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Braking System of Electric Go-Kart

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Abstract : A Go kart is a small four wheeled vehicle. Go kart by definition has no suspension and no differential. They are usually raced on scaled down tracks, but are sometimes driven as entertainment or as a hobby by non professionals. Carting is commonly perceived as the stepping stone to the higher and more expensive ranks of motor sports. Kart racing is generally accepted as the most economic form of motor sport available. As a free-time activity, it can be performed by almost anybody and permitting licensed racing for anyone from the age of 8 onwards. Kart racing is usually used as a low-cost and relatively safe way to introduce drivers to motor racing. Many people associate it with young drivels, but adults are also very active in karting. Karting is considered as the first step in any serious racer's career. It can prepare the driver for highs-speed wheel-to-wheel racing by helping develop guide reflexes, Precision car control and decision-making skills. In addition, it brings an awareness of the various parameters that can be altered to try to improve the competitiveness of the kart that also exist in other forms of motor racing.

Keywords: Go Kart, Disc, Caliper, Master Cylinder, Brake Line, Brake Pedal.

I. INTRODUCTION

Go-kart is a simple four-wheeled, small engine, single sealed racing car used mainly in United States. They were initially created in the 1950s.Post-war period by airmen as a way to pass spare time. Art Ingles is generally accepted to be the father of karting. He built the first kart in Southern California in 1956. From them, it is being popular all over America and also Europe.

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II. BRAKES

A. Introduction

A brake is a device by means of which artificial frictional resistance is applied to a moving machine member, in order to retard or stop the motion of machine. Brakes are generally applied to rotating axles or wheels but may also take other forms such as surface of a moving fluid (flaps developed into water or air).Some vehicles used combination of braking mechanism, such as drag racing car’s with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps rise into the air during landing. Most brakes commonly use friction between two surfaces press together to convert the kinetic energy of the moving object into heat, through other methods of energy conversion may be employed.

B. Goals

To design a braking system that is simple and ensures safety of the driver.
To design a braking system which takes least time to bring the vehicle to stop

III. SELECTION OF BRAKES

We are using disc brake of Bajaj pulsar 150cc for both front wheels and rear wheel considering the respective advantages,

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availability, and their limitations. The following reasons support the selection of disc brakes for the front and rear wheels.
Disk brake contributes for reduction in overall weight of the vehicle.
More braking torque needs to be generated by the rear brake even after weight transfer, because the single brake has to manage the braking torque requirement of the entire rear driveshaft.
Brake Caliper: achieving a better braking efficiency and to improve the for vehicle braking effect we have opted to use double calipers for rear wheels

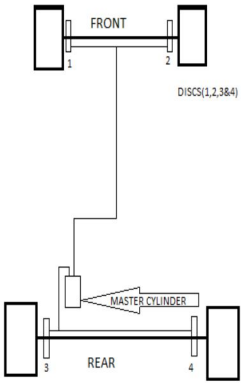

Fig.1 Brake Layout

IV. CALCULATIONS

A. Required Calculations

Where height of centre of gravity=1.01746m
h=0.08824m
Let us assume the static weight distribution ratio be 40:60
Static weight on front axle = (0.4xvehicle weight) = (0.4x1275)
=510N
Static weight on rear axle = (0.6x vehicle weight) = (0.6x1275)
= 765N
Let us take stopping distance as 2m.
From Newton's laws of motion
$V^2 - u^2=2as$
Where v is velocity after braking = 0m/s^2 u is velocity before braking = 21.11m/s^2
(i.e., the maximum velocity of the vehicle)
Deceleration = $((v^2-u^2)/2s) = ((0)^2–(21.11)^2)/ (2x2) = -111.408m/s^2$
As we know = u + at
Where t is the stopping time
t = ((v-u)/a) = (0-21.11) / (-111.408) = 0.1893s
Stopping time is 0.1893 seconds.
Dynamic weight transfer = h x wt x Deceleration)/ (l.01746x9.81)
= (0.0884x1275x111.408)/ (1.0174x9.81)
=1255.75 N-m
Dynamic weight on front axle = (static front weight + dynamic weight transfer)
=510+1255.75
=1765.75N
Dynamic weight on one front wheel = (Dynamic weight on front axle /2) = 1765.75/2
= 882.87N
Dynamic weight on rear axle = static rear weight + dynamic weight transfer

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= (765+1255.75)
= 2020.75N

Frictional force at each front wheel: = (0.4xDynamic weight on one front wheel)
=0.4x882.87
=353.148N

Frictional force at each rear wheel = (0.6xDynamic weight on rear axle)
=0.6x2020.75
= 1212.45N

Required braking torque at front wheel = (Frictional force at wheel x Front wheel rolling radius)
= (353.148x279.4x10^{-3})
= 98.669N-m

TABLE.I
REQUIRED VALUES

Parameter	Value
Maximum velocity(Kmph)	76
Pedal effort(N)	178
Adhesion factor of road	0.4
Coefficient of friction between brake pads and rotor	0.4
Stopping distance(m)	2
Stopping time(Sec)	0.1893

Required braking torque at rear wheel = (Frictional force at wheel x Rear wheel rolling radius)
= (1212.45x355.6x10^{-3})
=431.147N-m

Effective rolling radius of front wheel =228.6mm

Braking force acting on single front tire = (Torque/ effective rolling radius)
= 191.90 N

For Rear wheel (Disc Brake)

Area of piston in the calipers=3086mm^2

Pressure acting in the master cylinder = Pressure in the calipers.

Force acting on calipers =Pressure x area
=202920x3086
=626.211N/m^2

Clamping force generated on disc=1594.255N

Coefficient of friction between pad and rotor=0.4

Friction force between disc and pad =clamping force x coefficient of friction

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=1594.2550.4
=637.702N

Effective radius of rear disc = 114.3 mm
Torque developed = 143.25 N-m
Effective rolling radius of rear wheel =304.8mm
Braking force acting on single rear tire = (Torque/ effective rolling radius)
=469.9N

V. OBTAINED CALCULATIONS

The calculations are same for both front and rear wheel brakes, up to the brake line after master cylinder.
Estimated speed of the vehicle= 76Kmph
Estimated pedal effort of the driver= 178N
Mechanical advantage or pedal ratio= 4:1
Force acting on master cylinder = (Estimated pedal effort of the driverx4) =178x4
=712N
Diameter of master cylinder =0.75" =19.05mm
Area of master cylinder=285 mm^2
Pressure acting on master cylinder = (force x area)
= 712x285
= 202920N/mm^2
For Front wheels (Disc brakes)
Area of piston in the calipers=3086mm

TABLE.2
OBTAINED CALCULATIONS

Parameter	VALUE
Static front load(N)	510
Static rear load (N)	765
Dynamic front load(N)	1765.75
Dynamic rear load (N)	2020.75
Braking torque at each front wheel(N-m)	98.669
Braking torque at rear wheels (N-m)	431.14

The master cylinder piston diameter that was calculated is the maximum possible diameter that can be used for safe braking. The team decided to use a master cylinder with 10mm piston diameter as it can provide better braking force and is also commonly found on bikes.

VI. CONCLUSION

The conclusion of this paper is that to select an appropriate braking system for electric go kart and also help to enhance the stability of vehicle. The idea behind this braking system is that to get minimum stopping distance .As the design component of the paper, various, mathematical formula was derived from the fundamental to calculate the various parameters needed under assumption of some basic values of the vehicle

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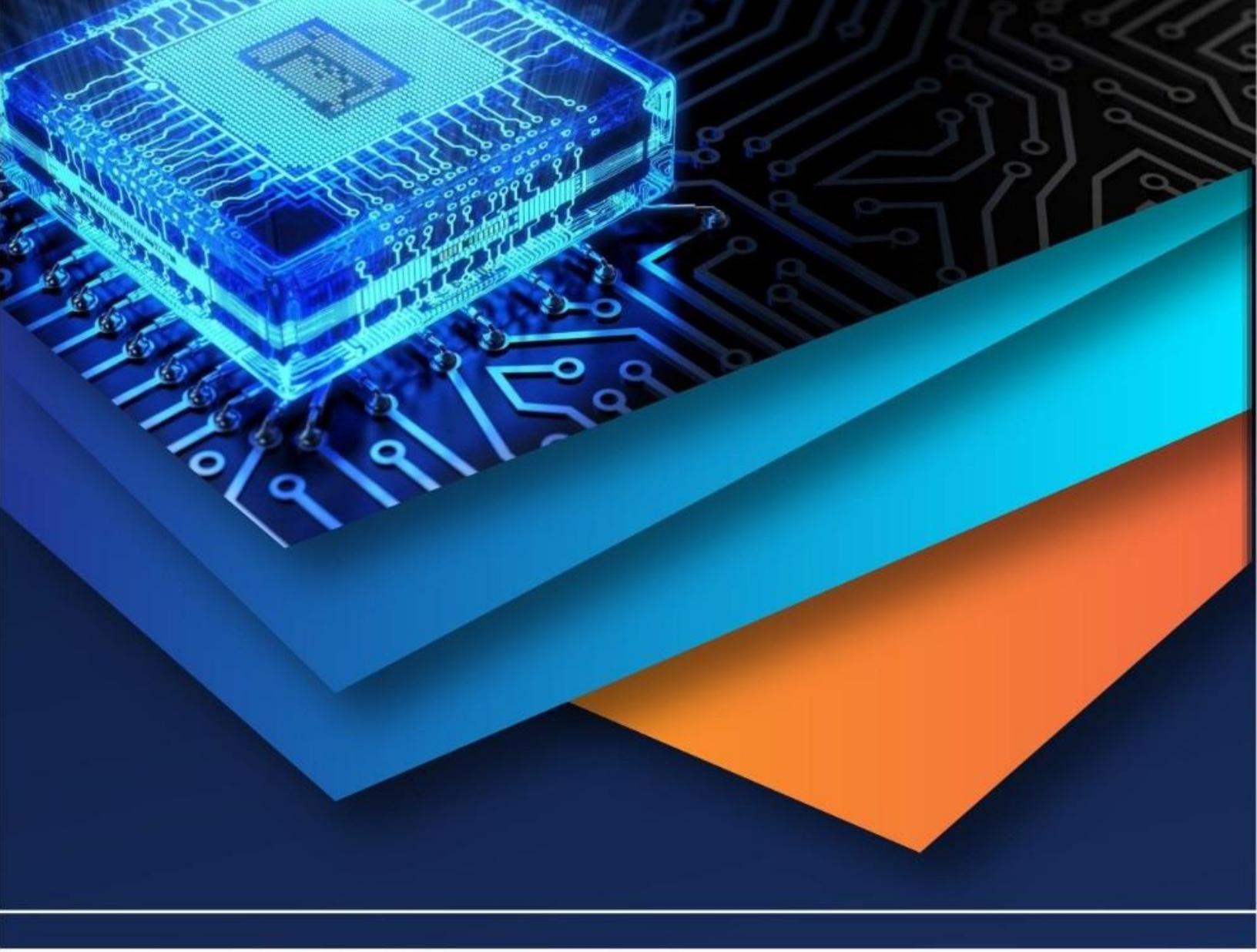

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