International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Material Handling Transporter

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ABSTRACT- *This paper describes the "Design and Fabrication of Material Handling Transporter". The transporter for material handling two wheeler attached by trolley is based on the principle of Segway. We need to reduce mechanical efforts of workers for material handling effortlessly. The main purpose of material handling transporter is to ensure that the right amount of material is carefully delivered to the desired destination at the right time and at minimum cost. The main objective was to build a vehicle of capable of transporting weight of a person and materials up to 150 kg and capable of travelling to some distance with varying speed. The operator's controls are supposed to be natural movements forward, backward in combination with tilting the handlebar. Sideways should be the only operator input required to operate the vehicle. This paper also take into consideration the material used with minimum possible cost.*

Key Words*: *Transporter, Fabrication, Segway, Gyroscopic, Self-Balancing, Electric Vehicle, Eco-friendly.

1. INTRODUCTION

A material handling system can be defined as movement, handling, storage and controlling of materials throughout the manufacturing process. The main purpose of using a material handling system is to ensure that the material in the right amount is carefully delivered to the desired destination at the right time at minimum cost. Material handling such as is not a production process and hence does not add to the value of the product but it costs 30-75% of the total product cost. An efficiently designed material handling system ensures the reduction in operation cost, manufacturing cycle time, MH cost, delay and damage. It promotes productivity, flexibility, better utilization of manpower, increases material flow in handling. This paper discusses the research carried out on material handling system design, MH equipment selection, Analysis and simulation from last decades to get the best solution for implementing the design of MH system in the existing facilities. The constraints and challenges in designing material handling system, solutions are identified and discussed.

1.1 Objectives

As discussed in introduction, most of research work was done in material handling transporter. Now a days in the material handling system lots of research work is going on, but the surrounding peoples are unaware about this material handling transporter. In recent market scenario modern material handling equipment's are very costly, so our aim is to design and fabrication of material handling transporter at affordable cost. Hence, overall materials handling system cost get reduced. Because of this we can able to achieve efficient material handling system with minimum cost.

The objectives of the project are to design a system for material handling which is:

- The purpose is to design and fabricate a transporter which is used for material handling at low cost.
- This kind of vehicle is interesting since it contains a lot of technology relevant to an energy efficient transportation in industries.
- The design of Transporter is such that it covers less space and comfort to the user.
- The main objective is to build a vehicle capable of transporting a person weighing up to 60 kg along with some material about 100 Kg and capable of travelling to some km distance with varying speed.

2. OVERVIEW OF TRANSPORTER

This gives an overview of the final transporter, which describes the design and implementation of the control system. The aim of this overview is to provide the better understand the transporter.

Fig. -1: Material Handling Transporter

2.1 Mechanical Overview

The best suitable material for chassis is iron due to its high strength. For handle we use 1 inch diameter steel pipe. The pipe is bended to form 'T' joint. The main purpose was to design and fabricate a fully functional two wheeled balancing vehicle which can be used as a means of transportation of materials in industry. It should be driven by natural movements; forward and backwards motion should be achieved by leaning forwards and backwards. Turning should be achieved by tilting the handlebar sideways. The motors are bolted to the chassis from the bottom. For transmitting the torque produced by motors to wheels we have designed coupling. This design will help to improve the torque of motors. The batteries are mounted on the chassis and control circuit below platform and rider is ready to ride.

Chassis

The chassis is the heart of the mechanical system which all other mechanical parts in some way are connected. The chassis is designed to provide the rider with a safe and robust standing platform and to protect the electrical system and components. The handlebar is attached to the chassis and serves as support for the rider.

Chain Drive

Chain drives are used to transmit power between motor and wheel. Type of chain is used Power transmitting chains (Bush Roller Type). Chain drives are used because it has the following advantages

- No slip.
- Occupy less space.
- High transmission efficiency.
- Highly preferable for small shaft distance.

Trolley

This trolley is used to carry the weight up to 150 kg. This trolley consists of four small wheels. Trolley is a common form of transport in distribution environments, for moving bulk loads. A very simple design offers a basic flat platform with four wheels.

2.2 Electrical Overview

The electrical system is centered on the battery and the distribution of the battery voltage and current to the other subsystems. Since the battery for this kind of vehicle contains a lot of energy it is necessary to monitor the operational status of the main electrical system and have safety features to turn it off in case of an emergency or malfunction. The safety measures in this system consist of fuses, a dead man's switch and a power management system.

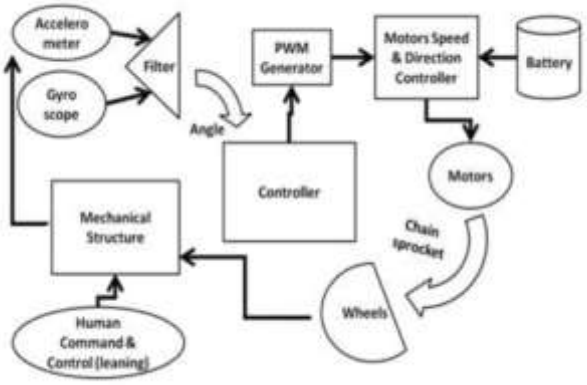

Fig. -2: Block Diagram of Electrical System

Battery

As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. Large-format lead–acid designs are widely used for storage in backup power supplies. In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide, with the electrolyte of concentrated sulfuric acid.

Limit Switch

A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.

Toggle Switch

A toggle switch is a class of electrical switches that are manually actuated by a mechanical lever or handle. It provides simultaneous actuation of multiple sets of electrical contacts. A toggle switch is used to change the polarity. Toggle switches make or break the connection of two conductors to two separate circuits. They usually have six terminals are available in both momentary and maintained contact versions.

Controller

Most control strategies solve similar requirements by changing a reference signal, using the controller to make the output of the system track this reference. If the rider is supposed to control the speed by leaning however, it becomes a tricky behavior to implement. When the rider leans forward or backward the center of gravity of the vehicle changes, and the system begins to tip over. It would now be impossible for the controller to know if this change has occurred because the rider wants to move or if the system has been exposed to a disturbance, say for example a bump in the road or a heavy gust of wind. To fulfill the goal

of controlling speed by leaning backwards or forwards, a different control strategy was used, where the goal is always to keep the pitch angle at zero degrees.

Motor

Motor is fixed with chassis through screwed bolt and it is the main source of power with is to drive the vehicle. There are two motors, each for one wheel. Each motor is driven by a separate 12v battery. They are DC motors that have a gear attached to them as shown in fig. from 2500 RPM, they are brought down to 120 RPM. Hence the torque generated by these motors is easily sufficient to move a person and the trolley with it. The motors are placed on opposite sides of the frame to help balance the transporter.

3. DESIGN CONSIDERATON

3.1. Torque Calculation

Maximum weight of Rider = 70 Kg

Chassis weight including batteries & material = 80 Kg

Therefore, Total weight = 150 Kg (Approx.)

Coefficient of friction between Road & tyre = 0.3

Torque Required = Coefficient of friction * Friction Force * Radius of Wheel

T = 0.3*150(kg)*7.5(cm)

T = 3.375 Kgf-m (Approx)

As two motors are used therefore torque required by each motor = 1.68 Kgf-m (Approx)

3.2. Cost Analysis

Total Cost: 26000 Rs.

Table -1: Cost of various parts

Sr. No.	Components	Quantity	Cost
1	Geared Motor	2	13000
2	Wheels	8	2350
3	Frame	1	1500
4	Battery	2	1800
5	Controller	1	2200
6	Accelerator	1	1200
7	Chain	2	600
8	Sprocket	4	1200
9	Toggle switch	1	150
10	Limit switch	2	500
11	structure	1	300
12	Spring	2	120
13	Miscellaneous	-	280
14	Fabrication	-	800

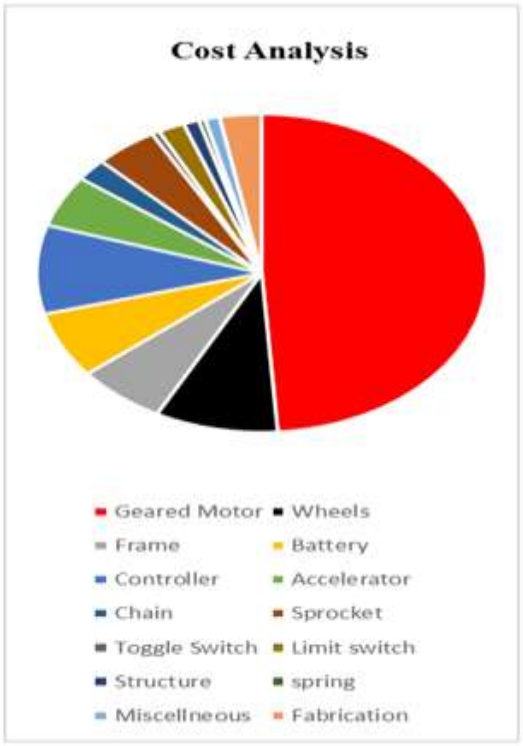

Chart -1: Cost Analysis

4. RESULT

The main objective was to build a transporter of capable of transporting a person weighing up to 150 kg and capable of travelling to some distance with varying speed has been obtained. The desired purpose of low cost material handling transporter has been achieved.

5. CONCLUSION

In the course of this work, the design and fabrication of material handling transporter was done. The attempt to change the existing design of material handling system was successfully completed. This work was implemented with an idea to find an effective solution to material handling transportation problem. The main objective is to reduce the effort and fatigue of operator especially for commuting over shortest distance.

6. SCOPE

1. Parts which is used can be minimized so that weight can be minimized.

2. Modification can be done by aligning the axis of board and motor and wheel.

3. Transporter can be transfer maximum weight by increasing the torque of motor and supply current.

ACKNOWLEDGEMENT

We express our deep sense of gratitude to our guide Prof. S. A. JADHAV for his valuable guidance rendered in all phase of project. We are thankful for his wholehearted assistance, advice and expert guidance towards making our work success.

Our special thanks to honorable Principal Dr. A. N. JADHAV & Head of Department Prof. Dr. D. N. DEOMORE for their keen interest, encourage and excellent support.

We would also like to express our thanks to all of other staff members of college & friends who helped us directly & indirectly during the completion of this Report.

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