Smart Assistance For Visually Challenged With Object And Facial Recognition

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Abstract- *This study presents a revolutionary smart assistant system that offers complete support for object identification, facial recognition, voice assistance including spatial awareness, therefore empowering those with visual impairments. With its extensive support for item identification and spatial recognition, the proposed smart assistant system is a major development in assistive technology for those with visual impairments. This system attempts to improve the freedom and quality of life for people with visual problems by integrating state-of-the-art technology. People who are visually impaired face unique obstacles in their everyday lives as a result of their handicap. Blind individuals face a difficult struggle in a society where the majority of knowledge is transmitted through sight and reading. In order to empower those who are blind or visually challenged, this project suggests developing an assistive technology solution utilizing Raspberry Pi. The Raspberry Pi Face recognition and Object detection systems are the foundation of this project. When the distance between the ultrasonic sensor and the subject drops below 20 cm, the camera will identify the subject and say their name over headphones.*

Keywords- 1, Object identification 2, Facial recognition 3, Voice assistance 4, Spatial recognition 5, Raspberry Pi 6, Visual impairments

7 *Highlights:*

- *Individuals who are visually impaired may have trouble identifying and differentiat-ing between items and people, which can have a detrimental effect on their quality of life.*
- *This project uses the Raspberry Pi microprocessor in conjunction with an ultrasonic sensor, a pi camera, an input microphone, and headphones.*
- *The cornerstone of this project is the Face and Object recognition systems built on the Raspberry Pi. A smart assistant for the blind and visually impaired may significantly improve the independence and quality of life for persons who are blind or visually impaired by offering capabilities like item identification, voice assistance, facial recognition, and spatial awareness, among many other benefits.*
- *The Raspberry Pi camera is useful for facial and object identification. While spatial awareness aids in fostering an awareness of one's surroundings, voice assistance aids in providing information about the user's needs.*
- *The user receives all of the information via a Bluetooth headset, enabling them to take appropriate action. Improved Object, Efficient Navigation, Safety, Enhanced Social Interaction, Educational Support, Employment Opportunities, Reduced Dependency, Continuous Improvement, and Integration with Other Technologies are a few of the main benefits.*

I. INTRODUCTION

In today's rapidly evolving technological world, there is constant development aimed at improving accessibility and inclusion for those with diverse needs. The creation of assistive technology stands out among these developments as a shining example of progress, enabling people with visual impairments to move around the world more independently and comfortably.

For day-to-day living, the capacity to perceive and identify faces and things is necessary. However, this talent can provide a substantial barrier for people who are visually challenged. Individuals who are visually impaired may have trouble identifying and differentiating between items and people, which can have a detrimental effect on their quality of life. Modern technologies like Raspberry Pi and advanced image processing techniques may be employed to tackle this issue. Essentially, this assistant employs object recognition technology to distinguish and describe distinct objects that are in the user’s environment. Additionally, it has spatial recognition features that let users confidently explore unknown areas and comprehend the layout of their surroundings. The camera acts as the system's main component, continuously taking pictures that are processed into audio based on the datasets that are supplied. Image processing has advanced significantly in recent years in the field of computer vision, notably in the detection of faces and objects.

II. PROPOSED SYSTEM

This project uses a Raspberry Pi microprocessor in conjunction with an ultrasonic sensor, a pi camera, an input microphone, and headphones. The Raspberry Pi Face and Object recognition systems are the foundation of this project. The distance between an item or person is measured using an ultrasonic sensor. The camera identifies the person or item with their name and speaks it over headphones as soon as the ultrasonic sensor distance is less than 20 cm. In addition, a microphone is positioned for questioning, and headphones are used to hear the responses that are given. In addition to object and text recognition, our methodology will also incorporate color recognition. By utilizing advanced color sensing technology, our system will describe the colors of objects and their surroundings, further enhancing the user's spatial awareness and enriching their understanding of the environment. To achieve these goals, we will develop a robust and efficient data collection process, creating a diverse dataset of objects, texts, and colors, which will be used to train and fine-tune our machine learning models. The project's success will depend heavily on iterative development and ongoing user feedback, which will guarantee that the system adapts to the particular requirements and preferences of its users.

2.1. Need for the project

1. Independence: The initiative gives blind people the ability to move about their environment more freely by helping them identify faces and things and by improving their spatial awareness. It fosters more independence and self-sufficiency by lowering their need on others.
2. Safety: Being aware of one's surroundings, avoiding obstacles, and securely traversing environments all depend on spatial awareness. Voice aid helps blind people navigate unfamiliar places and recognize possible risks by giving them real-time information about the architecture of a room.
3. Social Inclusion: Thanks to facial recognition technology, blind persons can recognize and communicate with others around them more successfully. By facilitating easier communication and contact with others, both known and unknown, this promotes social inclusion.
4. Efficiency: Voice help may provide blind people rapid and easy access to information about things and their surroundings, enabling them to work more productively and navigate their surroundings more easily.
5. Accessibility: Having technology at one's disposal to help with object and facial identification, as well as spatial awareness, makes places like homes, public places.
6. Quality of Life: In general, the project intends to improve blind people's quality of life by providing them with tools and technology that increase their capacity to engage with others, participate in everyday activities, and interact with the environment around them. It can support more self-assurance, social interaction, and general wellbeing.

III. METHODOLOGY

- There are two modes in this project. There are two modes available: object detection with facial recognition and voice assistance.
- The value will be read by the ultrasonic sensor after the kit is started. The camera takes a picture and uses Conventional Neural Networks (CNN) and OpenCV to identify the item when the ultrasonic sensor distance is less than 20 cm.
- When a human object is identified with OpenCV and the Harr Cascade algorithm, headphones are used to enunciate the person's name. It reads "Unknown person" if the individual is not known.
- The voice assistant mode generates speech responses to user questions, utilizing the chatgpt server to deliver comprehensive responses.
- To ask questions, an input microphone is positioned; the data is then read, directing

the user to the chatgpt server to get the answer. After that, the text is transformed to voice output using a piaudio module, and the response is audible through headphones.

3.1. Algorithm used:

Software requirements

- Raspberry Pi
- Python

Hardware requirements

- Raspberry Pi
- Pi Camera
- Ultrasonic Sensor
- Input Microphone
- Headphones

3.2 Software description

A unique piece of software called Vision Assist was created to offer visually impaired people full support. Vision Assist enhances the freedom and quality of life for blind users by utilizing Convolutional Neural Networks (CNN) and Open CV (Open Source Computer Vision Library) to provide sophisticated functions including object identification, voice assistance, and facial recognition.

3.2.1 Facial Recognition

Usually, in order to collect, process, and recognize faces, facial recognition software on a Raspberry Pi combines hardware and software elements. It requires a Raspberry Pi board, a camera module (like the Raspberry Pi Camera Module), and maybe some other extra accessories like headphones. The scene in front of the camera module is captured in still or moving photos by the module. After that, the program receives these photographs to process. To find faces in the photos, processing is done on them. Algorithms that examine the image's pixels to determine which areas most likely contain faces are used in this procedure. After faces are identified, the program gathers information about each face, including the dimensions and forms of the mouth, nose, and eyes. Each face is then given a distinct "face print" or template made from these traits. A database containing known face prints is used to compare the facial prints extracted from the collected photos. This might be a network-based remote database or a local database hosted on the Raspberry Pi. Usually, mathematical techniques are used to determine how similar the face prints are to one another. The software compares the identified face to each face in the database to see whether it matches any of the faces. The identification linked to that face in the database is obtained if a match is discovered. Lastly, the program may produce an output in the form of a screen displaying the name of the identified individual, starting an action (such opening a door), or recording the incident for additional study. In our project, the individual's name is spoken via headphones and displayed.

3.2.2 Voice assistance

There are usually a few stages involved in the process of utilizing OpenCV to develop voice assistance on a Raspberry Pi. In order to train the voice assistance model, we should first collect data. To do this, you might need to capture audio samples of the different instructions or words you want your system to learn. For any visual recognition jobs, you might also need to use OpenCV to gather picture or video data. You'll need to preprocess our data in order to extract pertinent characteristics once we get it. Techniques like extracting Mel-frequency cepstral coefficients (MFCCs) or converting audio to spectrograms may be used for audio data. You may use OpenCV to perform operations on picture or video data, such as scaling, normalization, and feature extraction. After your data has been preprocessed, you may use methods like deep learning (e.g., convolutional neural networks or recurrent neural networks) to build a machine learning model for voice recognition. For example, you may create and train your model using tools like PyTorch or TensorFlow. You may combine your voice recognition model with Open CV for real-time processing once it has been trained. The software block diagram is shown in fig1.

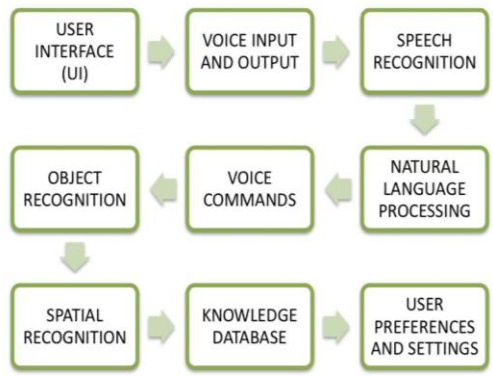

Figure 1 : Software blockdiagram

3.3 Hardware description:

There are several components involved in designing hardware for blind assistance that uses Convolutional Neural Networks (CNN) and Open CV for speech, object, and facial recognition. A camera module that can record both photos and movies is an essential component of the hardware. To obtain the finely detailed pictures required for object and face identification, it should have a high resolution. For voice commands and assistance, audio input must be captured via a microphone. It should be able to cancel out noise in order to improve identification precision. Completing sophisticated CNN image and speech processing algorithms requires a powerful CPU unit. This might be a bespoke processing unit designed for AI tasks, a microcontroller, or a single-board computer (like the Raspberry Pi). It takes enough RAM to store application files, temporary data, and trained CNN models. This comprises RAM (such as an SD card or inbuilt flash memory) for processing and storing. For data interchange, updates, and device interface, the hardware should enable many connectivity choices including Wi-Fi, Bluetooth, and perhaps cellular connectivity. The device should be portable and equipped with a rechargeable battery for continuous use without requiring a power source, as it is intended to aid blind folks. For blind people, tactile and auditory interactions are the main modes of engagement; however, having a speaker and a tiny display (such a Braille display) can be helpful in giving the user feedback or alerts. Proximity sensors and other additional sensors can help with navigation and object recognition. These sensors can assist in identifying obstructions and informing the user as necessary. In order to make the hardware simple to use, transport, and integrate with other assistive devices like canes or guide dogs, it should be developed with ergonomics in mind.Using libraries like OpenCV, CNN-based algorithms for object and face recognition are implemented in the software stack. Voice-to-text and text-to-speech libraries can be used to enable voice recognition and assistance. In addition, for interacting with hardware components, an operating system (such as one based on Linux) and the relevant drivers are required. Hardware block diagram is shown in fig 2.

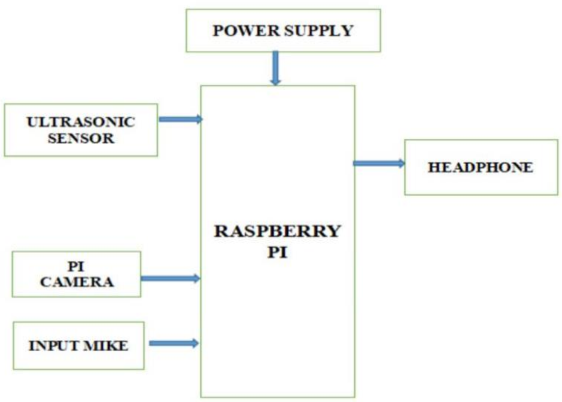

Figure 2: Hardware block diagram

3.4 Features

i. Facial Recognition: Users may teach the program to identify faces of friends, family, and acquaintances. VisionAssist reliably detects faces in real-time by utilizing CNN algorithms. Vision Assist gives the user audible clues when it recognizes a face, including calling out the person's name or displaying their facial expression.
ii. Object Recognition: VisionAssist can identify a variety of things in its surroundings using complex CNN models. By pointing the camera on their smartphone at an object, users may get a vocal identification via VisionAssist.Commonplace items like furniture and household goods, as well as particular products like bottles or cans, can all be recognized by the program.
iii. Voice Assistance: To communicate with the program, VisionAssist provides a voice based interface. Using natural language, users may issue instructions, seek information, and ask inquiries.The voice assistant part understands user commands and inquiries with precision thanks to sophisticated speech recognition algorithms.
iv. Real-Time Feedback: VisionAssist offers users prompt and accurate feedback to help them with their daily activities, whether it is identifying familiar faces, describing objects, or responding to voice commands. The software gives users real-time auditory feedback so they can confidently navigate their surroundings.

IV. CONCLUSION

In conclusion, wearable AI technology designed specifically for patients with visual impairments has the potential to transform healthcare and dramatically enhance the quality of life for these people. These technologies can allow patients greater autonomy and a more satisfying life by improving accessibility, delivering individualized care, providing cognitive support, guaranteeing safety, and upholding an intuitive user interface. They can also give caregivers and loved ones peace of mind. However, in order to foster confidence and guarantee the appropriate and advantageous application of new technologies in healthcare settings, great attention must be devoted to ethical issues. We have covered the project's conclusion using the suggested technique in detail; the next chapter will cover the project's future scope. Therefore, the project blind assistance is a big step forward in the direction of making places that are more accessible and inclusive for people who are visually impaired. These systems have the potential to significantly improve the lives of millions of people globally with more invention and improvement.

Conflict of Interest Statement:

Abdul Halik.Y, Justin Peniks.M, Bharathidasan.G and Akash.V declare that they have no conflicts of interest regarding the publication of this manuscript

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