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Optimization and Analysis of Electric Personal Vehicle

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ABSTRACT

This piece of elaborative literature intends to provide an overview of a non-conventional method of building up an electric personal vehicle accompanied by the analysis, which sets it apart from its conventional counterparts, especially when cost considerations are accounted for. The entire study, the innovations that sprung up and, the finally deduced desirability, was inspired from DIY (Do-it-yourself) projects like Segways and e-cars. The methodology prescribed and advocated in this literature is probably the most effective yet simplest way to get a personalized human scooter up and running. This might be referred to as an old school mechanical approach acting as a substitute to the conventionally dominant electric approach.

Keywords: EPV(Electric Personal Vehicle), personalized human scooter, Segway, enhanced scope.

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I. INTRODUCTION

A large number of masses around the globe have turned a keen eye towards the EPV genre of personalized mobility devices. Segway, is one of the most recent ones of them. Hover boards that stormed the markets recently, have been even more affluent with regards to impressing masses.Applications that these EPV's cater to are immense. They aid logistic activities in gigantic stretches of malls, airports, golf courts and what not. They can even be used and are used in many defense oriented activities by the uniformed institutions to make transportation easy and less harmful. [1]However, although being such an asset some countries have banned the use of EPVs like the Segway. The reason predominantly being that people wandering on these personalized and leisurely assets, have often been seen causing accidents on the streets. The self balancing mechanisms it comes stuffed with, sometimes prove to be its staunch drawback.This however stands undermined, given the number of DIY projects with regards to EPV's. People are obsessed with the idea of creating their own version of personalized human scooters. The traditional way of going about the built up process of the same is using arduino uno circuits which, nowadays are available online. They are expensive if one subscribes to original products. There are cheap ones available but their credibility is doubtful.To iterate the abstracted statement, this literature advocates a credible, non-conventional and sparsely electric approach to making an EPV. It also gazes upon the analysis of the method, which no DIY's would care to go about. [2]

I. CONSTRUCTION DETAILS

Like the conventional approaches, even this proposed vehicle uses two geared electric motors (250 Watt, 24V, having reduction ratio of about 9.78, 300RPM) to prime the movements of the vehicle. To power these motors two motors a battery of 24V can be utilized, if not available two batteries of 12V can be connected in series. Even this is similar to conventional designs. The methodology governing the movement of the EPV is what sets it apart from the others.[3]

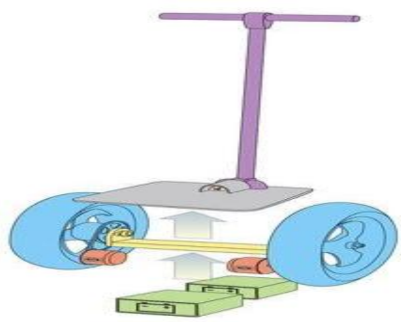

Fig 1- Constructions details of EPV

The material utilized to achieve this linkage-driven actuation utilizes springs, break switches, a pedal regulator and a customized handle which one can design with respect to his/her liking. The board in which the components are mounted can be metallic or wooden. A wooden board is advisable if cost reduction is aimed at. Cost of stainless steel is quite high compared to wood. The handle could be compiled using a T-section of PVC.The tires to be employed can be of any size, provided reduction of speed can be done by manipulating theoretically the diameters of the sprockets to achieve the desired speed. If that is not turning feasible one can try running the motors by individual batteries of 12V and 7- 8 amp rating which will reduce the speed drastically if the vehicle is going out of bounce.

The speed governing equation:

$$V= \{(\pi dn)/60\} \quad (m/s), \quad G=d2/d1=t2/t1=n1/n2$$

[Where: d=diameter, t=teeth of gears, n=speed in RPM]

The equations used in tandem provide us with the necessary speed requirements and sprocket specifications that are to be used for obtaining desired efforts.

Ideal speed for an EPV could be stated as 12-12.5 mph which in m/s stands at about 5-6 m/s. Values may vary with different sizes and motor specifics, however for 250 W, 300 RPM motor, standard 14 inch diameter tires with 3-4 inch sprocket is advisable. The analysis that unfolds in the literature to follow has been done on these specifications. A chain is to be employed between the sprocket and the geared motor. The transmission thus can be achieves successfully.

II. METHODOLOGY

The method incorporated, makes use of switches which can be understood by referring the figure below. It essentially highlights the use of a switch-pedal mechanism. Two batteries connected in series to each other prime the motors via these switches. The forward movement is governed by use of a pedal which provides for an acceleration control mechanism. By varying the current with respect to the force applied over it.

While turning left, the left switch ceases its operation, circuit is broken and the right one takes care of the turning motion. On similar lines the movement to the right can be governed. In all conditions the pedal provides for an additional safety character which essentially puts down the acceleration when a stoppage is intended. The actuation of the switches and hence the motor priming is so achieved by using the handle that protrudes as some sort of joystick.The bottom part of the same is attached to the switches with the help of springs. Thus a vital yet simplified mechanism is established which aids the movement. We save immense amount of cost here in, by avoiding the use of electronic controllers which might even burn off under adverse conditions.

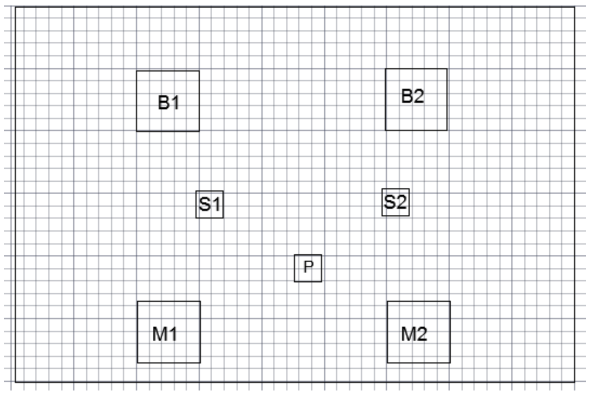

Fig 2- Getting to know the methodology

III. STRUCTURAL ANALYSIS

Structural analysis pertaining to this EPV, concerns the stress distribution and deformation specifics under the dead load and load of the driver. This analysis helps us to analyze the feasibility and constraints associated with the design under consideration.The simulation software, thus help us in understanding the areas of improvement and likewise make changes in the design or materials put to use while making the manufacturing the proposed EPV.

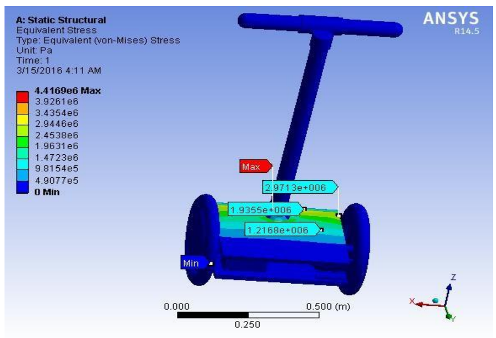

Fig 3-Simulation Analysis

The analysis obtained by conducting the simulation experimentation and applying varying loads also helps us in understanding the possible failure prone components which are failing the test of load applications and improve upon the same.

IV. VALIDATION

Validation of the EPV simply underlines the achieved, intended optimized results. Like mentioned before, EPV's are looked upon as costly devices by masses. However the EPV proposed uses simple yet effective mechanisms to achieve the desired mobility of the vehicle. The cost of a full-fledged segway or hover board touched about $4,000 in the initial years when it did hit the markets.[4]When private entities and people at large started having a DIY approach for making their very own personalized vehicles, there were a lot many innovative chores that surfaced. The cost dropped to as low as $400-500 gradually. The proposed EPV in the literature above, builds up a functional EPV in about 200-300$. For a firm intending to manufactures these sort of entities there would be a possible labor cost addition in the estimate, however the cutting down of the controller costs will still keep the cost aspect in check with regards to the final consumer. [5]

V. CONCLUSION

The EPV built-up methodology suggested is cost-efficient, manufacturer friendly and thus easy on the pockets of the end consumer too. Besides these advantages, it encourages innovative temper amidst masses, thus inculcating DIY chores. An enhanced scope in the genre of EPV's is quite evident.

A. Future Possibilities

The world of EPV's remains concealed even today. Yes, there are e-toy cars running in many households today which cater to the amusement needs of the young ones therein. However, the applications in strategic sectors have still not been discovered yet. EPV's are already in use in malls, airports and military bases to take care of logistic chores. The scope however should not be undermined in the other sectors.

B. Shortcomings

The predominant shortcoming that haunt EPV genre of personalized scooters is the driver ergonomic aspect. It is difficult to maintain the balance and it takes some getting used to before the user gets completely used to the whereabouts. This is because unlike the segway, self balancing mechanism is not employed in this version of EPVs.Given the shortcomings one cannot afford to miss the cost- effective nature of the vehicle proposed. Affluent buyers as well as not so affluent masses can also afford these EPV's. Enthusiasts can undertake the task of making it themselves.

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