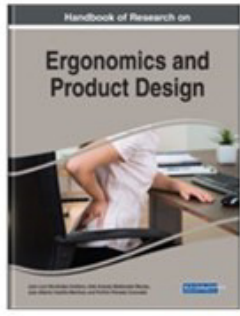




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Handbook of Research on Ergonomics and Product Design

Juan Luis Hernández Arellano (Autonomous University of Ciudad Juárez, Mexico), Aide Aracely Maldonado Macías (Autonomous University of Ciudad Juárez, Mexico), Juan Alberto Castillo Martínez (University of Rosario, Colombia) and Porfirio Peinado Coronado (Autonomous University of Ciudad Juárez, Mexico)

Release Date: April, 2018 | Copyright: © 2018 | Pages: 446
ISBN13: 9781522552345 | ISBN10: 1522552340 | EISBN13: 9781522552352 | DOI: 10.4018/978-1-5225-5234-5

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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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Table of Contents

Foreword	xx
Preface.....	xxi
Acknowledgment	xxviii

Section 1 Ergonomic Analysis

Chapter 1

Individual Risk Assessment (ERIN): Method for the Assessment of Workplace Risks for Work-Related Musculoskeletal Disorders.....	1
<i>Yordán Rodríguez, University of Antioquia, Colombia</i>	

Chapter 2

Ergonomic Bench to Decrease Postural Risk Level on the Task of Changing Forklift's Brake Pads: A Design Approach	28
<i>Arturo Realyvásquez, Instituto Tecnológico de Tijuana, Mexico</i>	
<i>Guadalupe Hernández-Escobedo, Instituto Tecnológico de Tijuana, Mexico</i>	
<i>Aide Aracely Maldonado Macías, Autonomous University of Ciudad Juárez, Mexico</i>	

Chapter 3

Modeling Simulation-Based Agents for Reducing Operative Deferral in Oncology in a Virtual Scenario using Ergonomics.....	48
<i>Adriana García, Universidad Politecnica de Aguascalientes, Mexico</i>	
<i>Alberto Ochoa-Zezzatti, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Juan Luis Hernández Arellano, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Aide Aracely Maldonado Macías, Autonomous University of Ciudad Juárez, Mexico</i>	

Section 2 Ergonomic Product Design

Chapter 4

Aging Suit: An Accessible and Low-Cost Design Tool for the Gerontodesign.....	56
<i>Annika Maya Rivero, Universidad Autónoma del Estado de México, Mexico</i>	

Chapter 5	
Product and Space Analysis Using the Product Perception Method.....	70
<i>Mario Osmar Moreno, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Juan Luis Hernández Arellano, Autonomous University of Ciudad Juárez, Mexico</i>	

Chapter 6	
Pedagogy as a Fundamental Part of School Furniture Design.....	79
<i>Natalia Anaya Echeverría, Universidad de Guadalajara, Mexico</i>	

Chapter 7	
Experimental Design to Analyze a Novel Stabilization Design of a Three-Wheel Vehicle	102
<i>Luis Elias Dávila-Leyva, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Ludovico Soto Nogueira, Autonomous University of Ciudad Juárez, Mexico</i>	

Chapter 8	
Design of Recreational Vehicles for Young and Adult People as an Alternative to Physical Activation in Open Spaces.....	113
<i>Mayra Ivette Peña Ontiveros, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Cesar Omar Balderrama Armendáriz, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>David Cortés Sáenz, Autonomous University of Ciudad Juárez, Mexico</i>	

Chapter 9	
Trials and Simulators Research in User Analysis and Sustainable Packaging Development.....	132
<i>Berthana Ma Salas Dominguez, Universidad Autónoma Metropolitana – Xochimilco, Mexico</i>	
<i>Silvia Ana María Oropeza Herrera, Universidad Autónoma Metropolitana – Xochimilco, Mexico</i>	

Section 3 Anthropometrics

Chapter 10	
Anthropometry Devices: A Comparative Study	153
<i>Julian Israel Aguilar-Duque, Universidad Autónoma de Baja California, Mexico</i>	
<i>Guillermo Amaya, Universidad Autónoma de Baja California, Mexico</i>	
<i>Victor M. Juarez, Universidad Autónoma de Baja California, Mexico</i>	
<i>Diego Tlapa, Universidad Autónoma de Baja California, Mexico</i>	
<i>Ulises J. Tamayo, Universidad Autónoma de Baja California, Mexico</i>	
<i>Ana Y. Tovar-Hernández, Autonomous University of Ciudad Juárez, Mexico</i>	

Chapter 11	
An Ergonomic Analysis on Working Postures of Construction Site Workers: A Framework for Construction Site Workers	172
<i>Suchismita Satapathy, KIIT University, India</i>	

Chapter 12	
Body Scanner Measurements for Apparel Design in Mexican Women.....	197
<i>Lilia Roselia Prado-León, Universidad de Guadalajara, Mexico</i>	
<i>Carlos Aceves-González, Universidad de Guadalajara, Mexico</i>	

Section 4
Usability and User Experience

Chapter 13	
Usability on Standard Work Visuals in Manufacturing.....	217
<i>Guadalupe Hernández-Escobedo, Instituto Tecnológico de Tijuana, Mexico</i>	
<i>Karina Cecilia Arredondo-Soto, Universidad Autónoma de Baja California, Mexico</i>	
<i>Carlos Aceves-González, Universidad de Guadalajara, Mexico</i>	
<i>Arturo Realyvásquez, Instituto Tecnológico de Tijuana, Mexico</i>	

Chapter 14	
Usability Test and Cognitive Analyses During the Task of Using Wireless Earphones	241
<i>Nora G. Bustamante, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Aide Aracely Maldonado Macías, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Adrian A. Durán, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Juan Carlos Ortiz Nicolás, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Andres R. Quiñones, University of Texas at El Paso, USA</i>	

Chapter 15	
User Characteristics and Ergonomic Properties for Daily Objects Design	264
<i>John A. Rey-Galindo, Universidad de Guadalajara, Mexico</i>	
<i>Elvia Luz González-Muñoz, Universidad de Guadalajara, Mexico</i>	
<i>Alicia Libertad Rizo-Corona, Universidad de Guadalajara, Mexico</i>	

Chapter 16	
The Comprehension of Figurative Images of Food Items: The Effect of Ergonomic Guidelines in Graphic Design	283
<i>Lilia Roselia Prado-León, Universidad de Guadalajara, Mexico</i>	
<i>Carlos Díaz de León Zuloaga, Universidad de Guadalajara, Mexico</i>	
<i>Adrian Antonio Cisneros Hernández, Universidad de Guadalajara, Mexico</i>	

Chapter 17	
Understanding the Context of Design for Social Innovations: A Methodological Case Study	301
<i>Juan Carlos Ortiz Nicolás, Autonomous University of Ciudad Juárez, Mexico</i>	
<i>Thomas Harrison, Imperial College London, UK</i>	

Chapter 18

A Creative Teaching Strategy to Generate Concept Designs and Their Possible Application in
Tourism 325

Juan Manuel Madrid Solórzano, Autonomous University of Ciudad Juárez, Mexico

Ercilia Loera Anchondo, Autonomous University of Ciudad Juárez, Mexico

Porfirio Peinado Coronado, Autonomous University of Ciudad Juárez, Mexico

Ludovico Soto Nogueira, Autonomous University of Ciudad Juárez, Mexico

Section 5

Additive Manufacturing and Technology

Chapter 19

Methodology to Apply Design for Remanufacturing in Product Development 347

Karina Cecilia Arredondo-Soto, Universidad Autónoma de Baja California, Mexico

Rosa María Reyes-Martínez, Instituto Tecnológico de Ciudad Juárez, Mexico

Jaime Sánchez-Leal, Instituto Tecnológico de Ciudad Juárez, Mexico

Jorge De la Riva Rodríguez, Instituto Tecnológico de Ciudad Juárez, México

Chapter 20

Selection of Prototyping Process and Part Orientation for Virtually Manufactured Gears 364

Divya Zindani, NIT Silchar, India

Kaushik Kumar, Birla Institute of Technology, India

Chapter 21

Thermal Power Sector Sustainability: A Framework for Sustainable Supply Chain Management.... 381

Suchismita Satapathy, KIIT University, India

Jitendra Narayan Biswal, KIIT University, India

Compilation of References 402

About the Contributors 437

Index..... 443

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

DOI: 10.4018/978-1-5225-5234-5.ch007

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

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

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