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Smart Recognition System for Visually Impaired People

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Abstract: ***According to the World Health Organization estimation, about 285 million people suffer from some kind of visual disability, of whom 39 million are blind, resulting in 0.7% of the world population. The inability to identify people during group meetings is a disadvantage for blind people in many professional and educational situation and also Identification of various denominations of currency is not an easy task for visually impaired people. Computer vision techniques and image analysis can help improve visually-impaired people. In this project, a system that allows for facial and currency recognition is adapted for the needs of disabled people is proposed, implemented and validated. The architecture has been carefully selected and subsequently implemented following an innovative PCA algorithm in order to increase recognition rate of facial and currency. The information provided to the user is composed by the name of the person/currency identified. This information is provided by means of a text-to speech tool.***

Keywords: Visually impaired, face recognition, currency recognition, Image analysis, Principal component analysis(PCA)

I. INTRODUCTION

Blindness is a visual impairment that affects a 0.7% of the world's population. According to the latest estimates, almost one million people in Spain suffering from visual disabilities and due to retinal diseases mentioned, about 70,000 people have total blindness. According to estimates of the World Health Organization (who), around 285 million people suffer from some sort of visual impairment, of which 39 million are
blind, which means a 0.7% of the world's population [1].
Visual impairment affects of unevenly to different age groups to be more incisive in people older than 50 years representing 65% of the total (while this group only represents 20% of the total population) [2]. The changes that occur in the vision as a result of age include [1]:

A. Loss of the sensitivity of the retina to lighting that originates a need to use brighter lighting.
B. Opacity of the lens that causes reduced vision and annoying reflections
C. Elasticity Of the crystalline lens and loss of ability to focus
D. Degeneration of the vitreous that causes the vision of stains
E. Reduction of the capacity of the conjunctiva and lacrimal glands to adequately lubricate the eyes.

All this leads to part of the visual capacity is lost with age and develop diseases such as cataracts, glaucoma, macular degeneration, eye conditions or dryness of the eyes**.** The technologies of information communication (technology ICT) are a great opportunity in the development of new systems and solutions that allow generally increase the quality of life for persons with visual disabilities. In this sense, the computer vision can be helpful to improve the daily life of these people.
In particular, facial analysis & currency identification can be used to extract very useful and relevant information in order to help people with visual disabilities in several of their daily tasks providing them with a greater degree of autonomy and security.
The proposed architecture has been validated with real users and in a real environment simulating the same conditions that could occur both in the images captured by a video as the images captured by a person with visual impairment through Camera.
The contributions are discussed below:
First proposes an algorithm for the normalization of the face of the robust user in terms of rotations and imbalances in face detection algorithm, it is then designed and implemented an architecture that is specially
designed to be run on devices with reduced abilities of computation,

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i.e. an algorithm has been designed and implemented in C++.The above method is followed same for currency identification too.

II. RELATED WORK

Automated face recognition has been the focus of extensive research for the past four decades. The approaches for this task can be broadly divided into two categories:

A. Feature-Based Methods

Which first process the input image to extract distinctive facial features, such as the eyes, mouth, nose, etc., as well as other fiducial marks and then compute the geometric relationships among those facial points, thus, reducing the input facial image to a vector of geometric features. Standard statistical pattern recognition techniques are then employed for matching faces using these measurements.

B. Appearance-Based (or Holistic) Methods

Which attempt to identify faces using global representations, i.e., descriptions based on the entire image rather than on local features of the face. Though face recognition methods traditionally operate on static intensity images, in recent years, much effort has also been directed towards identifying faces from video [10] as well as from other modalities such as 3-D and infra-red.

Several computer vision-based solutions have been developed lately to assist the visually impaired in their daily activities. Most of these systems focus on navigation and obstacle detection: e.g., vision based simultaneous localization and mapping (SLAM)has been recently proposed to support blind mobility.

However, these technologies suffer from some limitations.

Many techniques have been implemented for identification of various denominations.

The major techniques adopted are a scanner device that uses IR sensors and segregation devices based on image processing and signal processing techniques.

C. IR Sensors Based Device

A device has been proposed by the Edward Chen and Wilson Yum as a senior design project [1]. It makes use of IR sensors. IR sensors are capable of reflecting the light source that falls on the bill. The signal is captured by the sensors and voltage levels are measured. The measured voltage signals are compared with the pre-stored database. Based on compared results the bills are identified and displayed as Braille characters which make the identification much easier.

In India many devices are available for counting and identifying the notes. A leading manufacturer of such devices are Maxsell which makes use of I-scan technique

D. Identification using Image Processing Technique

Many Researchers have made use of image processing technique to identify the currency of various denominations.

Hanish Aggarwal et.al [8] proposed a technique where in the acquire image is localized using localization technique and denomination are identified for rupees (Indian currency).

Vipin Kumar Jain et.al [9] proposed a technique based on image processing to detect different denominations of Indian rupee. This method uses neural network training pattern for training the pattern of the acquired image. From the survey under gone it is clear that in India there is no special device for visually impaired community to aid in currency detection.

III. PROPOSED WORK

The objective of this project is to provide a security for visually impaired people, by adapting methods for face recognition, object detection and currency identification which makes their life easy in today's computer vision technology and also helps in security aspect.

The block diagram for Recognition system

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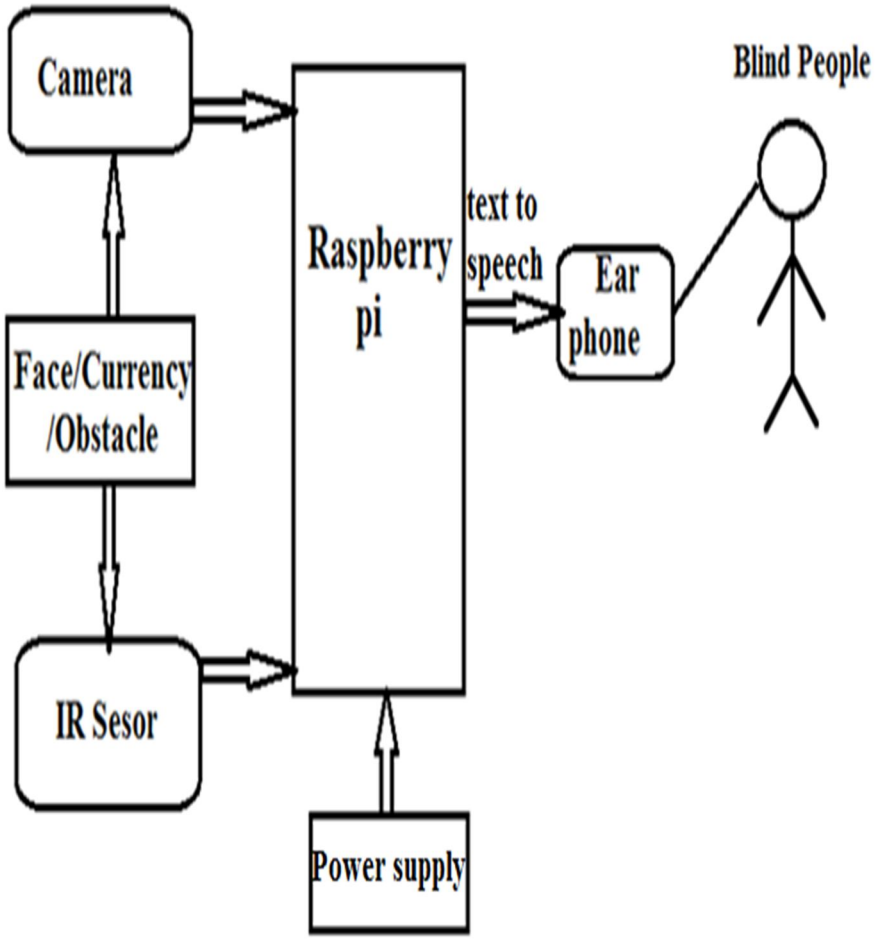

Fig 1:Block Diagram of Smart Recognition System

A. Raspberry Pi

The Raspberry Pi is a series of small single board computer developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level.

B. Camera

Web camera is a video camera that feeds or streams its image in real time, Webcams are known for their low manufacturing cost and their high flexibility, making them the lowest-cost form of video telephony.

C. IR Sensor

The IR Sensor-Single is a general purpose proximity sensor. Here we use it for collision detection. The module consist of a IR emitter and IR receiver pair. The high precision IR receiver always detects a IR signal. The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low. It gives a digital output.

D. Block Diagram Description

The face of person is sensed first and analysed it using camera, the captured face image is sent to raspberry pi, the controller then by using face detection algorithm detects the face angle ,also tracks the face position, which is compared with fed database using Principal Component Analysis algorithm. The computation is converted in the audio form which helps the blind person to identify a person meeting them. The Proposed method is followed same for currency identification.

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IV. PRINCIPAL COMPONENT ANALYSIS ALGORITHM

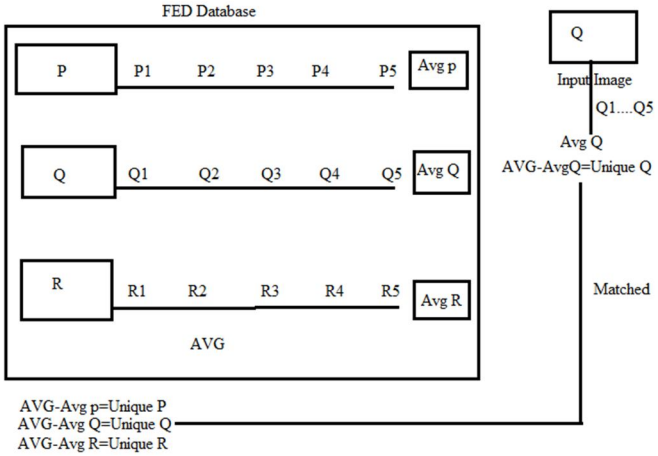

Fig 2: General description of PCA algorithm.

Let P,Q,R be the images captured of Faces or currency. P1..P5 is the feature vector of P in different pose or variation in the form of pixel count. Average of P image is then found. The process continues for Q & R image, which is known to be as training set. Now the total average is found i.e AVG=(AvgP+AvgQ+AvgR)/3.
The difference between AVG & Avg P,Q,R is done to get a unique result.
i.e AVG-Avg P=Unique P.
AVG-Avg Q=Unique Q
AVG-Avg R=Unique R
This computation is stored as database.
The input image Q follows the above same computation as shown in fig 2.
The Unique Q obtained for input image is compared with the database. Thus input image is matched with unique Q of training images. The result is audible as Q.
Fig 3 shows a structure of currency recognition using PCA.

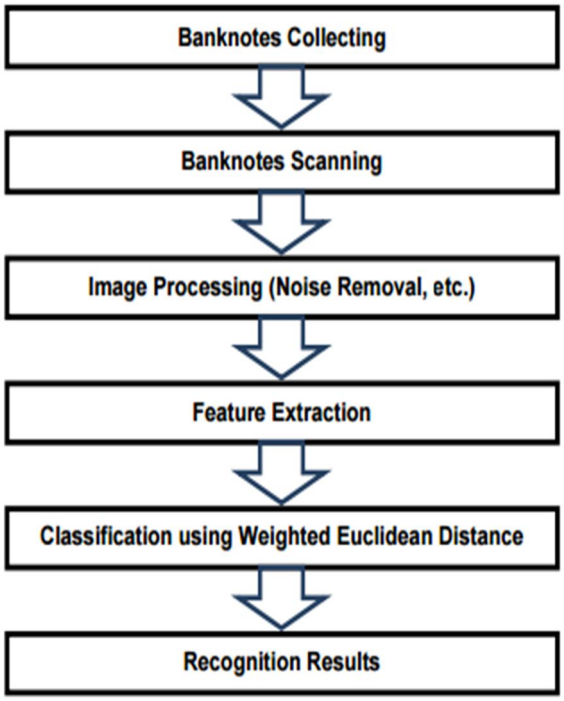

Fig 3: Structure of Currency Recognition using PCA.

V. RESULT

The setup for proposed prototype is shown Fig 4

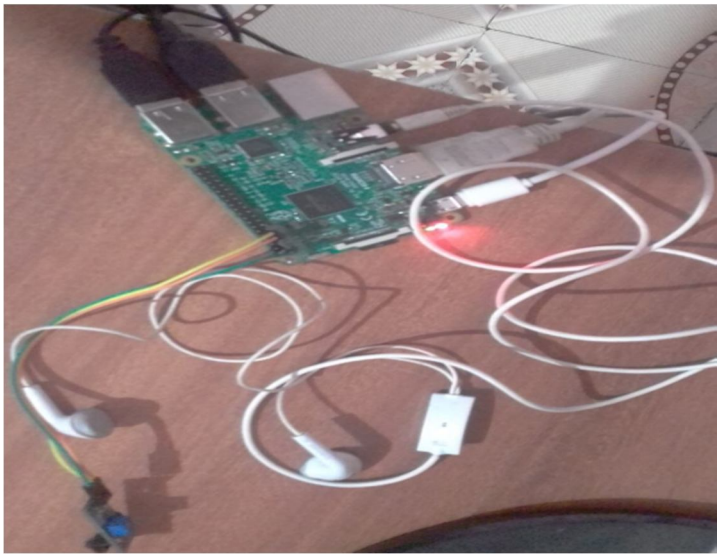

Fig 4: Smart recognition system prototype

The real time e.g of face recognition is shown in Fig 5.

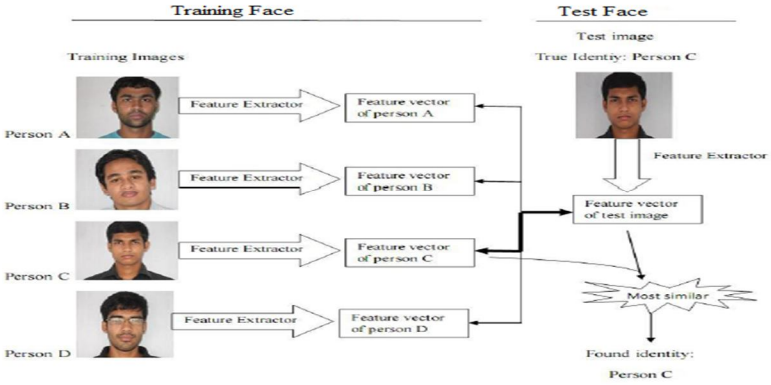

Fig 5:Schematic diagram of face recognizer

Fig 6: Training data sets

```
pi@raspberrypi: ~/Desktop/proj
File  Edit  Tabs  Help
    time.sleep(20)
KeyboardInterrupt
(cv) pi@raspberrypi:~/Desktop/proj $ python Demo.py
Demo.py:30: RuntimeWarning: No channels have been set up yet - nothing to clean
up!  Try cleaning up at the end of your program instead!
  GPIO.cleanup()
Demo.py:32: RuntimeWarning: This channel is already in use, continuing anyway.
Use GPIO.setwarnings(False) to disable warnings.
  GPIO.setup(19,GPIO.OUT)
Demo.py:33: RuntimeWarning: This channel is already in use, continuing anyway.
Use GPIO.setwarnings(False) to disable warnings.
  GPIO.setup(26,GPIO.OUT)
[[ 46 169 139 139]]
Face Detected
CNT : 5
CAPTURED
9 is Correctly Recognized with confidence
```

```
final_code1.py:41: RuntimeWarning: This channel is already in use, continuing an
yway.  Use GPIO.setwarnings(False) to disable warnings.
  GPIO.setup(19,GPIO.OUT)
final_code1.py:42: RuntimeWarning: This channel is already in use, continuing an
yway.  Use GPIO.setwarnings(False) to disable warnings.
  GPIO.setup(26,GPIO.OUT)
Training Recognizer for Face Images
[9, 8, 3, 19, 16, 14, 18, 12, 1, 13, 7, 11, 6, 2, 15, 4, 17, 10, 20, 5]
[[296  11 191 191]]
[[298  11 190 190]]
Face Detected
CNT : 5
CAPTURED
0
Playing WAVE '/tmp/tmpFB3tzj.wav' : Signed 16 bit Little Endian, Rate 22050 Hz,
Mono
```

The image caaptured is stored as training data set as shown in Fig 5. As the source codes run the face detected result is displayed on serial monitor for the face else said to be as object detected for currency/objectthe detected face is then recognised and the name of the person is audible,Playing WAVE command is displayed on monitor while the audio is playing.

VI. CONCLUSION

In this paper have presented an architecture for the facial & currency identification aimed at people with visual disabilities. The architecture has been designed and developed with the aim of achieving a robust and computationally light result that could be embedded in elements with a moderate computing capacity.
It is quite simple, efficient and easy to be understand clearly.

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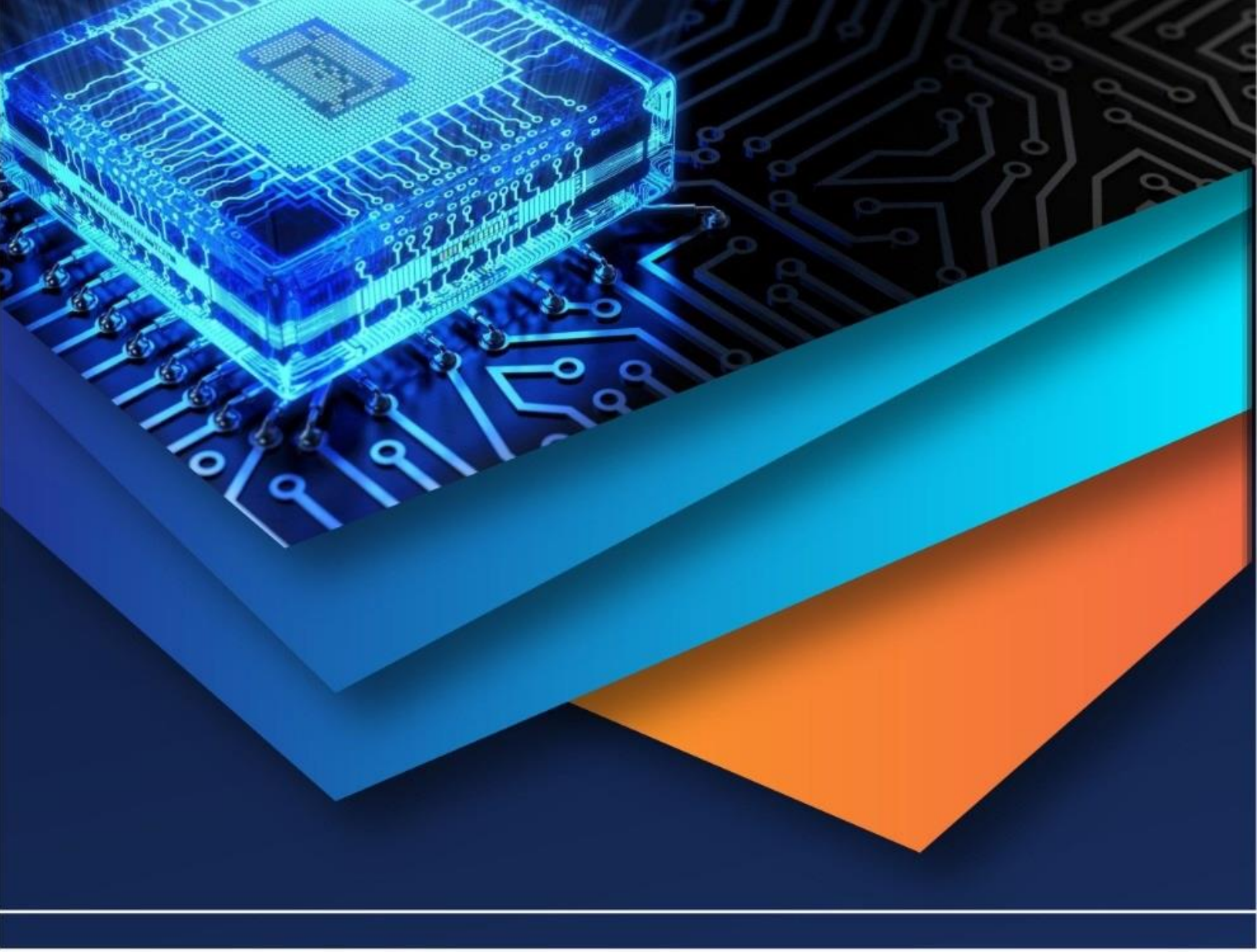

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