelchairs, tricycles (manual, powered), modified bikes and cars.

1. The wheelchairs are useful for short distance travel. The manual wheelchairs need physical work from user or care taker.
2. The tricycles can be used for some more distance than wheelchairs but are not useful for long distance travel and also gives more physical strain to user.
3. The retrofitted bikes can be used for longer distance travel. But for using bikes the wheelchair user should be capable to come out and in from the wheelchair to take the position on bike. So the bike is not useful for most of the wheelchair users.
4. In case of modified cars also, the user needs to come out from the wheelchair. But nowadays the ramp provision is there for some of the cars, so by climbing the ramp the wheelchair user can drive his wheelchair inside the car and take the position of driver.

From above options only car is fulfilling most the requirements of the disabled persons (leg disability). But for most of the population option of car is not affordable. So there is need of solution to the problems faced by disabled persons discussed above, which will be less costly and allows the disabled person to take the drivers position without coming out from the wheelchair.

2.2 Design and Fabrication of Brake and Accelerator by using single Pedal

The Project deals with construction and working of Accelerator and Brake operated by single pedal using on/off and cutoff limit switches for electronic vehicle and this same technique is also applicable to normal vehicles. It is technique for easily controlling of solar cart vehicle in the future and will reduce accidents and it can be used for physically challenged person. The main objective of this innovation is to eliminate the operator's risk of pressing the wrong pedal at the time of emergency as well as reduction in the driver's reaction time to switch from accelerator to brakes or vice versa. This new mechanism is designed in such a way that it can be implemented in any type of automotive vehicle. This concept is used to operate the brake and accelerator by a single pedal so it is simple and can be adopted conveniently. Now the automobiles are equipped with independent pedal controls for operating the accelerator and brake, these pedals being operated by right foot, and since the two functions are opposed and incompatible it is necessary to leave one pedal free in order to operate the other. It can therefore be supposed that some drivers have difficulty in removing their foot from the accelerator pedal and transferring it to the brake pedal quickly in emergency situations.[2]

2.3 Side-Car Manual

The cross-hatched area is the result of motorcycles with sidecars having different road resistance. The vehicles with a wide wheel track and of non-streamlined construction show up on the left edge of the hatched area.

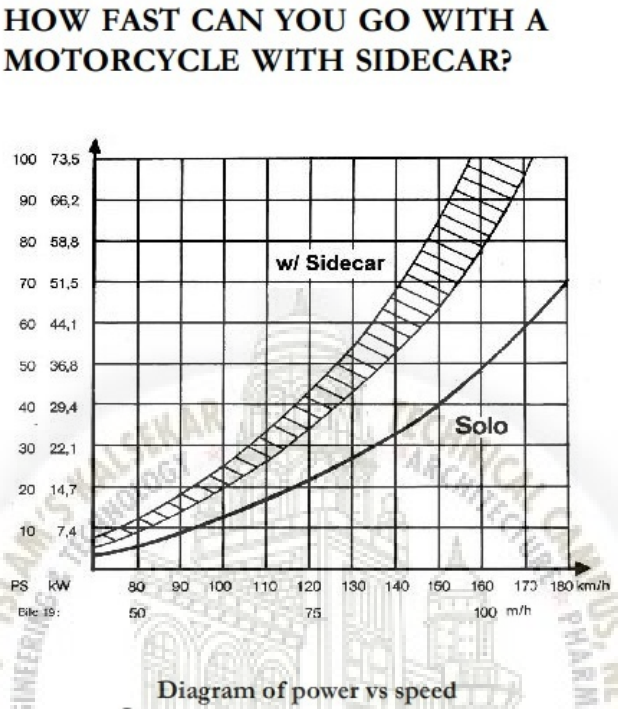


Figure 2.1: Power v/s Speed

The rolling resistance is not only increased by the third wheel but also by the increased weight. The constant friction of all three wheels increases the rolling resistance considerably. Pulling a 715 lb motorcycle with a rope attached to a spring-type scale, a pull of 8.8 lbs. is required at walking speed over a level road. For a motorcycle with sidecar of 715 lbs and under the same conditions a force of 13.2 ibs is required. Even when considering my measuring to have been done by a ”seat of the pants” method, the difference is 50

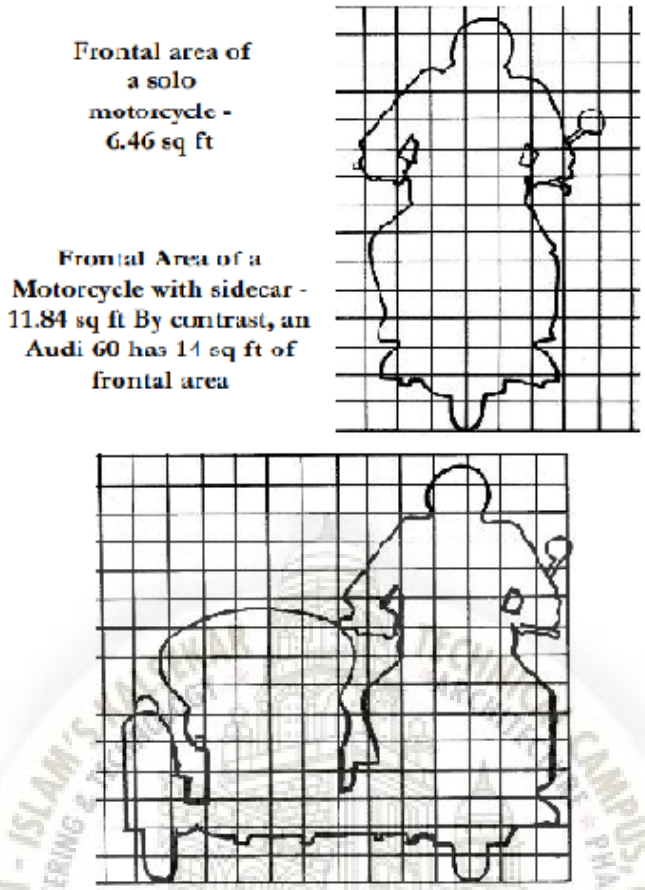


Figure 2.2: Side-Car Frontal Area

Steering: Since steering forces while turning witha sidecar are considerably larger - especially with solo motorcycles with a subsequently installed sidecar, having a correspondingly larger trail - the handlebars must have a correspondingly minimal width. In general, a minimum width of 26.52" is required. Stub-type handlebars and the like are not suitable for use with sidecars. Wider handlebars will give more leverage!.

Why does a motorcycle with a sidecar behave differently from a solo?

It is a dual-track vehicle, but it cannot be compared with other dual-track vehicles such as a car. The direct steering of the motorcycle and the offset third wheel are obvious. However, the most important factor is that the center of gravity is not in the center of the vehicle but is offset and located very high. It can only be determined by calculation. It is this location of the center of gravity in conjunction with the narrow track and the short wheel base which is responsible for the strange riding qualities of the motorcycle with sidecar. The center of gravity is the point at which the total weight of the vehicle is considered to act.

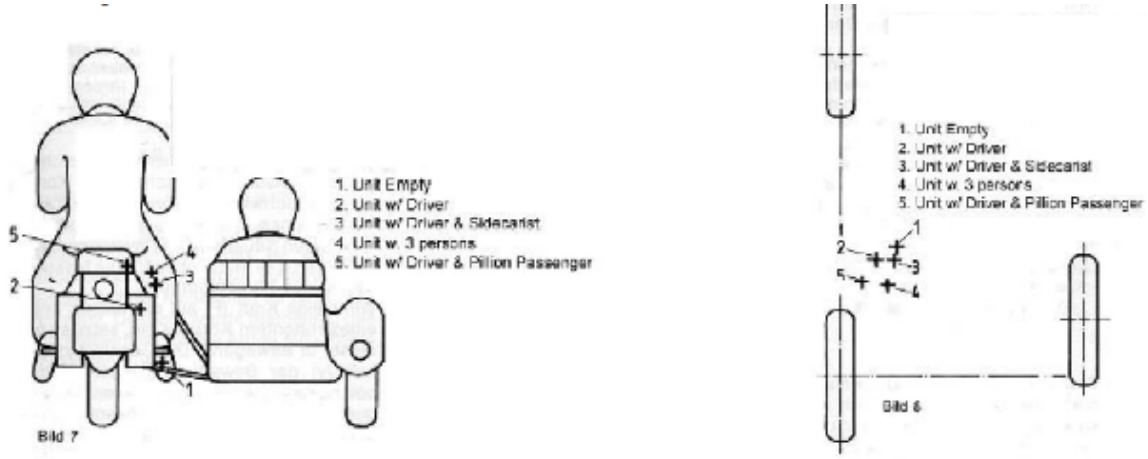


Figure 2.3: Centre of Gravity

The centrifugal force acts through the center of gravity to try and upset the motorcycle and sidecar!

The following can be deduced from this:
paragraphIf the position of the center of gravity is changed, the riding characteristics are changed as well as the possible turning speeds. Since road conditions also affect the riding characteristics, it is impossible to predict riding attitude and turning speed.A rider therefore requires a lot of experience before he can take full advantage of the riding possibilities of a motorcycle with sidecar. In order to learn what occurs when riding, why motorcycles with sidecars work or why they sometimes turn over, it is necessary to absorb some theory

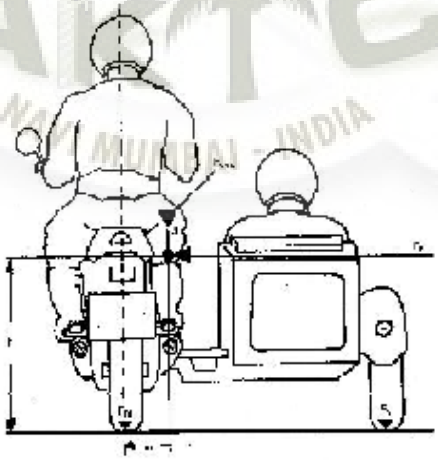


Figure 2.4: Action of Centrifugal force

The center of gravity is located to the right of the rider. The weight on several wheels add up to the total weight.Centrifugal force acts outwardly from the center of the curve; it acts through the center of gravity and tries to upset the motorcycle and sidecar. It is measured in kilograms or pounds (force). It increases with the

square of the speed and proportionally with the reduction of the radius of the curve. Centrifugal force, measured in kilograms or pounds, the height above the road surface to the center of gravity, measured in meters or feet, together form an angular momentum (torque). If the centrifugal force in kg is multiplied with the height in m, the resulting product will be mkg, the measurement of torque (1 mkg = 1Nm); or an equivalent value in ft-lbs in the U.S. system.

2.4 Design of an Innovative Retrofitted Tricycle for a Disabled Person

Ajit A. Mohekar etal., (2015) "Design of an Innovative Retrofitted Tricycle for a Disabled Person", in this paper the existing mean of transportation for disabled people require a disabled person to dismount from the wheel chair. A retrofitted tricycle is designed to overcome this problem by allowing the disabled person to wheel up or down his wheel chair onto or down the tricycle. This is achieved using a special designed platform that allows the wheel chair to be wheeled up or down. This paper discusses an attempt to be design and fabricate a retrofitted tricycle for disabled people. This tricycle is specially designed to suit wheelchair occupants.

2.5 Technical Review

Electric Power Steering (EPS) is a full electric system, which reduces the amount of steering effort by directly applying the output from an electric motor to the steering system.This reduces the effort required by handicapped person who is suffering from muscular dystrophy thus requiring less force to handle steering. The stability can be improved by moving the third wheel forward by 6 to 8 inch from rear wheel of scooter.

2.5.1 Advantages of Technology

a. Minimum Effort required for Steering.

b. Dual Control Unit for Steering.

c. Dual Braking Arrangement.

2.5.2 Reasons to use this Technology

a. Compact Pulse Circuit Module.

b. No Leakage problem as in case of Hydraulic Steering System.

c. Light in weight.

Chapter 3

Project Planning

3.1 Members and Capabilities

Table 3.1: Table of Capabilities

Sr. No	Name of Member	Capabilities
1	Bairagdar Hasnain	Design & Calculations
2	Kazi Saud	Design, Modelling & Editing
3	Khan Abdulahad	Fabrication & Aesthetics
4	Khan Faizurrehman	Fabrication & Aesthetics

3.2 Roles and Responsibilities

Table 3.2: Table of Responsibilities

Sr. No	Name of Member	Role	Responsibilities
1	Bairagdar Hasnain	Co-Leader	Design & Calculations
2	Kazi Saud	Co-Leader	Modelling, Design & Management of Work
3	Khan Abdulahad	Treasurer	Fabrication & Parts Purchasing
4	Khan Faizurrehman	Leader	Fabrication & Aesthetics Work

3.3 Project Management Approach

Two things were given utmost importance while discussing the Approach to accomplish the project viz. **Stability** and **Additional Control system**.Initially some measures have to be taken to improve the stability of side-car scooter and decrease the tendency to wobble at initial acceleration phase.After that an additional control system feasible and easy to merge into the prior system should be investigated and implemented into the system.After Successful Implementation of additional control system, if time permits some measures should be taken to increase the Aesthetics feature of side-car Scooter

3.4 Work Breakdown Structure

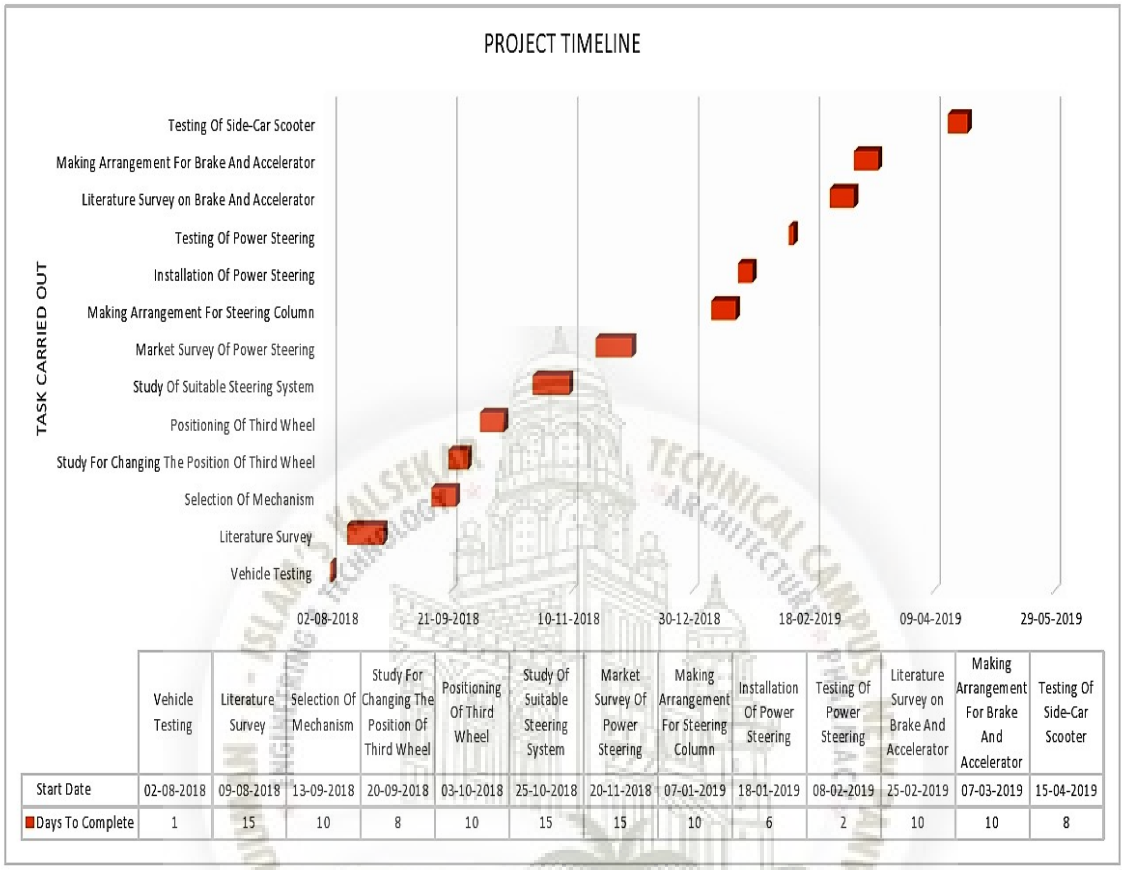
Figure 3.1: Work Breakdown Structure

3.5 Project Budget

Table 3.3: Project Budget

Serial Number	Particular	Price (in Rupees)
1	Aprilia SR 50	82500
2	Pipe Material	8360
3	Ramp Material	6000
4	Steering Column	2000
5	Rack and Pinion	1100
6	Pulse Circuit	1200
7	Brake and Accelerator Cables	500
8	Rods	3200
9	Acrylic	2650
10	Shock Absorber	2200
11	Paint	1000
12	Accessories	13500
13	Nuts and Bolts	2600
14	Electricals	3800
15	Petrol	1000
16	Fare	1000
17	Brake & Tyre Assembly	7500
	Total	140110

3.6 Project Timeline



	Vehicle Testing	Literature Survey	Selection Of Mechanism	Study For Changing The Position Of Third Wheel	Positioning Of Third Wheel	Study Of Suitable Steering System	Market Survey Of Power Steering	Making Arrangement For Steering Column	Installation Of Power Steering	Testing Of Power Steering	Literature Survey on Brake And Accelerator	Making Arrangement For Brake And Accelerator	Testing Of Side-Car Scooter
Start Date	02-08-2018	09-08-2018	13-09-2018	20-09-2018	03-10-2018	25-10-2018	20-11-2018	07-01-2019	18-01-2019	08-02-2019	25-02-2019	07-03-2019	15-04-2019
Days To Complete	1	15	10	8	10	15	15	10	6	2	10	10	8

Figure 3.2: Project Timeline

Chapter 4

Methodology

4.1 Steps Involved

1. DIVISION OF WORK
   (a) STABILITY IMPROVEMENT
   (b) STEERING MECHANISM
   (c) ACCELERATING AND BRAKING MECHANISM
2. POSITIONING OF THIRD WHEEL WITH RESPECT TO REAR WHEEL FOR STABILITY IMPROVEMENT
3. SELECTION OF CONTROL UNIT
   (a) ADDITIONAL STEERING SYSTEM
   (b) ACCELERATOR
   (c) BRAKE
4. FABRICATION
5. MOUNTING OF POWER STEERING AND LEVER
6. TESTING
7. REMODELLING
8. FINAL TESTING

Chapter 5

Stability Improvement and Suspension

5.1 Stability

Apart from looking similar and having the same controls, a scooter and sidecar is entirely different to a solo scooter. Adding the sidecar turns the scooter from a symmetrical, balance-steered vehicle into an asymmetrical, actively-steered one. Most of the weight is on the scooter. The drive and braking forces are now offset- power is applied only to the bike's rear wheel, and there may or may not be a separate brake on the sidecar's wheel. With the sidecar on the left, accelerating will tend to turn the combination to the left, and braking will induce a right-hand turn. Both of these need to be countered by the rider.

Cornering is now also different in each direction. Turning away from the sidecar, it acts as a stabiliser. Depending on the geometry of the three wheels, the machine will either slide or lift the bike's rear wheel. Turns towards the sidecar can lift the sidecar wheel off the ground completely. When this happens, you are immediately riding a two-wheeled vehicle again. You have to slow right down for turns in this direction. Experienced sidecar riders can adapt to this and happily 'fly the chair' in this way.

In contrast, a solo motorcycle acts the same turning in both directions, and doesn't steer when you accelerate or brake. Aside from falling over when it stops (that's what your feet are for) they are almost always going to be easier to ride. The narrow width of the bike also allows some accidents to be avoided entirely. The big exception is when riding in ice and snow, when three wheels wins on stability.

Historically, the advantage of a sidecar was cheap family transport, at a time when cars were relatively expensive and bikes were common. Nowadays they're something of a curiosity, ridden mainly by enthusiasts.

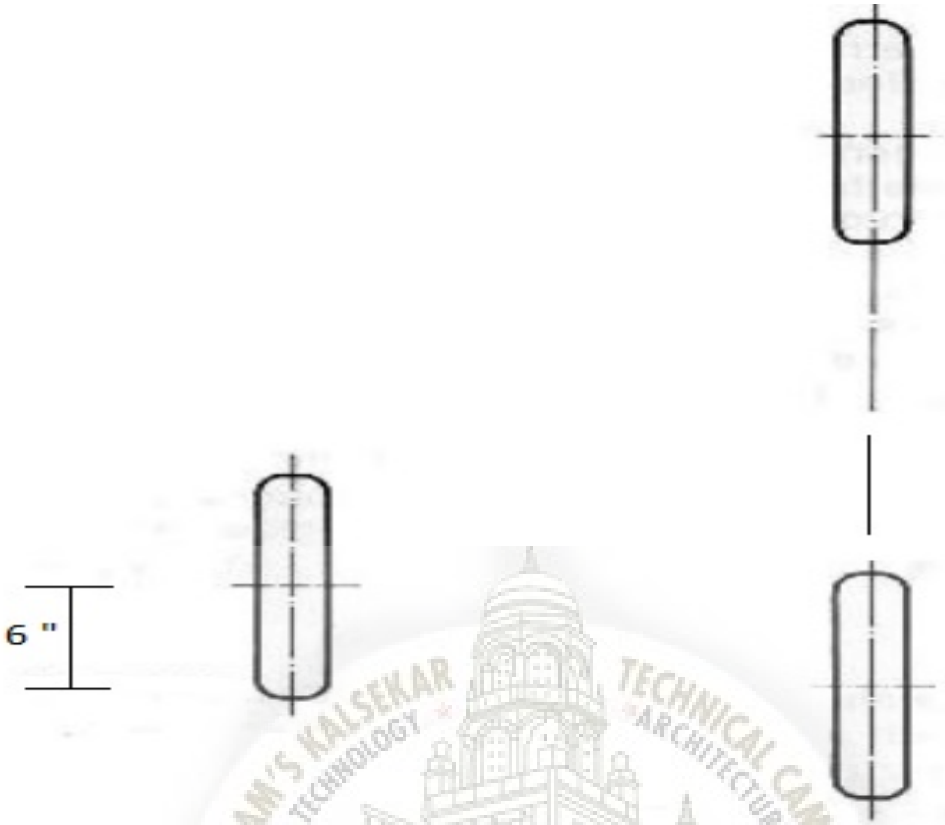


Figure 5.1: Measure to Improve Stability

To improve the stability of a side-car scooter the rear axis of side-car is advanced by **6 inches** as compared to rear axis of scooter, This enhances the stability and prevents wobbling of side-car scooter while initial phase of acceleration.

5.2 Suspension

5.2.1 Introduction

The automobile chassis is mounted on the axles, not direct but through some form of springs. This is done to isolate the vehicle body from the road shocks which may be in the form of bounce, pitch, roll or sway. These tendencies give rise to an uncomfortable ride and also cause additional stress in the automobile frame and body. All the parts which perform the functions of isolating the automobile from the road shocks are collectively called a suspension system. Broadly speaking, suspension consists of a spring and a damper. The energy of road shock causes the spring to oscillate. These oscillations are restricted to a reasonable level by the damper, which is more commonly called a shock absorber.

5.2.2 Objective of Suspension

- To prevent the road shocks from being transmitted to the vehicle components.
- To safeguard the occupants from road shocks.
- To preserve the stability of the vehicle in pitching or rolling, while in motion.

5.2.3 Arrangement of suspension on sidecar

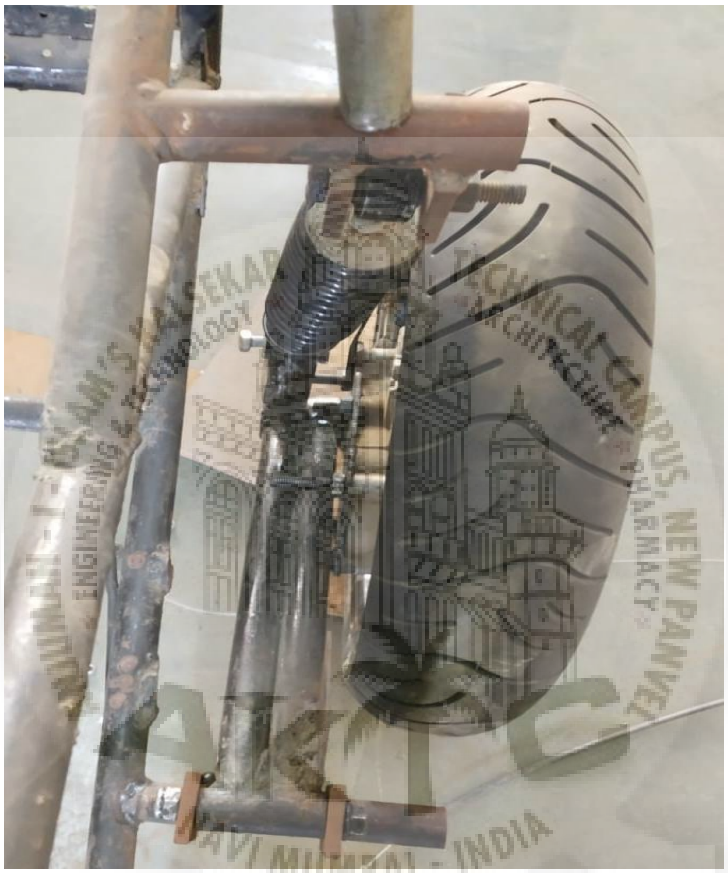


Figure 5.2: Suspension used in Sidecar Side

A motorcycle-sidecar outfit is designed to carry far more load than a solo machine. Light springing and weak damping will cause considerable roll, especially on cornering. Best results will be obtained by using firm yet not harsh suspension on all three wheels.If suspension is too soft, the outfit will roll to the direction opposite the turn just as with any two-track vehicle, unless a stabilizer is fitted.The passenger can have a very comfortable carlike ride in the sidecar if the body is sprung independently from the frame, especially if the degree of movement is also damped.

We are using Independent suspension system. Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. The tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The design of front and rear suspension of a car may be different.

The front wheel of Aprilia SR 150 is equipped with Hydraulic double-telescopic fork suspension and rear wheel has Hydraulic shock absorber.The side-car has an additional independent suspension attached to it to enhance the passenger comfort.

5.3 Side-Car Installation

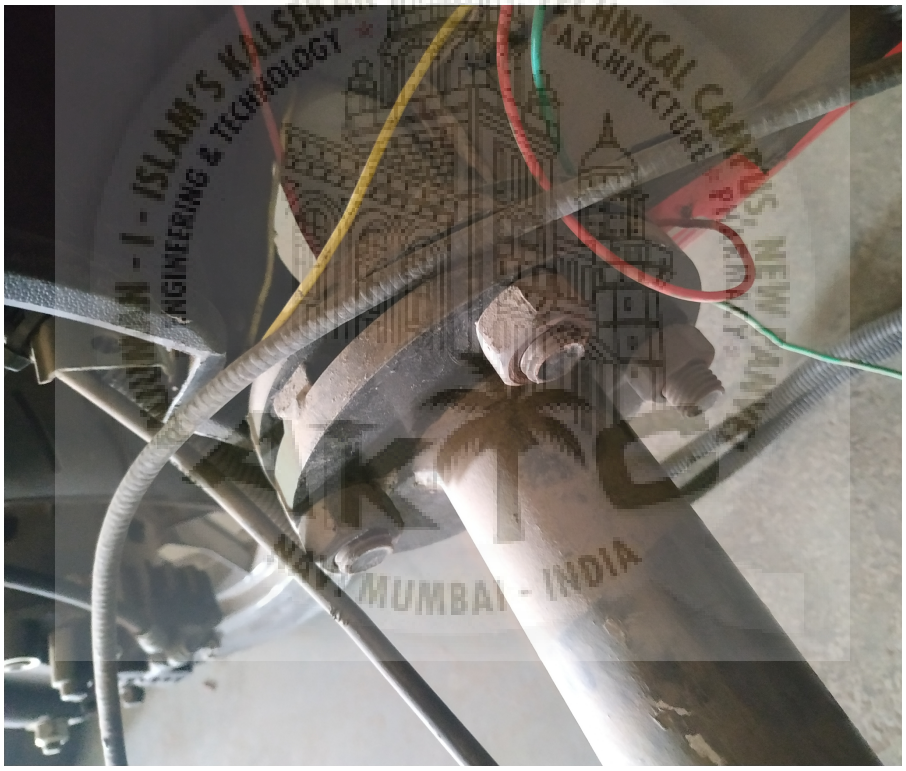


Figure 5.3: Flange

Care must be given to fitting the sidecar to the machine. All mountings must be made to the primary motorcycle frame. Rigid connections are preferred because flexing at any mounting point can result in steering wobbles or other handling problems.It is extremely important that the outfit be properly aligned. An ill prepared machine can be very tiresome to operate.When the machine is properly set up it should enable the operator to drive 30 mph on a flat surface without the machine pulling in either direction. To achieve this, the sidecar wheel should be toedin about 0.25 to

0.75 inches, the motorcycle should also lean outward 1 to 2 degrees and the side-car wheel should lead the rear wheel by 6 to 10 inches.Leaning the bike outwards slightly causes the bike to want to turn naturally to the right which partially off-sets the drag of the sidecar to the left. It also lifts the center of gravity slightly by making the weight on the sidecar wheel a little lighter.Toeing the sidecar wheel in slightly also tends to cause the rig to turn just a little to the right which further aids the tendency of the sidecar drag to the left.Moving the sidecar wheel forwards tends to make the bike less susceptable to tipping over the tipover line between the front wheel and the sidecar wheel. However, it also requires more steering effort as the sidecar wheel now drags. If moved too far foreward the sidecar wheel may pivot or turn backwards when turening sharply to the left.It is interesting as the original sidecars were setup with zero leanout, zero sidecar wheel lead, and zero toein.

Figure 5.4: Side-Car Fitting

The current settings are based on driving practice as rigs became heavier, more powerful, and faster. Sidecar weight should also be matched to the machine. The sidecar will be lifted very easily on sharp turns toward the sidecar if it's too light. If too heavy, overall performance will suffer considerably; also the effect of the sidecar, to lag behind on acceleration and to swing around on hard braking, will be accentuated. Typically, a sidecar that weighs about 30 percent of the weight of the bike seems to be about right. If too light, adding some weight, ballast, to the sidecar, car battery, weight, fuel tank, water tank, will aid greatly to the stability of the outfit.

Chapter 6

Additional Steering Unit

6.1 Introduction

An electronic power steering (EPS) system uses an electric motor to drive either the power steering hydraulic pump or the steering linkage directly. The power steering function is therefore independent of the engine speed resulting in power savings.

In automobiles, power steering is a device that helps drivers steer by augmenting steering effort of the steering wheel.Hydraulic or electric actuators add controlled energy to the steering mechanism, so the driver can provide less effort to turn the steered wheels when driving at typical speeds, and reduce considerably the physical effort necessary to turn the wheels when a vehicle is stopped or moving slowly.

Electric power steering systems use electric motors to provide the assistance instead of hydraulic systems.

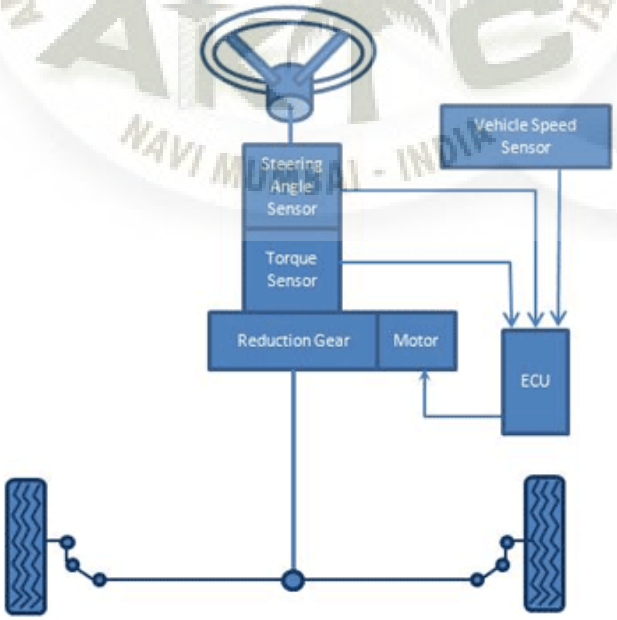


Figure 6.1: Schematic of Electric Power Steering

6.2 Why electric power steering is used for our project?

Electric Power steering allows a driver to have very smooth control and requires very less efforts for actuation or steering the wheels. In our case where Mr.Milind is suffering from muscular dystrophy cannot apply enough effort as required in normal steering control.

6.3 Mounting of Rack and Pinion

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion.

Figure 6.2: Rack

The rack carries the full load of the actuator directly and so the driving pinion is usually small, so that the gear ratio reduces the torque required. This force, thus torque, may still be substantial and so it is common for there to be a reduction gear immediately before this by either a gear or worm gear reduction. Rack gears have a higher ratio, thus require a greater driving torque, than screw actuators. In our application we have used rack and pinion of alto800 because it is small and was feasible for our application.

6.4 Assembly of Steering Column

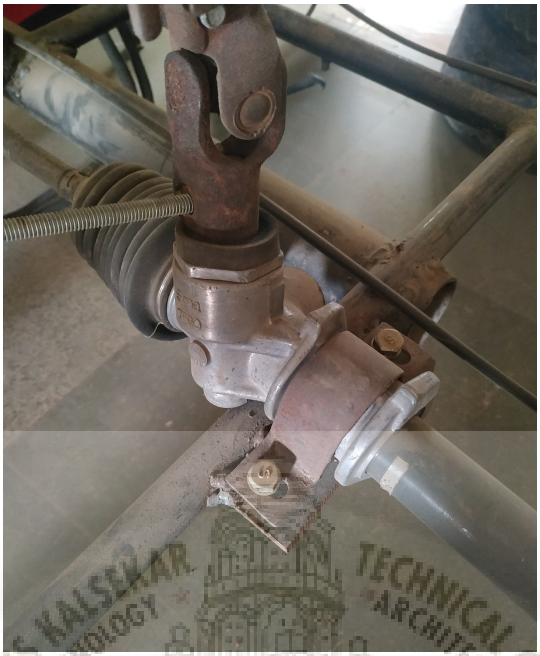


Figure 6.3: Mounting of Rack

The rack and pinion is mounted on side-car chassis by means of U-bolt arrangement.The length of tie rod is small. so,we had came with the solution for extending its length. For that one extension link is made of length 370mm and diameter of 18mm.This link is welded to tie rod from one side and another side is attached to ball joint. The tie rod on the other side of rack and pinion is not in use for our application so it has been removed.

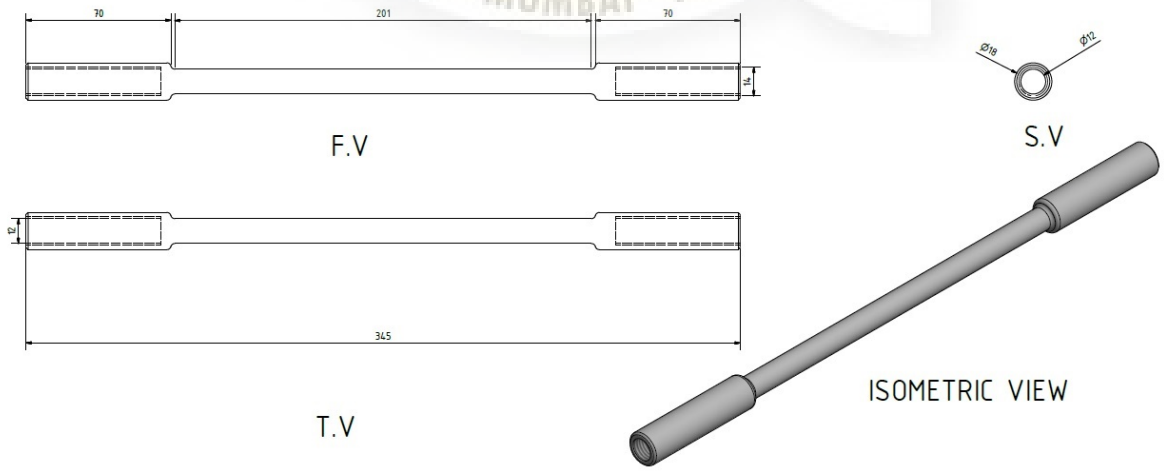


Figure 6.4: Extension Rod

Figure 6.5: Actual Extension Rod

6.5 Mounting of Steering Column

steering column is mounted on a extended pipe attached to the frame.To give strength 2 supports are provided to thepipe carrying steering column.

Figure 6.6: Extension Rod

Figure 6.7: Ball joint attached to Aprilia Steering Column

6.6 Pulse Generator Circuit

6.6.1 Introduction

Many devices require input pulses for their operation. Some device requires continuous train of pulses some requires single pulse. In some of the devices there is a provision to alter between continuous pulses and single pulse. For example a stepper motor controller can have two operating modes – auto and manual. In auto mode it requires continuous pulses to rotate motor continuously while in manual mode it requires single pulse to be generated when button is pressed manually.

The circuit presented here is 2 in 1 circuit that generates low frequency pulses in the output. It has two operating modes. In auto mode it generates pulses continuously and in manual mode it generates pulse when push button is pressed. The circuit is built using single IC555. To generate continuous pulses it is configured in astable mode and to generate single pulse it is configured in monostable mode.

6.6.2 Circuit Operation

Auto mode:-
For auto mode move sliding switch position to auto. This will short pin 6 and pin 2. Turn pot R1 to somewhere in the middle. So there will be some resistance between pin 6 and pin 7. This makes IC555 to be configured in astable mode. When supply is given the circuit will start generating low frequency (¡1 Hz) pulses. This can be observed as LED blinking

Manual mode:-

For manual mode move sliding switch position to manual. This will connect pin 2 with push button. Turn pot R1 fully towards pin 6. So the resistance between pin 6 and 7 will be zero – that means they are now short. This makes IC555 to be configured in monostable mode. Connect the supply to circuit and press push button. Short pulse is generated that is indicated by LED. Every time push button is pressed pulse is generated and LED glows.

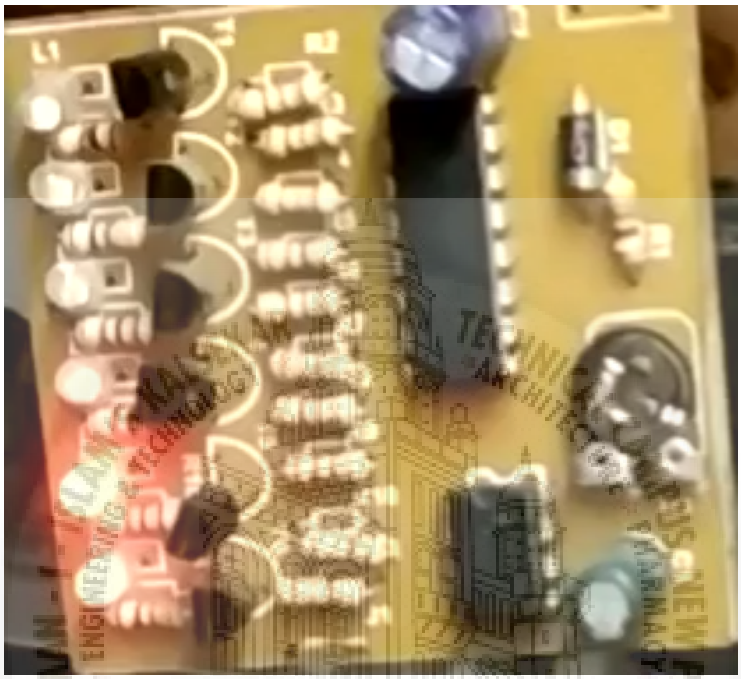


Figure 6.8: Actual Pulse Circuit

6.7 Battery Requirement

In our application we are using power steering system.This system is included so as to minimize the effort required by the handicap person.so this system has a motor of 12 volts.The electric motor provides the universally available, reliable, and economical energy supply for the Servolectric electric power steering system. The newly developed generation of brushless electric motors provides the assistance calculated by the Servolectric electronic control unit with high precision and in accordance with the particular driving conditions.Depending on the variant, the motor torque is transferred in various ways. On the paraxial variant the torque is transmitted to the servo gear system (toothed-belt drive and recirculating ball gear) via a toothed disc located on the motor shaft. On the Servolectric steering column variant and the dual-pinion variant, the torque is transmitted to the helical gear by means of a coupling.The EPS is given connection through battery positive and negative terminal and other through ignition coil and ignition switch.

The battery requirement is of 12 volt and 5 ampere. The daily running time of the vehicle will be approximately 3 to 4 hours so charging the battery in running condition is an difficult task. The battery will require approximately 5 to 6 hours for charging.

In future the battery can be charged with the arrangement of alternator.An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. The alternator can be attached on any of the either side-car wheel or rear wheel of the main vehicle.

Chapter 7

Acceleration Unit

7.1 Lever

7.1.1 Introduction

The accelerator is known as gas pedal. This pedal controls the amount of gas being fed into the engine and thereby controls the speed of the vehicle. You push the accelerator with your right foot with your heel resting on the ground. Do not be jerky with the accelerator. Rather, push it gradually while your car speeds up.

Figure 7.1: Schematic diagram along with two in one Connector

7.1.2 Design of Lever

The Lever assembly is made for brake and accelerator operation.The whole assembly along with dimensions is illustrated below:-

Figure 7.2: Lever

- The lever rod is of diameter 20mm and height of 85mm.
- The brake cable(inner) attachment of lever is of 4 inch.
- The accelerator cable(inner) attachment is having length of 15mm and height of 30mm.
- The bush of diameter 30mm is welded at the bottom of lever.
- The bus is inserted in bolt M16.

Figure 7.3: Bush

7.2 Design

According to our application the need is to have two acceleration unit.one of the main vehicle and the other of side-car scooter. So,that handicap person siting in side-car can operate the accelerator with the help of lever from side-car.And the normal person can operate it through main accelerator. So,in carburetor two cables are attached through some mechanism.one slot is made through which the cable of main vehicle is made to go inside the carburetor and the other cable of side-car scooter is pass through main slot.

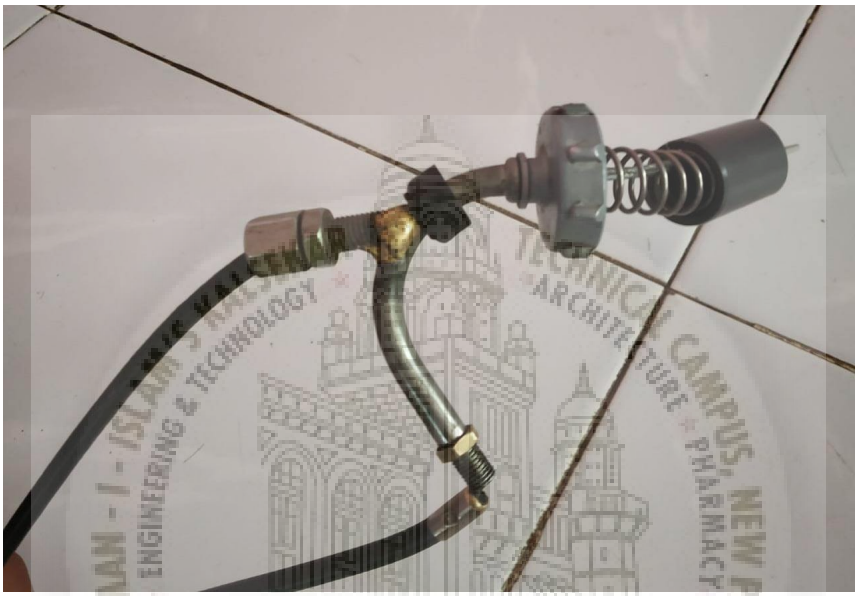


Figure 7.4: Two cables Arrangement

On the outer of carburetor cable the slot of 6mm is made and on which the setting pin of cable is attached.This attachment is done by brazing operation.So, through this slot cable is allowed to enter the carburetor.Now two cables come as a output from carburetor and one goes to main vehicle and the other one to side-car.

Figure 7.5: Lever Stopper

Figure 7.6: Lever Acceleration Arrangement

Another attachment is made to hold the cables.This is done by making slots on metal strip.This strip is welded in front of the lever.In the slot which is made in strip the outer of the cable is made to restrict.And the inner cable is attached to the lever by making slot in the lever.So, when the lever is pull backward the inner gets stretched and in this way the accelerator gets operated.This is how the mechanism is made to operate.

Chapter 8

Braking Unit

8.1 Principle

It goes without saying that brakes are one of the most important control components of vehicle. They are required to stop the vehicle within the smallest possible distance and this is done by converting the kinetic energy of the vehicle into the heat energy which is dissipated into the atmosphere.

8.2 Braking Requirement

1. The brakes must be strong enough to stop the within a minimum distance in an emergency.But this should also be consistent with safety.The driver must have proper control over the vehicle during emergency braking and the vehicle must not skid.
2. The brakes must have good anti-fade characteristic that is their effectiveness should not decrease with constant prolonged application example while descending hills.This requirement demands that the cooling of the brakes should be very efficient.

8.3 Brake Arrangement in Actual System

Braking systems vary considerably from outfit to outfit. Some have an integrated front and rear braking system. Others have an integrated rear wheel and sidecar wheel braking system. Some sidecar wheels have no braking system. Others have a sidecar wheel that can be independently braked either by a separate foot pedal or from a separate handlebar control. Regardless, the primary braking system continues to be that of the motorcycle itself. If a sidecar brake is used that is integrated with the rear wheel, it should be adjusted to become effective slightly after the rear brake has begun to act.Your sidecar outfit may have two or even three separate brakes. All are important. Strong application of the brakes on the outfit will cause different responses from those on a solo machine. Locking (skidding) the rear wheel, for

example, will not cause the outfit to lose control, but is still not desirable. A skidding tire increases stopping distance. Maximum braking is achieved by increasing braking pressure until the threshold of skidding is reached. Because much of the sidecar's weight is on the rear wheel, the rear brake is more effective than it is on the solo machine. Rapid stops should be made by applying both front and rear brakes. The sidecar brake, if available, can also improve braking efficiency.
The front Brake of Aprilia SR 150 is disc type and Rear wheel is equipped with Drum brake. An additional brake is provided on side-car having drum brake.The arrangement is made in such a way that when the lever is pulled backward both rear brakes are pressed simultaneously viz. the side-car scooter rear wheel brake and rear wheel of Aprilia SR 150.

Figure 8.1: Confinement of Outer Cover of Brake Cable

The outer cover of both the cables viz. rear wheel of scooter as well as side-car are fixed on a metal plate and the plate is welded on the frame.The beads are put into the slot provided on lever to get appropriate braking into the system.By this arrangement both rear wheel brakes are in control of an handicap person.

Figure 8.2: Attachment of brake cable to lever

8.4 Quick Stop

A sidecar outfit, unlike a solo motorcycle, has a very unequal weight distribution. Sudden and harsh application of the front brake can cause the outfit to slew around quickly. On the other hand, locking the rear wheel may do little more than accelerate wear on the rear tire. It will not result in loss of control, unless the front wheel is turned sharply to the left when the rig may slide by 180 to 360 degrees.Both brakes should be coordinated to achieve optimal stopping distances. If a sidecar brake Is installed, it can be used for emergency stops. But unless properly hooked up and applied with common sense, a sidecar brake may be a nuisance. Improved stopping power can be achieved by using softer disc pads or linings on the motorcycle brakes, by adding a second disc to the front wheel, or by converting a single leading shoe to a twin leading shoe. The latter usually involves changing the brake plate. The chair brake, if properly fitted and used, will also reduce stopping distance. A well braked outfit can stop in distances of 25 feet or less, from 30 mph, much less than any legally required stopping distances and as good as many solos or automobiles.

8.5 Avoiding Obstacles

A quick stop may not be sufficient to keep from avoiding an object in your path. Using the sidecar characteristics you can execute a whipchange, either right then left, or vice versa, much faster than you can on two or four wheels. To change direction on two wheels you must first get the cycle to lean in the direction you want to go, whereas with an outfit you simply wrench the handlebars first one way then the other and your whip lane change is complete. The whip-change is possible on a rig because even though you may have wrenched the steering wheel sharply to the right and the sidecar wheel begins to come up, it takes some time for the sidecar wheel to come up, but before then you have whip changed the other direction and now force the sidecar wheel down. Then you straighten out and travel is again normal. If a whip lane change is insufficient to avoid an obstacle and you must make a panic stop to avoid a collision, lock both front and rear wheels.The outfit will come to a stop in the shortest distance po ssible but with minor loss of steering control. The outfit will stop in a straight line, but may swing around. You then present the side of the sidecar to the object rather than a head-on collision. This last is for extreme emergencies only, it should not be attempted until practiced first on a deserted gravel lot, then on an abandoned parking lot. An emergency stop while turning into the sidecar may cause the ouflt to move to the left across incoming traffic.

Chapter 9

Testing

There were various stages of testing the side-car scooter.Initially the side-car scooter was tested to find out the difficulties inculcated into the system then the difficulties were note down and various methods and Emperical relations were surveyed into various research papers and some tips and ideas were taken from skilled workers in these field.

Tests carried out are as follows:-

TO1

- Test Condition : Initial Testing of Vehicle.
- Expected Result: Check out the problems and to get solutions to solve it.
- System Behavior: The vehicle was wobbling during take the turn and steering seems to be hard while turning.

TO2

- Test Condition : Third wheel testing.
- Expected Result: To check and get solution to change the position of the wheel.
- system Behavior: It was making problem while turning and imbalance of vehicle.

TO3

- Test Condition : Third wheel testing after new positioning.
- Expected Result: Improvement in the balancing of the vehicle.
- system Behavior: It improves the stability and the problem of turning.

TO4

- Test Condition: Testing of EPS Circuit.
- Expected Result: To get pulse signal.
- system Behavior: IC of circuit got damage.

TO5

- Test Condition: Testing after replacing IC.
- Expected Result: Get appropriate pulse.
- System Behavior: It was generating pulses.

TO6

- Test Condition: Power steering testing.
- Expected Result: To get less effort as comapared to conventional system.
- System Behavior: It was successfully working as per our requirement.

TO7

- Test Condition: Testing of brake and accelerator.
- Expected Result: To get Dual operation of brake and accelarator.
- System Behavior: It seems to be working as per requirement some improvement can be done.

Chapter 10

Guidelines

10.1 Trouble situations

All motorcyclists should be constantly on the lookout for potential trouble situations. With a sidecar attached, the motorist sees a vehicle approaching that begins to have a size comparable with his own. Reluctantly he may begin to recognize a sidecarlst as a threat and allows him his right of way.

Good driving requires that you scan the road several seconds ahead to detect any suspicious movement, obstruction, or hazardous road situation, so you have plenty of time to avoid it or take corrective action.

Like a solo motorcyclist, the sidecar driver can use his height to advantage looking through the car ahead, to observe cars ahead of it that are stopping or turning. If the car ahead then panic brakes you are prepared. Always watch the roadside for cars that appear to be parked but are waiting to get into the flow of traffic; for pedestrians, children, or animals who suddenly dart out into the stream of traffic without warning and without looking; and for a driver who has just parked. His door may suddenly fly open without warning as he vacates his car, oblivious to the traffic situation.

10.1.1 Head Checks

A motorcycle outfit has blind spots just as a car does, but for different reasons. Proper location of suitable mirrors can provide nearly complete coverage of what is going on alongside and to the rear. However, many cycles suffer from vibration at certain engine speeds, rendering the mirrors useless. It is a good idea to develop a practice of turning your head completely to the side to scan traffic movements behind you before changing lanes. A sidecar outfit can make whip lane changes much more quickly than can a solo motorcycle or an automobile as mentioned previously. These rapid lane changes can surprise and frighten the motorist. Do nothing to ruffle his feathers. If you treat the motorist as a hybernating bear, your chances of survival will be enhanced. When changing from an outside to a central lane be sure there is

not a motorist changing from the other side to the same lane, also. He will survive – not you.

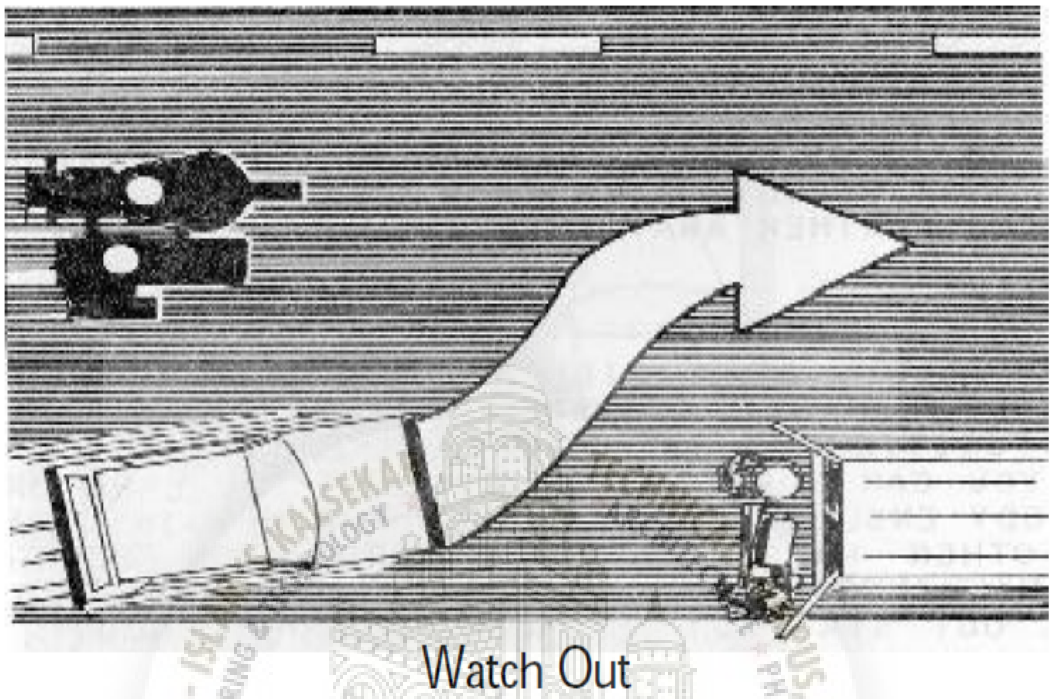


Figure 10.1: Head Checks

10.1.2 Using your Mirrors

Traffic situations change quickly. Always keep your eyes moving. Scan the road ahead, then glance to each side, and check each rear view mirror. With practice, this will become routine. Try to gauge the behavior of those behind you and alongside you. Become totally aware of where you are and where they are. Try to predict what a motorist will do based upon his observed behavior pattern. In this manner you won't be caught off guard. A motorist will often accelerate to pass then cut in and rapidly brake to pull off the highway right in front of you.

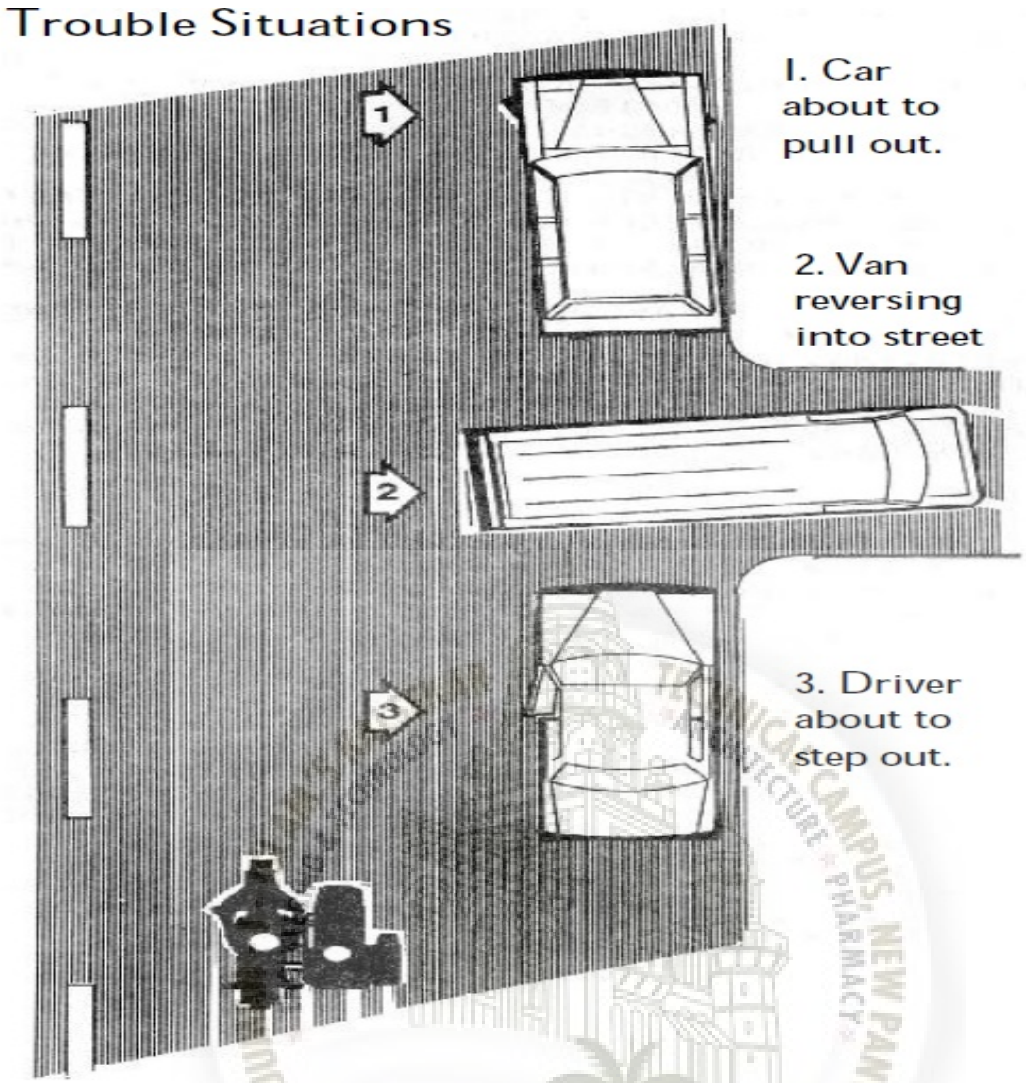


Figure 10.2: Using your Mirrors

Use your mirrors to watch behind you. You must become aware of tailgaters and "shake them". Do not allow a tailgater to stay behind you. If you cannot pull away without exceeding the speed limit, try slowing gradually until he either drops back or overtakes you. It may be necessary to pull off the road and allow him to pass, which is much safer than having him too close behind you in case you need to stop quickly. When stopped at an intersection watch behind you. Unfortunately, there is little you can do to prevent the motorist from slamming into you from the rear if you cannot proceed because of a red light or cross traffic. Use both mirrors, signal, and turn your head every time you change lanes or make a turn. If convex mirrors are fitted, the distortion of distance results so that objects will appear farther away than they really are.

10.1.3 Car pulls out from curb

Typical urban steet scene. You are proceeding along an urban throughfare. You are intently watching the cars "parked" along the sidewalk. You suddenly see a telltale puff of smoke from the exhaust of a parked car immediately followed by the front left wheel suddenly angling out. You have several choices. You know, from past experience that the driver is not looking in his/her rear mirrors to see if there is any rearwards traffic, nor will you see a head poke out of the driver's window, turn, and see if there is any traffic coming from behind. No, and you can take this to the bank, that the driver's eyes are frozen onto the left-rear bumper of the car ahead to ensure his/her right-front section of the bumper does not make contact as he/she tears out of the parking space. What you do depends on what equipment you have. If you have just the OEM horn, don't bother with it. That puny horn will not penetrate through the enclosed cocoon of glass and steel especially when the AC is on full blast to compensate for the heat soaked interior, and with the hifi turned up full blast to overcome the AC noise.

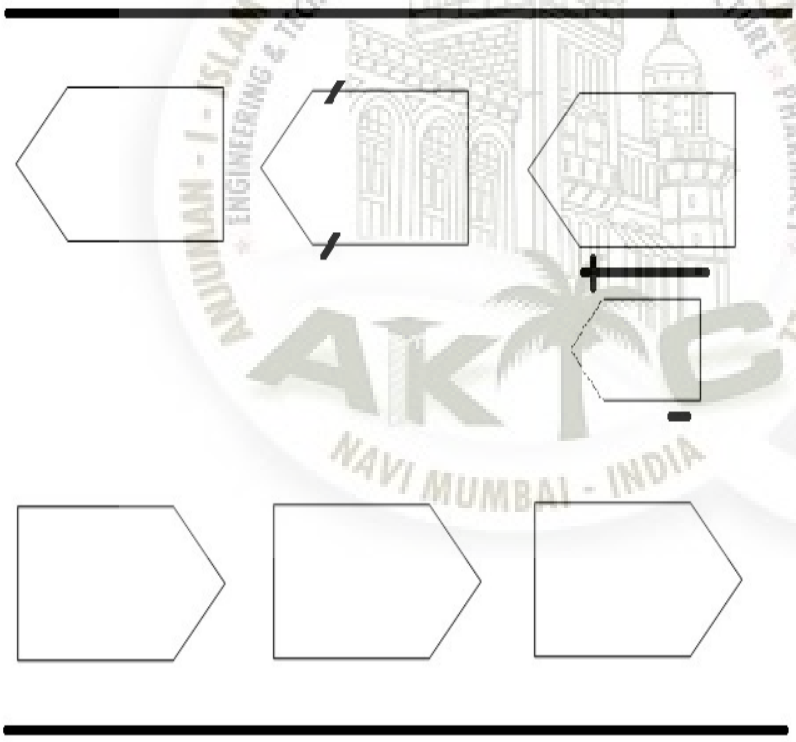


Figure 10.3: Driver about to pull out into your space

You can take a chance and "hope" the driver will see you and brake hard as he/she suddenly becomes aware of your presence. Also not good. Or you can brake to a halt and allow the driver to get out ahead of you. Probably the best choice so far. Or if you installed a set of airhorns with the builtin compressor, a small blast

may get the driver's attention. On the other hand, the driver may react adversely and unexpectedly.

10.1.4 Driver Steps Out

Same situation - urban thoroughfare. Row of parked cars. This time, driver spots a puff of smoke stop from a parked car. Also sees slight movement of the driver's door. Based on past experience, driver knows that auto driver is about to slam his driver's door open and exit into the street. Driver did not see driver's window roll down and a head protrude to see if all was clear from behind. Also, that driver did not check rear mirrors so was entirely ignorant of approaching sidecarist. What to do? As auto engine off there is a possibility that auto driver may hear horn. Sidecarist can brake to a stop and allow the car driver to alight, perhaps the safe and manly thing to do. Or, a blast of the air horn might get the required response, but do not count on it.

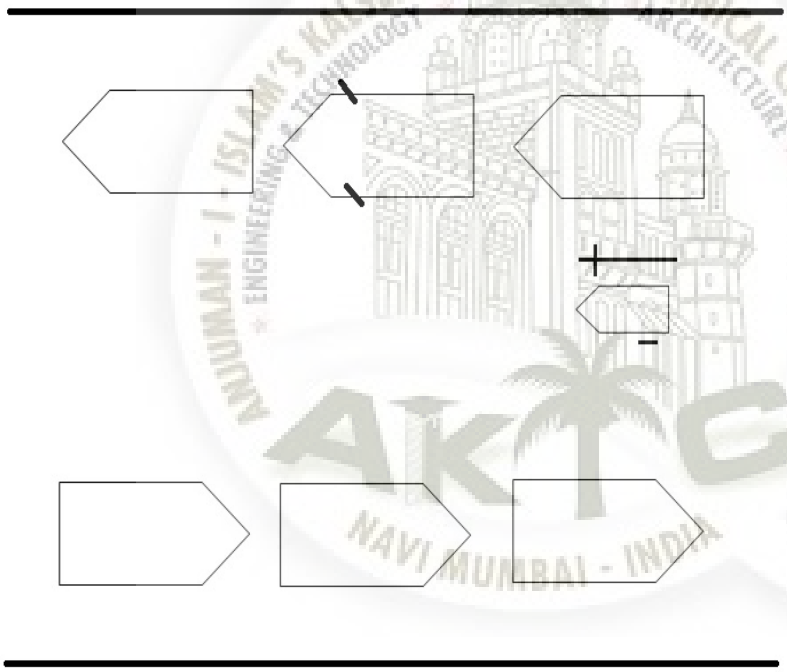


Figure 10.4: Driver steps out

10.1.5 Driver Reverses into Roadway

As you proceed down the residential street on a weekday mid-afternoon you see a woman reversing down her drive and soon to reverse onto the road. Yes, she should be looking to the right and to the left to ensure the road is clear before reversing onto the roadway. But in fact just where is she looking? Cannot be too sure but it is in

one or the other of two places. Either dead ahead to ensure that the automatically closing door is in fact closing properly, else dead behind to ensure she does not run over Johnnie's bike he left lying on the driveway. She is certainly not looking either up or down the road to ensure she can back onto the road in safety. What do you do?

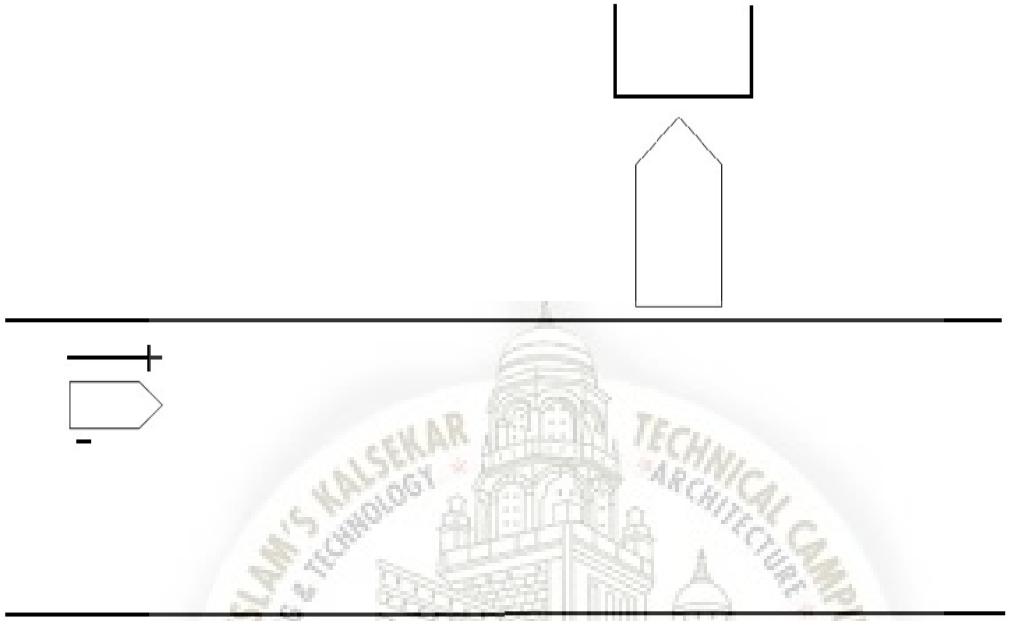


Figure 10.5: Driver Reverses into Roadway

You can try your horn but for reasons stated it probably will not get her attention. You can stop and allow her to complete her unsafe operation. This is definitely the safest if you can stop without making the situation worse. Or you can hit her with your air horn. This might work, but then again, it might not bring the desired response from her.

10.2 Space Cushion

As the operator of a sidecar outfit you are not much better off than the driver of an automobile as far as optimum positioning in traffic is concerned. To some extent, you can move to one side of the lane . On the other hand, at an intersection you can peer around buildings, parked cars, or bushes without having to stick out six feet or more of your hood. Also, if planning to execute a U-turn, you can angle the outfit into a position from which you can easily observe oncoming traffic. The safest protection you can provide is a space cushion between yourself and other road

users. If someone makes a mistake, there is time to react, and you can seek a place of refuge.

10.2.1 Following distance

The two-second rule is an easy way to judge a safe following distance. It allows a sufficient distance between you and the car ahead to react if necessary. Pick a landmark, such as a road sign or an overpass, in front of the vehicle ahead of you. Begin counting when that vehicle passes the stationary object. ”One thousand and one, one thousand and two”. You should arrive at that landmark at the same time you say ”two”, or later. Many suggest that a gap of 3 to 5 seconds is even safer, if it can be maintained. Keep this distance from the car ahead even when traffic slows or stops. If a motorist behind you does not stop, at least you may have a chance to move up and get out of his way.

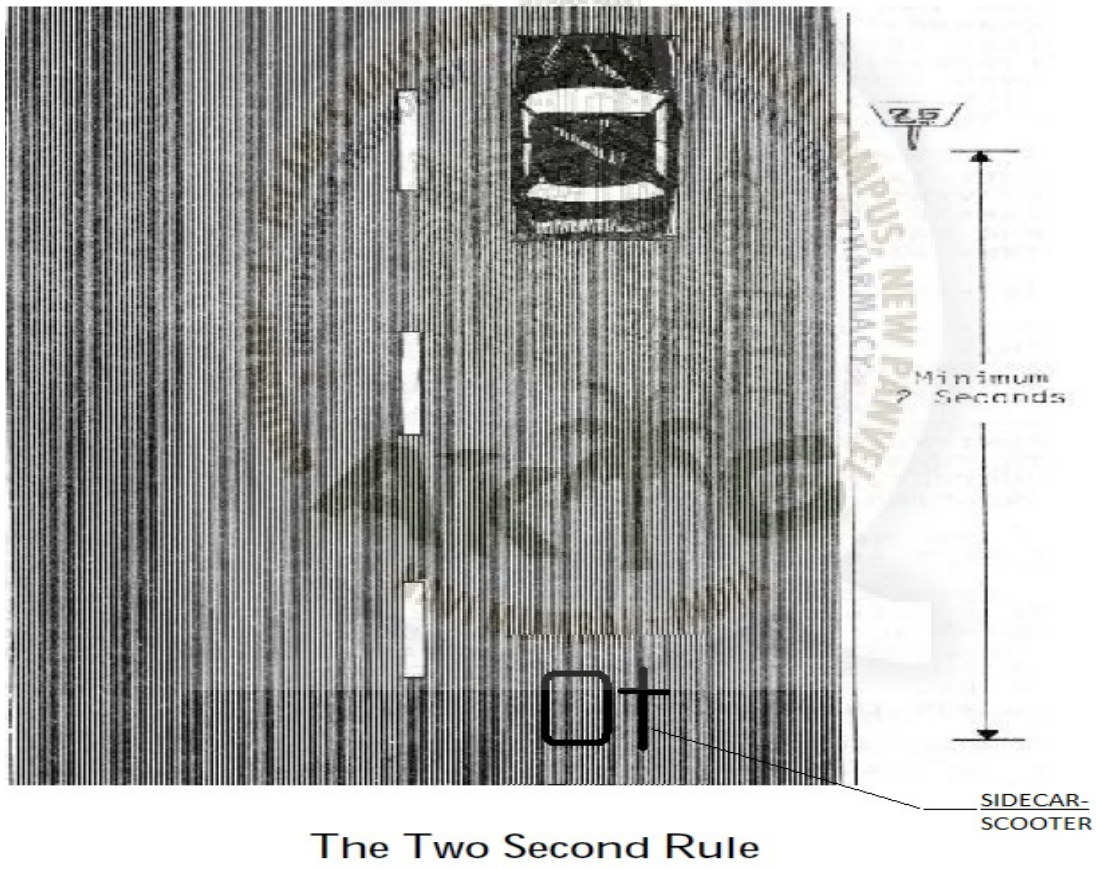


Figure 10.6: Safe Distance

10.2.2 Distance to the Side

Avoid riding next to any other vehicle. This will insure you can move laterally if a problem arises. The driver of a sidecar outfit like the motorist cannot alter his lane position appreciably, unlike the soloist who can alter his lane position as traffic conditions change. Still, as the average outfit is less than five feet in width in lanes

that may be ten feet or more, the sidecarist can move over to some extent. When being overtaken, for example, crowd the lane opposite to the overtaking vehicle. If traffic is of uniform density on either side, stay in the center of your lane. Give way to any motor vehicle that is larger than you, especially large trucks and buses. In addition to their drivers not recognizing you as a threat, they can also create wind gusts that buffet you. Unlike the soloist who may lose control, in strong gusts, to the sidecarist they will simply be a mild discomfort to you.

10.2.3 Intersections

Most motorcycle-car collisions happen at intersections. This may be partly due to the drivers not paying attention to their driving (they also hit pedestrians and cyclists) and partly due to their lack of fear of the motorcyclist. A typical accident is as follows: A motorcyclist, with or without his lights on, is continuing straight ahead. The approaching car signals to turn, comes to a full stop, establishes apparent eye contact, then proceeds directly into the path of the oncoming motorcyclist. A car may also pull into the main street from a side street and collide with the motorcyclist. Always assume the car will enter your path if it can. Your greater width and increased conspicuity over a solo motorcycle may offer some degree of protection but do not count on it. Move as far from the car as possible. If the car is on your right move to the left, and vice versa. If possible, change lanes and use other vehicles to run interference. Always approach intersections slowly, in a gear that will allow maximum acceleration if necessary. If the driver does want the spot you are in, brake, swerve, or accelerate to get out of his way.

10.2.4 Parked Cars

When passing parked cars, the sidecarist has little advantage over the motorist. Drivers of parked cars often fail to look behind them and open their doors with gay abandon. When pulling out, they are often more concerned with whether their right front bumper will hit the left rear bumper of the parked car ahead than with what damage or consternation their pulling into traffic will have. They may suddenly execute a U-turn in front of the motorcyclist, leaving him with no place to go. Always check parked cars for any signs of movement such as the sudden turning of the front wheel or the tell-tale puff of smoke from the exhaust. Approach cautiously with the fingers on your left-hand poised on or near the horn button or headlight flasher or both, and the fingers of your right hand poised over the brake front lever.

10.2.5 Sharing Lanes

Cars and motorcycle-sidecar outfits each need a full lane to operate safely. Do not share a lane. Your width does not allow you to squeeze between adjacent traffic

lanes. Nor should two outfits ride abreast in a single lane, although this may sometimes be permissible for solo motorcyclists. Always discourage a potential lane-sharer by staying in the center of your lane. Be prepared to drop back and yield your space if another road-user insists on taking it.

10.2.6 Merging Cars

Cars entering a highway from an entrance ramp often are not concerned with disrupting the traffic flow on the highway, especially if they see only a small vehicle in their path. Change lanes or yield your position rather than risk an altercation.

10.2.7 Cars Alongside

Unless traffic is bumper-to-bumper, do not ride alongside other vehicles. Motorists often change lanes with a total disregard for other vehicles, especially those smaller than themselves. Always try to keep a clear space on either side for emergencies, should anything happen in your lane.

10.2.8 Distance Behind

Be constantly aware of tailgaters. Change lanes, if possible, and let them go on their way, or try to open up additional distance. If necessary, pull over and stop. Better the tailgater on another motorist's bumper than on your unprotected rear wheel.

10.3 Handling Unusual Surfaces

A sidecar outfit is one of the most stable vehicles, on or off the road. When irregular surfaces such as ice make normal travel difficult, the sidecarist will find little difficulty. Snow, slush, sand, oil slicks, wet manhole covers, painted lines, uneven road surfaces, road bumps, or even patches of black ice are dangerous to the solo motorcyclist but present few problems to the sidecarist. Part of the sidecar's unique ability to handle all road surfaces is that one wheel is used for steering, one for traction, and one for stability. Each preforms its allotted task.
Regardless, the sidecarist always should show respect for such surfaces, approaching and traveling on them with caution. There is never any need to use your feet as outriggers as one would on a solo machine. For glare ice or mud, chains are available for added traction. These chains are similar to those used on solo machines for hillclimbing.

10.3.1 Uneven Surfaces

Watch for uneven surfaces such as bumps and broken pavement, chuckholes, and railroad tracks, and approach with caution. Rarely will you encounter a situation bad enough to lose control, but traveling over such surfaces at speed will do neither your machine nor your kidneys any good. Therefore, if they cannot be avoided slow down and try to cross any minor obstacles head-on. Take care not to straddle rocks protruding from the road bed with a low slung outfit. You can get high-centered and damage an unprotected fiberglass sidecar bottom. Shock of impact over rough road surfaces can be lessened by rising slightly on the footpegs and allowing your knees and elbows to absorb the shock. However, your sidecar passenger will experience a rough passage.
Most railroad tracks do not present any problem and may be crossed at any angle without fear. It is best, however, to cross at an angle over rails running parallel to your path, to avoid catching a tire alongside the rail.

10.3.2 Riding over Objects

Sidecars can be driven over extremely rough ground with any or all wheels in the air with no loss of control. Just take care not to high center a low-slung chair on a protruding object.
Sometimes you have little choice but to ride over an object in your path. If an object must be riden over, keep a firm grip on the handlebars. Keep the course straight, and rise slightly on the footpegs to allow your knees and elbows to absorb the shock. Check tires, wheel rims, and spokes for damage after hitting a solid object.

10.3.3 Grooves and Gratings

When driving an outfit over rain grooves or metal bridge grating, little traction change will be noted. No loss of control or even a tendency to wander is experienced as might be the case with a solo motorcycle.

10.3.4 Sloping Surfaces

Driving an outfit on a severely sloping surface will tend to make it want to edge off the road. A solo motorcyclist would compensate for this by leaning up-slope; this has no effect on directional control with a sidecar. Instead, pressure must be exerted on the handlebars, pulling one and pushing the other, to maintain travel straight ahead. If a sidecarist often drives on high-crowned roads, he can compensate by adjusting motorcycle lean-out slightly, or by increasing toe-in, or both. When driving on flat roads the outfit would now have a tendency to veer to the right, unless pressure is placed on the bars to straighten the rig.
The only effect of turning an outfit to the left on a severely banked right-hand surface

is that a little more force must be applied to the handlebars to turn. On the other hand, turns to the right will be considerably easier. Normal road speeds are permissible for sidecar outfits on sloping surfaces.

10.4 Sidecar Care

Your sidecar outfit should always be maintained in good condition at all times. In addition to the normal safety checks each time you ride, you should also make the following checks, periodically or weekly:-

- Check tires for tread wear. If the wear is uneven, your outfit may not be correctly aligned. A rear tire can become totally worn-out in less than 1500 Km if the sidecar is badly misaligned. Also check for cuts or cracks that could result In a blowout. Pressure should be maintained properly.
- Check for worn or loose wheel bearings. Front wheel wobble can be caused by the tire or wheel being out of round or out of balance. Sidecar operation puts considerably more strain on wheels.
- Check steering braces and steering damper.
- Check and lubricate all controls, cables, and linkages. All controls should function smoothly. All cables should be free of kinks or broken strands.
- Check shock absorbers for action. If they bottom out or leak, they should be adjusted, rebuilt, or replaced.
- Check all scooter and sidecar fasteners and parts for loose or missing nuts, bolts, or pins. Scooter is subjected to severe vibration which shakes and breaks things off.
- Check brakes for proper action.

Chapter 11

Screenshots of Project

11.1 SIDE-CAR SCOOTER

Chapter 12

Conclusion and Future Scope

12.1 Conclusion

We have made this project (Dual operated side-car scooter) to give comfort and effortless ride to the person suffering from muscular dystrophy. We have work on stability improvement of the vehicle.This was done with changing the position of the third wheel of the side-car scooter. And we also worked on additional control system (steering,accelerator and brake), this was done by successfully installing electric power steering. So that less effort is required to steer the wheels.we have came out with the testing of the power steering and results turn worthy.As it requires less effort as compared to conventional steering system. Other task was the control of dual accelerator and brake system.This is done by providing lever in the left side of the driver seat in the side-car.This mechanism is in such way that when the lever is push forward the brake will apply and when the lever is pull backward the acceleration operation is done. In this way these two controls were made and we got the fruitful results

12.2 Future Scope

In India itself, there are approximately 5,436,604 patient suffering from movement disability.So this major problem can be converted into opportunity.This will enhance the life of disabled person to a great extent and make them independent. Future scope in the side-car scooter can be mass production and inculcation of different technologies to reduce the cost and make affordable for middle class and below poverty line people.
Some Advancements may be:-

- Arrangement of mechanism to provide reverse turning.
- Improvement in aesthetics.
- Design of body to reduce aerodynamic drag.

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