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Smart Glasses for Visually Impaired Persons

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A B S T R A C T

Visually impaired people cannot read text with existing technology. The goal of the proposed project was to design glasses with a camera that blind and partially sighted people could use using modern OCR (optical character recognition) and text to speech (TTS) technology to read whatever they want. This proposed smart reader reads all kinds of documents such as books, magazines and mobile phones. This new technology can be used by blind and visually impaired people. An earlier version of the proposed project was successfully developed with a mobile reader, which had certain disadvantages, such as high cost due to the mobile needs of Android, not user-friendly and incorrect focus. To overcome these disadvantages, this project proposes a cost effective and efficient glasses reader with a camera.

Keywords: Raspberry pi2, Raspberry pi2 camera, ultrasonic sensor

1. INTRODUCTION

In the realm of addressing the intricate challenges faced by visually impaired individuals, researchers are at the forefront of proposing groundbreaking solutions, one of which involves the introduction of specially adapted smart glasses tailored to the needs of the visually impaired community. The presented prototype, a commendable fusion of a Raspberry Pi and Pi camera for intricate facial recognition processes, coupled with the utilization of an ultrasonic sensor for obstacle detection, establishes a robust and all-encompassing control system. This innovative endeavor, powered by a 5V supply to sustain the continuous operation of the Raspberry Pi, signifies a remarkable stride in harnessing technology to significantly enhance the quality of life for visually impaired individuals. It stands as a testament to providing effective and secure assistance, particularly in navigating unfamiliar environments where these individuals often encounter considerable difficulties in communication .The amalgamation of facial recognition and obstacle detection capabilities within this smart glasses prototype reflects a holistic approach to addressing the unique challenges inherent in the visually impaired community. Noteworthy is the strategic utilization of widely available and cost-effective components such as the Raspberry Pi, underlining the practicality and potential scalability of this envisioned smart glass solution. Beyond the confines of smart glasses, this study extends its reach to a more comprehensive mobile guidance system, integrating advanced technologies like ultrasonic sensors, GPS, and facial recognition.

This comprehensive approach not only facilitates navigation for visually impaired users but also establishes a continuous communication link with their family members, caregivers, and support network. The system strategically employs cameras to capture images for object identification, effectively communicating potential obstacles to caregivers when the user halts and promptly notifying relevant parties when assistance is required. Acknowledging the intricate challenges faced by visually impaired individuals in managing both indoor and outdoor environments, the proposed mobile guidance system, characterized by its intelligent, lightweight, and cost-effective design, empowers the visually impaired to navigate independently. Crucially, the system maintains constant contact with their support network, thereby not only increasing their mobility but also fostering a sense of security and connection. The incorporation of facial recognition technology further elevates the system's functionality, allowing for a more nuanced differentiation between people and objects in the user's surroundings. The significance of this research transcends mere technological innovation, delving into the fundamental importance of ensuring safe and independent mobility for the visually impaired .The proposed mobile guidance system emerges as a practical and holistic solution to the challenges of direction-finding for the visually impaired. By systematically reducing barriers and seamlessly integrating real-time communication capabilities, the system facilitates a nuanced understanding of the environment, thereby enabling visually impaired individuals to navigate with heightened efficiency from their starting point to their intended destination. In essence, this research represents a pivotal and commendable step in the ongoing journey to advance assistive technologies, ultimately promoting independence and markedly improving the overall quality of life for people living with visual impairments

2. METHODOLOGY

Developing smart glasses for the visually impaired involves several key steps. Belove figure shows the flowchart of the proposed approach

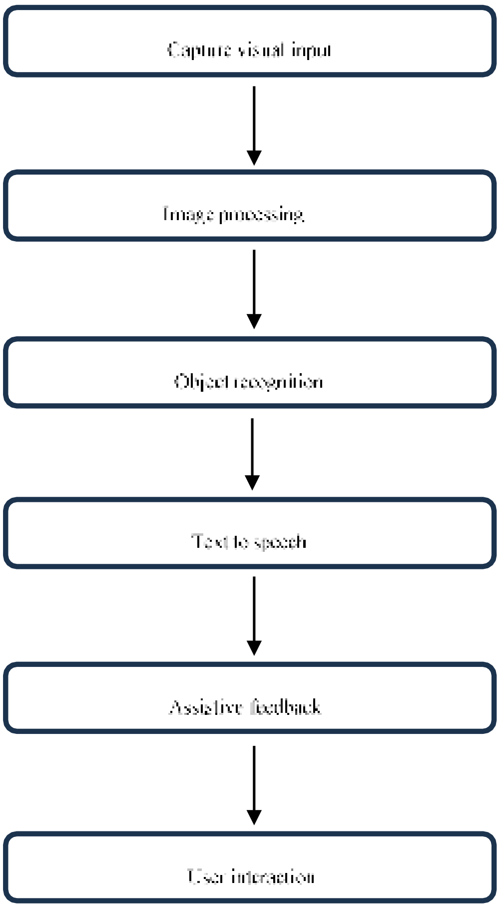

Fig. flowchart of proposed model

2.1 Capture visual input:

Smart glasses for the visually impaired integrate cutting-edge technology that greatly improves the daily life of users. These glasses usually have a sleek and lightweight frame with built-in cameras and sensors that act as the wearer's eyes. One of their main tasks is object recognition, where advanced computer vision algorithms analyze the environment and provide real-time audio feedback describing objects and scenes to the user. The speech synthesis feature is another important aspect of these smart glasses. By capturing and interpreting printed text, they allow users to retrieve information from various sources, such as books, documents or labels. This function opens up new possibilities for independent reading and information consumption. Navigation assistance is key, using GPS and mapping technologies to guide users through different environments. Whether you're walking down the street or navigating public spaces, these glasses provide audio cues and instructions, promoting mobility. Facial recognition features allow users to recognize people around them, adding a social dimension to the technology. In addition, the connectivity features allow the smart glasses to be synchronized with smartphones and other devices, which expands their functionality. Voice control further enhances the user experience by enabling hands-free operation and a more intuitive user interface. Essentially, these smart glasses represent a transformative fusion of assistive technology and artificial intelligence. Their goal is to break down barriers for the visually impaired not only by providing better vision, but also by promoting greater independence and inclusion in their daily experiences

2.2 Image processing:

Image processing is an interdisciplinary field that uses computer techniques to process and analyze visual information. Essentially, it involves various tasks aimed at enhancing, interpreting or extracting meaningful insights from images.One of the main aspects of image processing is image enhancement, where image quality is improved by adjusting characteristics such as contrast, brightness or sharpness. This is particularly useful in applications where visual clarity is critical, such as medical imaging or satellite imaging Image restoration focuses on restoring an image to its original state from a degraded or noisy version. This is common in scenarios where images may be distorted due to environmental factors or technical limitations. Image compression meets the need for efficient storage and transmission of visual information. By reducing the file size of an image while preserving important information, compression techniques play an important role in applications such as multimedia communication and web development. Object detection and segmentation involves identifying and accounting for certain entities in an image. These tasks are essential for computer vision applications, enabling automatic systems to interpret and respond to visual stimuli. Pattern recognition and feature extraction help to understand complex structures in images.

These technologies are widely used in fields such as machine learning and artificial intelligence for various tasks, from facial recognition to autonomous vehicle navigation. Algorithms developed in medical imaging analyze images in different formats to aid in diagnosis and treatment planning. Overall, image processing plays a central role in modern technology, influencing many different fields such as healthcare, remote sensing and computer vision, and constantly improving our ability to interpret and use visual information.

2.3 Object recognition:

Object recognition, a core part of computer vision, involves teaching machines to recognize and classify objects in visual da ta. This process has advanced significantly with the integration of machine learning, particularly convolutional neural networks (CNNs).Basically, object detection requires training algorithms on large datasets by exposing them to labeled examples of different objects. With this discovery, algorithms learn to distinguish patterns and features, allowing them to generalize and identify similar objects in new images or video footage.CNNs, a common object recognition architecture, automatically extract hierarchical representations of features, improving their ability to detect complex patterns. Transfer learning further improves performance by adapting pre-trained models to specific detection tasks, which is particularly useful when data is limited.Object recognition applications span a number of industries. In autonomous vehicles, it helps detect pedestrians, vehicles and obstacles. In surveillance, it plays a key role in tracking and detecting objects or events. Retail uses item recognition to manage inventory and improve customer engagement. In healthcare, it helps analyze medical images, while manufacturing relies on it for quality control .Despite significant progress, challenges remain, such as dealing with differences in scale, perspective, and lighting conditions. Ongoing research focuses on improving the reliability and efficiency of target detection systems so that they can be adapted to different real-world scenarios. As technology advances, object detection continues to be a cornerstone in revolutionizing the industry and driving innovations based on visual data interpretation

2.4 Text to speech:

Text to speech (TTS) is a technology that converts written text into spoken language. It involves analyzing input text, applying linguistic rules, and synthesizing speech using either pre-recorded human voices or computer-generated voices. TTS has a wide range of applications for improving accessibility for the visually impaired, providing voice guidance in navigation systems, supporting e-learning through speech-based content delivery, and supporting speech-impaired communication devices. Continued advances have resulted in more natural-sounding voices, making TTS an integral part of various technologies designed to bridge communication gaps and promote universal access to information.

2.5 Assistive feedback:

Assistive feedback in smart glasses for the visually impaired represents a transformative fusion of technology and accessibility, aimed at enriching the lives of individuals facing visual challenges. These innovative devices employ advanced functionalities to provide real-time information and support in various aspects of daily life.One pivotal aspect is object recognition, where smart glasses utilize cameras and image recognition software to identify objects in the user's vicinity. Through spoken feedback, these glasses offer dynamic, detailed descriptions of the environment, empowering users with a deeper understanding of their surroundings. Navigation assistance takes center stage as well, with GPS and sensors guiding users with step-by-step directions and audible cues, ensuring safer and more independent mobility.Text-to-speech functionality further extends the utility of smart glasses by converting written text into spoken words. This includes reading signs, menus, or any written content, fostering greater independence in accessing information. Facial recognition technology adds a social dimension, allowing the glasses to identify individuals and provide spoken feedback about the people encountered. Obstacle detection, color and light recognition, and integration with voice assistants contribute to a comprehensive support system. The glasses' sensors detect obstacles, alerting users in real-time to navigate around them. Recognition of colors and light levels enhances environmental awareness, while seamless integration with voice assistants enables users to perform various tasks through voice commands .Customizable settings add a personal touch, allowing users to tailor the feedback system according to their preferences. Whether adjusting volume, information delivery speed, or the level of detail in descriptions, customization ensures a user-centric experience.In essence, assistive feedback in smart glasses is a symbiotic blend of cutting-edge technologies, empowering visually impaired individuals with a more inclusive, informed, and independent interaction with the world around them.

2.6 User interaction:

Smart glasses for the visually impaired have revolutionized user interaction by using the latest technology to improve independence and accessibility. These innovative devices use a combination of cameras, sensors and audio feedback to provide real-time information about the user and the environment. One key part of user interaction is the intuitive control system integrated into these smart glasses. Using simple gestures or voice commands, users can navigate menus, access information and seamlessly interact with the device. This hands-free approach allows the visually impaired to interact with the world more effectively, reducing dependence on traditional assistive devices. The inclusion of artificial intelligence (AI) plays a key role in improving the user experience. Smart glasses can identify and describe objects, people and even text, communicating this information to the user through audio signals or text-to-speech technology. This not only aids in navigation, but also promotes a deeper understanding of the environment and spatial awareness. In addition, connectivity features allow the smart glasses to access online databases that provide up-to-date information on points of interest, public transportation schedules, and more. This real-time data makes the user experience more dynamic and responsive, allowing people to make informed decisions along the way. Personalization is another important element of user interaction. Smart glasses often allow users to customize settings and adapt the device to their specific needs and preferences. This flexibility ensures a customized experience that meets individual requirements, resulting in a greater sense of control and comfort.

3. WORK FLOW MODEL

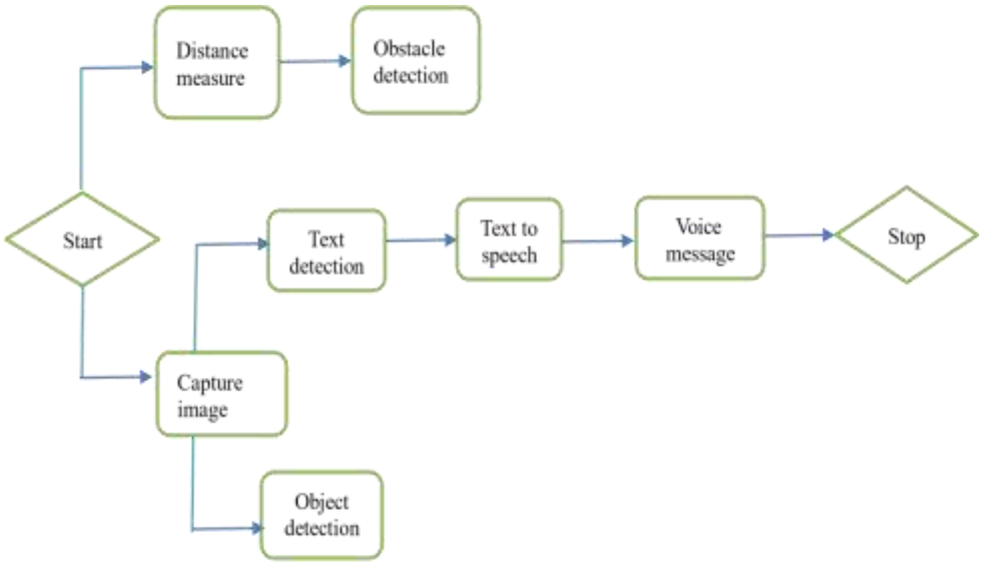

Fig. work flow model of proposed model

The smart reader glass method for the blind and partially sighted is well described in Figure. Since image processing plays a central role in this project, it is important to describe the process flow so that readers can easily understand it. clearly explains the concepts of converting a scanned image to audio text.

3.1 Image capture/scanning:

A micro camera is installed in the lens of the glasses, which is used to record documents that can be read after clicking the image button.

3.2 Pre-estimation:

The main processes of pre-estimation are slope correction, linearization and denoising. The main step in pre-evaluation is tilt detection, which is applied to the scanned text image to convert it to digital format. The second step of the preliminary evaluation is the linearization, which supports the linearization of the optoelectronic transfer function (OECF) with three methods such as Full Image Range, Modulation Transfer Function (MTF) or Full Data Range. The final stage of pre-evaluation is denoising, where unwanted by-products such as random variation in image brightness or color information and usually an electronic noise component are removed to remove ambiguities from the original data.

3.3 Feature extraction:

A feature is expressed as information about the content of an image. The purpose of feature extraction is to specify certain structures in an image, such as points and edges.

3.4 Detection:

Image detection is a technique used to capture, process, exploratory and sympathetic images. It is the ability to detect fine lines in a digital image.

3.5 Text to Speech:

Good text image quality is finally converted to sound through TTS (Text to Speech), which is listened to through headphones.

4. CONCLUSION

This article introduces the idea of intelligent management a device for the visually impaired to help them move safely and effectively in difficult indoor and outdoor spaces to the environment. When computer vision algorithms, sensor technologies and hardware were used together, the idea of developing wearable or wearable assistive technologies for the visually impaired emerged. We developed the device with low production costs, it has an audio output and it is convenient to use it in daily activities. The original version of these systems used basic image processing and computer vision techniques, while the latest versions are intelligent enough to design a safe path for the user to navigate. The system proposed in this paper is cost-friendly to the consumer and can be easily used like glass. We proposed an advanced system that provides facial recognition, ultrasonic sensors and IoT that provides distance calculation, audio outputs and facial recognition. Thanks to the ability to load and train the facial recognition module, we can store and process N number of known faces. And it would bring a person to life effortlessly and without the help of anyone else.

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