A Virtual Eye to Assist Visually Impaired People for Social Interaction

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Overview

INTRODUCTION

- Our project responds to the need for empowering the visually impaired by introducing innovative technology to address challenges related to recognizing individuals and fostering independent communication.
- Employing advanced techniques like the Haar Cascade algorithm for face detection, LBPH for face recognition, and ORB analysis along with some precomputations for currency detection, our application aims to seamlessly bridge communication gaps and enhance safety for visually impaired individuals.
- Prioritizing simplicity, our user-friendly prototype will ensure easy navigation, featuring audio messaging for instant identification and the capacity to add new faces to the system database.
- Motivated by the challenges faced by visually impaired individuals in identifying people, our goal is to make their lives more manageable and safer.

WORK DONE IN PREVIOUS SEMESTER

1. Face Detection
   - Video Capturing
   - Image Processing
2. Face Recognition
   - Extract Face Frame using Haar Cascade Classifier
   - Compare the Face Frame with Dataset using LBPH algorithm
   - LBPH identifies the closest matching image in the dataset
   - Identified Face is Displayed with Name
3. Currency Recognition
   - We generated key points and descriptors of the input image by using the SIFT algorithm.
   - We iterated over the data set using a for loop and generate key points and descriptors for each image in the dataset.
   - Using kNN classification, we compared the descriptors of the input image and the image under iteration.
   - In the next step, we stored all the good matches as per Lowe's ratio test.
   - If the total number of good matches exceeds a minimum threshold, then we stored the image under iteration as an output image.
   - Finally, we displayed a plot of matches between the input image and the output image. (only for debugging and advancement purposes)

WORK DONE IN PREVIOUS SEMESTER

results obtained

Figure 1: Result of Face detected

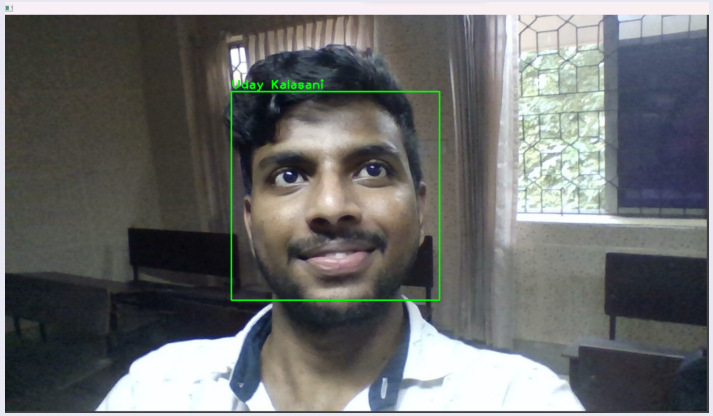

Figure 2: Result of Face Recognised

METHODOLOGY and WORK DONE IN THIS SEMESTER

Currency Recognition

- The ORB algorithm is used instead of the SIFT algorithm ORB is a fusion of FAST key point detector and BRIEF descriptor with some added features to improve the performance.
- Generally number of matches in ORB is very less when compared to the SIFT algorithm so we used some precomputation methods like rotation to increase the number of matches and also cropping to decrease the number of computations.

WORK DONE IN THIS SEMESTER

Extraction of the region of interest in the input image (CROPPING)

- Here canny edge detection is used to extract the edge of the currency note. The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.
  - noise reduction
  - Gradient Calculation
  - Non-Maximum Suppression
  - Hysteresis Thresholding

Figure 3: Canny edge filter if a currency note

WORK DONE IN THIS SEMESTER

ROTATION OF THE CURRENCY NOTE

- ORB is a non-rotation-invariant algorithm .From a research paper rotation angles proportional to 90 degrees, ORB, and SURF always present the best Matching rate, while for other angles of rotations such as 45, 135, and 225, SIFT presents the highest matching rate.
- So rotating the axis of the currency note to either horizontal or vertical will result in higher matches
- For the amount of rotation that needs to be done, we are computing the vertices of the rectangular region and calculating the slope of its axis
- rotating by this angle results in either a horizontal currency note or a vertical currency note.

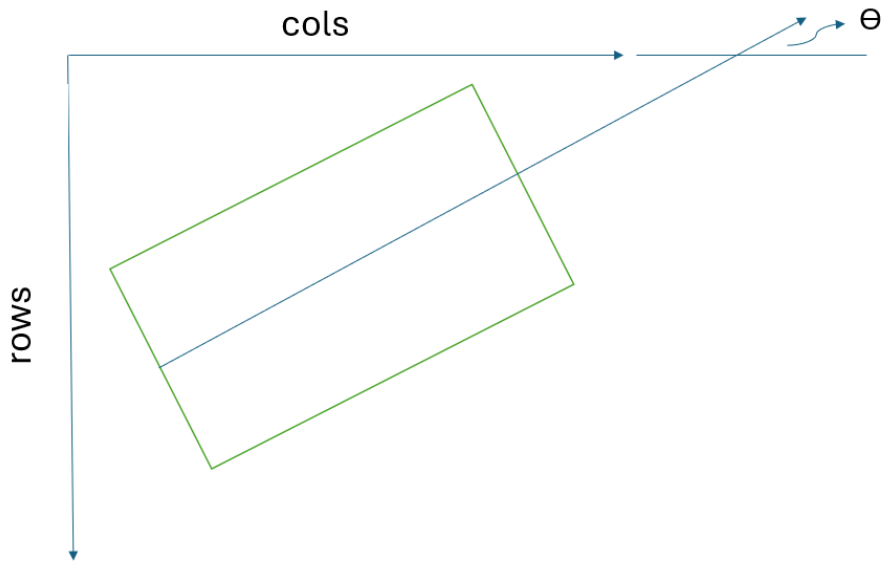

Figure 4: sketch depicting boundary of the currency note

results obtained for rotated images

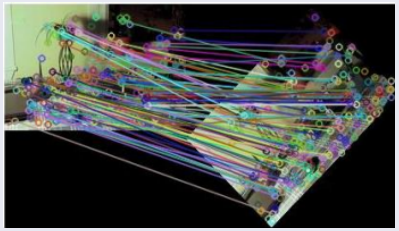

Figure 5: Matches in SIFT

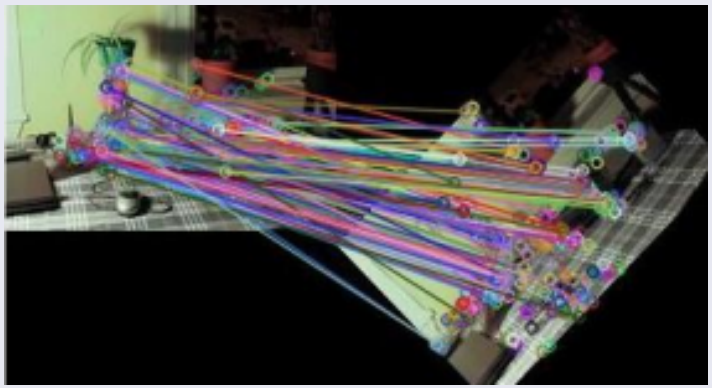

Figure 6: Matches in ORB

WORK DONE IN THIS SEMESTER

Date and Time

- An in-built module of date and time is used.
- With minor string and control flow statements manipulation, the 24 HRS format is converted in hrs format.
- The numerical data is converted into an alphabetical i.e 12-2-2024 is converted to twelfth February twenty twenty-four.

Announcer module

- USING PYTTSX3 we converted text to speech and created an announcer module such that passing a string argument to the method results in speech.
- This module is used in multiple sections of the code which addresses the fact of reusability.

WORK DONE IN THIS SEMESTER

Face Recognition

- Simplified the process of dataset creation by automating the labeling and using file handling
- Test images are captured from a live camera, image is sent to try block where our trained model predicts the label of the face.
- If the face in the test image is not recognized for 10 seconds, then the system gives output as the unknown face.
- If try block throws an error then except block gives the output as NO FACE FOUND.

Face Recognition

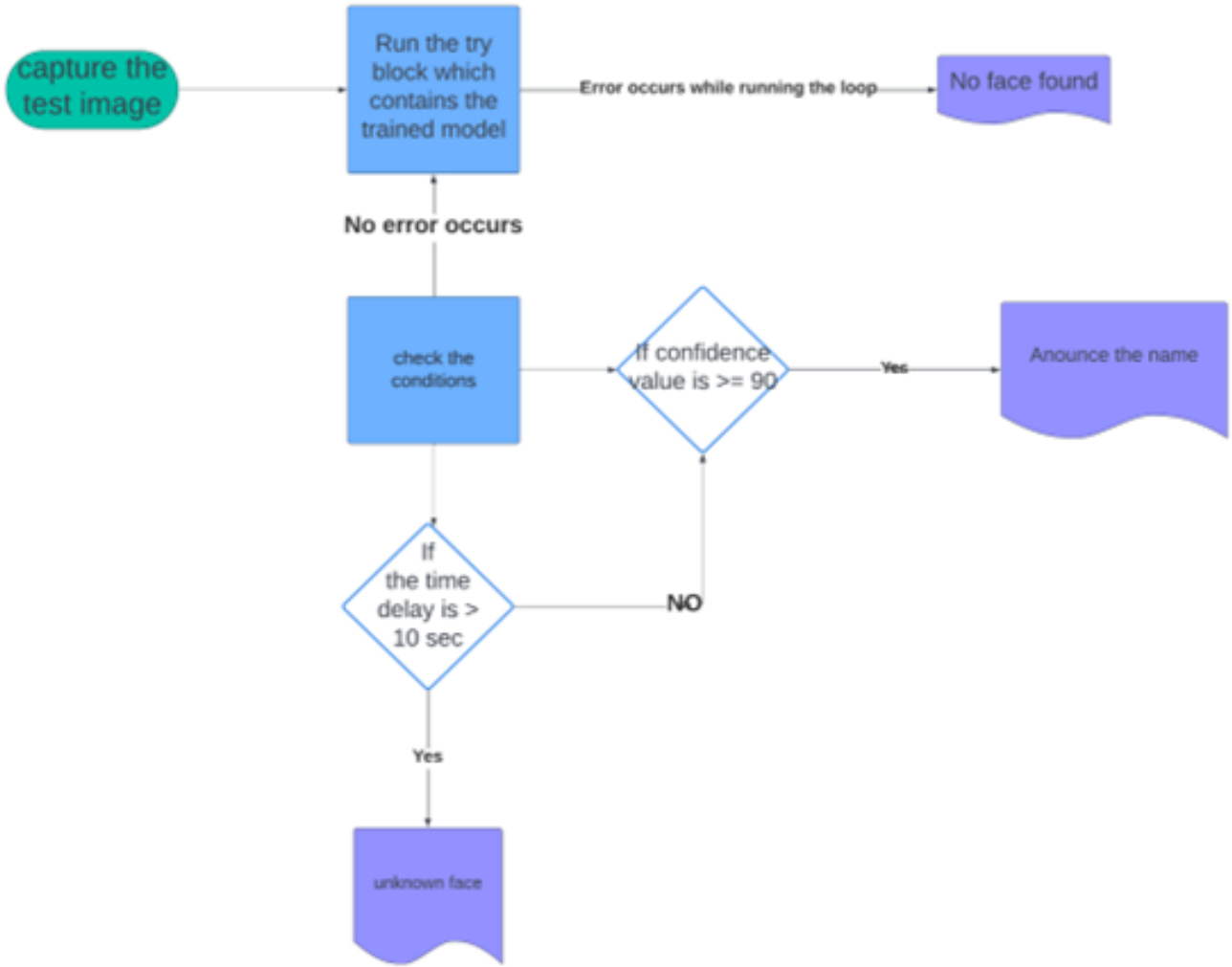

Figure 7: Flow chart of face recognition

WORK DONE IN THIS SEMESTER

Single user interface for overall system

- The entire program is user-friendly and completely voice-controlled on both the input and output sides using the inbuilt Python modules like VOSK for speech-to-text and pyttsx3 for text-to-speech.

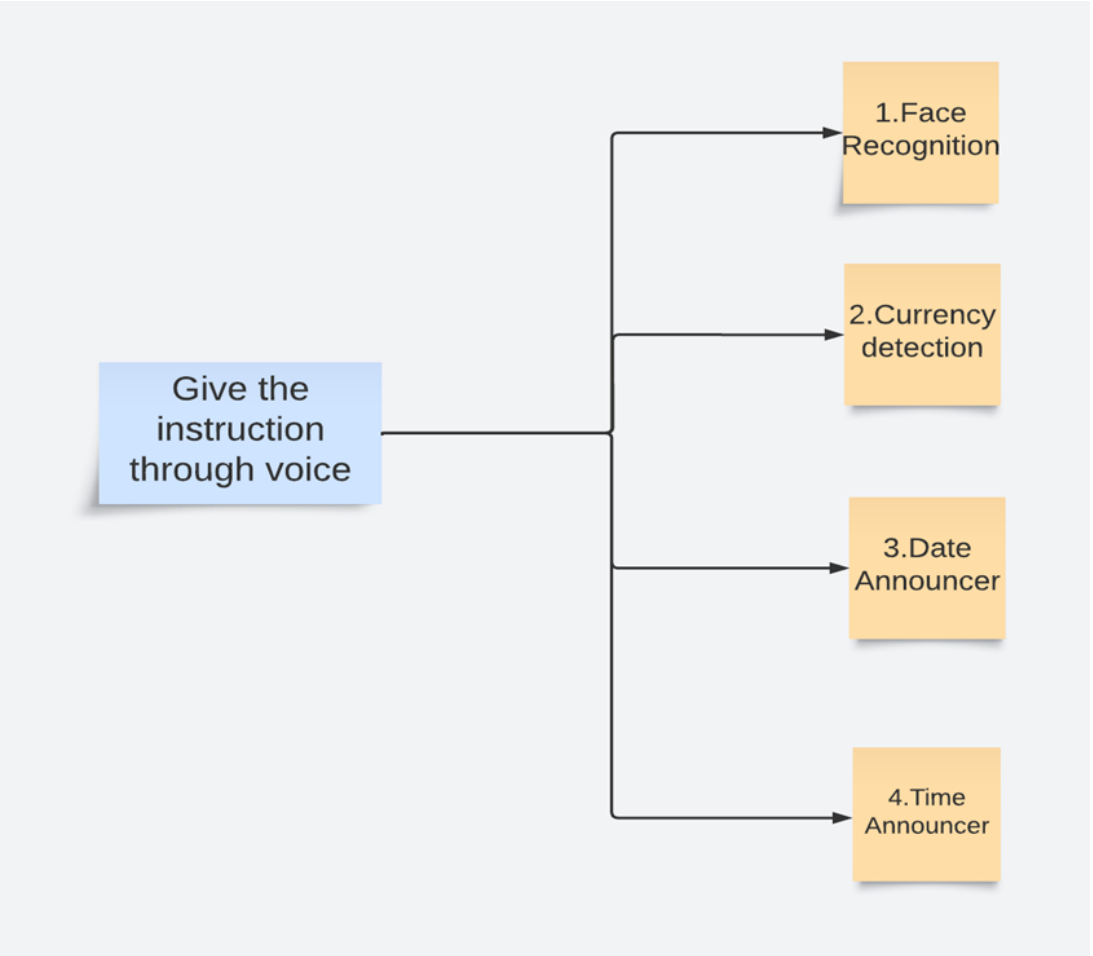

Figure 8: Interface

Results

a. Currency Detection:

- Time taken for currency detection using the SIFT algorithm : 21.29 sec
- Time taken for currency detection using ORB algorithm: 7.67 sec
- Time taken for currency detection using ORB algorithm with edge processing: 6.25 sec
- Maximum number of matches using SIFT: 549
- Maximum number of matches using ORB: 169
- Maximum number of matches using ORB and image rotation: 180

b.Face Recognition:

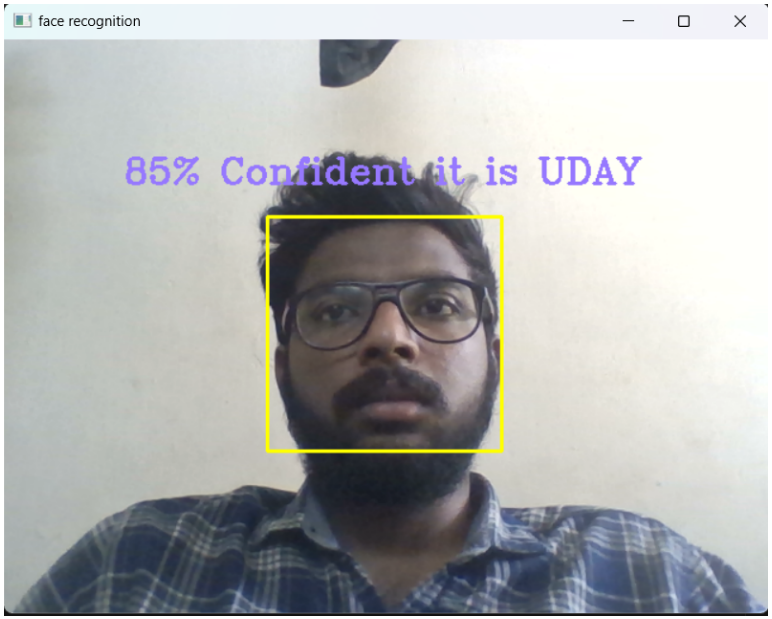

Figure 9: Result of the system for known faces

Results

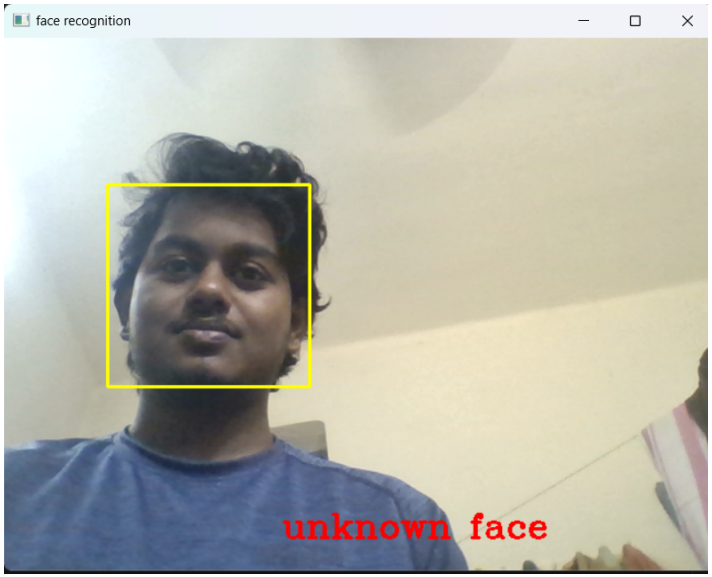

Figure 10: Result of system for unknown faces

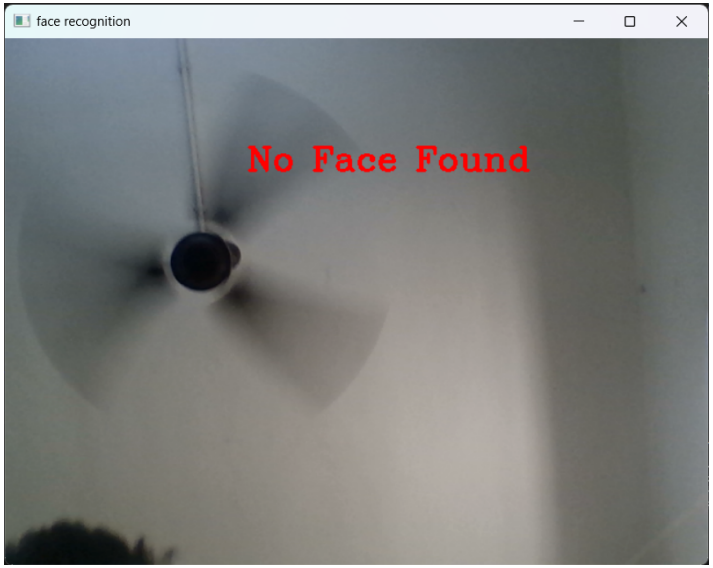

Figure 11: Result of system for no face found

Work to be done

- Future work includes the development of a mobile application for face recognition and currency detection. The app will be built using a mobile development framework such as Flutter for cross-platform development or native frameworks like Swift for iOS and Kotlin for Android. Integration of existing Python code for face recognition and currency detection will be done using tools like Chaquopy for Android and PyObjc for iOS to run Python code within the app.
- The user interface (UI) will be designed to include features such as camera access for capturing images, buttons for triggering recognition, and display areas for results. Face recognition and currency detection functionalities will be implemented by capturing images from the camera, passing them to the Python code for processing, and displaying the results on the screen.
- Testing will be conducted to ensure that the app functions as expected on different devices and scenarios. Optimization will be performed to enhance performance and efficiency, especially regarding the computational requirements of image processing.

References I

V. Aza, Indrabayu and I. S. Areni, "Face Recognition Using Local Binary Pattern Histogram for Visually Impaired People," 2019 International Seminar on Application for Technology of Information and Communication (iSemantic), Semarang, Indonesia, 2019, pp. 241-245, doi: 10.1109/ISEMANTIC.2019.8884216. keywords: visually impaired people;Haar-Cascade Classifier;LBPH;Gamma Correction;Difference of Gaussian;face recognition,

Z. Xu, X. Baojie and W. Guoxin, "Canny edge detection based on Open CV," 2017 13th IEEE International Conference on Electronic Measurement Instruments (ICEMI), Yangzhou, China, 2017, pp. 53-56, doi: 10.1109/ICEMI.2017.8265710. keywords: Image edge detection;Graphics processing units;Acceleration;Instruments;Programming;Hysteresis;Edge detection;Canny operator;hysteresis threshold;Open CV,

A. CS, D. M, H. V. R and A. Anju, "Currency Recognition For The Visually Impaired People," 2022 IEEE Delhi Section Conference (DELCON), New Delhi, India, 2022, pp. 1-3, doi: 10.1109/DELCON54057.2022.9753373. keywords: Deep learning;Image recognition;Image color analysis;Shape;IEEE Sections;Conferences;Mobile applications;Machine Learning;Image Processing;Currency Recognition;Bag Of Words;SIFT;The Android Application,

P. Garkoti, P. Mishra, N. Rakesh, Payal, M. Kaur and P. Nand, "Indian Currency Recognition System Using Image Processing Techniques," 2022 9th International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, India, 2022, pp. 628-631, doi: 10.23919/INDIACom54597.2022.9763134

Thank You