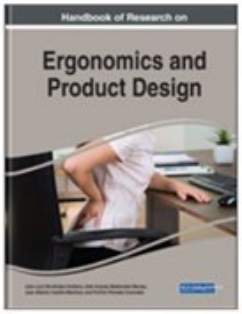

Handbook of Research on Ergonomics and Product Design

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Description

Product design is an important field where ergonomics and human factors should be applied. To achieve this goal, effective strategies for process improvement must be researched and implemented.

The **Handbook of Research on Ergonomics and Product Design** is a critical scholarly resource that provides new theories, methodologies, and applications of ergonomics and product design and redesign. Featuring a broad range of topics such as additive manufacturing, product analysis, and sustainable packing development, this book is geared towards academicians, practitioners, and researchers seeking current research on new theories, methods, and applications related to ergonomics and product design.

Topics Covered

The many academic areas covered in this publication include, but are not limited to:

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Chapter 7
Experimental Design to Analyze a Novel Stabilization Design of a Three-Wheel Vehicle

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ABSTRACT

Given current trends in pedal vehicles, this chapter is intended to develop a product that is capable of driving without the use of hands, for people with disabilities or for simple recreation. An apparatus was developed to measure and record the necessary parameters to design the most adequate mechanism to achieve this objective. Twelve different positions were analyzed for the user, two vertical seat positions, two inverted angle configurations of the inverted pendulum, two free degree limits of the pendulum, two wheel rotation degrees regarding the body of the mechanism, and regarding the axis motion, two axial configurations. The conclusion resulted that the function of the mechanisms was optimal.

INTRODUCTION

Due to the increment of ecologic consciousness and personal care, more and more people around the world are using alternative means of transport to the internal combustion automobiles, as electric and pedal vehicles (Reiser 2nd, Peterson, & Broker, 2002). Focusing on these last ones, we found a growing and continue innovation market, which implies two main strands for this project: inclusion and diversification. Inclusion refers that all population segments to have the capacity to choose the mean of transport they prefer and suits them best. In this case, it pretends to include people with some dysfunction, injury or amputation of the upper limbs. Meaning, they cannot drive a bicycle or tricycle even if their lower motor skills are intact. Diversification is obtained by thinking in a different way of driving a vehicle; as long as you keep focus on the road, it will allow you to occupy your hands in various activities such as

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eating a fruit or an energetic shake on your way to college or work, take care of a fragile item, and even rest arms crossed while enjoying your drive.

Bicycles have been a means of transport widely used in all areas, both recreational and utilitarian because of its versatility, easy to use, and dynamic stability (Astrom, Klein, & Lennartsson, 2005). Even when its static stability is zero, dynamic stability resembles when a rod is balanced in one hand palm, which allows us to intuitively swing against the drop point (Schwab, 2012). In addition, the more speed it takes, the more it requires force to perform rotation, breaking the linear inertia, which paradoxically results in greater stability at a higher speed (Patterson & Leone, 2010). However, despite all the positive features of conventional bicycles, they do not meet the main requirement of diversification for the present project as they are not statically stable, that is, they do not stand on their own at rest. Static stability is essential for the application of a mechanical driving system without the use of hands. Not to mention that a recumbent bicycle is more efficient than the conventional bicycle in its biomechanics, ergonomics, kinematics, and power development (Ahmed, Qureshi, & Khan, 2015).

Even since 1896, when the first patent registration of a recumbent bicycle was made, just like the conventional bicycle, the general changes presented have been minimal; even when there are patents with some modifications in driving (Mighell, 2009), stability (James, 1941), and inclination (Roqueiro, Vieira, & Faria, 2010)

The main reason for searching a statically stable vehicle is because, if a person wants to drive without hands, the person should be getting on the vehicle should be done in the same way, which is not achieved with a bicycle. Taking into account that the most suitable position to get on and accommodate in some type of device is the sitting position (Mircheski, Kandikjan, & Sidorenko, 2014), the vehicle configuration should be one in which the user remains seated with his legs in front and his arms relaxed, starting this way from static to dynamic without altering his position. In addition, we take advantage of the fact that an ideal cardiovascular state is generated for cardiac rehabilitation, a highly recommended exercise (Kato, Tsutsumi, Yamaguchi, Kurakane, & Chang, 2011).

Starting from the premises described in the previous paragraphs, vehicles of three or more wheels will be taken into account because they have the characteristic of being statically stable, although these vehicles are not as dynamically stable as the two-wheeled vehicles. To overcome this disadvantage and introduce an innovative transport option, it is proposed to design and develop a completely mechanical system that generates a tilt in the vehicle by curving it, re-positioning the center of mass in relation to the centripetal and normal force vectors, at the time you reconfigure the position of the wheels, which would expect stability to increase.

All of this in order to be able to re-position along with the body a few centimeters of the frame and direct the vehicle without the use of hands or arms. The original design requires the investigation of all involved factors in the static and dynamic stability of the mechanism, with special attention in the immediate reaction and control derived from what will be a comprehensive analysis of the ergonomics and usability of it. In addition to the material resistance analysis and the selection of mechanical elements, submitting experimental tests to the models derived from the applied calculations.

OBJECTIVE

In the present study, it is intended to obtain all necessary data, both ergonomic and operational of the mechanism through experimentation in a mechanical system designed and manufactured to modify all