Smart Glasses for Visually Impaired Person

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***Abstract*— This paper is about the idea proposal and design of the computer-aid glass for sightless people to help them find the target object in a limited range area. This is a serious challenge to find a pen on the table for a person with no vision. Now, the user can just command this smart glass, the name of the desired object and then the glass will start to scan the area for finding the target. According to object distance, the glass will navigate the person to the object. Finding distance is calculated by the raspberry pi based on the data from the Dual camera. Voice command is received by the microphone and transferred to raspberry pi by an ADC and the navigation is released by a speaker from a DAC. Machine learning is the main key to scanning objects and understanding the voice command. Python is the program environment that has been used for this project. During this quarter, general logic design, preparing the requirement components, and testing them individually have been done.**

I. Introduction

According to the World Health Organization, the number of individuals with visual impairments has been steadily rising over the past few decades. (WHO). Near- or farsightedness affects at least 2.2 billion people worldwide, which has a major financial impact. In reality, it's estimated that productivity losses due to vision impairments cost the economy around US$411 billion annually.

Technology that is accessible to people with disabilities is becoming more and more crucial to helping people with vision problems. The head-mounted device is a common kind of assistive technology. These gadgets have a big advantage over other gadgets because they naturally point in the direction of viewing, so no extra directions are required. Head-mounted gadgets have consequently emerged as the preferred technology for many users who [2].

A new set of glasses called the OrCam My Eye 2 is intended to aid those who have vision problems. Any set of eyeglasses can have a smart camera mounted on the frame, and it employs audio feedback to speak visual information to the user. By using voice commands to guide the device to the desired spot, where it will read the text out loud, users can navigate text with ease. Users can ask the device to guide them to doors and other objects using an orientation feature that is currently under development on the device. Overall, the OrCam My Eye 2 offers a practical and convenient way to assist people with vision impairments in navigating their environment, possibly enhancing their quality of life.

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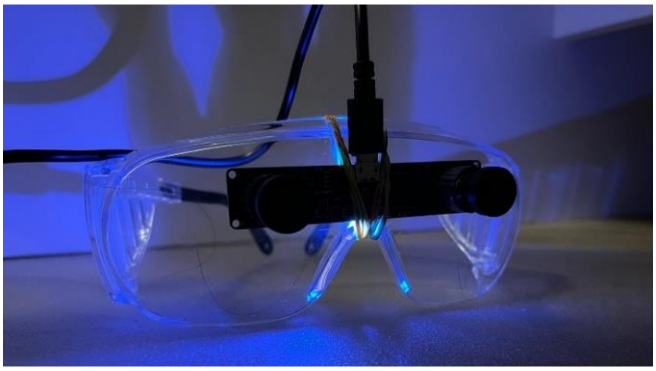
Visual Aid Glasses for Sightless People, our initiative, is a piece of disability accessibility technology created to assist people who are blind or visually impaired in navigating their environment. The two primary features of our glasses are distance detection and object recognition. They can identify target items input by the user and can detect objects in their line of sight. They have a buzzing function to warn users when things are approaching or moving away. For the convenience of use, our product also includes voice interaction. By giving blind or visually impaired people a handy and useful tool to aid them in navigating their surroundings, our product aims to better their quality of life.

Our Visual Aid Glasses primarily employ distance measurement with the camera and object recognition based on the OpenCV edge detection algorithm. Machine learning techniques are included in the potent library OpenCV to address computer vision issues. In our project, we use OpenCV to recognize items and to pinpoint specific objects that users mention while interacting with the glasses within the device's range.

We use the camera and a Canny edge detection algorithm to measure distances. This algorithm aids in measuring the user's distance from adjacent objects, which is essential for precise navigation. Combining these techniques, our product can identify objects and calculate distances, giving visually impaired people the knowledge, they need to manage their environment successfully.

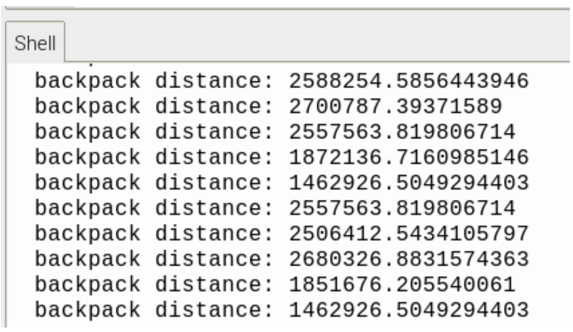


II.

III. MATERIALS USED

A Raspberry Pi 4 Model B offers the required processing power to process data and carry out object recognition in our smart glasses for visually impaired people. Impressive 8GB RAM, a Broadcom BCM2711 64-bit quad-core CPU running at 1.5GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 5.0, and gigabit Ethernet are all included in the Raspberry Pi 4 Model B. Additionally, it has two USB 3 connections and two USB 2 ports for connecting a camera for computer vision processing. On the Raspberry Pi, we run our software, which contains object detection for a specific object as requested by the user. Our glasses can process data swiftly and precisely using the robust computing powers of the Raspberry Pi 4 Model B, giving visually impaired people the knowledge, they need to successfully navigate their surroundings.

The dual-lens USB camera we've decided to use has a 960p resolution, stereo synchronized lenses, and a 1.3MP dual lens video webcam functionality. The camera is perfect for our needs because it has a 100-degree field of view and operates without deformation. The Raspberry Pi 4 Model B, which offers the required processing power for data processing and object recognition, is connected to the camera. We have chosen a Dollatek lithium battery pack expansion board with a switch and a 3800mAh capacity to power the Raspberry Pi, providing 5V electricity to the gadget. The user can conveniently use the smart eyewear while on the go thanks to this battery pack's portability. Overall, the goal of these hardware elements is to build a prototype of smart eyewear that works well. For the glasses to correctly detect and recognize objects in the user's environment and give them the information they need to navigate their surroundings, each sensor and actuator has been carefully chosen. The concept of smart glasses has been applied in a variety of contexts, including as a support system for Alzheimer's patients, and we think that our prototype has a great deal of potential to help visually impaired people in their everyday lives. [5].


Shell
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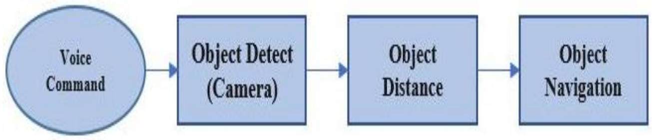
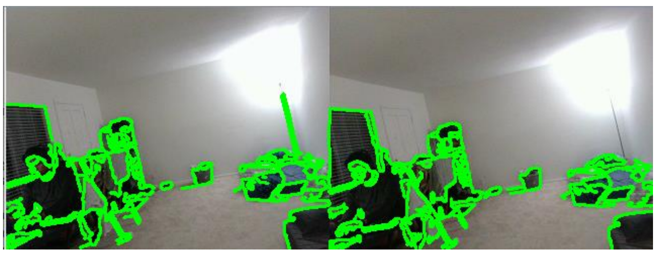
IV. HIGH-LEVEL HARDWARE AND SOFTWARE SYSTEM

Machine learning methods are the foundation of the sophisticated software system used in smart glasses. In order to handle object recognition issues, the OpenCV library is used. The COCO file includes frequently found items like people, cars, and cell phones. The camera records live pictures that are then converted to regular pixel sizes. Deep Neural Networks (DNNs) are used by OpenCV to create setup weight files and train the model. The network is then created by loading these files. To determine the class, confidence level, and shape of an object that has been identified, use OpenCV's detect method. On the screen, a rectangular frame is drawn around the detected item, and text information is shown within it.



V. METHODS

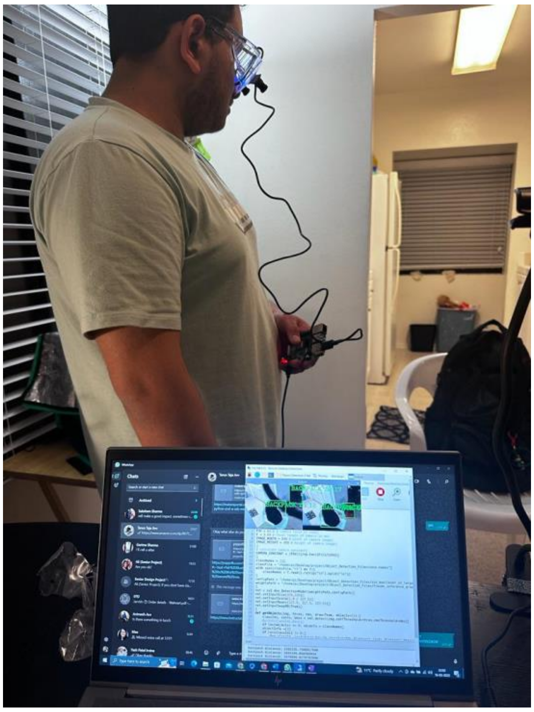
To ensure the seamless and effective functioning of the glasses, various methodologies are employed. For instance, to enable the feature that assists the user in finding a specific object, a program is designed and an object detection model is deployed. The code begins by initializing a camera object using OpenCV's VideoCapture function, where the camera's FOV and focal length are defined in degrees and millimeters, respectively. A camera constant is then calculated using these values, which are used to convert the size of an object in pixels to its actual size in millimeters. This is a crucial step in applications where knowing the real-world size of detected objects is necessary, such as in robotics or industrial automation.



Furthermore, the code loads a pre-trained object detection model using OpenCV's DNN module. The model used is ssd_mobilenet_v3_large_coco_2020_01_14, trained on the COCO dataset, and its configuration file and weights file are loaded from configPath and weightsPath, respectively. The input size, scale, mean, and channel swapping parameters are then set for the model. The setInputMean function sets the mean values for the input image, as the model was trained on images with mean values. Additionally, the setInputSwapRB function is set to True to swap the Red and Blue channels of the input image, as OpenCV reads images as Blue Green Red (BGR) channels, but the model expects Red Green Blue (RGB) channels.

Overall, the code utilizes a pre-trained object detection model to detect objects in real-time video from a camera, using the MobileNet v3 architecture trained on the COCO dataset. By applying these techniques, the glasses can accurately and effectively recognize and locate objects, improving the overall user experience.

To understand how we map the distance of the object from the user, we start with a breakdown of the distance detection part alone. The camera's initialization and definition of its characteristics, such as its field of view, focal length, and image size, are done in the first section of the code. These variables are used to determine the camera constant, which is then used to calculate the distance to objects that are subsequently detected. After that, the program starts a loop that records every frame of the video stream and analyzes it to look for objects. To minimize noise, the frame is first made grayscale, and then it is blurred with a Gaussian filter. The Canny edge detection algorithm is used to identify the edges of the items in the image.



The cv2.findContours function is then used to locate the contours of the edges that were identified. In a sense, contours define the boundaries of the items in an image. Only the outermost contours should be taken into account, according to the RETR_EXTERNAL signal, and the contours should only be approximated using their endpoints, according to the CHAIN_APPROX_SIMPLE flag.

The area and perimeter are then determined for each contour as the loop iterates over the identified contours. Since they are likely to be noisy, contours with regions smaller than 100 pixels are disregarded. The cv2.approxPolyDP function is then used to approximate the contour as a polygon, which minimizes the number of vertices required to describe the contour.

The distance to the object is calculated using the width and height of the bounding rectangle as well as the camera constant when the polygon has four vertices and is considered to be a rectangular object. The console is then written with the distance.

The initial frame is then shown with the contours that were detected overlaid on top.

VI. RESULTS

The project was successfully finished, and we were able to recognize five objects that a team member had entered and had chosen based on how relevant they were to their everyday lives. The detection of these objects' distances when they enter the frame has also been effectively implemented. The Canny edge detection and contour functions are used by the distance recognition algorithm. The contour is ignored when the area of the contour is less than the threshold number. Additionally, the Ramer Douglas Peucker algorithm is used to estimate the contour as a polygon using the approximate polygon function. We can correctly recognize the object with a precision of 75% or higher using these three algorithms to determine its distance from the user. The customer is then informed of this information.

VII. CONCLUSION

The initiative had many goals. The main objective was to determine the locations of five necessary objects that blind people would need and to recognize them and deduce their locations. The second goal was to correctly map the user's proximity to the object and convey this information to the user. The team also wanted to incorporate haptic actuators, particularly vibration motors, to show the user the object's direction. In order to direct the user to the object's position, the team had trouble segmenting the space into distinct areas. Despite these difficulties, the study produced insightful information about the difficult process of object recognition and location mapping for people with visual impairments.

VIII. SUMMARY

It's essential to consider the possible effects of this technology on people with disabilities or visual impairments in addition to the project's technical aspects. The glasses could facilitate everyday activities and enhance their quality of life in general. There are countless opportunities to enhance spectacles and increase their functionality as technology develops.

Additionally, this endeavor is an excellent representation of how computer vision methods and algorithms can be used to solve actual issues. The program makes use of OpenCV, a well-liked computer vision library that offers numerous functions for analyzing images and videos. This code's algorithm combines object recognition, edge detection, and contour detection. To locate the edges of items in an image, the edge detection algorithm Canny edge detector is used. The contours of the items are then determined using the contour detection algorithm. Last but not least, the object detection algorithm employs a trained neural network to recognize the particular items contained within the contours.

There are countless opportunities for further development and expansion of technology, and glasses can help people with disabilities and enhance their quality of life.

IX. REFERENCES

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