

Finger-Mounted Obstacle Detector for People with Visual Impairment

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Abstract—Mobility is the ability to move. People with visual impairment has limited mobility as they have limited vision to move safely without colliding against obstacles. This paper presents a wearable device using technology to help people with visual impairment to detect obstacles. The device uses an ultrasonic sensor to obtain real time information of distance between device and obstacles. This information is interpreted into an audio feedback which will alert or notify users the presence of obstacles in their path. The device is small enough to be worn on the finger and direction of detection can be changed by pointing the hand or finger elsewhere. Three experimental testing were conducted to evaluate the prototype. First experiment was to determine the detection rate on indoor and outdoor obstacles of different sizes and shapes in a controlled environment. Second experiment was to test the prototype with participants wearing blindfolds (no vision simulator) and walking in an indoor environment filled with real life obstacles. Third experiment was conducted with participants wearing low vision simulators walking in an outdoor environment. Results showed the prototype works better for people with low vision than no vision.

Index Terms—assistive technology, obstacle detection, ultrasonic rangefinder, visual impaired

I. INTRODUCTION

Mobility is the ability to move easily and safely from one location to another. Human beings are designed to be a mobile creature but not everyone is mobile. Disease, accident, and genetic can result in mobility limitation. One limitation, visual impairment, reduces the mobility of people who suffers from the impairment.

Assistive devices or tools are used to improve the mobility of people with visual impairment such as a cane, guide dog and human assistance. However, the existing tools have limitations. Sweeping or tapping of the cane on the ground helps people with visual impairment in detecting ground level obstacle but not obstacles that are above waist level such as tree branches and open windows. Guide dogs could be trained to stop when there is obstacle, but it requires more care and expenses to maintain the dogs. Human assistance is the best solution but is very impractical as it involves constant human supervision.

II. BACKGROUND

Numerous studies were conducted to improve the mobility of people with visual impairment by designing a device that can detect obstacles. Two common obstacle detection techniques used are vision-based and sensor-based. Vision-based obstacle detector obtains information through camera which can be mono-camera, stereo-camera or RGB-D camera [1]. In most vision-based applications, it requires a processor with high computational power to break down and obtain the desired information from the camera image which contains many information. There are many algorithms developed by researchers to do certain tasks but it has limited functionality in obtaining information on objects that are transparent and in dark environment.

Sensor-based method is usually straightforward as the sensors are designed to perform a specific task. Laser sensor has high precision and resolution which are commonly found in mobile robot navigation. The sensor, however, can be expensive and may not perform well in an environment exposed to strong sunlight. An ultrasonic sensor can measure distance of obstacles but it has lower accuracy when compared to laser. It has a wider range of detection but depending on usage, this characteristic can be a drawback when a precise detection of obstacle location is desired.

Some existing research works are ultrasonic-based obstacle detection which can be categorized into cane, robot and wearable. Smart canes are walking sticks used by people with visual impairment embedded with smart technology and are developed by several researchers [2]-[6]. The distinct differences of the developed prototypes are the amount of sensor implemented, the feedback system used for notification, length of the stick, and the field of detection.

Two ultrasonic sensors were implemented and were located at the bottom of the stick [2]. It detects ground level obstacle from left and right simultaneously. Haptic feedback was implemented on the handle of the cane. The prototype was designed to replace walking stick and is capable of detecting obstacle taller than 10cm. However, the maximum detectable height was not evaluated.

A similar prototype [3] was built with two ultrasonic sensors located at the bottom, haptic feedback but with an additional feature of audio feedback. Sets of sound are stored and will be played when obstacles are detected. It is designed to detect ground-level obstacle so people with

Manuscript received January 26, 2018; revised March 5, 2018; accepted April 10, 2018.

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Hand Guide Obstacle Detector

**Margherita Antona, Constantine
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Wearable Haptic Devices for Realistic Scenario Applications Federica Barontini, 2024-11-02 This book delves into the application of wearable haptic feedback technology in various contexts focusing on prosthetics for individuals with upper limb loss and navigation systems for the visually impaired Central to the book is the development of technologies that address users needs and demands It highlights the pivotal role of a user centred approach in designing and creating novel feedback mechanisms Beginning with focus groups and experimental campaigns each chapter introduces innovative haptic devices that are characterized tested and refined to consistently meet user requirements The research culminates in the creation of a fully integrated feedback system within a prosthetic socket This book provides comprehensive insights into developing practical user friendly haptic devices that significantly improve the quality of life for individuals with sensory impairments

Low Vision - E-Book Christine Dickinson, Ana Hernandez Trillo, Michael Crossland, 2022-11-04 Providing an ideal balance of theory and practice Low Vision Principles and Management covers all aspects of providing effective eye care to individuals with visual impairment This concise yet comprehensive resource covers everything from theoretical background to current rehabilitative aids and low vision treatment strategies all while adopting a practical approach to vision care It brings practising eye care professionals and students fully up to date with current optical and electronic devices and how they are used in everyday practice as well as evidence based vision rehabilitation guidelines Features comprehensive guidance on visual rehabilitation for acuity loss and visual field loss Describes a wealth of practical advice and real world case scenarios to help guide your day to day patient interactions as well as your most challenging situations Covers hot topics including the link between mental health and low vision assistive technologies measures of quality of life and other outcome measures WHO classifications of visual impairment and best practices for auditing and commissioning vision services Contains over 200 diagrams illustrations and patient photos to aid in visual understanding Explains how eye care professionals can work within a multi disciplinary team to provide complete care An eBook version is included with purchase The eBook allows you to access all of the text figures

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Robotics Text Book Manish Soni,2024-11-13 Welcome to Robotics From Fundamentals to Advanced Applications your comprehensive guide to understanding and mastering the field of robotics In an era where automation and intelligent systems are revolutionizing industries robotics stands at the forefront driving innovations across manufacturing healthcare exploration and more As we delve deeper into this transformative technology it is essential for both beginners and seasoned professionals to grasp its fundamental concepts and applications thoroughly This book is meticulously crafted to serve as a complete learning resource catering to the diverse needs of learners at all levels Whether you are a student embarking on your first exploration into robotics or a professional seeking to enhance your expertise this guide provides the essential tools and resources necessary to achieve your learning goals **Assistive Technology for Visually Impaired and Blind**

People Marion Hersh,Michael A Johnson,2010-05-12 Equal accessibility to public places and services is now required by law in many countries For the vision impaired specialised technology often can provide a fuller enjoyment of the facilities of society from large scale meetings and public entertainments to reading a book or making music This volume explores the engineering and design principles and techniques used in assistive technology for blind and vision impaired people This book maintains the currency of knowledge for engineers and health workers who develop devices and services for people with sight loss and is an excellent source of reference for students of assistive technology and rehabilitation Human-Computer Interaction - INTERACT 2017 Regina Bernhaupt,Girish Dalvi,Anirudha Joshi,Devanuj K. Balkrishan,Jacki O'Neill,Marco Winckler,2017-09-19 The four volume set LNCS 10513 10516 constitutes the proceedings of the 16th IFIP TC 13

International Conference on Human Computer Interaction INTERACT 2017 held in Mumbai India in September 2017 The total of 68 papers presented in these books was carefully reviewed and selected from 221 submissions The contributions are organized in topical sections named Part I adaptive design and mobile applications aging and disabilities assistive technology for blind users audience engagement co design studies cultural differences and communication technology design rationale and camera control Part II digital inclusion games human perception cognition and behavior information on demand on the move and gesture interaction interaction at the workplace interaction with children Part III mediated communication in health methods and tools for user interface evaluation multi touch interaction new interaction techniques personalization and visualization persuasive technology and rehabilitation and pointing and target selection Handbook of GST Procedure, Commentary and Rates, 7e Rakesh Garg, Sandeep Garg, 2021-09-20 About the book and key features This book comprehensively discusses various provisions procedures and compliances prescribed under the GST Laws It is a very useful handbook for professionals corporates and regulators as all the provisions have been explained in a lucid manner The book has been divided into three parts Part A Important Reference Tables Part B Commentary Detailed analysis of provisions of GST through illustrations tables and graphs Part C GST Rates Comprises of upto date list of GST rates on goods and services Highlights Important reference tables containing compliance chart with limitation periods non creditable supplies penalties and offences etc covering the vital provisions under the GST law Detailed commentary on GST provisions through illustrations tables graphs Upto date HSN Code wise rates and exemptions in GST Goods and Services along with scheme of classification of services and the corresponding explanatory notes Free online access to GST Laws for the readers **The Mechanical Systems Design Handbook** Yildirim Hurmuzlu, Osita D.I. Nwokah, 2017-12-19 With a specific focus on the needs of the designers and engineers in industrial settings The Mechanical Systems Design Handbook Modeling Measurement and Control presents a practical overview of basic issues associated with design and control of mechanical systems In four sections each edited by a renowned expert this book answers diverse questions fundamental to the successful design and implementation of mechanical systems in a variety of applications Manufacturing addresses design and control issues related to manufacturing systems From fundamental design principles to control of discrete events machine tools and machining operations to polymer processing and precision manufacturing systems Vibration Control explores a range of topics related to active vibration control including piezoelectric networks the boundary control method and semi active suspension systems Aerospace Systems presents a detailed analysis of the mechanics and dynamics of tensegrity structures Robotics offers encyclopedic coverage of the control and design of robotic systems including kinematics dynamics soft computing techniques and teleoperation Mechanical systems designers and engineers have few resources dedicated to their particular and often unique problems The Mechanical Systems Design Handbook clearly shows how theory applies to real world challenges and will be a welcomed and valuable addition to your library **Manual of Classification of Subjects of**

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Contributors include a variety of researchers and practitioners around the world Features practical tested applications of technological mobility solutions for visual impaired people Presents topics such as obstacle detection systems urban mobility smart home services and ambient assisted living Includes a number of application examples in education health electronics tourism and transportation

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Table of Contents Hand Guide Obstacle Detector

1. Understanding the eBook Hand Guide Obstacle Detector
 - The Rise of Digital Reading Hand Guide Obstacle Detector
 - Advantages of eBooks Over Traditional Books
2. Identifying Hand Guide Obstacle Detector
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Hand Guide Obstacle Detector
 - User-Friendly Interface
4. Exploring eBook Recommendations from Hand Guide Obstacle Detector
 - Personalized Recommendations
 - Hand Guide Obstacle Detector User Reviews and Ratings

- Hand Guide Obstacle Detector and Bestseller Lists
- 5. Accessing Hand Guide Obstacle Detector Free and Paid eBooks
 - Hand Guide Obstacle Detector Public Domain eBooks
 - Hand Guide Obstacle Detector eBook Subscription Services
 - Hand Guide Obstacle Detector Budget-Friendly Options
- 6. Navigating Hand Guide Obstacle Detector eBook Formats
 - ePub, PDF, MOBI, and More
 - Hand Guide Obstacle Detector Compatibility with Devices
 - Hand Guide Obstacle Detector Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Hand Guide Obstacle Detector
 - Highlighting and Note-Taking Hand Guide Obstacle Detector
 - Interactive Elements Hand Guide Obstacle Detector
- 8. Staying Engaged with Hand Guide Obstacle Detector
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Hand Guide Obstacle Detector
- 9. Balancing eBooks and Physical Books Hand Guide Obstacle Detector
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Hand Guide Obstacle Detector
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Hand Guide Obstacle Detector
 - Setting Reading Goals Hand Guide Obstacle Detector
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Hand Guide Obstacle Detector
 - Fact-Checking eBook Content of Hand Guide Obstacle Detector
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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