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Review on Basic Components of E-Kart

Prof. Mayur Shelke[1], Ashutosh Dikondwar[2], Atharva Patil[3], Gokul Goyte[4], Vivek Tapase[5], Ankush Dahake[6], Akash Wase[7]
[1, 2, 3, 4, 5, 6, 7]*Mechanical Department, K. D. K. College of Engineering, Nagpur*

***Abstract:** This review paper presents the design and development of an E-kart. The moto behind making this Electric-kart is to lower the number of pollutants and hazardous gases such as carbon monoxide, hydrocarbons, nitrogen oxide, etc. These types of gases are produced in an immense amount from vehicles. Therefore, we decided to make a vehicle that works efficiently on an electric motor and controller. We have used BLDC (brushless dc motor) motor which is powered by direct current and voltage. Motor control the motor controls the energy flow to the motor processes like throttle, brake, and control switches are connected to controller commands from these inputs i.e. Throttle, brake, etc., and control very precisely torque, speed, direction on and horsepower of the vehicle. The battery we used is a rechargeable lithium-ion battery. The main focus during the frame design was the stability of the E-kart and the safety of the driver. We also surveyed the market on chassis material, motor, brake, controller, and transmission system for cost and availability. International standards were followed during the whole project.*

I. INTRODUCTION

Electric kart is a type of go-kart which is powered by batteries and motors. Art ingles invented the first go-kart in 1956, go-karts became very popular and spread over other countries. Since then go-kart works on gasoline. The use of fossil fuel not only increases air pollution but also leads to the diminishment of fossil fuel, to keep the environment pollution-free, we aimed to design and development of electric go-karts. Initial torque produced in electric go-karts is more than the go-karts. In today's era, the automotive industry uplifts eco-friendly vehicles. An alternative for the engine is an electric motor which gives the same power output. As the motor is replaced with the engine the kart design and performance eminently change. So, the vehicle works only on electricity, the vehicle is designed in such a way that it fulfills the karting requirements. Frame i.e. chassis is the acts as a suspension and holds the whole weight of the kart and driver hence the chassis has to be rigid and must not fail during extreme conditions. Therefore, the stiffness should not be compromised with flexibility. The main motto behind making this E-kart is to lower the number of pollutants and hazardous gases. The track width and wheelbase are chosen accordingly by the designer.

II. MATERIAL USED

We have used AISI 4130 steel which provides enough strength and flexibility needed. The first and second digit of 4130 denotes a class of steel and the percentage of alloying element and other elements, the last two digits denote carbon concentration in increment of 0.01%. By considering these rules 4130 steel is chromium-molybdenum near about 0.01% molybdenum/chromium by mass with including 0.30% Carbon. The chemical composition of 4130 steel is given below, with tolerance

1) 0.7- 0.9% Manganese
2) 0.28- 0.33% Carbon
3) 0.15- 0.25% Molybdenum
4) 0.8- 1.1% Chromium
5) 0.15-0.35% Silicon
6) ≤ to 0.04% Sulphur
7) ≤equal to 0.035%

Mechanical properties	Metric
Modulus of Elasticity	205 MPa
Ultimate tensile strength	670 MPa
Tensile yield strength	435 MPa
Rockwell B Hardness	92
Elongation of Break	25.5%

Table. 3.1

Phosphorus. 4130 steel is considered as low carbon steel which has a density of 7.85 g/cm³ and has good heat treatment which provides the necessary hardness. It is having good weldability, it is easily cold worked, hot worked, forged also it has very good ductility when annealed. The ultimate and yield tensile strength provide maximum stress to a material that material can withstand before its failure. We also did a market survey and then considering all these benefits and comparing with other materials we decided to use 4130 steel.

III. CHASSIS

The material used to make the chassis is AISI 4130 steel. Which has good weldability, ductility, and hardness. While making this chassis we used arc welding. Chassis is the main component in kart which holds all the weight and provides suspension so it should have good hardness and should not be compromised with flexibility. The design of the chassis is done by Solid-works software as shown in fig. The weight of the chassis is 18kg

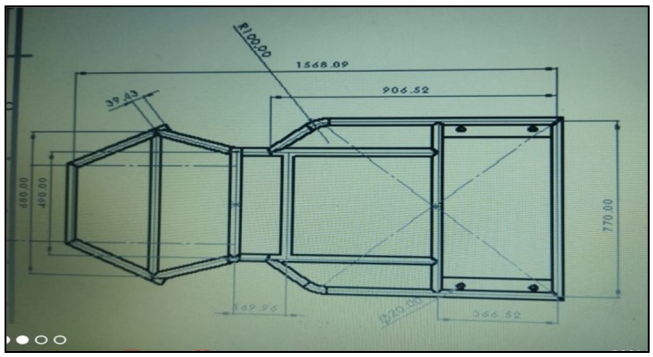

Fig.3.1 Chassis

IV. STEERING

The steering which we used is Ackerman steering which satisfies all our needs. The Ackerman geometry avoids the need for tires to slip sideways around the curve. The difference between steering angle and direction in which tire foot is taking is called slip angle. Slip angle is important for the very subtle rotation motion of the e-kart More the vertical load on the tires, the greater lateral force it can produce. It is necessary to make sure that both tires operate at their peak slip angle simultaneously to get maximum performance. During the turn of a vehicle, the inner front wheel needs to turn at different angles to the outer because both wheels are turning at different radii. The Ackerman steering mechanism is a geometric arrangement of steering linkages designed to turn inner and outer wheels at appropriate angles. Therefore, we used Ackerman steering in E-kart

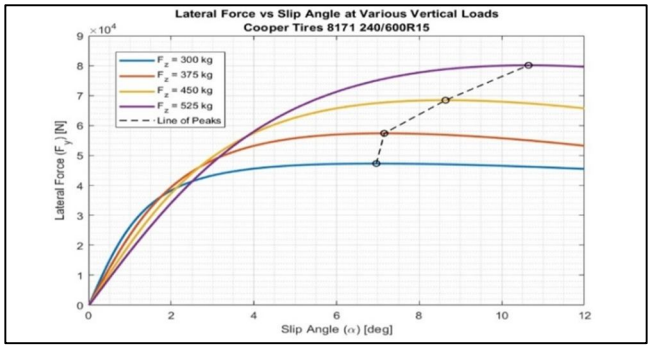

Fig.4.1 Slip Angle

V. BATTERY

In electric Go Kart, the working of motor battery is the main source. The cathode is the positive terminal and the anode is the battery's negative terminal. We select the lithium-ion battery for our electric Go Kart because of its rechargeable, low self-discharge, and high energy density properties than the other types of batteries. In lithium-ion batteries, the cathode material is an intercalated lithium compound and the anode material is typically graphite. During charging of lithium-ion batteries, lithium-ion transfer from the positive electrode to the negative electrode with the help of electrolyte and during the working of battery means discharge the process is similar but revers. The lithium-ion battery is having a discharge and the charge percentage is 79 to 91.

VI. CONTROLLER

An electric vehicle, controller ensures the flow of energy balance between motor and battery. which means it acts like a 'middleman' in between both. It finds out the amount of energy required to run the electric vehicles smoothly on the road. According to the running direction, its reverses or forwards the motor rotation. According to the running condition, it regulates speed, decreases or increases torque, and mainly protects the motor against overload conditions.

VII. MOTOR

A motor is a machine that converts supplied electrical energy into mechanical work. BLDC is abbreviated as a brushless direct current motor. We have used the BLDC motor in our project to drive the wheels. As their name implies, the BLDC motor does not have brushes, and its torque-speed characteristics are similar to the DC motor.

BLDC motor works on the principle of Lorentz force law. It states that whenever a conductive material is placed in a magnetic field and current will pass through a conductor, it experiences a force. As a consequence, the equal and opposite force acts on the magnet. In the BLDC motor, the current-carrying conductor is stationary and the permanent magnet is moving. This motor uses a Hall effect sensor to indicate the current position of the rotor. When the stationary part or armature winding is connected to the source, the uniform electromagnetic field is produced in the air gap. Due to the force of interaction between stator and permanent, the rotor starts rotating. While the Hall sensor which is placed on the motor sense the rotor position and produced high output i.e. 1 when exposed to the N-type of the rotor and low output i.e. 0 otherwise. It required less maintenance cost due to the absence of brushes and commutator. Also, it has high efficiency and output power to size ratio due to the use of a permanent magnet rotor.

VIII. BRAKING SYSTEM

To stop the vehicles the braking system is widely used in the automobile sector. There are four types of brake.

1) Drum brakes
2) Disc brakes
3) Emergency brakes
4) Antilock brakes

In our E kart project, we have used a disc braking system because it required less time and distance to stop the vehicle than the drum brakes. The purpose of the disc braking system is to moderate the speed of wheels like a car wheel, truck wheels, etc. by using a brake rotor to create friction. And this friction slows down the shaft rotation. In the disc braking system to stop the vehicle, there are calipers fitted above the rear shaft mounted on the chassis. Caliper moderates the speed of wheels when you apply the brake. Disc braking system has four components and they work together to complete the braking system. This part namely as brake pad, brake support, brake caliper, and caliper support. Each performs a different function to operate the braking system.

In a disc braking system, the operation to stop the vehicle is done by converting the kinetic energy of the vehicle into heat energy, and this energy is moved out to the atmosphere.

Disc braking system gives extra stopping power and hence it is useful for short and long-distance as well. Disc brake allows more accurate braking power it makes wheel lock-up less likely.

IX. TRANSMISSION SYSTEM

For transmission of vehicle widely used systems are chain drive and belt drive transmission systems. For E kart we are using a chain drive transmission system because chain drive has a long life and is well compared to belt drive transmission. Chain drive is used in various types of machines and vehicles to transmit mechanical power from one place to another place. Chain drive gives a perfect velocity ratio because there is no mistake and glide during power transmission. In a chain drive transmission system, the driving wheel gives accurate speed concerning the driven motor. Therefore, it has high transmission efficiency of up to 98%. Pin joints are available to joint several rigid links to form a chain and this chain is connected between the driven motor and the driving wheel to transmit the mechanical power.

In chain drive transmission chain provide the essential flexibleness to wrap driven and driving wheel. The sprocket is used to run the wheel over the chain. The classification of chains in transmission systems is as follows.

1) Blockchain
2) Roller chain
3) Silent chain or inverted tooth chain

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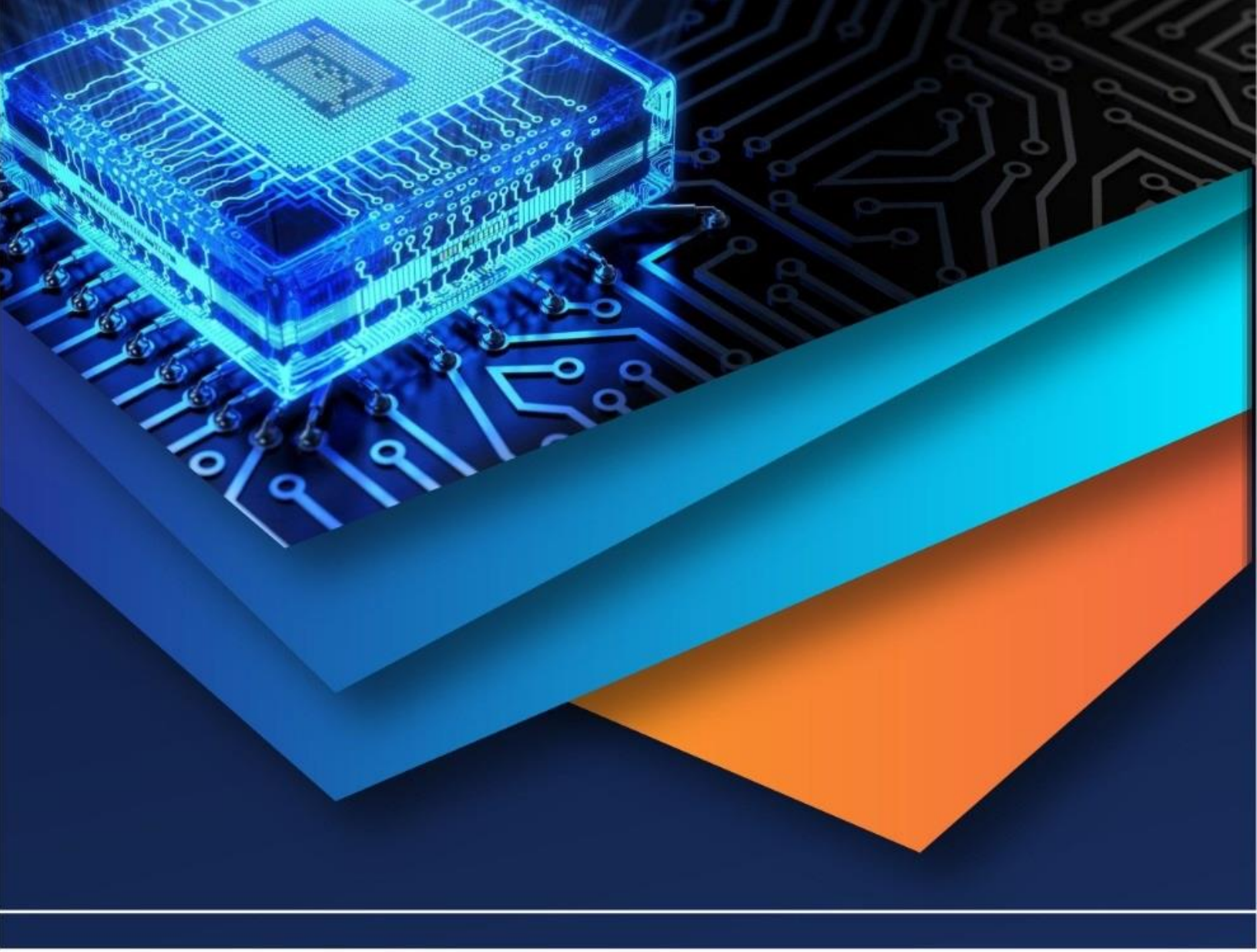

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