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Sensor-Based Assistive Device for Visually Impaired People

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Abstract: This paper presents the design and development of a sensor-based assistive device for visually impaired individuals, integrating object detection, Optical Character Recognition (OCR), and color detection capabilities. The device is equipped with advanced sensors and cameras to detect and identify objects in the environment, providing real-time audio feedback to the user. The OCR function enables reading text from printed materials, converting it into speech for improved accessibility. The color detection feature also allows users to recognize colors, enhancing daily activities such as choosing clothing or identifying objects. This assistive device aims to empower visually impaired individuals by improving their mobility, independence, and interaction with their surroundings through cutting-edge technology.

The **"SENSOR BASED ASSISTIVE DEVICE FOR VISUALLY IMPAIRED PEOPLE"** is a wearable device designed to assist individuals with visual impairments by providing real-time object detection and auditory feedback. Utilizing advanced computer vision techniques, the goggle is equipped with a camera that identifies surrounding objects, and people in the environment. The detected objects are processed using Artificial intelligence mark-up language (AIML) algorithms for accurate classification and recognition.

Keywords: OCR, text to speech, real-time object detection, API.

I. Introduction

The Sensor-Based Assistive Device for the Blind is an innovative solution designed to empower visually impaired individuals by enhancing their awareness of the surrounding environment. This smart device integrates multiple technologies, including object detection, Optical Character Recognition (OCR), and color detection, to provide comprehensive assistance in daily activities. Using advanced sensors and AI algorithms, the device identifies nearby objects and obstacles, alerting the user through tactile or auditory feedback. The built-in OCR feature allows users to read printed text by converting it into speech, while the color detection capability helps in identifying different colors, which is useful for tasks like selecting clothes or identifying items. Compact and wearable, this device is a powerful tool for promoting greater independence, safety, and convenience for the visually impaired.

II. Proposed Method

The proposed system has a fully functional model of smart glasses that are built to assist the visually impaired people in several ways. It detects the object and give the real time audio feedback to the person.

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III. SYSTEM DESIGN

The system design of the proposed model consists of 2 parts: the hardware and the software.

1) Hardware design:

The various components that are used to build the device are:-

a) Raspberry Pi: Raspberry Pi is a pocket-sized minicomputer that is available in various models with the latest model of Raspberry Pi 4 B. The model that we are using in this system is Raspberry Pi 3 B It requires a connected keyboard, mouse, display, power supply memory card, and an installed operating system. It includes GPIO (General Purpose Input/Output) pins to control various sensors. It is used for various educational purposes, coding, and building software. The operating system that we are going to use in this system is the Raspbian operating system.

b) Webcam: A webcam is a small digital video camera that connects to a computer or network, allowing users to capture video in real-time for various purposes such as video conferencing, live streaming, online classes, and remote communication.
In this model, we have used a (2 MP) webcam to detect the object. Features of 2MP web camera:

- Resolution:-The camera captures video or still images at a resolution of 1600 x 1200 pixels. This is sufficient for most online communications, though not as high as 4K or Full HD cameras. For video, this typically means 720p HD or slightly higher video quality, depending on the camera's capabilities.
- Video Quality:-30 fps (Frames Per Second): Most 2MP webcams offer smooth video at 30 frames per second, which is the standard for video conferencing and casual video chats. Auto-focus and Auto-light adjustment: Some 2MP cameras include automatic focus and lighting adjustments to improve image quality in different lighting conditions.
- Field of View (FOV):-Field of View refers to how much of the environment the camera can capture. A typical 2MP webcam might have a field of view ranging from 60° to 90°.

c) Earphones: By using earphones, the system ensures that the feedback is discreet and directly accessible to the user without disturbing others, while also offering an intuitive means of communication that complements the sense of hearing, often heightened in blind individuals. Additionally, the use of earphones minimizes distractions from external noise, enhancing the overall experience of the assistive device. In this model, we are using earphones with both ambient and ANC features.

- Ambient earphones are designed to allow users to hear the sounds of their surroundings while listening to music or other audio. These earphones are particularly useful in environments where situational awareness is important.
- ANC (Active Noise Cancellation) uses advanced technology to reduce unwanted ambient sounds, providing a more immersive listening experience.

2) Software design:

The various software technologies used to build the device are:-

a) Open CV library: Open CV stands for OPEN- SOURCE COMPUTER VISION which is used for machine learning projects. Released under the BSD 3 Clause license, it is free to use. It is compatible with both desktop and mobile devices and supports all major operating systems. In this model, we are using it on the Raspbian operating system as it offers some predefined libraries.

b) .Text To Speech: In sensor-based assistive devices for visually impaired people, text-to-speech (TTS) technology enhances object detection by providing real-time auditory feedback. These devices use sensors like ultrasonic, infrared, or cameras to detect obstacles or important objects in the environment, once an object is identified, the system converts this information into spoken words using TTS, which is then relayed to the user

IV. IMPLEMENTATION

We have used Python language for programming the model in open CV.

Step 1: **Importing Libraries**

1. import cv2
2. import pyttsx3

- import cv2: This is the OpenCV library, used for computer vision tasks such as image and video processing. It includes methods for loading the deep learning model and performing real-time object detection.
- import pyttsx3: This is a Python text-to-speech (TTS) library that converts text into spoken words. It is used to announce the names of detected objects verbally

Step 2: **Object Detection Function**

```
def getObjects(img, thres, nms, draw=True, objects=[]):
classIds,confs,bbox=
net.detect(img,confThreshold=thres,nmsThreshold=nms
)
```

Step 3: **Text-to-Speech Initialization**

```
engine = pyttsx3.init()
def speak(text):  engine.say(text) engine.runAndWait()
```

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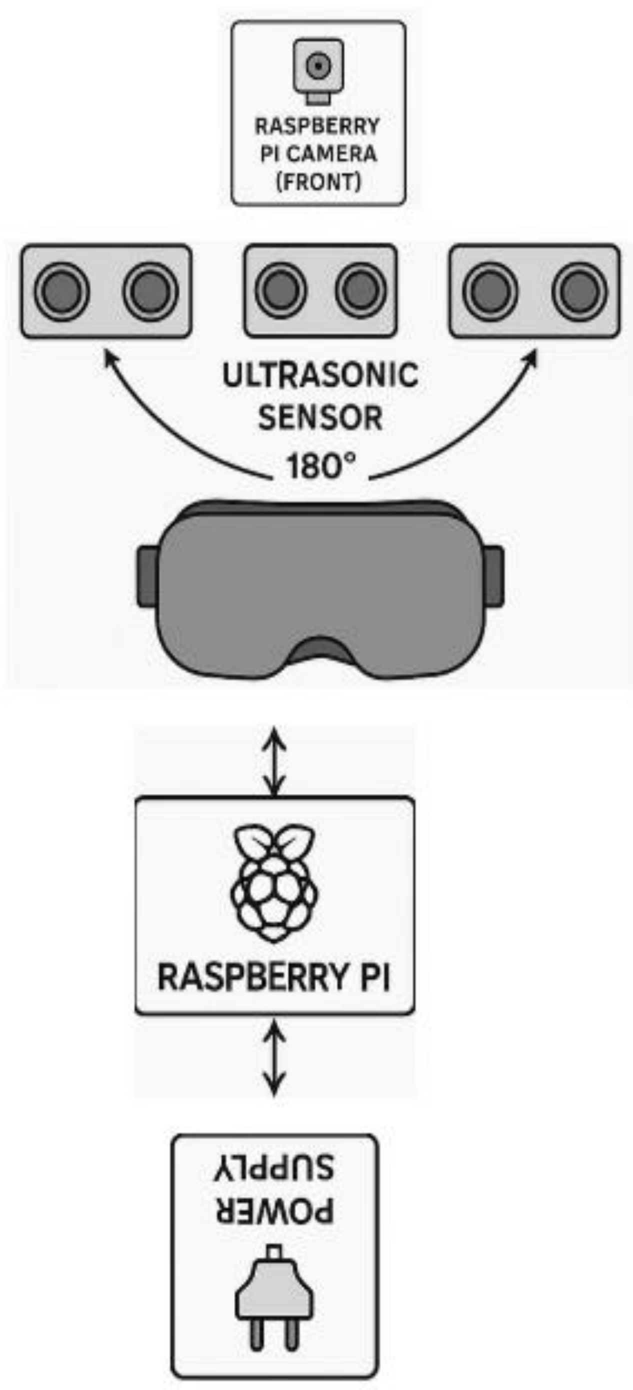
V. BLOCK DIAGRAM



VI. CONCLUSION:

Sensor-based assistive devices for visually impaired people hold great promise in enhancing mobility, independence, and safety. These devices, which utilize various sensors (e.g., ultrasonic, GPS, and cameras), provide real-time feedback to users, helping them navigate their surroundings more effectively. Successful devices are characterized by accuracy, ease of use, comfort, and long battery life. They can significantly improve the quality of life by reducing obstacles, increasing confidence, and fostering greater independence. However, challenges such as cost, accessibility, and user adaptability remain, and ongoing advancements are needed to address these issues. Ultimately, these devices have the potential to transform daily experiences for visually impaired individuals, enhancing both their mobility and overall well-being.

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