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Design and Analysis of Go-Kart Chassis

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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, Racing, Design, Frame, Analysis.

I. INTRODUCTION

In the case of vehicles, the term CHASSIS can be described as the frame which supports all the components of the vehicle. The wheels of the vehicle are mounted on the chassis with the help of king pin and sprockets and the other parts are also attached with bolts and welding process. The chassis should be rigid from all the Bending and Torsion stress. To ensure the safety of the driver the chassis should be designed to comply with basic safety rules and at the same time serve its purpose.

II. DESIGN METHODLOGY

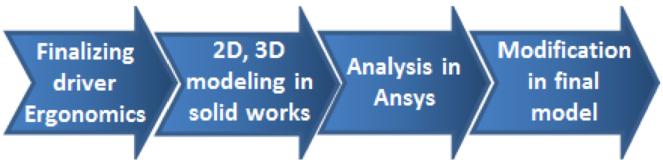

Fig. 1.Design methodology of chassis

III. CHASSIS

A. Goals

- To ensure safety of the driver.
- To maintain low center of gravity.
- To ensure that all the systems fit onto the chassis.
- To design a chassis with high strength and low weight.

B. Our design specifications

- Wheelbase:1220mm
- Track width 70%. Of the wheelbase i.e (863mm)
- Overall length: The overall length of the vehicle is 1651 mm excluding the front and rear bumpers
- Roll Bar is used in the structure and its top is extended over the drivers helmet

TABLE I SPECIFICATIONS OF CHASSIS

Chassis weight	25 Kgs
Width	838 mm
Wheel base	1220 mm

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Track width (front)	863 mm
Weight distribution	40:60
Total weight	140 Kgs

C. Chassis views

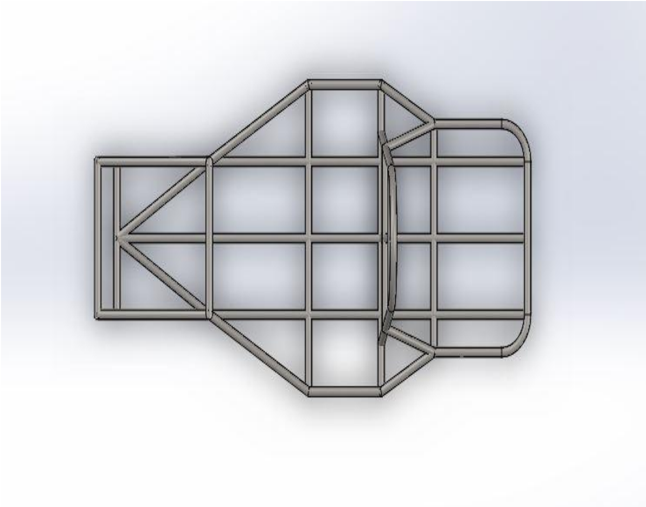

Fig. 2. Top view of chassis

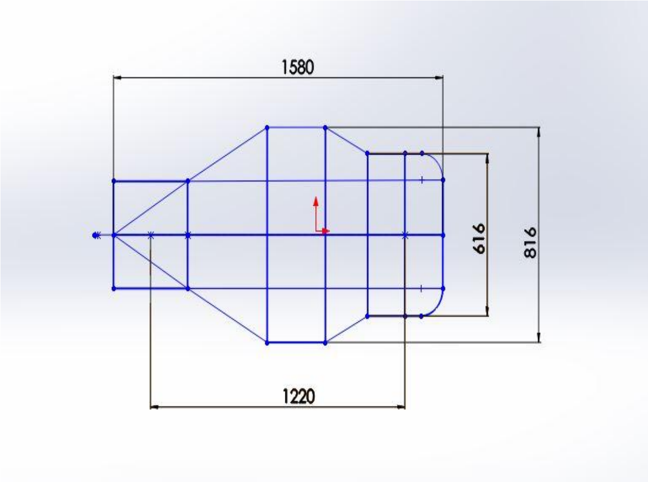

Fig. 3. Top view with dimensions

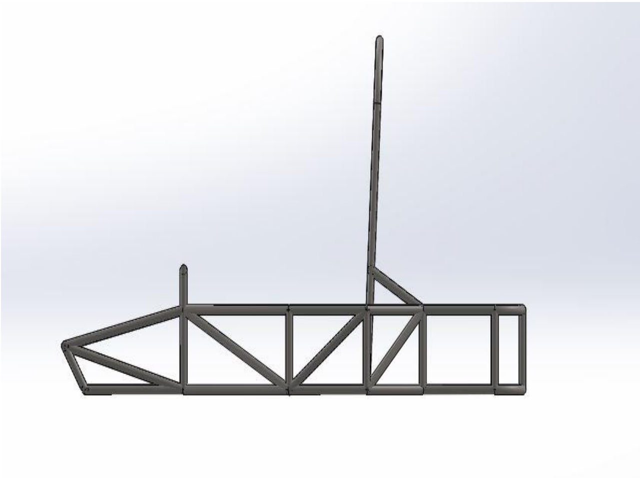

Fig. 4. Side view

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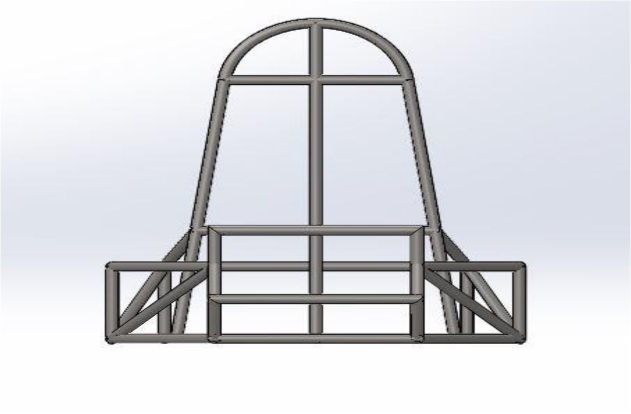

Fig. 5. Front view

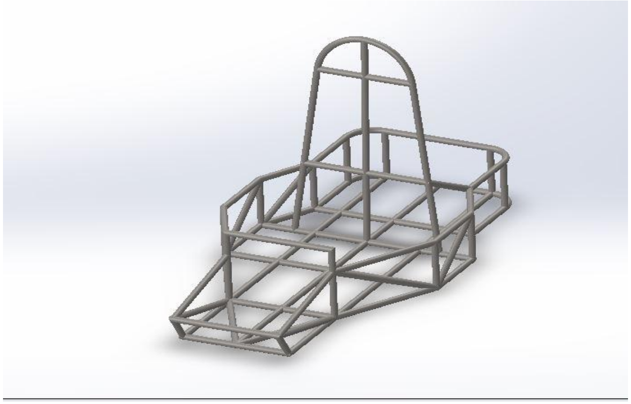

Fig. 6. Isometric view of chassis

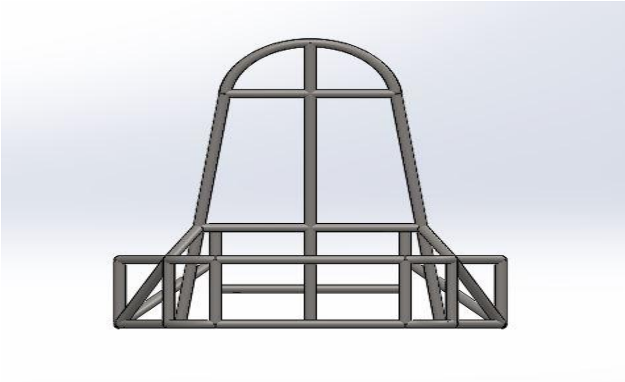

Fig. 7. Rear view

IV. MATERIAL SELECTION

Cost, availability, weight, strength & weld ability are the four key factors which determine the material selection. Tubing is available in standard fractional sizes to the 1/8th of an inch: 1, 1.12, 1.25 and 1.5. The wall thickness is limited to the common Birmingham Tubing Gauges. In this case these are: 1.5, 1.8, 2, 2.5 and 3 mm. The most commonly available materials are:

TABLE II COMPARISON OF MATERIAL PROPERTIES

Materials	Yield strength (MPa)	Percentage elongation at break
AISI 1026	260-440	17-27%
AISI 4130	435-979	18-26%
AISI 1020	230-370	18-28%
AISI 1018	270-400	18-29%

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It is observed that material which has high machinability and inexpensive is AISI 1018 hence was a good choice but strength to weight ratio is greater for 4130. AISI 1020 was rejected because of its high cost. AISI 4130 was rejected because of its high carbon content and lack of Machinability, 4130 have the superior harden ability that other iron alloys like 4130 and 4140 possess. But 4130 is popular steel in race car industry but is not easily available in India.
Therefore, the material that the team chose to use is **AISI 1018**. The benefit of using the AISI 1018 is that it can be easily wielded than the 4130 chromyl. The AISI 1018 has the same Modulus of Elasticity (E) and density as the 4130, so using it does not affect the weight or stiffness in member with same geometry.
AISI 1018 has excellent weld ability and produces a uniform and harder case and it is considered as best steel for carburizing parts. The 1018 carbon steel offers a good balance of toughness, strength and ductility. Considering the above factors we choose **AISI 1018** for our chassis material.

TABLE III CHEMICAL COMPOSITION OF AISI 1018

Chemical composition of AISI 1018 ELEMENT	**CONTENT**
Carbon (C)	0.14-0.20%
Sulphur (S)	<=0.050%
Iron (Fe)	98.81-99.26%
Manganese (Mn)	0.60-0.90%
Phosphorous (P)	<=0.040%

TABLE IV SPECIFICATION OF MATERIAL SELECTED

Primary members Wall thickness	2 mm
Secondary members wall thickness	1.2 mm`
Primary members diameter	1 inch
Secondary member diameter	1inch

TABLE V PHYSICAL PROPERTIES OF AISI 1018

PROPERTIES	**VALUE(Metric)**
Density	7.87g/cc
Yield tensile strength	370 MPa
Ultimate strength	440 MPa
Elongation at break(in 50 mm)	15%
Poisons ratio	0.29
Modulus of elasticity	200GPa

A. Floor pan material
Aluminium checker sheet is selected for floor pan

V. VIEWS OF THE KART

A. Cad Model

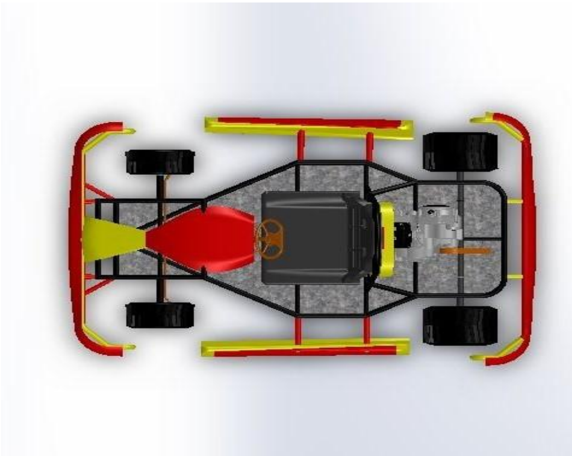

Fig. 8. Top view

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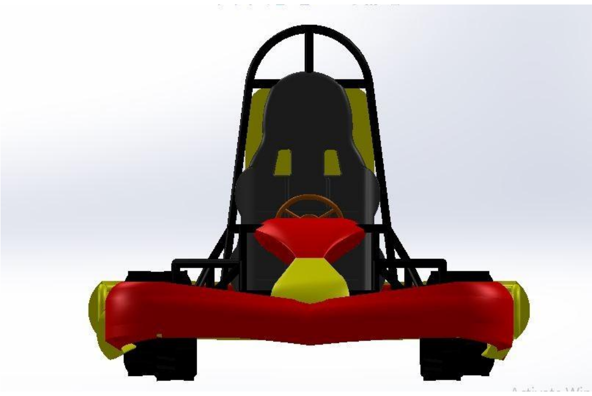

Fig. 9. Front view

Fig. 10. Rear view

Fig.11. Side view

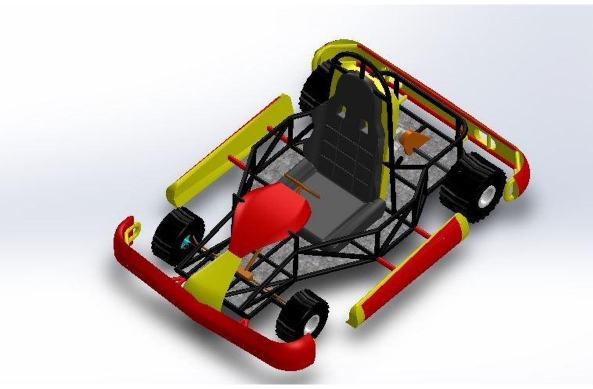

Fig. 12.Isometric view

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B. Bumpers and Body Works

External appearance of the vehicle depends upon bodyworks. It is an important part of the vehicle design. It also dominates sale and marketing of the vehicle.

We have selected fiber /fabricated on the basis of market survey because of its

- light weight
- good electrical insulator

Bumpers are made of steel material with upper pipe and lower pipe with diameter as 16mm and 20 mm resp. and thickness of 2mm and will be covering with fiber/fabricated wax for the external appearance.

The above dimensions are for front, rear and side bumpers.

1. Firewall: Fire Wall Has Been Incorporated In the Design of the Go-kart for the Safety of the Driver aluminium is selected as the firewall material and it coated with sodium silicate to prevent the heating.

VI. ANALYSIS

Structure, after designing must be validated to know its reliability. Conventionally in FEA, the frame is subdivided into elements. Nodes are placed where tubes of frame join. The assumption made in using beam elements is that the welded tubes have stiffness in bending and torsion, thus a higher factor of safety is desirable

A. Frontal Impact

Frontal impact has been done by considering the kart going at its maximum possible top speed and undergoing a head collision with a rigid body. Load of 8000N was applied during the analysis. .

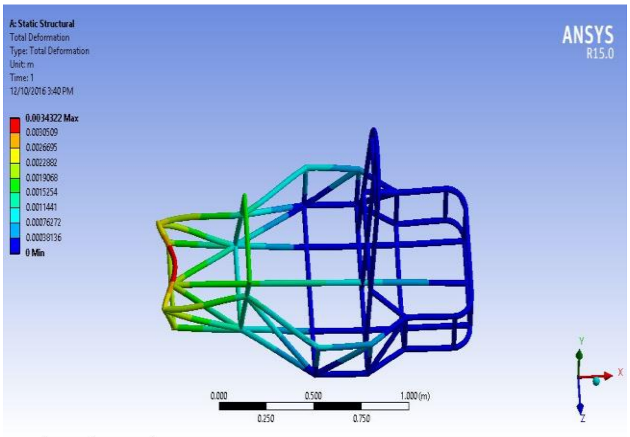

Fig. 13. Deformation during front impact

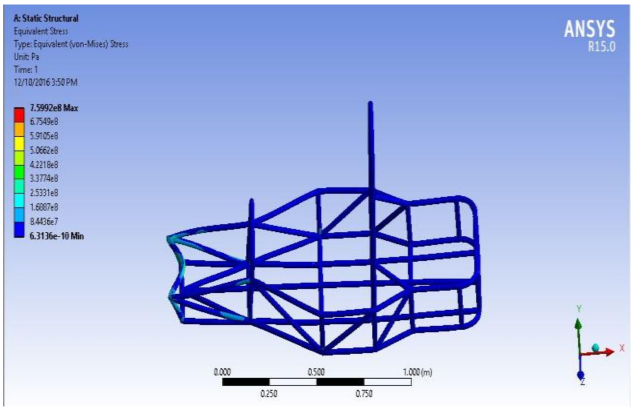

Fig. 14. Stresses during front impact

TABLE VI FRONT ANALYSIS RESULT

Load applied	8000N
Maximum deformation	0.0034322 m

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Maximum stress	759.92MPa
FOS	1.5

B. Rear Impact

The rear impact analysis has been done by considering the kart getting hit by another vehicle at its top speed the force calculations are same as that of front impact. Load of 8000N was applied during analysis.

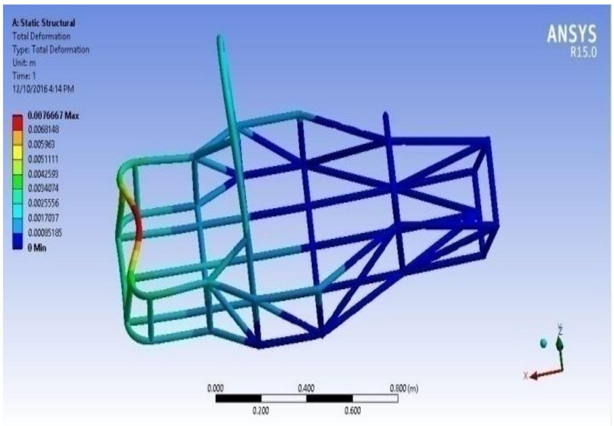

Fig. 15. Deformation during rear impact

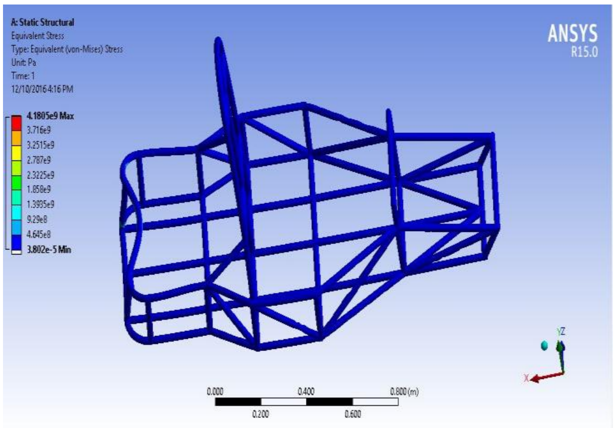

Fig.16 Stress during rear impact

TABLE VII REAR ANALYSIS RESULT

Load applied	8000N
Maximum deformation	0.0076667 m
Maximum stress	4180.5MPa
FOS	1.91

C. Side impact

Load of 8000N was applied during the analysis

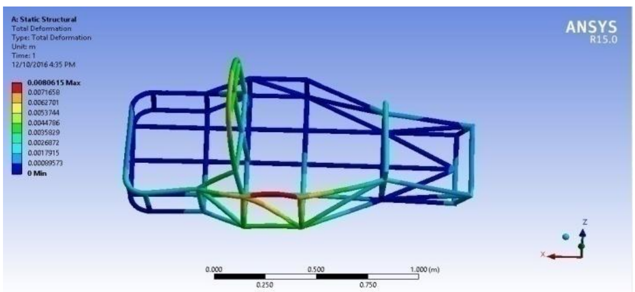

Fig. 17. Deformation on Right Side during Torsion

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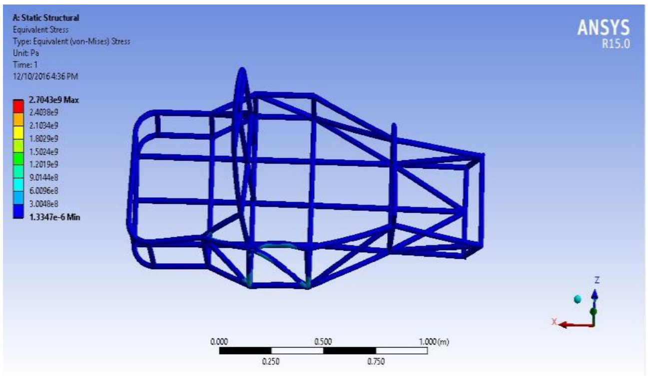

Fig. 18. Stress on Right Side

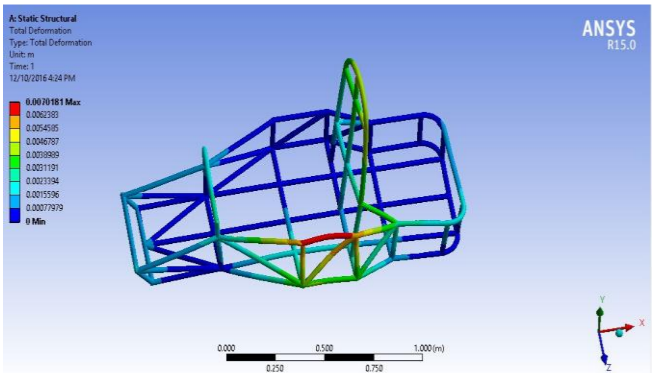

Fig. 19. Deformation on Left Side

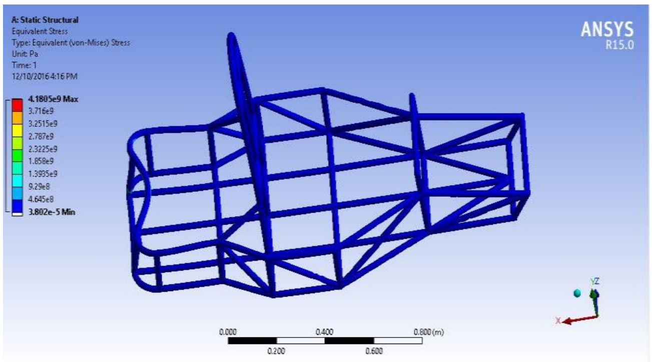

Fig. 20. Stress on Left Side

TABLE VIII SIDE ANALYSIS RESULT

Deformation right side	0.0080615 m
Deformation left side	0.0070187 m
Stress of right side	2704.3 MPa
Stress on left side	2494.6 MPa

VII. CONCLUSION

The design and construction for GO-KART has become more challenging due to the increased participation. Our team is participating for the first time in this event so a detailed study of various automotive systems is taken as our approach. Thus this report provides a clear insight in design and analysis of our vehicle. The making of this report has helped us in learning of various software. We want to give a vote of Thank you in this regard as IGC competition has given as this opportunity to learn many things which will also help us in leading a bright future

We have designed it keeping in mind the safety of the driver as well as the kart and also which is light in weight. We have incorporated many sensors in the go-kart and also some automated systems has also been used and we call it as smart go-kart.

We would like to conclude by saying that keeping in mind the design of conventional go-kart we have design our go-kart in the firm of F1 type approach

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BIOGRAPHIES

Dr. Syed Azam Pasha Quadri was born in the city of Andhra Pradesh, Hyderabad in 1975. He received the B.E from Osmania University in April 1998, M.TECH from JNTU Anantapur in August2006 and Ph.D. degree from N.I.T Warangal in February 2016, respectively. His main areas of research interest are I.C Engines, Alternative Fuel, Non convectional resources. Dr. Syed Azam Pasha Quadri is holding a position as Head of the department (HOD) in Lords Institute of Engineering and Technology.

Mr. Mohd Yousuf Ahmed was born in the city of Andhra Pradesh (Now in Telangana), Karimnagar in 1990. He received the B.Tech from Mother Theressa College of Engineering & Technology, JNTU HYD, Karimnagar in May 2013 and M.E. from Muffakham Jah College of Engineering and Technology, Osmania University, Hyderabad in September 2015, respectively. Mr. Mohd Yousuf Ahmed is an Assistant Professor in Lords Institute of Engineering and Technology.

Mohammed Salman was born in the year 1996 in Hyderabad Andhra Pradesh (now in Telangana). He is pursuing B.Tech (Mechanical) from Lords Inst of Engg and Tech, Hyderabad and is presently in the final year. His main areas of interest are automobiles and designing.