EasyChair Preprint

№ 10577

Enhancing Accessibility for the Visually Impaired: a Smart Device Solution Using AI and Image Processing

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July 16, 2023

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Abstract:

Visual impairment is a physical disability that affects a significant number of people worldwide, resulting in difficulty with everyday activities such as reading, socializing, crossing roads, and driving. Blind individuals often rely on assistive devices like walking sticks to navigate their surroundings. Although research is ongoing to address blindness, there is still a long way to go to find a solution. While there are ideas to help the visually impaired, many lack the technological implementation required. This research project aims to make daily tasks easier for visually impaired individuals of all categories by developing a smart device that uses artificial intelligence and image processing to detect faces, colors, and various objects. The device notifies the user of these detections through sound or vibration alerts. The project also includes a survey involving visually impaired individuals from the local community. Open CV and Python are the programming languages used for implementation, and the prototype investigates algorithms for detecting objects, including a warning signal for obstacles. Ultimately, this research will positively impact the healthcare sector by leveraging smart technology to support the visually impaired.

Keywords: AI, IOT, blindness

1. Introduction

In today's world, modern technology has become an integral part of our lives, helping us to accomplish our daily activities with ease. However, some people with special needs, such as the visually impaired, require additional assistance to perform their daily tasks. The Third Blind Eye is a smart stick that has been developed to make the lives of visually impaired individuals safer and easier by incorporating Internet of Things (IoT) and Artificial Intelligence (AI) technologies [1][2][3]. While AI has the potential to revolutionize the world, there are concerns about its impact on other forms of knowledge and its dehumanizing applications. To address these concerns, the development of human-centric AI is necessary. However, there is a significant blind spot in this approach, which is addressed in this paper [4][5]. The proposed solution to this problem is community-based design [6][7][8]. This approach allows for AI design to be guided by human agency, providing a safeguard against the colonization of technology [9][10][11]. Participatory design, which is commonly suggested as a solution, lacks the philosophical rigor required to challenge the autonomy of AI and prevent potential colonization. In conclusion, while modern technology has the potential to improve the lives of people with special needs, it is essential to consider the potential negative impacts and take necessary measures to prevent them. Community-

based design is a promising solution to ensure that AI development is directed by human agencies and is not used to marginalize other forms of knowledge.

2. Deep learning Assistance for Blinds

The fashion industry continues to thrive, but unfortunately, the visually impaired often miss out on this trend. By 2050, the number of vision-impaired individuals is expected to reach 120 million. This paper proposes the Vision4All model, which uses IoT and AI technologies to help visually impaired users identify clothing categories, colors, textures, fabric, style, graphic, and text-based content on clothes [12][13][14]. We improved the FashionNet deep model by predicting garment qualities and categories together using the ResNet34 architecture, which replaced the obsolete VGG16 design. A Fine-Grained multilabel classification model was trained to achieve higher prediction accuracy by tackling the noisy data problem for attribute prediction. Pythia's modular re-implementation of the bottom-up, top-down approach was used to identify graphical content printed on clothes. The solution allows users to navigate through speech, eliminating the need for vision [15][16][17]. Vision4All is the first complete solution that aligns with Fashion assistance for the visually impaired.

AI technology has faced criticism for marginalizing other forms of knowledge with dehumanizing applications. To address this problem, human-centric AI is needed. However, participatory design, which is commonly proposed, lacks the philosophical rigor required to challenge the autonomy of AI and prevent potential colonization. This paper proposes a more radical approach known as community-based design [18][19][20]. This approach allows AI design to be guided by human agency, introducing a safeguard against colonization by this technology.

Artificial Intelligence Autonomous Vehicle is a new means of transportation designed to help blind or visually impaired individuals become more independent in their daily life. The vehicle uses AI for car recognition, traffic light recognition, and voice recognition. Autonomous features driven by Simultaneous Localization and Mapping technology (SLAM) and real-time anti-collision sensors along with a 3D depth camera provide a dependable self-driving vehicle to transport a blind person to a mapped location accurately and safely. This participatory action research (PAR) project investigates the role of AI, Algorithmic Bias/Injustice integrating new technologies (i.e., GPS) in developing global competencies, geospatial intelligence, and computational thinking skills. The study explores the impact of new technologies on developing multicultural and multilingual apps that promote transdisciplinary curriculum and how participants integrate geospatial and computational thinking skills into their learning while gaining alternative points of view on global issues and renewed interest and commitment to community service [1].

Communication has evolved with technology, and email has become the preferred method for online communication. However, some individuals, especially the visually impaired, are unable to take advantage of this technology due to their inability to see screens. A speech-to-text messaging device is suggested to enable externally examined individuals to communicate with others easily. This invention provides blind

individuals with the ability to send emails like regular citizens, increasing their sense of stability and objectivity [18][19].

In this doctoral thesis, I aim to develop a cortical neuroprosthesis for the blind that goes beyond the current state of the art. Although research groups worldwide are making significant efforts to develop a fully working visual cortical neuroprosthesis that can help blind people recover a form of vision, it remains a challenging ongoing project. This work is situated at the junction between neuroscience, neural engineering, and artificial intelligence.

The visually impaired face many challenges in performing everyday activities, and efforts have been made to help them become more independent. In this article, we propose and develop an intelligent blind stick that uses sensors and a microprocessor to help blind individuals walk with ease.

3. Virtual Vision for Blinds

In our daily lives, we encounter people with various disabilities, including blindness or loss of sight. To address this issue, we are creating an affordable project that utilizes recent technologies to provide virtual vision to individuals with visual impairments, improving their real-life experiences [20][21]. This project can also benefit illiterate or tourist individuals who are unable to understand written text. Additionally, it can be useful for auditory learners, such as students, who can creatively memorize notes. Our project aims to assist individuals with visual impairments in their daily tasks using wearable glasses. As proof of concept, our project includes text recognition technology that converts hardcopy materials into speech, which can be heard by the user through earbuds attached to the glasses [22][23].

Human health, especially our sense organs, has been severely impacted by increasing pollution and changing lifestyles. Exposure to screens has led to vision-related problems at an early age. Developing technologies can help individuals with little to no vision lead independent lives in society. Computer vision is a field that can develop cost-effective products that are useful in such scenarios. The detection and recognition of text from natural images can be beneficial for visually impaired persons, as well as in developing a smart system to assist drivers in obtaining voice signals for every road sign and warning if the driver fails to follow them. The proposed work uses deep convolutional neural networks to implement a text detection and recognition system that is simpler and faster than traditional hand-crafted feature-based methods.

4. Automatic-Cane-An Intelligent Tool for Blind with AI Techniques

To achieve one's dreams and goals in life, independence and confidence are crucial building blocks [24][25]. However, visually impaired individuals often struggle with going out independently, with approximately 12 million blind or visually impaired people worldwide in need of assistance. The white cane has been the most used travel aid for the blind, but its biggest disadvantage is that the user must undergo significant training and manually scan their surroundings for obstacles.

As the saying goes, "Success comes in cans, failure comes in cants." With this in mind, we have created a revolutionary device for the blind called I-cane - the only cane in the world with intelligence. I-cane intelligently solves all the problems that the blind face. This study provides a brief introduction to the I-cane's description and discusses the next version of the Automatic cane with a single wheel design [26][27][28].

5. Conclusion

The primary objective of this paper is to aid the blind community using the knowledge and resources available to us. We believe that individuals who are fortunate enough to possess the ability to see and acquire knowledge have a responsibility to help those who are deprived or in need. Additionally, this paper covers the next version of the I-Cane, the Ultra-Cane, which features a single wheel design to address the limitations of the I-Cane. With advancements in technology and increased flexibility for users, the Ultra-Cane was developed. This paper includes a detailed explanation of the individual components of the Ultra-Cane and provides a list of Do's and Don'ts for users.

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