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Three Wheeled Drive Forklift

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***Abstract*: Industries requires forklift for transporting heavy goods inside the shop floor and industries. There are number of goods which weighing around 40-80 Kg that cannot be moved easily by manual assistance. To fulfill this requirement, the proposed Three wheeled drive will lift and move the goods across the industries. This project contains two wheels connected with engine by sprocket and chain. One manual winch for lifting mechanism.**

***Keywords*: Engine, Forklift, Hand winch, Lifting mechanism.**

1. Introduction

Factories, industries and storage go downs need forklifts and crane for storage and moving large goods. Also, there are a number of goods weighing around 40-80 Kg that are comparatively lighter but cannot be moved around easily by human labor. To fill this need we here proposed a three wheeled drive forklift to lift and such transport such medium weight goods across factories and low power consumption vehicle that does not require much space to move around. Forklift runs on petrol engine. It has a perpendicular handle ahead to hold on as well as take turns. The lifting of weight is done by manual winch.

2. Literature Survey

The Journals are collected from different websites related to Three wheeled Drive Forklift. In this study totally 14 papers are collected for three wheeled drive forklift.

Akshay, V. Ombale, Nayan N. More, Ganesh S. Shinde, Vrushabh Mahadik, Gaurav P. Deshmukh (2019) Instead of hydraulic system they used rope and pulley for lifting mechanism and chain and sprocket for wheel movement and also small-scale industries can't afford expensive automated material handling system to overcome this they designed and fabricated human powered forklift.

Leopoldo Armesto, Josep Tornero, Juan Carlos Torres (2003) Making the forklift fully automated using internal and external sensors for steering wheel control and speed control of the rear wheel.

Sandip Patil, Ayubkhan Pathan, Manohar Chavan, Sajid Shikalgar, B. Nangare Patil (2017) In this paper they use motion transmission where using chain to move the device and also use chain for lifting mechanism it is fully mechanical device which is useful for small scale industries.

M. A. Pachakawade, Akash Thakare, Aditya Kadam, Akash Chavhan, Satish Kalapad, Kiran Pilawan (2018) Using of three wheels will be fast, efficient and low power consumption this forklift runs on hub motor. The lifting mechanisms can be done by using either hydraulics or electric motor.

Hir Doci, Vegim Imeri (2013) Dynamic analysis of forklift is done to enhance or to avoid the accidents of forklift using Modeling and simulation. Various parameters like force, momentum, speed and oscillations affects the forklift's construction and stability during load lifting. Speed of lifting and after stoppage of lifting should be slow due to high speed forklift tend to oscillation by having minimum speed the oscillation can be controlled.

Giovanni Garibotto, Stefano Masciangelo, Paolo Bassino, Christopher Coelho, Annita Pavan, Mario Marson (1998) Traditional forklift is converted into fully automated forklift using computer vision called ROBOLIFTTM. It can be operated manually and also automated mode through a switch. The Commands like acceleration, steering control, brakes, forklift are controlled by computer. Electric motor is used to control steering movement under computer vision during manual mode motor is decoupled through an electromagnetic clutch. Landmark algorithm is used for movement of the vehicle in computer vision. Camera in fork is used in forklift to detect the end of the destination line.

K. K. Yuen, S.H. Choi and X. B. Yang (2010) During the operation of forklift accidents is occurred in the industries due to lack of training, experience. For this there is a simulation for the forklift operation in a computer, but it has only front view and back view but it is not enough. To avoid this, they created a VR simulation using CAVE (Cave Automated Virtual Environment) this helps the driver to train under various situation. This system has 3600 view and it have gaming steering wheel, pedals this helps driver to have real-time experience by this method driver can be fully experienced before operating forklift vehicle so that accidents can be avoided in the industries.

Abbhinav Kshirsagar, Neha Kesarkar and N. S. Chandrashekhar (2019) Designing of Automated Two-wheel forklift with retracting third wheel. However, to maintain the balance of vehicle after lifting of load third wheel is required. When the vehicle didn't lift weight third wheel is not required for this, a retracting wheel is provided using sensors in forklift

when weight is lifted by forklift sensors in the forklift helps to retract the third wheel so that the vehicle will be balanced.

Kelen C. T. Vivaldini, Jorge P. M. Galdames, Thales S. Bueno, Roberto C. Araujo, Rafael M. Sobral, Marcclo Bcckcr, and Glauco A. P. Caurin (2010) Nowadays industries are turning to industrial 4.0 to that a robotic forklift is required. This paper deals with it, Using Routing, Path Planning, and Auto-localization. Routing system used the AGV to choose the correct path for that algorithm based on Dijkstra's shortest-path method was implemented in C/C++ and Path Planning is based on routing system, Routing system tells the start point and end point to the path planning system so that vehicle will reach its position for this A* algorithm is used.

S. J. Chu (2013) Lock nut is loosening in a forklift drive axle, contact surface of the locknut is collapsed due to excessive contact pressure there is also vertical scratch is also occurring due to rotation while vibration. It is that locknut is loosening due to slippage on it. Wearing on the failed surface lead to lock nut loosening

S. Liawatimena, B. T. Felix, A. Nugraha, R. Evans, in industries still man is used to work the forklift to avoid this mini robotic forklift is introduced in this RFID (Radio-frequency Identification Device) it communicate through radio waves so that data can be exchange between the reader and electronic tag attached to an object. It helps to pick the correct object and Height sensor is used to know whether the forklift arm reaches the specified row. It runs in DC Motor and a line follower to forklift to follow the position to go or place to go, it works on magnetic field from the line. In this back sensor doesn't work properly due to poor design in back of the forklift.

Tua Agustinus Tamba, Bonghee Hong, and Keum-Shik Hong (2009), In this vehicle two wheels at front one wheel on right side doesn't have any traction or steering ability one wheel on left side for steering and driving. Necessary sensors are attached and the steering and driving motor are controlled through PC. This forklift works on automated mode as well as manual mode. The sensors used in this forklift are LRF NAV 200 for 3D map building, and STMA-506MD for detecting obstacles, Ultrasonic sensors are used to detect the moving object and also for measuring the pallet position cameras are attached. Gyro sensor is used to calculate or to know the current position of the forklift path finder is used to detect the path but during turning performance is poor.

3. Objectives

The main objective of this project is to develop a human powered three-wheel drive forklift. It's mainly for small scale industries. The purpose of this project is listed below:

- To build an equipment for carrying load of 40-80kg from one place to another place.
- To build an equipment for small scale industries.
- To reduce the human effort.
- To be useful for industries, other works, etc.

4. Calculation

Calculation of Tractive torque:

F=M*A

Mass of forklift vehicle with driver = 250 kg

Acceleration assumed as = 1G

F= 250*9.81

F= 2452.5

F(normal) = 2452.5/2

= 1226.25

F (frictional) = 0.75*1226.25

=919.6875

Torque required to move the forklift vehicle

T = F* Radius of wheel

T= 919.68*127

= 116800.31Nmm

= 116.80 NM

By hand human can apply force 10 KG

F = 10*9.81 N

We know total torque required to move the vehicle =116.80Nm

As speed of vehicle is very less so neglecting the dynamic weight distribution

Total weight of forklift vehicle = 250kg

Total weight will be divided into two axles of

forklift vehicle 60% of total weight acted on

Rear and remaining 40% on Front axle

Front axle = 190Kg

Rear axle = 60Kg

Torque required to move front axle

T= F*Radius of wheel

F= 60*9.81

= 588.6 N

F (normal) = 588.6/2

= 294.3N

T= 294.3*(25.4*5)

=37.37 Nm

Speed ratio = T2/T1

= 116.80/37.37

=3.12

Number of teeth on driving sprocket /Number of teeth on driven sprocket = 2

Sprocket of 200 mm diameter, will enough to distribute torque

The standard sprocket having diameter of 180 mm and 40 number of teeth

From driving sprocket specifications and speed ratio

Driven sprocket diameter = 90 mm and number of teeth =20

Calculation of Centre of Gravity:

Calculation of CG along X

CG mass = addition of all masses along x

= 250 kg

So, taking moment,

250* X = (100 *0) + (4.5 *430) + (65*866)
X = 232.9mm
CG along Z Vertical Axis
1695 * H = (100*800) + (4.5*450) + (65*450)
H = 656 mm
CG along Y
If we look at the geometry, it is symmetrical about Y
So, CG lies in Y axis
So, CG height = 656mm, CG in X=232.9mm and lies in Y.

5. Component Details

The various components involved in the Three wheeled drive forklift is listed below in table 1.

Table 1
Component of the three wheeled drive forklift

S.no.	Description	specifications	Qty.
1	Engine	2 stroke single cylinder	1
2	Hand Winch	Lifts 900kg	1
3	Wheel	18" diameter	3
4	Universal Joint		1

6. Functions of Components

A. *Engine*

TVS XL 100 engine which is 2 stroke single cylinder produce maximum power of 4.35ps@6000rpm and maximum torque of 6.5Nm@3500rpm, it has a fuel capacity of 4litre. It is an automatic transmission type engine and air-cooled engine.

B. *Hand Winch*

Manual hand winch which lifts weight up to 900kg. It's made of zinc plated heavy gauge steel frame, Drop forged galvanized steel safety hook.

C. *Wheel*

It has a 13" diameter of wheel rim the tire of 5".

D. *Universal Joint*

A universal joint is a positive, mechanical connection between rotating shafts, which are not usually parallel but intersecting. They are used to transmit rotary power, motion or both.

7. Design

Design of the project is done in SolidWorks 2019.

Fig. 1. Front View

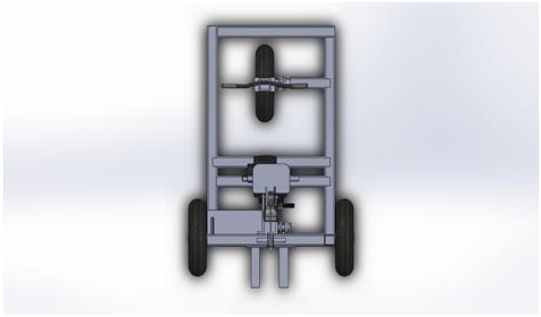

Fig. 2. Top View

Fig. 3. Side View

Fig. 4. Isometric View

8. Fabrication

Fig. 5. Font View

Fig. 6. Isometric View

9. Conclusion

This project helps to gain experience while doing projects, through this project we gained knowledge about designing, fabrication, machining and assembly. It is noticed that this project will be helpful to the small-scale industries. Hand winch is used for lifting mechanism and sprocket chain, engine is used to move the forklift. This will reduce the human effort as well as labor cost. Due to engine weight no need of counter weight is required to balance since the load being lifted.

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