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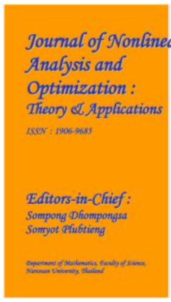

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SMART GLASSES FOR PHYSICALLY CHALLENGED PEOPLE

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ABSTRACT: The number of visually impaired people has been growing over the past decades. About 285 million people worldwide are estimated to be visually impaired. However, so far, many faculties and jobs cannot accommodate them mainly thanks to lack of assistive technologies and economic barriers. As a result, most of them still live on a low level of income. Even though technologies are available, they are too expensive and the affordable ones have limited functions. The main goal is to help blind people and people who have vision difficulties by a technology that involved. Main aspect here is to give them support to walk independently.

Blind mobility is one among the main challenges encountered by visually impaired persons in their daily lives. Their life and activities are greatly restricted by loss of eyesight. They normally travel using blind navigation system or by their accumulated memories in their future exploration. The main objective of this work is to develop a low cost, reliable, portable, user friendly, low power and robust solution for smooth navigation. This paper (Smart Glasses for visually disabled people), is meant for the visually impaired people. It has an in-built sensor in it which spreads ultrasonic waves in the direction the person is going by scanning at most 5-6 meters of range. As soon as the obstacle is detected, the sensor detects it and sends it to the device which generates an automatic voice within the earphone connected to the person's ear.

I. INTRODUCTION

Visual impairment poses significant challenges to individuals in their daily lives, hindering their ability to navigate the world independently. With the increasing prevalence of visual impairments globally, it has become imperative to develop assistive technologies that cater to the unique needs of the visually impaired community. In recent years, smart glasses have emerged as a promising solution to enhance the lives of blind individuals, providing them with a range of functionalities and improving their overall independence. The population of individuals with visual impairment has been steadily increasing in recent decades. According to the World Health Organization (WHO), approximately 285 million people worldwide are estimated to be visually impaired [1]. Unfortunately, many schools and workplaces are still unable to accommodate their needs due to a lack of assistive technologies and financial barriers [2]. Consequently, 90% of visually impaired individuals continue to live with a low income [1]. Even when assistive aids or technologies are available, they often fall into one of two categories: either they are prohibitively expensive (costing $3000 or more), or they are affordable (around $200) but offer limited functionality with a single task [3].

Among the various assistive devices, wearable devices, particularly head-mounted devices, have proven to be the most beneficial, as they allow for hands-free operation or require minimal use of hands [4]. The key advantage of head-mounted devices is that they naturally align with the user's line of sight, eliminating the need for additional directional instructions, unlike other devices [5]. This paper introduces a new design of smart glasses that can assist users in multiple tasks while maintaining a low production cost. The design incorporates the Raspberry Pi 2 single board computer, a camera, and an earpiece for conveying information to the user. Due to space limitations, this paper focuses on demonstrating the reading task exclusively, while also discussing the experiment results and potential for adding additional tasks.

II. LITERATURE SURVEY

The Braille reader is widely recognized as the most popular device for reading, enabling individuals to read and write by utilizing a configuration of dots to form various letters [4]. Another device commonly used for reading is the audio book, which allows users to listen to books or newspapers saved in an audio format provided by specific suppliers [6]. Screen readers and e-book readers are designed to read digital content displayed on computer screens and convert the text into an audio format using text-to-speech synthesis [6].

In terms of eyewear devices, a recent technological advancement is the commercially available OrCam glasses. These glasses incorporate an embedded computer with a gesture recognition system, allowing users to perform various tasks such as reading, with the information conveyed to the user in an audio format [7]. Another eyewear technology, known as Esight, is designed for individuals with low vision. It captures and processes live scenes, displaying them on a specialized screen in front of the user's eyes [8].

III. METHODOLOGY

Proposed Smart Glasses Design and Implementation

The smart eyewear design focuses on the central role played by the Raspberry Pi 2 as the processing unit, allowing for versatile functionality. By utilizing a Linux-based ARM processor, the eyewear system benefits from the robust capabilities of the Raspberry Pi platform. The inclusion of a micro SD card slot enables the expansion of task functions as needed, ensuring adaptability to the user's requirements. With the Raspberry Pi camera serving as the primary image acquisition tool, it captures real-time visuals that are crucial for various applications. This camera is seamlessly connected to the Raspberry Pi using a flexible cable, providing reliable data transfer and synchronization. Placing the camera on the top middle of the glasses ensures optimal image capturing by aligning it with the user's line of sight, facilitating accurate representation of the user's visual field. Furthermore, the Raspberry Pi's audio port enables the integration of an earpiece, enabling the user to receive auditory feedback and interact with the smart glasses discreetly. By configuring the Raspberry Pi GPIO port to receive input from push button switches, users can easily initiate different functions and tasks with a simple press, enhancing usability and control. Finally, the inclusion of a custom-designed frame with red borders aids in text identification, making it

easier for the smart glasses to locate and process text from reading materials.

Figure 1: Raspberry Pi Camera

The smart glasses follow a user-centric approach, employing an intuitive interaction mechanism for seamless operation. By adhering to a simple and consistent workflow, users can effortlessly navigate through different modes and functionalities. When utilizing the text recognition mode, the glasses employ an intelligent algorithm to verify the proper positioning and readability of the text area. If any issues are detected, such as misalignment or obstructed text, the glasses prompt the user to adjust the orientation of the material to ensure accurate processing. Once the text area is confirmed, the smart glasses leverage their real-time image processing capabilities to capture and analyze the view. The captured image is swiftly transmitted to an optical character recognition (OCR) software, which performs advanced algorithms to extract the text from the image accurately. Subsequently, the extracted text is seamlessly forwarded to a text-to-speech synthesizer, which converts it into audio output that can be audibly perceived by the user. This user- initiated mode is conveniently activated through a straightforward push of a button, allowing for effortless engagement with the smart glasses' functionalities.

To achieve optimal image processing results, the smart glasses employ a range of advanced techniques and algorithms. By utilizing Simulink, a powerful software tool, various image processing operations are performed to enhance the captured image's quality and legibility. Since reading mode requires precise identification of the text area, the first step involves detecting the red borders of the custom-designed frame, which acts as a visual indicator for the boundaries of the reading material. Additionally, the orientation of the frame is determined to ensure accurate alignment with the user's view. To simplify subsequent image processing and provide valuable feedback, an intuitive indicator system is proposed. This indicator assists the user in identifying any significant skewing or cropping of the frame, enabling them to make necessary adjustments for optimal text recognition. Following this initial stage, the captured text area is localized and cropped, paving the way for a series of image enhancement techniques. These techniques encompass noise filtering, contrast enhancement utilizing histogram matching techniques, and morphological operations to refine the image further. Finally, the Tesseract OCR engine, a renowned optical ch-aracter recognition tool, is employed to accurately extract the text from the processed image. The extracted text is then seamlessly converted into an audio output, allowing the user to access and comprehend the content efficiently.

IV. RESULTS

The research experiment involved the preparation and testing of several sample texts using the proposed smart glasses designed for visually impaired individuals. The results of the experiment, presented in Figure 1, demonstrated the effectiveness of the smart glasses in assisting with reading tasks. The selected sample text, although relatively simple, served as a proof of concept, validating the fundamental principles of the smart glasses design.

During the experiment, the smart glasses utilized the Raspberry Pi camera, integrated into the eyewear, to capture images of the reading text. The captured images were then subjected to a series of image processing techniques. These techniques included noise filtering, contrast enhancement, and morphological operations, aimed at improving the image quality and enhancing the legibility of the text. By refining the images, the smart glasses ensured that the subsequent text recognition process would yield accurate results.

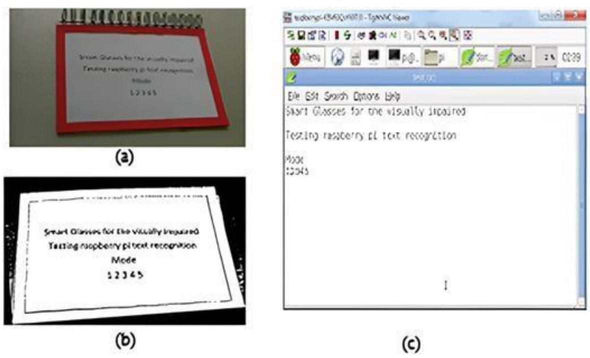

Fig. 2. Text recognition: (a) original image, (b) image after enhancement, (c) Tesseract OCR resultof reading material.

Following the image processing stage, the extracted text underwent optical character recognition (OCR) using the Tesseract OCR engine. This OCR software employed sophisticated algorithms to recognize and convert the extracted text into a readable format. Once the text was converted, it was seamlessly forwarded to a text-to-speech synthesizer integrated into the smart glasses. The synthesizer transformed the text into an audio output that could be perceived by the user, providing them with an accessible and convenient way to comprehend the content. The results of the experiment demonstrated the successful functioning of the smart glasses in fulfilling their intended purpose of assisting visually impaired individuals with reading tasks. Although the chosen sample text was relatively straightforward, it served as a valuable validation of the core functionalities of the smart glasses design.

Moving forward, future research efforts will focus on further enhancing the performance of the smart glasses. One key area of improvement will be the implementation of additional image processing techniques to compensate for the limitations of the Raspberry Pi camera. These techniques will aim to enhance the recognition and extraction of text from low-quality images, enabling the smart glasses to handle a broader range of text complexities and variations effectively. By integrating more robust text recognition algorithms, the smart glasses will be able to provide reliable assistance to visually impaired individuals when faced with various reading scenarios. This includes handling more complex texts, such as those with intricate formatting or irregular layouts. Additionally, ongoing research will explore ways to optimize the overall speed and accuracy of the text recognition process, further improving the user experience.

The results obtained from this initial experiment serve as a solid foundation for future advancements in smart glasses for visually impaired individuals. As technology continues to evolve, there is significant potential to refine and expand the capabilities of these assistive devices. With continued research and development, smart glasses can play a crucial role in enhancing the daily lives of visually impaired individuals, empowering them with increased independence and accessibility in various reading and information-based tasks.

V. CONCLUSION

In conclusion, this research paper titled "Empowering Differently Abled Individuals through IoT: Smart Glasses for the Visually Impaired People" has shed light on the potential of smart glasses as an innovative assistive device for individuals with visual impairments. By leveraging the power of Internet of Things (IoT) technology, these smart glasses have the ability to significantly enhance the lives of visually impaired individuals, particularly in the context of reading tasks. The findings of this study have emphasized the importance of providing accessible and affordable assistive technologies for visually impaired individuals. Traditional solutions such as Braille readers, audio books, and screen readers have limitations in terms of cost, functionality, and ease of use. In contrast, smart glasses offer a promising solution by providing a wearable and hands-free device that can assist in multiple daily tasks. They leverage IoT technology to create a more intuitive and natural user experience, eliminating the need for additional direction instructions and offering increased independence.

The design of the smart glasses presented in this research paper utilized a Raspberry Pi 2 as the central processing unit, along with a camera for image acquisition and an earpiece for audio output. This combination of hardware components enabled the smart glasses to capture images of reading materials, process them using image processing techniques, extract the text using optical character recognition (OCR) algorithms, and convert it into audio output through a text-to-speech synthesizer. The experiment results demonstrated the successful functioning of the prototype, validating its effectiveness in assisting visually impaired individuals with reading tasks.

The significance of smart glasses lies in their ability tobridge the gap between visually impaired individuals and the vast amount of printed materials in the world. They empower individuals to access and comprehend information from various sources such as books, documents, and newspapers. By providing real-time text recognition and audio output, smart glasses enable visually impaired individuals to participate more actively in educational settings, professional environments, and everyday activities.

However, there are areas for further research and improvement in smart glasses technology. One key aspect is the enhancement of image processing techniques to ensure accurate and reliable textrecognition, especially when dealing with low-qualityimages. The development of advanced algorithms and machine learning models can contribute to improvingthe overall accuracy and efficiency of the text extraction process.

Additionally, the incorporation of additional functionalities, such as object recognition or navigation assistance, would expand the utility of smart glasses, further enhancing the independence and quality of life for visually impaired individuals. The successful implementation and future potential of smart glasses rely on continuous research, development, and collaboration between experts in various fields, including computer vision, IoT, and assistive technologies. It is crucial to address the economic barriers associated with assistive technologies, ensuring that smart glasses are accessible and affordable for all individuals who couldbenefit from them. Furthermore, user-centered design and usability testing are essential to optimize the user experience and ensure that smart glasses meet the diverse needs and preferences of visually impaired individuals.

To conclude, smart glasses hold great promise in empowering differently abled individuals, particularlythose with visual impairments, by providing a novel and versatile solution for accessing and interacting with the visual world. As technology advances and research progresses, smart glasses have the potential to revolutionize the lives of visually impaired individuals, enabling them to overcome barriers and fully participate in society. By embracing the principles of inclusivity, accessibility, and affordability, we can create a more inclusive society where everyone, regardless of their abilities, can thrive and reach their full potential.

VI. FUTURE SCOPE

This research paper introduces an innovative concept of smart glasses specifically designed to cater to the needs of visually impaired individuals. The design of these smart glasses utilizes the cost-effective single board computer raspberry pi 2 and its camera module. While the primary focus of this paper is on demonstrating the capabilities of the glasses in text recognition, it is important to note that the system can be expanded to accommodate multiple tasks by incorporating additional models into the core program. However, the size limitations of the raspberry pi SD card must be taken into consideration when adding new functionalities. The proposed system allows users to independently select and execute their desired task, thanks to the distinct models representing each specific task or mode. By offering this flexibility, visually impaired individuals can personalize their smart glasses experience based on their unique requirements. The paper delves into the details of the system design, working mechanism, and underlying principles, providing a comprehensive understanding of its functionality.

Furthermore, the experiment results presented in this paper validate the successful implementation of the concept. The positive outcomes of the experiments demonstrate the potential of these smart glasses to significantly improve the lives of visually impaired students, even in the face of economic challenges. The affordability of the raspberry pi 2 and its camera module makes this technology more accessible to a broader user base, ensuring that visually impaired individuals can benefit from its capabilities. Moving forward, the research team acknowledges the importance of user-friendliness and power management optimization in the further development of the smart glasses. It is crucial to prioritize the ease of use and intuitive interface of the system to ensure a seamless experience for visually impaired users. Additionally, optimizing the power management of the computing unit will contribute to maximizing the device's battery life, ensuring extended usage periods without interruption.

In conclusion, this research introduces a new concept of smart glasses designed specifically for visually impaired individuals, employing the raspberry pi 2 as the central processing unit and its camera for image acquisition. The demonstrated text recognition functionality serves as a proof of concept, with the potential for further expansion to incorporate additional tasks. The research highlights the significance of this concept in improving the lives of visually impaired students, regardless of their economic circumstances. The paper concludes by outlining future directions, emphasizing the importance of user-friendliness and power management optimization for a more refined and efficient smart glasses system.

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