DESIGN AND FABRICATION OF TROLLEY WITH DUAL MAN POWER CYCLE USING ACKERMAN'S STEERING WHEEL MECHANISM FOR SWAATCH BHARATH

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1. ABSTRACT:

Our project is to Design and fabricate a trolley, working by two humans with the help of Ackerman steering principle.

In our trolley, we use Ackerman's principle for steering operation. Ackerman's geometry is a arrangement of linkages in the steering of a car or other vehicle to solve the problem of wheels on the inside or outside of turn needing to trace out circles of different radii.

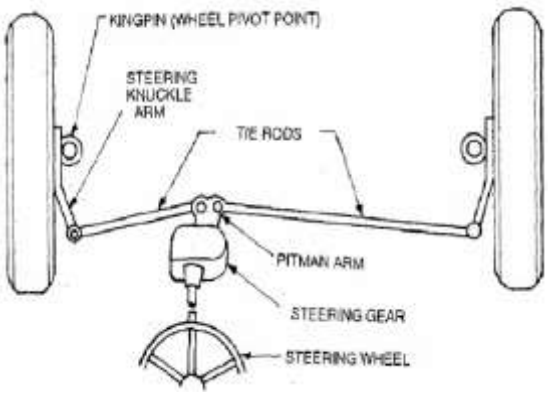
This article focuses on the synthesis of a steering mechanism that exactly meets the requirements of Ackermann steering geometry. It starts from reviewing of the four-bar linkage, then discusses the number of points that a common four-bar linkage could precisely trace at most. Two cycle frames are attached to the chassis of the trolley therby providing a dual pedalling mechanism to power the trolley manually. The fabrication of this trolley can bring about a change in daily life cleaning purpose for garbage cleaners under swatch bharath scheme.

KEYWORDS: Ackermann criteria, steering mechanism, four-bar linkage, trolley, Dual man power.

2. INTRODUCTION:

In modern day, our life is depending on the machines for every work that will make many health problems so we have planned to design and fabricate another way for carrying small loads from one place to another and also in an eco-friendly manner.

The generally used steering mechanisms for four wheel vehicles are four-bar linkages1,2 which are often called Ackermann-type steering mechanisms. The input motion from the driver at the steering wheel is transmitted directly to the front wheels by basic mechanical linkage. The main kinematic requirement of the steering linkage of a vehicle is to provide the steerable wheels a correlated pivot such that their axes intersect at a point on the rear wheel axis. The objective for the synthesis of steering mechanism is to minimize the difference between the steering centres over the full range of steering angle inputs while fitting in to a reasonable space. To obtain the target, several conflicting requirements should be simultaneously considered. A possible formulation of the optimisation based synthesis problem is to search for the values of parameters. Most trucks and off-highway vehicles have rigid steering axles equipped with Ackermann steering linkage. So synthesis of function generators is a common mechanism design problem for steering systems of vehicles.



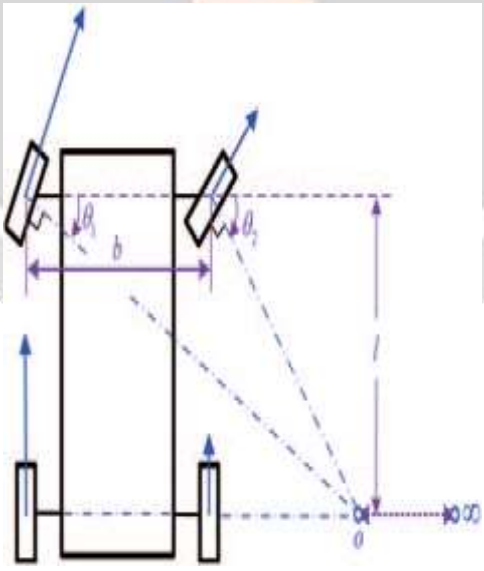
(Fig2.1 steering mechanisms)

The deviation between the desired and the real pivoting angles given to the wheels by the steering mechanism is called steering error. It requires finding the geometric parameters for which the input–output relationship of the mechanism best approximates a specified function. Error optimisation studies in steering linkages have been attempted by many researchers. The primary goals are ensuring minimum wheel-slip and symmetric steering control for left and right turns, ensuring minimum cross-coupling between steering and axle oscillation, maintaining favourable pressure angles in the joints, and avoiding interference between the moving parts of the mechanism and between them and the body of the vehicle.

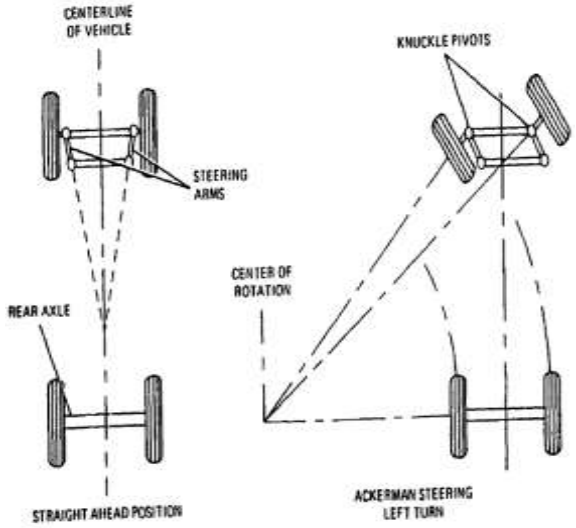
2.1 Ackermann-type steering mechanism

This section focuses on the synthesis of Ackermann steering geometry and proposes a steering mechanism that could satisfy the ideal turning requirements.

2.1.1Principle:



(fig 2.1.1.1 Steering turning axis)



(fig 2.1.1.2 Steering turning position)

3. LITERATURE SURVEY:

[1]. Thomas Gillespie el et "To control the angular motion of the wheels and thus the direction of vehicle motion.To provide the direction stability of the vehicle.

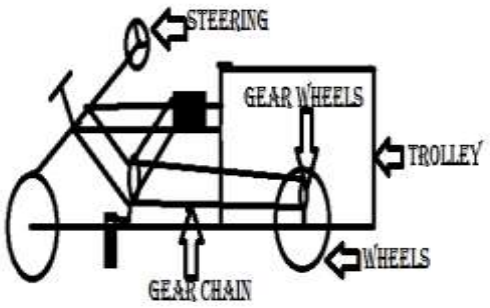
[2].Jing-Shan Zhao. The input motion from the driver at the steering wheel is transmitted via a steering box and the steering control linkage to one of the steering knuckles and then transmitted to the other one through the Ackermann steering linkage.

[3]Richard "Doc" Hathaway, Understanding what it takes to turn your race car as you enter and continue through the turn is critical to improving your lap times. This technical article will discuss this fairly complex concept by methodically going over the issues involved. Tires obviously are a key component in getting your race car to turn and the understanding of tire slip angles is important and will be presented. The mechanical design of the steering system to produce correct toe-out in the turn will also be discussed.

[4].Allan B. Jones et el, A hand driven vehicle does not produce as much power as a foot pedalled vehicle.

4. METHOLOGY:

4.1 Fabrication:



(fig 3.1 Concept selection)

The ackerman's mechanism is fitted to the front end of a frame, which acts as a chassis to the trolly, two bicycles are setup side by side in a horizontal manner with measured distance between the themselves and the chassis, hence achieving the concept of two people riding the bicycles by parallelly and simultaneously to

produce ample driving power. The ackerman's steering model is set up at the right side of the chassis which is controlled by one of the rider while the other has a fixed support to help himself in keeping balance. The seats are designed in a comfortable position both in reach and height which helps the driver to manoeuvre the trolley with ease and with stability.

The driving wheels which can be pedalled by both the riders at the same time or by any one, which is achieved by the slip mechanism given in the chain sprocket of the common bicycle. A common spindle is attached from the chain sprocket of the two bicycles and the power is transmitted to the rear wheels with the help of gears and chain drive, hence the trolley is a rear wheel transmission drive unit.

Finally the load bucket is framed above the rear wheel chassis into which the disposal materials to be transported can be loaded.

The theoretical calculation for the turn radius using ackerman's principle is given as follows.

(fig 3.2 ackerman's steering model)

Under steer: When the slip angle of front wheels is greater than the slip angle of rear wheels

Over steer: When the slip angle of front wheels is lesser than the slip angle of rear wheels

Neutral steer or counter steering: When the slip angle of front wheels is equal to the slip angle of rear wheels.

5. Turning Radius

Turning circle is the diameter of the circle described by the outside wheels when turning on full lock.

Fig.5.1 vehicle base

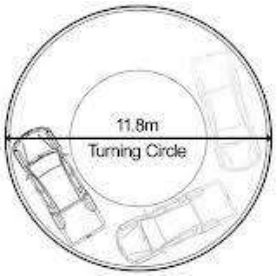


Fig .5.2 Turning circle

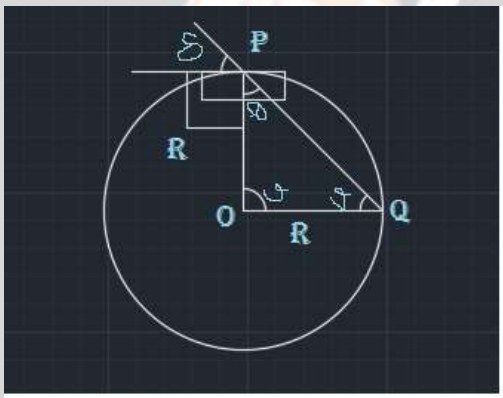


Fig .5.3 Turning circle angles

For triangle OPQ;

$$u + 2v = 180°$$

Also, $\delta + v = 90°$

$$v = 90° - \delta$$

$$u = 180° - 2v$$

$$u = 180° - 180° + 2\delta$$

$$u = 2\delta$$

$$L^2 = R^2 + R^2 - 2R^2 cosu$$

$$L^2 = 2R^2[1 - cos2\delta]$$

$$L = 2R\ sin\delta$$

$$R = \frac{L}{2\ sin\delta}$$

$R -$ turning radius.

$u -$ initial velocity.

$v -$ final velocity of the vehicle.

$L -$ length of the frame.

$\delta -$ angle of incidence.

6. Design Using Cad Modelling:

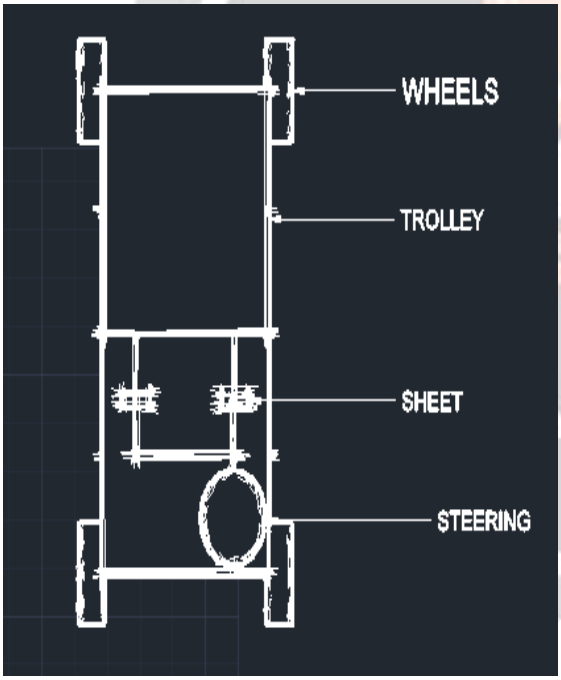


Fig6.1 [top view of the vehicle]

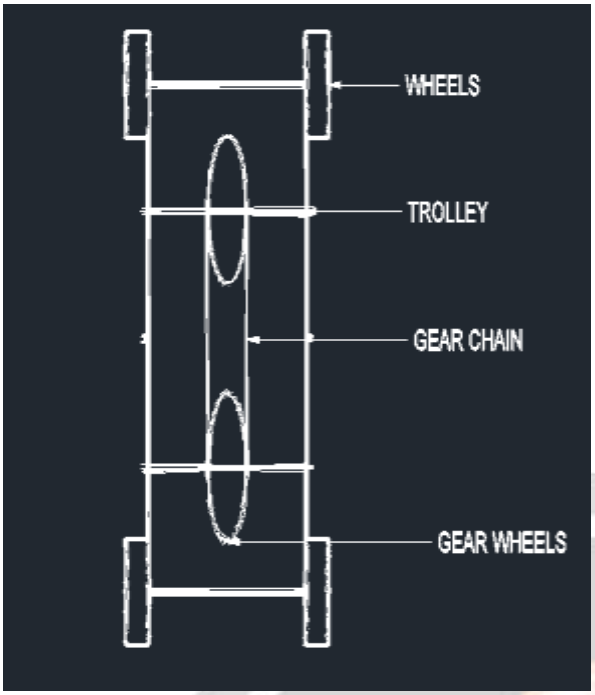


Fig 6.2 [Bottom view of on vehicle]

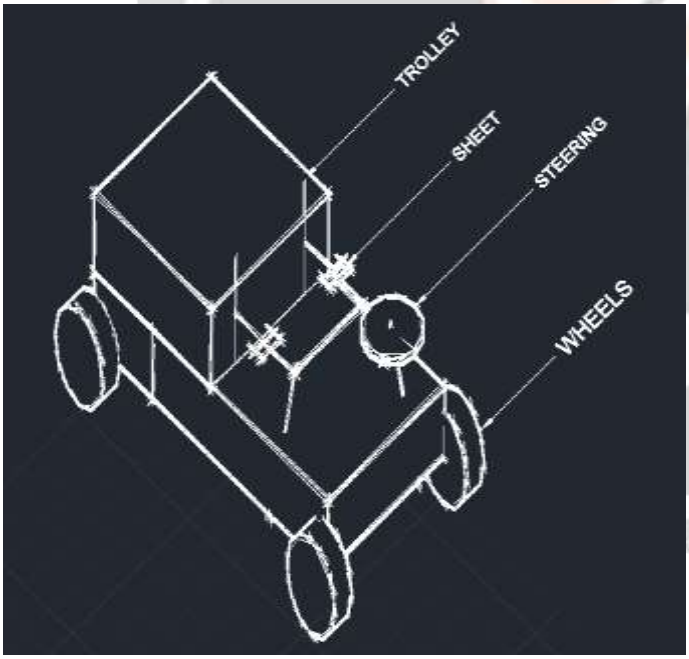


Fig 6.3 [SW isometric view of on vehicle]

7. RESULT:

Fig 7.1 Fabrication our project

The proposed design is very useful for the people working under the swatch bharath scheme for waste disposal, workers currently use a trolley which only can be pushed and is not very stable. Heavy loads of weight also cannot be transported and manoeuvring the vehicle is also a difficult task. This project can help the people to pedal the turn the trolley with ease along with a heavy load. The design is also very financially economical compared to the current trolley which is being utilised.
Further funding can bring about a better design and advancements in this fabricated structure.

8. REFERENCES:

[1].Thomas Gillespie , ("Fundamental of steering systems"), SAE-1992. ("Lecture-3, Date-12/01/2015").

[2].Jing-Shan Zhao, Xiang Liu, Zhi-Jing Feng and Jian S Dai("Design of an Ackermann type steeringmechanism"),(ARCHIVE Proceedings of the Institution of Mechanical Engineers Part C Journal of Mechanical Engineering Science 1989-1996 (vols 203-210) November 2013DOI: 10.1177/0954406213475980).

[3].By Richard "Doc" Hathaway, H&S Prototype and Design, LLC. ("Steer angles, Ackerman and Tire Slip angles")
(Tech 04)

[4].Julian Mendez, 1221 Congreso, 1706
Haedo, Buenos Aires, Argentina(TWO-WHEEL MAN-POWERED VEHICLE)(Appl. No.: 24,995,Filed: Mar. 29, 1979)

[5].Allan B. Jones, Jr.,'(HAND PEDALLED TRICYCLE WITH IMPROVED STEERING)
(Appl. No.: 470,313,Jan. 25, 1990)

[6].Thierry Suptil,(MANPOWER-DRIVEN CYCLE WITH ROWER MECHANISM)(Appl. No.: 09/979,797,May 29, 2000)

[7].Chenghao Piao, Changchun (CN);
Yuze Luo, Changchun (CN) (MANUALLY POWERED VEHICLE)
(Appl.No.:10/647,036 Aug. 23, 2003)