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Next gen assistive technology smart glove for blind

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Abstract: God has given all of his creations, but especially humans, the priceless gift of sight. Some people, on the other hand, are denied this beauty and are unable to see the world's wonders for themselves.

"Third Eye for the Blind" is a multidisciplinary initiative that empowers visually impaired people by combining hardware design, software engineering, and scientific ideas. This allows the individuals to confidently and independently explore their environment. This is accomplished by using ultrasonic waves to identify items in the immediate vicinity and deliver feedback in the form of vibrations or beep sounds.

A startling 285 million individuals worldwide are estimated to have visual impairments, according to the World Health Organization (WHO). Of them, 39 million are blind and 246 million have poor vision. These people deal with a lot of difficulties in their day-to-day life. The Third Eye project is a creative approach that provides the blind with significant advantages. "Third Eye" is committed to helping those who are blind or visually impaired identify everyday items and faces. Through the use of machine learning, the system can recognize faces and detect objects. Additionally, it uses Optical Character Recognition (OCR) technology to read text from recognized objects, such as product names and signboards.

Keywords: Smart glove, Image processing text to voice, raspberry pi.

I. INTRODUCTION

New developments in technology have given rise to creative solutions for those who are blind or visually impaired, including the "third eye for the blind." The components of this gadget are a glove with ultrasonic vibrators on the fingertips that are managed by a microcontroller and an ultrasonic sensor attached to the glove's rear. The microprocessor translates the ultrasonic sensor's wave emissions which are reflected off surrounding objects into vibrations that are sent to the glove's fingertips. The wearer's capacity to identify adjacent objects and impediments is improved by the vibrations' tactile feedback, which also helps them travel more autonomously. This system's main objective is to save expenses while providing a workable solution to help blind people connect with their environment more effectively and enhance their mobility. Here, we detect the things using image processing techniques, and then use speech recognition to tell the person in voice over what's around them.

The suggested system is made up of an input microphone for speech modulation, an output speaker and device screen for text and picture display, a camera for image acquisition, and a keyboard for message typing. The device enables text- to-speech (TTS) conversion and allows the user to respond by text message. The little but potent speaker provides the output. The text to speech (TTS) conversion process is used to read a text after the image has been taken by the camera. Additionally, the device recognizes user gestures and displays relevant text. Next, depending on what a typical person would say, the device converts speech to text (STT) and shows it on the screen. It needs inputs from the microphone.

II. LITERATURE SURVEY

[1]. Intelligent Obstacle Avoidance with a Head Mount Wearable Device for the Visually Impaired and Blind By Ke Wang, Andy Song, and Peijie Xu. This essay discusses how people who are blind or visually impaired (BVI) face serious risks and hazards when navigating barriers, especially when they are alone. Therefore, to help BVI individuals with this difficulty, an intelligent head-mount gadget has been designed to prevent this. This gadget is capable of accurately identifying obstructions in real time and issuing alerts. Head-mounted gadgets with sensors, like LiDAR and ultrasonic ones, that can detect obstructions in the user's path in real time.

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AI algorithms are included to improve sensor data utilization and enable smarter decision-making in obstacle avoidance situations. The disadvantage is that object detection becomes less accurate as a result of the user's rapid head motions.

[2]. Deep Learning-Based Smart Glass System for the Blind and Visually Impaire By Jinsoo Cho and Mukhriddin Mukhiddinov.This essay discusses the challenges that people with blindness and other visual impairments face in moving around independently and dealing with everyday issues. Artificial intelligence and computer vision techniques provide a solution by enabling blind and visually im- paired (BVI) people to carry out their daily tasks with less reliance on others. For those living in the BVI, smart glasses offer a possible assistive device that can help with independent travel as well as social comfort and safety. Practically speaking, though, the BVI cannot move by themselves, especially at night and in dimly lit environments.

[3]. Upgraded Real-Time Fire Alert System for Visually Impaired Individuals Utilizing Cutting-Edge Technologies Written by IEEE members Abdusalomov and Akmalbek Bobomirzaevich. In an emergency where fires occur indoors, this paper discusses early fire detection and notification approaches that provide blind and visually impaired (BVI) per- sons with timely access to fire prevention and safety information. Sensor-based technologies are used in most conventional ways to identify fire scenarios; how- ever, these technologies are dependent on changes in illumination and ambient conditions. Additional investigation has revealed that, in order to improve fire safety, camera-based fire-detection systems produce far better outcomes with high prediction accuracy, low cost, and shorter processing times.

[4]. LidSonic V2.0: A LiDAR and Deep Learning Enabled Green Assistive Edge Technology to Boost Visually Impaired People's Mobility By Rashid Mehmood and Iyad Katib. This research discusses blind individuals and suggests a unique method for data collection and object prediction utilizing deep learning for environment perception and navigation. The method involves combining a LiDAR with an ultrasonic sensor and a servo motor. They used this strategy to help the blind identify obstacles by providing them with a pair of smart glasses dubbed Lid Sonic V2.0. The Lid Sonic system comprises of a smartphone app that uses Bluetooth to transfer data and an Arduino Uno edge computing de- vice that is built inside the smart glasses. Arduino collects information, controls the smart glasses' sensors, uses basic data processing to identify impediments, and gives visually impaired users feedback through a buzzer.

[5]. Sensor-Integrated Smart Walking Stick for the Blind by Srinivasan Padmanaban Kamalesh Kumar, Raju Athira, and Ramdas Akshara. There are a lot of visually challenged people in our culture. If you see them, you will know that they require assistance to walk; they cannot go where they are going on their own. In their daily lives, they encounter numerous challenges. Despite the speed at which technology is developing today, there isn't an accessible gadget for those who are visually impaired. Because it is difficult for blind people to carry out their everyday responsibilities, a Smart Blind Stick was created to make movement and task completion easier. But it's extremely risky for visually challenged persons to go on the road since they have trouble seeing potential hazards. Among the greatest tools for pointing is a smart stick. This stick has two ultrasonic sensors that can detect impediments up to four meters away from the user, as well as infrared sensors that can identify stair cases.

[6]. Monitoring Scenes in Real Time for the Deaf and Blind Written by Mitch Miller and Kevin J. Mitchell. This paper discusses the emerging field of research on real-time scene monitoring for deaf-blind people, which aims to improve communication and environmental awareness for those with dual sensory impairments. Researchers investigate the use of machine learning and sensory substitution devices to transmit visual information through touch and audio in-put. A key role is played by wearable technologies, which use haptic feedback and sensors to deliver real-time environment information.

[7]. Outdoor Localization for the Visually Impaired at Intersections Using BLE RSSI and Accessible Pedestrian Signals Written by Anne Roudaut and Junhaeng Lee. This study examines how people who are blind or visually impaired (BVI) navigate crossings on foot. To help address this issue, many nations are now producing auditory signals at crossings for those who are blind or visually challenged. However, because visually challenged individuals are unable to distinguish between signals when traveling across several crossings in intricate road architecture, these accessible pedestrian signals may cause confusion for them. In order to address this issue, we suggest an assistive system known as the Crossing Assistance System (CAS), which gets around the inherent restriction of outdoor noise to allow us to locate the user efficiently. It does this by extending the concept of the BLE (Bluetooth Low Energy) RSSI (Received Signal Strength Indicator) signal for both indoor and outdoor location tracking. In two trials, they deployed the device at a real-world intersection and gathered data to show that outside RSSI tracking is feasible.

[8]. The Unfolding Space Glove: An Apparel for Blind Individuals to Replace Their Spatio-Visual with Haptic Sensations By Lasse Scherffig and Alexander Neugebauer. application and assessment of the open-source sensory

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substitution glove known as the Unfolding Space Glove. It helps with navigation tasks like object recognition and wayfinding by transmit- ting the relative location and distance of nearby objects as vibratory stimuli to the back of the hand, allowing blind persons to haptically explore the depth of their surrounding area. The prototype is visually unobtrusive, functions under all lighting conditions, doesn't require any external hardware, and gives constant and instant input.

III. IMPLEMENTATION

The project is mainly designed for the blind people for their image recognition and processing. this project acts as third eye and guide blind people. Project consist of mainly Raspberry Pi , Camera , Speaker and Mainly Project contains two modules.

- Object Detection and Recognition
- Text Reading to voice conversion

1. Component Selection

The components were chosen based on their compatibility and performance in the context of wireless power transfer and IoT applications. The key components included:

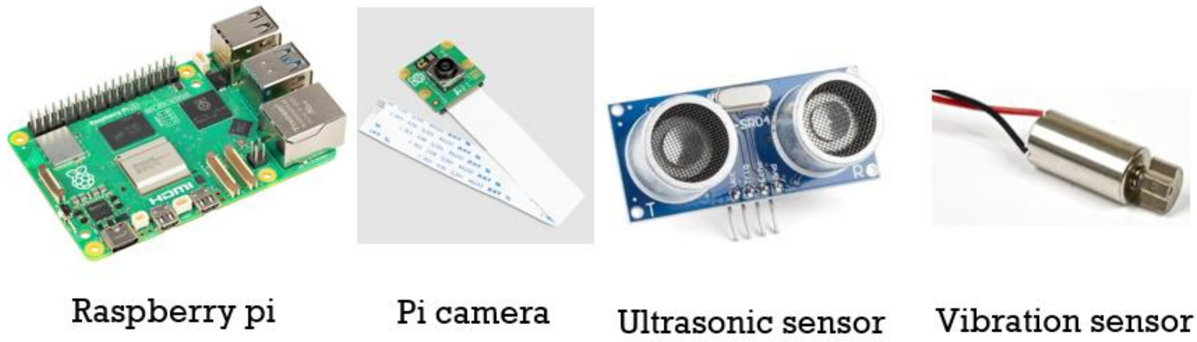

Fig. 1 Components for the project

Raspberry pi: A Raspberry Pi is a small, affordable computer that fits in the palm of your hand. It's popular for DIY electronics projects, learning programming, and running lightweight servers. Its versatility and low cost make it ideal for hobbyists and educators alike.

Ultrasonic sensor: An ultrasonic sensor measures distance by emitting and receiving ultrasonic waves.

Raspberry pi camera: The Raspberry Pi Camera is a compact, high-resolution camera module designed for Raspberry Pi boards, ideal for capturing images and video in various applications.

Vibration sensor: Provided a stable power supply to the entire system.

2. Hardware Assembly

To set up the hardware for this project, begin by connecting the Raspberry Pi Camera module to the CSI (Camera Serial Interface) port on the Raspberry Pi board, ensuring it's securely seated. Next, connect the ultrasonic sensor: wire its VCC and GND pins to the 5V and GND pins on the Pi respectively, connect the Echo pin to a GPIO input pin (like GPIO17), and the Trig pin to another GPIO output pin (like GPIO18). For the vibration motor, connect its positive lead to a GPIO pin configured as an output (like GPIO27) through a transistor for sufficient current handling, and connect its negative lead to ground. Ensure all connections are secure and consider using a breadboard for ease of prototyping. This setup allows the Raspberry Pi to capture images and video through the camera module, detect objects using the ultrasonic sensor, and activate the vibration motor based on programmed conditions, enabling a versatile IoT or robotics application.

3. Software Development

The software for this project, ensure system is up to date and install necessary libraries like `RPi.GPIO` for GPIO control and either `pi camera` or `open cv` for the camera module. Set up GPIO pins for the ultrasonic sensor's Trigger and Echo,

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and for the vibration motor, then initialize the camera module with appropriate settings. The program will continuously read distance measurements from the ultrasonic sensor and activate the vibration motor when an object is detected within a specific range. Additionally, integrate functionality to capture images or video based on sensor readings. Ensure proper resource cleanup of GPIO pins and the camera upon program exit to prevent hardware issues, enabling the Raspberry Pi to effectively manage the camera, sensor, and motor for versatile IoT or robotics applications.

4. System Integration and Testing

For system integration and testing, start by verifying individual components: ensure the camera module captures images and video correctly, the ultrasonic sensor accurately measures distances, and the vibration motor activates as expected when triggered. Next, integrate these components into a single program, initializing the GPIO pins and camera, and setting up a loop to continuously read sensor data, activate the motor based on distance thresholds, and capture images when specific conditions are met. Conduct comprehensive testing by simulating various scenarios, such as objects at different distances, to validate that the system responds correctly and consistently. Monitor the system for any anomalies or performance issues, ensuring all components function seamlessly together. Finally, implement error handling and resource cleanup to maintain hardware stability and reliability.

5. Challenges and Solutions

One challenge you might face in this Raspberry Pi project is managing power and ensuring stable operation of the vibration motor, especially when driven directly from the GPIO pins, which can only supply limited current. This could lead to inconsistent motor performance or potential damage to the GPIO pins. The solution is to use a transistor as a switch to handle the higher current required by the motor. By connecting the motor's positive lead to a power source and using the transistor's collector-emitter path to ground the motor, you can control the motor with a GPIO pin connected to the transistor's base through a current-limiting resistor. This setup ensures the motor receives adequate current while protecting the Raspberry Pi, resulting in more reliable and efficient operation of the vibration motor.

IV. WORKING

Projects consist of mainly Raspberry-Pi, Camera, Speaker and Mainly Project contains two modules Object Detection and Recognition & Text Reading so that blind can read text. Character segmentation errors frequently result in low recognition rates for Optical Character Recognition, the original technique for character recognition. An essential function of any OCR system is segmentation. It divides the picture text documents into words, characters, and lines. The segmentation algorithm that is being employed has a major impact on the OCR system's accuracy. When compared to printed English or any other printed document, handwritten text is more difficult to segment due to its more complicated structure and larger character set. It has both vowels and consonants. There may be some character overlap. Only characters and lines that do not overlap can be segmented using profile-based approaches. This essay discusses the division of a handwritten text document into lines, words, and characters using the most widely used script in the Indian subcontinent. In this step, the text images are taken via the built-in camera. The camera being utilized determines the quality of the image that is captured. We are employing a webcam with a resolution of 2592 x1944 pixels and at least 5MP.

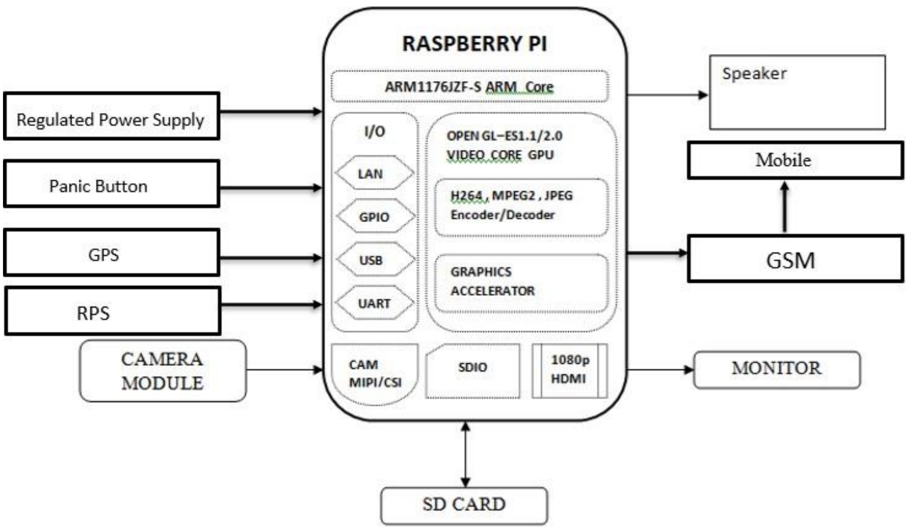

Fig. 2 Block diagram

Image pre-processing process includes thresholding, warping, cropping, noise reduction, edge detection, and color to grayscale conversion. Since many OpenCV functions require the input parameter to be a grayscale image, the image is transformed to grayscale. Bilateral filters are used to reduce noise. To improve contour detection, the grayscale image is subjected to canny edge detection. The image is cropped and twisted in accordance with its contours. This allows us to eliminate the undesired backdrop and identify and extract only the text-containing section. Thresholding is ultimately applied to the image to make it resemble a scanned document. This is done so that the image may be efficiently converted to text using OCR.

Image to text conversion the text-to-speech pipeline is depicted above. The OCR and picture pre-processing components make up the first block. The pre-processed image in.png format is changed to a text file (.txt). Our tool of choice is Tesseract OCR. The voice processing module is located in the second block. The.txt file is converted to an audio output. Here, a Festival TTS speech synthesizer is used to translate the text to speech.

Object Detection and Speech Output Analysing video sequences is the process of video surveillance. In the field of computer vision, it is active. It has enormous data display and storage capacity. Activities related to video surveillance fall into three categories. There are three types of video surveillance operations: fully autonomous, semi-autonomous, and manual. Human content analysis is included in manual video surveillance. These days, a lot of people use these systems. While there is some visual processing involved in semi-autonomous video surveillance, there is still a lot of human interaction. Carry out basic motion detection. A human expert will only record and send the footage if there is noticeable motion for analysis. The only input for a fully autonomous system is the video sequence captured at the location of the surveillance.

V. RESULT

The Next gen assistive technology smart glove for blind is demonstrated several successful outcomes, aligning with the project's goals and objectives. The results can be categorized into several key areas, highlighting the system's performance, user experience, and overall efficiency.

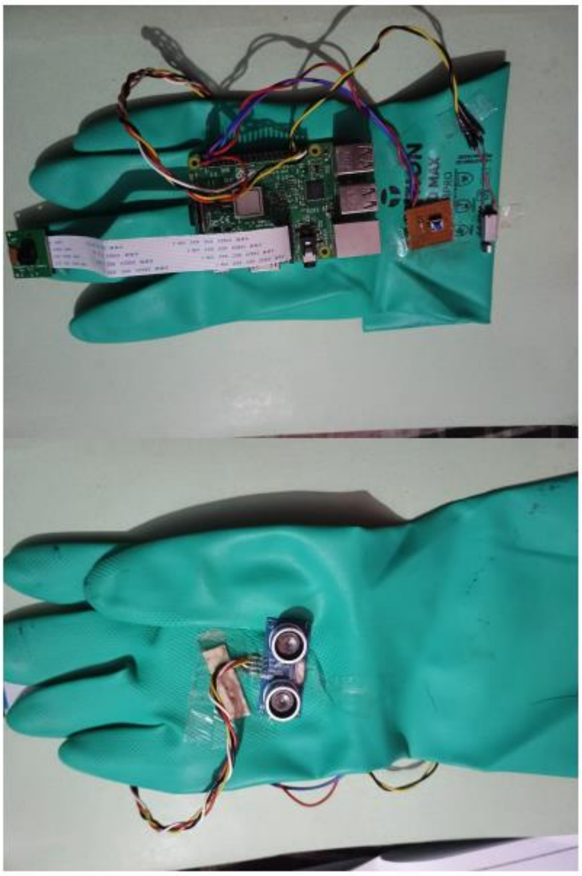

Fig. 3 Project output

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The image to speech conversion system with blur detection was implemented using a Raspberry Pi 3B, a Raspberry Pi Camera 5MP, a speaker and an amplifier. The software was developed using Python and the following libraries: OpenCV (cv2), Raspbian OS, NumPy(numpy). If the broader topic development "blends the perspective of marketing, design, and manufacturing into a single approach to product development," then design the act of talking the marketing information and creating the design of the product to be manufactured. Systems design is therefore the process of defining and developing systems to satisfy specified requirements of the user.

Pseudo code

Pseudo code is an informal high-level description of the operating principle of a computer program or other algorithm. It uses the structural conventions of a programming language, but is intended for human reading rather than machine reading. Pseudocode typically omits details that are not essential for human understanding of the algorithm, such as variable declarations, system-specific code and some subroutines. The programming language is augmented with natural language description details, were convenient, or with compact mathematical notation. The purpose of using pseudo code is that it is easier for people to under- stand than conventional programming language code, and that it is an efficient and environment independent description of the key principles of an algorithm. It is commonly used in textbooks and scientific publications that are documenting various algorithms, and also in planning of computer program development, for sketching out the structure of the program before the actual coding takes place.

Image-to-speech using camera (ITSC)

The second process is developed for blind people who cannot read normal text. In order to help blind people, we have interfaced the Logitech camera to capture the image by using OPENCV tool. The captured image is converted to text using Tesseract OCR and save the text to file out.txt. Open the text file and split the paragraph into sentences and save it. In OCR, the adaptive thresholding techniques are used to change the image into binary images and they are transferred to character outlines. The converted text is read out by the espeak.

VI. CONCLUSION

The purpose of this essay is to address the obstacles that visually impaired people must overcome on a daily basis. This research discusses a hand glove prototype that can assist eliminate problems to some extent. Some of the capabilities of this glove that enable blind people to navigate smoothly without assistance from others are obstacle detection, object identification, image to text and text to speech conversion. Experimental Results confirms its correctness and guarantees blind people can utilize it in their daily lives. This glove offers a plethora of career opportunities. It may be connected via IOT in the future. Therefore, family members should always be watching a blind person as they move. Additionally, a vocalizer can be added to this glove, allowing all types of disabled people to utilize it (Deaf Dumbs).

REFERENCES

[1]. Rocha, D.; Pinto, L.; Machado, J.; Soares, F.; Carvalho, V. Using Object Detection Technology to Identify Defects in Clothing for Blind People. Sensors 2023.

[2]. Busaeed, S.; Katib, I.; Albeshri, A.; Corchado, J.M.; Yigitcanlar, T.; Mehmood, R. LidSonic V2.0: A LiDAR and Deep-Learning-Based Green Assistive Edge Device to Enhance Mobility for the Visually Impaired. Sensors2022,22,7435.

[3]. Xu, P.; Song, A.; Wang, K. Intelligent Head-Mounted Obstacle Avoidance Wearable for helping the Blind and Visually Impaired. Sensors 2023, 23,9598.

[4]. A.B. Abdusalomov, M. Mukhiddinov, A. Kutlimuratov, and T.K. Whangbo. Enhanced Real-Time Fire Alert System Utilizing Cutting-Edge Technolo- gies for Individuals with Visual Impairments. 2022, 22, 7305 sensors.

[5]. A wearable assistive device that integrates a fuzzy decision support system for visually impaired and blind people was designed and developed by Boutera,Y. 2021; Micromachines 12, 1082.

[6]. Smart Blind Walking Stick with Integrated Sensor, Akhil, P., Akshara, R., Athira, R., Kamalesh Kumar, S.P., Thamotharan, M., and Shobha Christila,S. Mater. Proc. 2022, 10,12.

[7]. Shin, K., Chang, M.; Han, C.; Lee, J.; Roudaut, A.; McConville, R.; Metatla,O. Outdoor Localization for the Visually Impaired at Intersections Using BLE RSSI and Accessible Pedestrian Signals. 2022, 22 and 371 sensors.

[8]. The Unfolding Space Glove: A Wearable Spatio-Visual to Haptic Sensory Substitution Device for Blind People is published by Kilian, J., Neuge- bauer, A., Scherffig, L., and Wahl, S. Sensors 1859, 2022, 22.

[9]. Kassem, K.; Caramazza, P.; Mitchell, K.J.; Miller, M.; Emadi, A.; Faccio, D. Real-Time Scene Monitoring for Deaf-Blind People. Sensors 2022, 22, 7136.

[10]. Mukhiddinov, M. and Cho, J., "Deep Learning-Based Smart Glass Sys- tem for the Blind and Visually Impaired." Electronics 20, 2756 (2020).