

Design and Fabrication of Tilting Trike

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Abstract -Safety is the most important consideration for two-wheelers. The tilting mechanism increases the maximum speed in curves. The use of tilting mechanism in automobile would decrease the rate of accidents due to skidding. It will give better dynamic stability as well as directional stability to the vehicle, better road grip and better comfort to the passengers. The tilting trike uses a mechanism includes a parallelogram linkage which allows tilting of the vehicle similar to any other two wheelers. The tadpole configuration of the trike provides more stability compared to delta design. Tilting mechanism is operably connected to the frame of the vehicle using a set of vertically aligned bearings which holds it in place. The mechanism ensures proper alignment of the independent wheels in all possible types of movements.

Key Words: Tadpole, Trike, Skidding, Directional Stability, Parallelogram linkage

1. INTRODUCTION

A three wheeled vehicle, also known as a trike, is an automobile having either one wheel in the front for steering and two at the rear for power or two in the front for steering and one in the rear for power, or any other combination of layouts. Having one wheel up front and two in the back is known as the delta configuration. The second type of three-wheeler setup is called the tadpole or reverse trike. The opposite of the delta, this formation has two wheels up front and one in the back. Due to its handling superiority, an increasingly popular form is the front-steering tadpole or reverse trike. Tadpole designs are much more stable than the delta setup because the back wheel drives the vehicle while the two wheels up front are responsible for steering. There's also an aerodynamic benefit, since the vehicle is shaped almost like a teardrop, wide and round up front and tapering off in the rear. This allows air to flow easily over the vehicle body.

1.1 NEED OF THE PROJECT

Nowadays most of the accidents occur on two wheelers are because of the instability of vehicles in slippery conditions and the skidding of vehicles. Travelling in bikes during rainy season or snowy seasons are risky. Safety of passenger must be considered as the primary concern. Trikes are designed in order to provide maximum safety to passenger. Avoid skidding during ride is very much important factor for a bike. For such situation trikes play a major role to provide safety to passenger. The Tilting trike is much safer than motorbikes and scooters, and much smaller and lighter than any car. The third wheel offers better braking as well as increased stability while braking. It offers more traction when roads are slippery.

1.2 PRINCIPLE

The design consists of a parallelogram link which connects the two individual suspensions with tyres and the body of the bike. The parallelogram link allows tilting of the tires. The link is connected to the body of the bike using two bearings which is primarily welded and fixed to the body. Tilting occurs by the action of parallelogram link. During turning the parallelogram link will tilt and thereby the fork attached to it will also tilt. Thus tilting of wheels occurs. It is very essential to tilt in order to avoid skidding of vehicles.

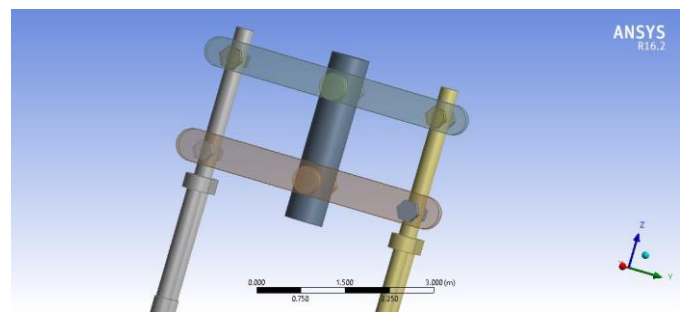


Fig - 1 Parallelogram Linkage

2. LITERATURE SURVEY

Deaths in India due to accidents [21]

The incidence of accidental deaths has shown an increasing trend with 51.8% in the year 2012 as compared to 2002; however 0.2% decreases was observed in 2003 over previous year 2002. The population growth during the period 2003-2012 was 13.6% whereas the increase in the rate of accidental deaths during the same period was 34.2%. A total of 1,18,533 males and 20,205 females totaling 1,39,091 persons were killed during the year 2012. A total of 32,318 persons (23.2%) were died due to accidents of 'two-wheelers', 'truck/lorry' accounted for 19.2%, 'cars' accounted for 10.1% and 'buses' accounted for 9.4% of accidental deaths during the year 2012.[21]

Stability Analysis of Three-Wheeled Motorcycles. [3]

Modal analysis of a three-wheeled tilting motorcycle is explained in this work. This vehicle has a tadpole design consisting of two front wheels and a single rear wheel, but can be driven like a normal motorcycle. In order to study the stability of the system in straight running, two models have been developed: a simplified motorcycle model, with locked suspensions and rigid and thin tires and a model having 14 degrees of freedom, in which the stiffness and damping of suspensions and the radial stiffness of tires have been taken into account. In both models the frame has been considered as rigid and the driver was assumed to be fixed to the frame. A linear model with transient behavior has been employed for describing the tire behavior. Analyzed and discussed in this work. Two different models of the vehicle have been set up, by taking or not into account the compliance of suspensions and tires. In order to compare the stability analysis of such vehicle with a similar two wheeler, a model for this latter vehicle has been also developed. The obtained results have shown how in straight running the three wheeled motorcycle has a higher stability of the weave mode if compared to the two wheelers; indeed it has been found stable in the whole examined speed range. [3]

Review on tadpole design – issues & challenges [4]

The three wheel configuration allows the two front wheels to create the wide round surface of the vehicle. The single rear wheel allows the vehicle to taper at the back. Having one less wheel also increases fuel efficiency because of decreased rolling resistance. The disadvantage of a rear drive, non-tilting three wheel configuration is instability – the car will tip over in a turn before it will slide, unless the centre of mass is much closer to the ground or the wheelbase is much wider than a similar four wheel vehicle. To improve stability some three wheelers are designed as tilting three wheelers so that they lean while cornering like a motorcyclist would do. The tilt may be controlled manually or by computer. Electric three-wheelers often lower the center of gravity by placing the heavy battery pack at the base of the

vehicle. This conclusion is easily understandable if a 3-Wheeler with two front wheels is considered. If the center of gravity of the vehicle occupants assembly is sufficiently low to be under the pyramid, the vehicle will not roll sideways in a curve and will not tip backward when accelerating or tip forward when braking.[4]

3. DESIGN METHODOLOGY

We have come up with one of the simplest and elegant design for our tilting trike. Earlier developed trikes had complex wishbone type suspension at the front end. It also had a tyre span almost equalling a small car. This makes it difficult to be used in high traffic conditions. It also increases the turning radius of the time. Further it made the vehicle very heavy which result in lowering of overall efficiency. We designed our trike to be more compact and user friendly. It does not add much weight and therefore is much efficient compared to previous trike designs. Compact design allows it to be used in all traffic conditions. The design consists of a parallelogram link which connects the two individual suspensions with tyres and the body of the bike. The parallelogram link allows tilting of the tyres. The link is connected to the body of the bike using two bearings which is primarily weld fixed to the body. Suspension is used which is basically using two forks side by side as a single unit. The two suspensions are connected in the parallelogram link such that the distance between tyre s is about 35 cm.

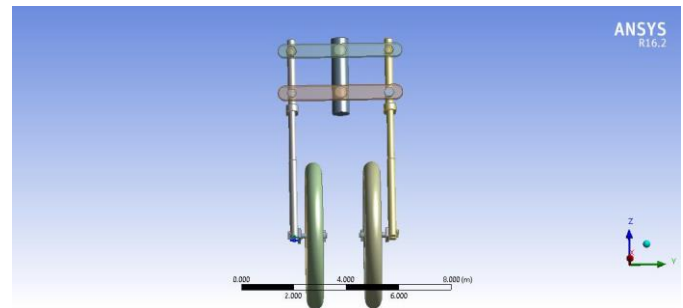


Fig- 1 Front view of Suspension

4. FABRICATION

The front suspension was disassembled. The disassembled parts include the head, forks, wheels etc. Two extra forks are collected. Two of them are joined together to form a single suspension. Joining two forks together gives more strength compared to single fork. The dual fork suspensions and wheels are then joined together. The two front plates are then properly fixed. Now the UCT bearings are weld fixed one below the other with the help of iron bars. These bearings are on which the parallelogram link is fixed. The tilting mechanism includes two lateral links and two vertical links. The fork suspension makes up the vertical links. The centres of two lateral links are fixed to each of the UCT

bearings. Caser and camber angles are properly adjusted and the whole assembly is fixed or welded.



Fig - 2 Tilting trike after completion

5. CONCLUSIONS

We have successfully designed and fabricated a prototype model of tilting trike, which combines the advantages of reverse trike and leaning mechanism. From the study we know that the most of the accidents take place due to skidding of the front wheel in the sudden braking condition while taking a turn, our design has two wheels in the front and also the ability to lean, which prevents the vehicle from skidding and losing control of the vehicle on road. The performance, handling and safety of the tilting trike are much better than any other commercially available three wheelers.

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