Electric Kart with Intelligent Braking System

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Abstract **- This paper concentrates on explaining the engineering behind designing and fabrication of an electric kart which is a low ground clearance vehicle, usually runs over flat racing circuits considering a safer, rigid and torsional free frame, well-mounted gear system along with braking and steering mechanism. We proceed towards our design and modelled its various components in Solid works & PTC Creo and Whenever required finite element analysis (FEA) was also done on the continuously loaded components. Four simple objectives must be met through the iterative design process, and they must be applied to every component of the vehicle: durability, safety and ergonomics, light weight, and high performance.**

We also introduce a very New Concept of "Intelligent Braking System" (IBS) which can stop the vehicle within 3 to 4 seconds running at a speed of around 50 KM. The intelligent braking system is a completely autonomous system. Intelligence braking system is an advanced braking system in which a very natural and gradual braking is practiced. The complete IBS circuit is designed using several speed and object detection sensors and micro controller to activate the solenoid valve. when the solenoid valve is activated, the compressed air passes to the double Acting Pneumatic Cylinder and pushed the pneumatic piston towards outwards exerting a required force over the master cycler of the hydraulic braking system. The braking arrangement is used to slow down the wheels gradually or suddenly due to the piston movement.

Index Terms **- Durability, DFMEA, DVP, Ergonomics, FEA, IBS, Safety.**

I.INTRODUCTION

Electric go-kart is a four wheel open spaced single seated vehicle which has no suspension and no differential usually raced on scaled down tracks, it is battery operated vehicle driven by motor and it is economical and ecological to use and the intelligent braking system is installed as innovation which contributes high speeding by accommodating effective braking and safety to driver.

Braking system in the automobile always given the highest priority concerning the safety reasons because inappropriate braking system causes accident and risk to life so to overcome this a appropriate braking system is needed in which the response time is decreased by providing rapid response using electronic control system and the stopping distance also reduced by choosing effective braking system arrangements.

Intelligent braking system is widely used in advance and automated smart vehicle, and it has better application in highway to avoid crashing of vehicles in low visibility road caused due to fog and smog, and intelligent braking system is also used in industrial purposes and automated guided robots so by accommodating the advantage technology and equipment it is widely used.

In the intelligent braking system the "TRANSMITER" circuit transmits the infrared radiation spectrum towards the path if any obstacles is there in path the rays are reflected back and received by receiver circuit and it transfer the signal to the control signal circuit and the control circuit activate the solenoidal valve then the compressed air passes to the pneumatic cylinder which function the pistons rod, when the piston rod moves forward braking action performed and the piston movement is controlled by control valve according to need and perform the smooth braking. And a model is also constructed by us to structure analyze and study has been analyzed by software and practically.

II. LITERATURE REVIEW

[1] While working on this project we went through the volume 1 and volume 2 od Dr, Eung Soo Kim which

was on the, “Fabrication of Auto Braking System Using Sensor”. In which the system that they made was working on the IR i.e., Infra-Red sensors. He clearly talked about the betterment of the IR over the Ultrasonic sensors because choosing of sensors is clearly dependent on the type of work you are performing and for this application IR sensors turned out to be better. So, after analyzing this paper we decided to use IR sensors instead of Ultrasonic sensors.

[2]While further working on this project and going through the paper of, “Intelligence Braking System” using IR Sensor by Author Gunjan Koli (et al) Vol 3 , Issue 2 , 2017, we were clear about using the IR sensor i.e. Infra-Red Sensor but there was one problem with this simple type of IR sensor that these are influenced by haze, smoke, fog and sunlight but after we went through the paper of Gunjan Koli where mentioned that the IR LIDAR TF-Luna Sensor does not get influenced by smoke, fog, sunlight or haze. So, after analyzing this paper we decided to use IR LIDAR TF-Luna Sensor instead of a simple IR sensor.

[3]While working on this project we were not clear about the type of brakes which we have to use but we were clear about something that has to be light in weight and quick in action so we went through the paper, “Design And Analysis of Intelligence Braking System” by Tushar Kavatkar (et al), 2017, where he suggested of using disc brake assembly instead of a set of drum brake as the disk brakes are light and has less components in it and they are very quick while in action and these have better anti-fading characteristic. So, after analyzing this paper we decided to use disc brakes instead of drum brakes.

[4] While working on this project we were concerned about the smooth working of the but had no idea on how to remove the jerkiness in the system but after going through the paper, “Design and Analysis of Intelligence Braking System” by S. Suresh (et al),2017, where he suggested to use the pneumatic system as these lowers the jerkiness in the system and provide smooth experience while performing the task and these will be pollution free and clean. So, after analyzing we decided to use the pneumatic system.

[5]While still working on this project we were slightly confused about the usage of ultrasonic sensor but after going through the paper, “INTELLIGENT BRAKING SYSTEM” by K. Harsihwar Reddy (et al) Vol 8, Issue 5, JETIR, 2017, we found out that that the sensor that they used in their system had a shorter ranger of action but after more research we came to a conclusion that Lidar sensor has more range of action and these can perform better than the ultrasonic sensors at any time depending on the type of task you are performing

FIG 1: ELECTRIC GO KART

III. FRAME DESIGN

A. Objective

The chassis goal is to efficiently and safely enclose all of the kart's components, including the driver. Driver safety, drive train integration, structural weight, and operator ergonomics were all important features of the chassis during design and execution. The safety of the driver was the top consideration in the chassis design. By using Finite Element Analysis (FEA), the design assured:

1. To safeguard the driver's safety.
2. To keep the centre of gravity low.
3. Verify that all of the systems will fit on the chassis.

B. Material used

The material AISI-1018 was chosen for the frame design because of its good weldability and strength.

TABLE 1 : PHYSICAL PROPERTIES

S.N.	PROPERTIES	VALUES
1)	Tensile strength, Ultimate	450 MPa
2)	Tensile strength, Yield	380 MPa
3)	Bulk Modulus	200 GPa
4)	Shear Modulus	80 GPa
5)	Modulus of Elasticity	200 GPa
6)	Poisson’s ratio	0.29
7)	Elongation at break	16%

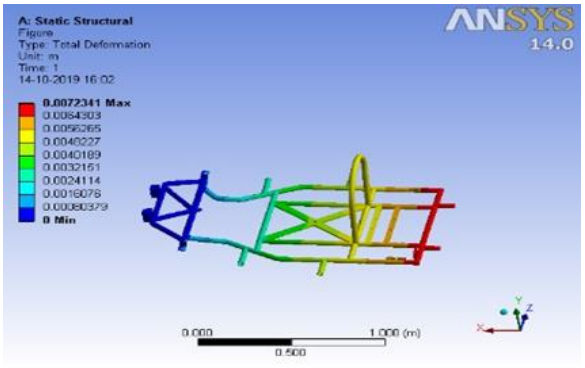

FIG 2 **:** CHASSIS MODEL

TABLE 2: Specifications of Chassis

SR. NO.	CHASSIS MATERIAL	SPECIFICATION
1	Type (Seam or Seamless) & Grade	Seamless
2	OD (outer diameter)	25.4mm
3	Wall thickness	2 mm
4	Cross section (circular, Rectangular, Square)	Circular
5	Material testing Certificate (Yes/No)	Yes

FORMULA USED

Impulse moment theorem = Newton's second law. $F*t = M (V_f – V_i)$

IV. CALCULATIONS

EVALUATION OF PNEUMATIC PUMP

- Cylinder pressure = 10 bar
- Bore = 25 mm
- Length of cylinder= 150mm

Assume the normal force applied on the pedal: 350 N

1) Force (F):

AS per formula, $F=P*(\Pi d^2 /4)$

$F = 1\times\pi (25)^2 /4$

$F = 491$ N

Which is more than required paddle force

2) Volume of cylinder (V): As per formula, (V) = A×L

$V = \pi d^2 /4\times L = \pi\times252 /4\times150$

$= 73.63\times103$ mm^3

3) Discharge (Q) = volume/ time = 73.63 ×103 /60

$= 1227.16$ mm^3/sec

4) Area of piston (A): $A = \pi d^2 /4 = \pi\times252 /4$

$= 78.54$ mm

5) Piston Speed (S): As per formula, $s=28.8\times(Q/ A)$

Where, S = velocity in mm/ sec

Q = volume of flow mm^3 /sec

A = area of piston in mm^2

$S = 28.8\times1227.16 /78.54$

$= 450$ mm/sec= 0.45 m/sec.

CALCULATION FOR BRAKING SYSTEM:

- Gross weight of the vehicle:

W = weight of the vehicle (with load conditions) in kgs * 9.81 = 200*9.81= 1962 N.

- Brake line pressure:

P = force on the brakes / area of master cylinders (as pedal ratio is 4:1)

= pedal ratio *force on the pedal/area of master cylinder= 4*350/(π/4)*(0.01)2 = 17.82 MPa

- Clamping force (CF): CF= brake line pressure *(area of caliper piston*2)

$= 17.82*((\pi / 4) * (25.4 * 10\text{-}2) 2 * 2)$

$= 18059$ N

- Rotating force : RF= CF* NO. of caliper pistons *coff. friction of brake pads

$=18059*0.3*2 =10835.4$ N

- Braking torque: BT:

= rotating force* effective disc radius

$= 10835.4*0.09 =975.186$ N-m

- Braking force :

=(braking torque /tire radius)*0.8

$=(975.18/0.179)*0.8 =4358.37$ N

- Deacceleration: f=-ma (-vee sign indicates force opposite direction)

a=-BF/m=-4358.37/200 = -21.79 m/s2

- Stopping distance: $(v^2 - u^2) = 2as$ (v=0, u=15 m/s) so, Stopping Distance = 5.23 meter

V. INTELLIGENT BRAKING SYSTEM

Speed and control are the highly desirable things we want in our vehicle. And this is not fulfilled by manual braking system it is not easy for human beings to coordinate with different mechanism efficiently at a time, so for the better results we are introducing a new concept of "INTELLIGENT BRAKING SYSTEM"

The "TRANSMITER" circuit transmits a light beam with a wavelength close to that of the infrared spectrum. The rays are reflected if there is something in the way. The receiver circuit, known as the " RECEIVER," receives the reflected photons.

The control circuit gets the control signal from the receiver circuit, which receives the reflected rays. The solenoid valve is activated through the electric circuit.

The pressurised air goes to the Double Acting Pneumatic Cylinder once the solenoid valve is activated. The piston rod is moved by compressed air, which activates the pneumatic cylinder.

The braking system is initiated as the piston travels forward. Because of the piston movement, the braking system is employed to break the wheel gradually or suddenly. The "FLOW CONTROL VALVE" controls the braking speed by altering the valve.

In this project, we'll use this braking system in an electric go-kart. Compressed air is supplied through a compressor. Compressed air is delivered to the flow control valve via a Poly-urethene tube. As shown in the diagram, the flow control valve is connected to the solenoid valve.

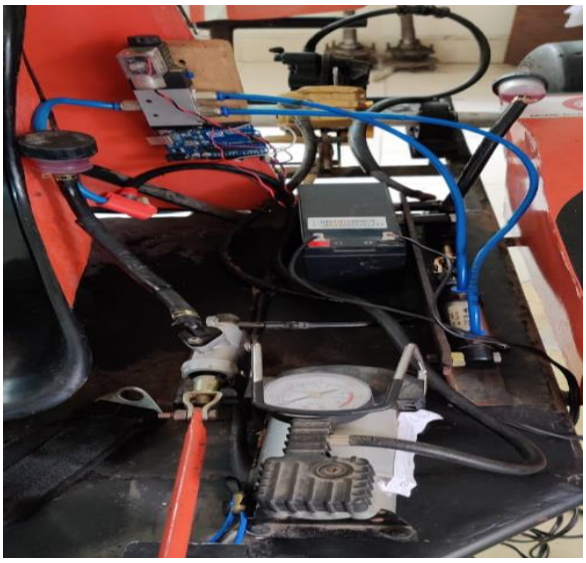

FIG 3 : IBS SETUP

VI. APPLICATIONS

- One of the primary issues that emerges is parking, because in congested places, automobiles that are larger in size make it difficult to accomplish the operation, and people sometimes end up hitting other objects around their vehicle.
- Because these brakes are less expensive, they provide the same level of safety as those found in high-end automobiles.
- One of the major areas that results in driving is the ease of braking; by using this system, we can reduce the jerkiness felt while braking because it analyses the situation automatically and produces the exact amount of force required to stop the vehicle while also considering the comfort of the passengers.
- Using the intelligent braking system in the vehicle, we will also avoid vehicle crashes on highways due to reduced visibility caused by fog and smog.
- The usage of an IR LIDAR Sensor decreases the possibility of false sensor activation when turning around or passing another vehicle.

FIG 4 : SENSORS POSITIONING

VII. RESULT AND CONCLUSION

An intelligent braking system is the braking system of the future. The inter-disciplinary interaction of mechanics and electronics provides its greatest benefits –sensors, valves, and pneumatic cylinders work together and permit novel, highly dynamic brake. In this system, the Sensors unit sense the obstacle which can't be judge easily by basic human beings. This sensor gives a control signal and therefore the process of application of brake is completed within a few seconds. The intelligent braking system is beneficial in avoiding the damage and accidents that occur during the parking of a vehicle on the parking side especially when the driver parking a vehicle from the rear side Behind designing this technique, our main aim is to enhance the technique of prevention of accidents and also reducing the hazard from accidents like damage of the vehicle, injury of humans, etc.

Intelligent braking is one among the smart options which may be implemented in various applications for stopping a moving body without jerky motion. The innovative idea of implementing the intelligent braking system is discussed and thereby analyzed its various parameters for normal realistic application.

The application of pneumatics produces smooth operation, by using more techniques, they will be modified and developed according to the applications. By implementing this project, we will reduce the price of high-end cars by giving similar forms of safety.

Approaches and conclusions that we present are somewhat preliminary and need further significant investigations, while making some changes we will use this on any available vehicle. The application of the intelligent braking system for the critical dynamic condition must be analyzed. Also improved and precise programming is important for real-time process.

REFERENCES

[1] Dr.Eung Soo Kim,"Fabrication of Auto Braking System Using Sensor", International Journal Of control And Automation, Vol-2, and no1.

[2] Gajanan Koli,Akshay Patil, Shubham Sokashe, "Intelligent Braking System using the IR Sensor", International Journal of Advance in Scientific Research and Engineering ,volume 03,Issue 2,March-2017,ISSN:2454-8006.

[3] Mr. Tushar Kavatkar, Mr. Harshal Salvi, Mrs. Minal Rahate, "Design and Analysis of Intelligent Braking System", International Journal of Engineering Development and Research, Volume 5, Issue 1 |,2017, ISSN: 2321-993.

[4] S. Suresh, T. Prashanth, B. Sahaya Joba, R. Tamilkumaran, R. Venkatesh "Design and Analysis of Intelligence Braking System" Paper ID: IJERTCONV5IS07019 Volume & Issue: ETDM – 2017 (Volume 5 – Issue 07) ISSN: 2278-0181

[5] K Harishwar reddy, B srikanth, D Sagar, G Vijay, "Intelligent Braking System using Ultrasonic Sensor", International Journal of Emerging Technology and Innovative Research, Vol.5, Issue 9, ISSN:2349-5162.

[6] Kanaad Bhardwaj, Mahesh Kumawat, Abhinav Pamecha Aryan Sharma, Hemant Choudhary, Dhruv Rana, Ajit Singh Gour, Atul Katara " Design and Performance Evaluation of an Electric Go-Kart" IJARIIE-ISSN(O)-2395-4396 Vol-6 Issue-3 2020

[7] "Practical Finite Element Analysis" by Nitin S Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar, Anand N Thite published 2002 by Finite to Infinite.