An Innovative Facial Recognition Based Smart Glasses Equipped with QR Code Scanning and Object Detection for Blind People

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Abstract—Blind people often face difficulty in normal and daily communication, they also face great difficulty in day-to-day mobility and even after sustaining all this they also are greatly challenge while picking groceries. To tackle this, we have design facial recognition based smart glasses equipped with object detection and QR code scanning to aid them in all these essential daily activities. We utilized OpenCV framework for facial recognition, ultrasonic sensor for object detection and text to speak module to aid the user in hearing the recognized surrounding.

Keywords—face recognition, object detection, QR code scanning, OpenCV, framework, smart glasses

I. INTRODUCTION

Visually impaired individuals face tremendous hurdles in their day-to-day activities, from movement around unfamiliar surroundings to identifying people during social interactions and accessing essential information stored in text or QR codes. The conventional assistive aids like white canes or guide dogs, although useful, are limited in terms of solving these more expansive needs. As technology develops, the invention of smart glasses for visually impaired individuals has emerged as a groundbreaking answer, [1-2] incorporating such innovative aspects as facial recognition, obstacle identification, and QR code scanning to open up more independence and accessibility. [3-13]

The cutting-edge prototype for smart glasses being developed using open-source and low-cost tools and technologies is unveiled in this research paper. The system utilizes Python's OpenCV library and facial recognition library to recognize people, [6-12] providing visually impaired users with a way to identify friends through audio cues. Obstacle detection is driven by ultrasonic sensors, which detect distances to inform the wearer of objects in proximity, allowing for safe movement in crowded spaces. [10-11] Moreover, the Pyzbar library also supports real-time QR code scanning, making users capable of accessing important information like product information, location hints, or digital content. The convergence of these capabilities into one wearable device solves several pain points experienced by the visually impaired population. Facial recognition makes social interaction easier by recognizing familiar faces in real-time.[7] Ultrasonic sensor-based object detection provides safer movement by identifying obstacles,[9] and the use of QR code scanning allows easy access to encoded data, thereby filling the information gap. In contrast to traditional tools, these smart glasses system utilizes artificial intelligence and sensor-based technologies to provide actionable, real-time feedback in a portable, user-friendly package. [5-8]

Current solutions tend to cover only a single or two of these areas, without offering a complete assistive device for blind users. The smart glasses system presented here breaks the mold by integrating these functions into one, light-weight, and affordable system. By leveraging open-source libraries and hardware such as Raspberry Pi and ultrasonic sensors, [4-15] this system strikes a balance between performance and price and thus promises feasibility for mass production. This study also identifies practical issues, such as real-time processing limitation, energy efficiency, and environmental robustness, presenting novel solutions for these challenges.

With the integration of facial recognition, ultrasonic-based hazard detection, and QR code reading, [12-14] such intelligent glasses mark a dramatic advancement in assistive technology for the blind. Through the offering of voice-based feedback, the device not only enables its users to move about their environment with confidence, but also improves their social interaction and access to important information. without any significant stress or worrying in their day to day lives. The design, development, and implementation of this combined system are described in this paper, demonstrating the system's ability to significantly improve and better the lives of visually impaired individuals by increasing safety, independence, and quality of life.

Fig. 1. Smart glasses model.

II. RELATED WORK

Past research has investigated numerous assistive technologies for the visually impaired. Facial recognition technology, as proposed by Marinova et al. (2025) and Lajevardi & Wu (2012), has proved the power of deep learning in expression and identity recognition. Yet numerous solutions utilize high-level hardware, rendering them costly and less accessible.

Obstacle detection has been extensively researched, with Veelaert & Bogaerts (1999) leading the way in ultrasonic-based navigation and Sundar Srinivas (2020) using Raspberry Pi to use low-cost approaches. Likewise, QR code identification has been extended by Kamnardsiri et al. (2022) and Xiao & Ming (2019), with optimized detection algorithms for real environments.

Although these improvements have been made, there are not many systems that incorporate all three features (facial recognition, obstacle detection, and QR scanning) into one wearable device. Our project fills this gap by utilizing low-cost, open-source libraries (OpenCV, Pyzbar) and sensors to produce a cost-effective and usable solution.

III. DATASET

We have sourced our data from creating a library of pictures taken by our raspberry pi camera and using them to train our model and then utilizing that information for creating a great facial recognition system. Our project creates a particular folder for each face and uses the name of the folder to depict the name of the identified individual and recite the name of identified person.

Fig. 2. Model physical demonstration.

IV. LITERATURE REVIEW

Smart Glasses for People with Visual Impairment That Integrate Facial Recognition, Object Detection, and QR Code Reading Technologies.

A. Introduction

Smart glasses have become a promising assistive technology for the blind and visually impaired (BVI), which combines latest computer vision, machine learning, and a approaches using sensors to improve navigation, object recognition, and social interaction. This literature review synthesizes results from 15 critical studies, including facial expression recognition, obstacle detection, barcode scanning, and human activity recognition, all of which contribute to building effective smart glasses for the BVI community.

B. Facial and Expression Recognition

Facial recognition is an essential aspect of smart glasses, facilitating social interaction and awareness of the environment.

Marinova et al. (2025) presented a deep learning-based method for facial expression recognition (FER) with smartglasses, which yielded high accuracy for real-time scenarios (IEEE Access).

Lajevardi & Wu (2012) investigated FER in perceptual color spaces, enhancing lighting variation robustness (IEEE Transactions on Image Processing).

Yang & Huang (1994) did seminal work in face detection with complex backgrounds that is still useful today in the context of modern smart glass systems (Pattern Recognition).

Xu et al. (2018) designed a sensor-assisted multi-view face recognition system for smart glasses and improved accuracy using multiple sensors (IEEE Transactions on Mobile Computing).

These papers suggest the role of deep learning and multi-sensor fusion in facial recognition for the benefit of BVI users.

C. Obstacle Detection and Navigation
Obstacle avoidance is an essential functionality in smart glasses for safe navigation.

Veelaert & Bogaerts (1999) proposed an ultrasonic potential field sensor for sensing obstacles, showing early development in sensor-based navigation (IEEE Transactions on Robotics and Automation).

Sundar Srinivas (2020) employed obstacle detection with Raspberry Pi, which offered an affordable solution for smart glasses (IJEAST).

Balaji et al. (2023) suggested a smart glass system incorporating face and obstacle detection, stressing the importance of real-time processing for BVI users (IRJMETS).

These contributions highlight the application of ultrasonic sensors, computer vision, and embedded systems in the construction of robust navigation assistances.

D. Human Posture and Activity Recognition
Knowledge of human posture and activity can improve contextual awareness for BVI users.

Iazzi et al. (2018) employed projection histograms and Support Vector Machines (SVM) for posture recognition, being effective in assistive wearable systems (ISIVC).

Marinova et al. (2025) too made a contribution towards activity recognition with smart glasses using deep learning for enhancing accuracy (IEEE Access).

All these studies indicate that machine learning models can well interpret human movement to enhance interaction with the environment.

E. QR Code Recognition
QR code scanning allow users to access product information to assist with shopping and navigation.

Kamnardsiri et al. (2022) compared deep learning methods for 1D barcode detection, shedding light on the best detection strategies (Sensors).

Xiao & Ming (2019) developed an integrated geometric and deep-learning method for barcode recognition to enhance detection in noisy environments (Applied Sciences).

Shin et al. (2012) investigated user experience of QR codes, noting psychological factors behind adoption (Computers in Human Behavior).

These results indicate that integrating deep learning and geometric correction improves barcode scanning reliability for smart glasses.

F. Smart Glass Prototypes for the Visually Impaired
There have been various studies creating functional prototypes for BVI users.

Harisha (2023) created smart glasses for real-time support for navigation and object detection (IJIREEICE).

Rampur Srinath & Suhas Bharadwaj (2022) developed an assistive smart glass system with obstacle detection and facial recognition (IRJMETS).

Dr. Vani Priya (2021) developed smart glasses with multi-modal feedback (audio/tactile) for improved usability (IJRES).

These applications show the potential of combining multiple assistive technologies under a wearable device.

V. METHODOLOGY

For a better understanding of methodology of this project, we would like to demonstrate the algorithms used in form of a flowchart.

A. Algorithm

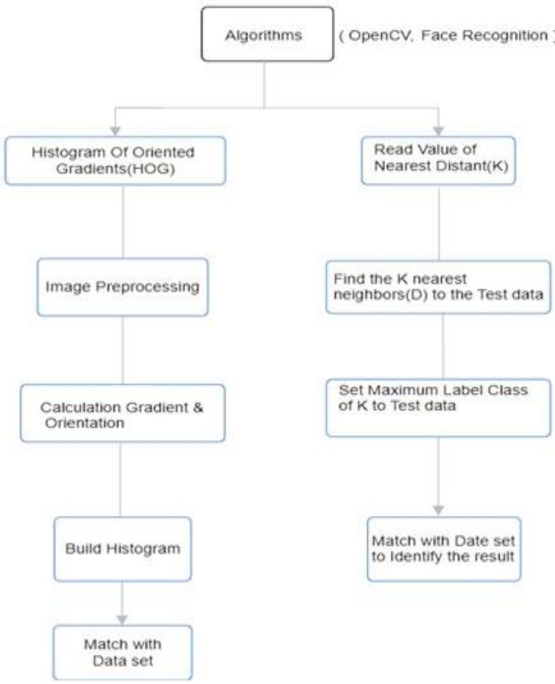

Fig. 3. Algorithm flowchart for face recognition

B. Local Binary Pattern Histogram for Facial Recognition

Local Binary Pattern (LBP) is a very powerful, but very intuitive texture operator that labels the pixels in an image by thresholding the local neighborhood and reading the result as a binary number. LBP appeared in 1994 and has since been well established as a good texture classification feature. Also, it has been proven that the combination of LBP and histograms of oriented gradients (HOG) descriptors can improve detection performance significantly across many sets. With the help of the LBP and histograms, facial images can be represented by a simple data vector.

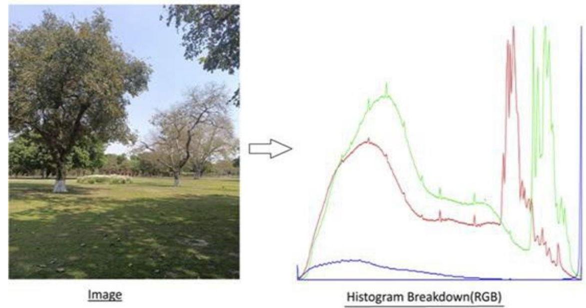

Fig.4 Histogram representation

Parameters: the LBPH works with 4 parameters:

- Radius: The radius is employed to construct the circular local binary pattern and is the radius of the central pixel. It is typically fixed at 1
- Neighbors: The number of sample points employed to construct the circular local binary pattern. Remember: the greater number of sample points you include, the more complex the calculations will be. It is typically set equal to 8.
- Grid X: The number of cells in the x-direction. The higher the number of cells, the more detailed the grid, the larger the dimensionality of the resulting feature vector. It is typically set to 8.
- Grid Y: The number of cells along the vertical axis. The more cells, the more detailed the grid, the higher the dimensionality of the resulting feature vector. It is commonly set at 8.

C. Pyzbar library for QR code Reading

QR code represents data in graphical representation and is machine-readable. For making QR code Reader in Python. We are using pyzbar library. Using pyzbar we can decode the one-dimensional QR code. This pyzbar can return 3 fields based on the QR code object:

• Data: Data is the information that is stored in the QR code. This data may take various forms, including alphanumerical, numerical, or binary forms, depending on the nature of the QR code used.

•Location: This is This is the collection of points that are in the code. For QR codes, these points are starting and ending line boundaries for QR code, is a list of four points corresponding to the four corners of the QR code quad.

D. Block Diagram

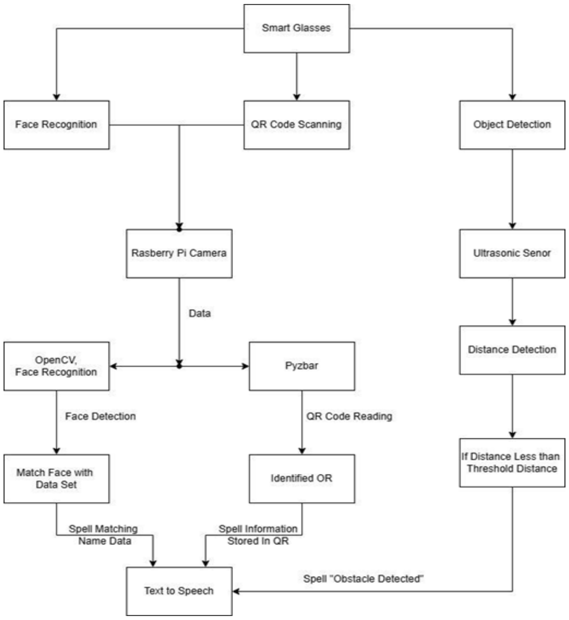

Fig. 5. Working of smart glasses for facial recognition, object detection and QR scanning.

V. RESULT

We have arrived at the following distinguish in factors that give us a clearer picture of the overall resultant, derive along with the efficiency and accuracy figures that would also be depicted.

A. Accuracy

a) Facial Recognition: Facial recognition working accurately as depicted by the captured by the live testing image of the smart glasses.

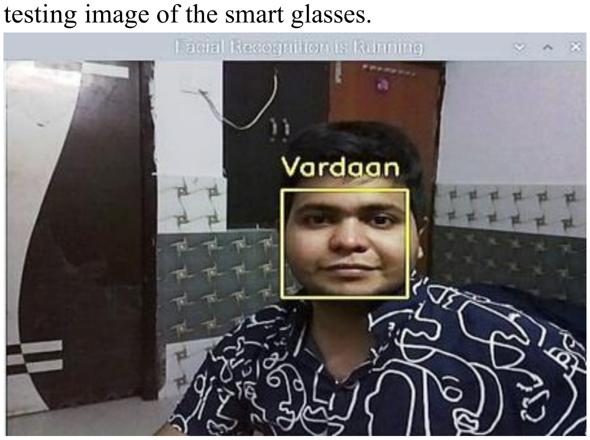

Fig. 5. Accurate face detection and recognition.

b) QR Code Recognition:

Glasses are able to detect the QR code and also interpret the stored data within the code.

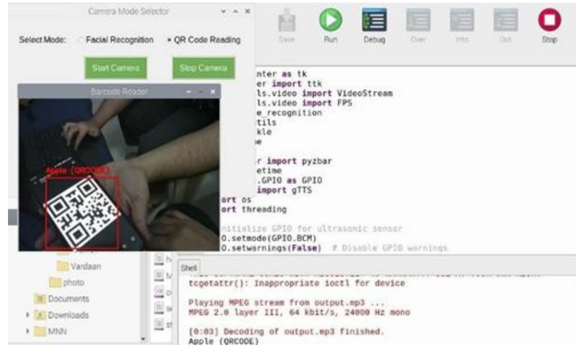

Fig. 6. QR code detection and decryption.

c) Collision Avoidance:

Glasses with the help of ultrasonic sensor are able to identifying the obstacle in front of the glasses and warn the user.

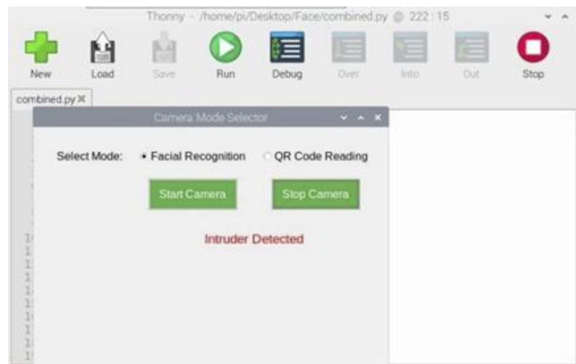

Fig. 7. Object detection and distance calculation.

B. Efficiency

We conducted 15 independent test and found out our smart glasses to be accurate in 12 out of 15 observation that is also depicted through the following graph.

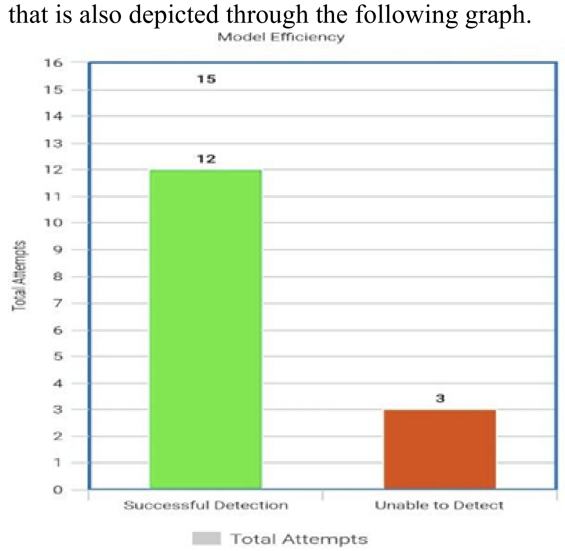

Fig. 8. Efficiency graph of the model

VI.CONCLUSION

The development of facial recognition-based smart glasses equipped with object detection and QR code scanning has demonstrated promising results for aiding visually impaired individuals.

Key accomplishments include:

1. Improved Facial Recognition: Leveraging the OpenCV framework and LBP combined with histograms, the system efficiently recognizes individuals with enhanced accuracy.
2. Collision Avoidance: Ultrasonic sensors effectively detect objects in the surroundings, ensuring better mobility and safety.
3. QR Code Recognition: The PyZbar library accurately scans and decodes QR codes, enabling the identification of items and assisting in grocery shopping.
4. Real-time Feedback: The integration of a text-to-speech module ensures that users receive immediate auditory information about their environment, significantly improving their ability to interact with surroundings.
5. User-friendly Design: The use of a lightweight and wearable device powered by Raspberry Pi ensures practicality for everyday use.

The research highlights the potential of technology to empower visually impaired individuals by addressing critical challenges in their daily lives. The smart glasses system provides a robust facial recognition feature that helps users identify people in their surroundings, reliable object detection to prevent collisions and enhance mobility and effective QR and barcode scanning capabilities to aid in grocery identification and other daily tasks. The implementation of this system paves the way for innovative assistive technologies that can significantly enhance the independence and quality of life for visually impaired individuals.

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