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Ergonomic & Fe Analysis of Smart Hand Cart

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Abstract: *New product design always needs to be analysed for function and non- functional aspects of design. A Previously designed Smart Hand Cart is proposed to be analysed for kinetic, kinematic and ergonomic aspects of design. The functional aspects will be validate using Finite Element analysis. This Analysis would be carried out for dead loads, paddle forces and braking forces. Further the same will also proposed to be studied for the ergonomic aspects for ease of use.*
This work proposes to check the functional aspects of design of its various subsystems using finite element method and also proposes to throw some light on the man machine interaction for the ease of handling and use. Further the analysis may lead to certain modifications in the existing design which will be subsequently carried out, if required.

I. Introduction

Product design is always a challenging task as there is always a scope for improvement in each of the existing product. The Product evolved have more scope for improvement than those which are designed using an engineering approach. One such product most commonly found on the Indian road is "Hand Cart" which has not been much evolved in the almost last years. But in year 2012-13 Mr. Satish P. Lokhande has done a work on it to get new design approach for hand cart and get it to next level his attempt to modify a conventional "Hand Cart" The design and deployment approach in his project had major focus on the issues like providing the paddling, steering and breaking mechanism. Then in year 2015-2016 Mr. Amit R. Mutyalwar modified the project of Mr. Satish Lokhande and develop and modify the existing paddling mechanism. He also works on safety and security, hygiene and modular approach to storage area. Now this prototype of smart hand cart is ready to sale in market but in both the studies they do not consider the human comfort and aesthetics. Ergonomics plays a key role in the designing of cycle. It provides the comfort as well as maintains the aesthetic look of cycle. Proper steering and comfort the handle height is important because human height is very with person to person.

One of the important phases in the product development process is the field durability test and ergonomic analysis which is not done in earlier studies prototype testing are no longer affordable against the time and cause constraints for developing a competitive product. Today, analysis tools in the form of computer simulation have been developed to such a level that they reliably predict performance. So, this project to intended for ergonomic and FE analysis of existing project of smart hand cart using modern tools for analysis.This project works is taking care of the human ergonomics aspects and FE analysis of different members of hand cart.

II. Literature Review

There has not been much efforts to develop the hand cart using engineering approach, hence there is not much literature available. However, the two previous works carried out in this institute are significant to mention. This is followed by some relevant papers on product design, FEM and ergonomic aspects of design in the following survey.

2.1 Dissertation On Design And Development Of "Smart Hand-Cart" submitted by Mr. Amit R. Mutyalwar As an M.Tech CAD/CAM Thesis during year 2015-2016.
This project is a successful attempt following points.

1) By redesigning the things, the use of fifth wheel was completely eliminated
2) A complex and costly steering mechanism replace with simplest, precise, and cheaper steering mechanism. This is achieved by installing both the front wheels in one bracket, and the bracket is pivoted in the bearing assembly This results in more stable drive than the three-wheeler trolley.
3) Aesthetics in looks, having a predetermined thematic shape
4) Safety features installed like Horn, Head lamp, indicators, rear view mirror, reflectors

5) The efforts have been made to minimize the pains of hand-cart owner by providing additional features.

Further it should be noted that these complete efforts were made considering financial constraints of the user and hence it was principally decided to keep the cost of product as minimum as possible. Some ideas like battery operated motorized drive and use of solar panel for battery charging purpose was dropped, as these would have added to the cost of product Also, the effort has been made to make it as compact as possible along with the aesthetic requirement for good looks. The trolley is having a sliding arrangement to the base of the trolley to increase working space resulted into a beautiful, elegant efficient, user friendly means a "Smart Hand-cart1"

2.2 Dissertation On Product Design Approach For Design And Development Of "Hand-Cart" submitted by Mr. Satish P. Lokhande As an M.Tech CAD/CAM Thesis during year 2012-13 Patent file in official journal 10052013 with patent Application No.1464/MUM/2013 A

This project is a successful attempt to modify a conventional & "Hand- cart" The design and development approach in this Project had major focus on the issues like

a) Providing a steering mechanism.
b) Provision of seat along with paddling mechanism.
c) Provision of braking.

For fulfilling the above objective, a design taken into consideration is the conventional hand cart along with some changes. The major challenge to apply a steering mechanism to front two wheels, the front wheels are to be mounted independently so that a steering mechanism can be provided with a linkage. The operation of steering mechanism is nice and smooth with perfection of turning sensitivity. Handle provided is just like a handle of bicycle having provision of hand brake and horn the paddling mechanism was also provided on rear wheels of cart. However, it uses the fifth wheel during paddling which makes the operation complex.

The seating position of driver is outside the cart trolley (i.e. some inches away from the rear wheels shaft) that offsets the driver weight from rear axle making the cart tilt. For overcoming this issue, a fifth wheel has been provided that makes the cart unnecessary heavy and creating more resistance during paddling. Though the steering mechanism is sensitive independent axle front wheels give effective steering of hand cart.

Some other issues which are not addressed in the existing design are,

1) Security and Safety; needs more attention on those issues.
2) Hygiene; the cart is open during the use; this leads to unhygienic conditions.
3) Aesthetic consideration in design so that it looks smart.
4) Efficient paddling, the efforts taken during the paddling are more and there is unnecessary increase in cost due to provision of fifth wheel.
5) Ergonomics, which can make the use of cart more comfortable and easier the survey has been conducted during this project; the major requirement of hawkers was change of storage unit size and shape i.e. to be modular.

The Market survey shows that the requirement of storage space must be different for different purposes for example the pani puri stall needs wooden platform because steel get corroded due to acidic water of pani puri and tea stall needs steel platform because of use of stove. So, the storage platform must be detachable from main chassis easily and also easily attachable One should take this modular approach on priority during modification of the hand-cart. During this project some on standardization of dimensions proposed which would be modified as per design requirement.

2.3 Investigation Done By S.M. Mowade And Dr.H.T. Thorat

An investigation is done by S. M. Mowade & H. T. THORAT in VNIT Nagpur on "Development of Handcart for climbing Obstacles". In this work various types of mechanisms are used for wheels of a cart are analyzed. The analysis is done for minimizing the effort required for pushing a cart to overcome climb the obstacles. The mechanism for wheel of a cart is formulated and presented in the work. Based on the analysis, the mechanism is selected for the same is included. Design of mechanism is followed by design of various mechanical components.

The modified hand cart with mechanism using 4 set of 3,4 & 5 wheels is fabricated; trials are conducted and the results are prepared. Analysis is concluded by some facts as, for smaller obstacle up to 75mm conventional hand-cart shows much higher performance. Three-wheel drive is on par at lower range, found to be superior in 125 mm range not so good at higher obstacles. Four wheels are similar to conventional for smaller obstacles but for larger obstacles it is slightly inferior. Five-wheel trolley requires less effort as compare to conventional. Taking into account effective larger diameter of five wheels, five-wheel drive and conventional wheel of equivalent diameter have similar performance. Larger single wheel can be considered as superior drive over multi- wheel drive to similar performance and simpler construction. An investigation done by Professor

B. K. Chakravarthy is a faculty at industrial design center (IDC). Indian institute of Technology, Bombay, on New post box design for Indian postal service.

In this project the brief given by Indian post was to design a maintenance free letter box, justified so, since the existing letter boxes which are made of mild steel were damaged easily and rusted rapidly. As a result, the postal department spent a lot of effort and money in painting, repairing and maintaining them. A study conducted prior to design the letter box among postal staff and Public to obtain feedback on the difficulties they faced while using the post box as also the additional feature they would like to have to make it more user-friendly.

III. Scope, Methodology & Objectives

Scope And Methodology

In order to achieve the objective, the scope of the project must befulfilled.

The scopes and methodology of the project are listed below.

1) To provide the optimum design for Paddling Mechanism and Position of Seat
2) Create Smart Hand Cart Cad model by using "Catia V5" software.
3) Export this model in ".igs" (Initial Graphics Exchange Specification) format to ANSYS.
4) With the help of ANSYS analysis of Static stresses.
5) Comparing this result with analytically.

Objectives

- The main objective of this study is to
- Obtain the FE analysis for chassis of hand cart.
- Investigate ergonomics design of a handle and paddling system.
- To choose the optimal material for hand cart chassis.