Wearable Autonomous Device providing Personal Assistance to Alzheimer Patients

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Abstract: Alzheimer's disease (AD) is a serious disease happened to many old people. Taking care of patients with Alzheimer's disease is both physically and mentally demanding. At the same time, it is also important to allow patients to live on an independent life. The proposed system is developed from application point of view. The wearable device consists of a Raspberry Pi module, Pi camera for Face recognition to recognize the person who comes in front of the patient and the text-based information associated with the individual's face is converted into audio using Google text to speech API and it will be played through headphones. Various devices already in existence utilize technologies that are expensive, complicated or highly unreliable. The proposed system is aimed to be reliable and cost-effective when compared to existing systems.

Index Terms **- Alzheimer's disease, Face recognition, Google text to speech API, Raspberry Pi.**

I. INTRODUCTION

Dementia is the most common neuropsychiatric disorder that affects a large portion of the elderly population across the globe. Worldwide, around 50 million people have dementia, and there are nearly 10 million new cases every year. It mainly affects cognitive functions and memory. Alzheimer's disease is considered a more specific form of Dementia as it mainly affects the memory of the individual.

A potential cause of injury to elderly people is the increased risk of falling. The risk increases drastically when the elderly suffer from Dementia or Alzheimer. An elderly person who is suffering from Dementia or Alzheimer disease will most likely be under the care of the family or a home nurse in the case that the individual is at their own residence. A device to address these issues is the need of the hour.

The proposed system aims to be reliable and services by using a portable method for combining the hardware and software as per requirement in the most optimized way. The system uses Raspberry pi 3B+ embedded with a Pi camera for face recognition of the dear ones. The system gets power supply from the portable power bank. Additionally, the system consists of a voice reminder for reminding the user to take the correct medicines on time.

Facial recognition is used to recognize the person's face that comes in front of the Alzheimer's patient. Using the Linear Binary Patterns(LBP) combined with histograms we can represent the face images with a simple data vector. Haar cascade algorithm is a machine learning based approach where a cascade function is trained from a lot of positive and negative images used to identify objects in an image or video and based on the concept of Haar features [3]. We will be using Haar Cascades for face detection and as LBP is a visual descriptor is to be used for face recognition tasks in our proposed system.

II. RELATED WORK

Our proposed method will have processing and classification technique for Facial Recognition as Local binary patterns- one of the popular algorithms for face identification and Google API for Text to Speech (TTS). A detailed survey has been conducted during the proposal of the design to understand the related work done.

Sanjana Nonavinakere [1], developed a device specifically targeted to individuals with Alzheimer's Disease, aiding their ability to recognize people using a face recognition model which matches the facial features of a person with stored pictures of known people. The device identifies the person in front then outputs the person's name and relationship to the user so that it is easy for any individual with a memory disability to identify the people they interact with.

Fatma Ghorbel [2], proposed a MEMO_Calendring, a smart reminder to help Alzheimer's disease patients organize their daily life. This intervention has advantages; It automatically generates some additional helpful information about the scheduled events e.g., displaying the address of a place, the user needs to go to; It is designed to be facile and pleasant to use. This paper helped to explore various other information could be added for constant reminders without any human intervention.

Di Huang [4], presented a comprehensive survey of LBP methodology along with more recent variations. Local Binary Patterns (LBP) is a non-parametric descriptor whose aim is to efficiently summarize the local structures of images. As a typical application of the LBP approach, LBP-based facial image analysis is extensively reviewed, while its successful extensions in dealing with various tasks of facial image analysis are featured. The survey inspired us to explore the LBP algorithm for face recognition for our proposed design.

Prachi Pise [6], proposed language recognition system from speech. Language recognition through speech using the HMM model. This system is based on the internet of things, where Google API for language recognition through speech. Recognition language will result in text format. Google API has been quite effective compared to other APIs.

Jia-Jing Lin [8], implemented a low-cost LBP-based visitor access control system for the senior citizen. The embedded platform to install the LBP is Raspberry Pi. The OpenCV is adapted as the classifier and the USB camera is used as the input device for capturing the face images. The experimental results show that the implemented system can achieve 90%face recognition rate. The result from this system shows the advantage of LBP among other complex algorithms.

III. MOTIVATION

Dementia affects 50 million people worldwide, with a new case of dementia occurring somewhere in the world every 3 seconds as per Alzheimer Disease International. Dementia could also affect individuals under the age of 65 (young onset dementia). Greater awareness and understanding of dementia is important to challenge the myths and misconceptions that surround the condition. Since there is currently no cure for most types of dementia, we proposed our experimental setup as wearable support for Alzheimer affected patients.

IV. METHODOLOGY

In this section, we have presented an overall description of how we have developed the solution. Our solution consists of two main modules, as depicted below:

4.1 MODULE I

Face recognition and Text to Speech conversion

4.1.1 Real-time face detection

Video capturing takes place once the device starts by initializing the pi camera device. The Haar cascade classification provided by OpenCV is adopted to classify the captured image and locate the face during real-time capture.

4.1.2 Detected face's features are extracted through LBP

The LBP algorithm in this system is used to retrieve local texture features from the input image. The algorithm works as follows: At first, each image in the training set is taken out and is divided into M*N cells. Next, every pixel in each cell retrieves the Eigen value of LBP that is defined within a 3x3 pixel area. The center pixel is used as the reference point for comparing the gray-scale. If the gray-scale of any adjacent pixel exceeds the reference point, the pixel is marked as 1; otherwise, it is set to 0.

4.1.3 Compare the respective real time face features with the dataset

Before the system starts, the face images stored within the database need to execute the training processing. The Haar cascade classifier and LBP algorithm is used for our training processing to retrieve the image feature vector. In this system, the face data set initially consists of 8 individuals' face images. Each individual has 100 face images, a total of about 800 face images. The face images of each individual have different capture angle, posture, etc. All images are represented in a 256x256 greyscale format. This data set is treated as the training set for our face recognition.

Therefore, the real time face's features are extracted then it is compared with the dataset provided. Once the face gets matched with the dataset then the face id is further used for giving the output. If the face is not matching with any of the dataset, then the output is given out as speech that the person is unknown.

4.1.4 Conversion of Identified face's ID text into audio using gTTS API

The Google TTS engine gives us all provisions for conversion of text to relevant audio natural speech. It supports several languages (nearly 50 languages). The Face ID text is converted into audio output using Google TTS API. The audio output is saved as an mp3 file in the system

4.1.5 Audio output through headphones

The mp3 file saved in the system is given out as audio output through headphones.

4.2 MODULE II

Voice Reminder for any specific daily life activity

4.2.1 Set time for the particular activity

In the system, the care-taker will set the time as per prescription or taking medicines. This is the initial stage of the voice reminder application in our proposed system.

4.2.2 Compare the set time with the current time

Once the time is set, when the system will start running, it will continuously compare the current time with the set time. If the set time matches with the current time, then the output will be given out as voice to take the medicine.

4.2.3 Relevant audio generation using gTTS API

The reminder in text format is converted into audio file, the text is as follows "It's time to take medicine". The text can be edited by the care taker or dear ones as per requirement and can also be used for managing other daily activities/events as well. The mp3 file is saved and runs when the condition of set time is true.

4.2.4 Audio output through headphones

The mp3 file saved in the system is given out as audio output through headphones.

V. EXPERIMENTAL RESULTS

Fig.1 is the snapshot of the implemented system. In this setup the data set consists of eight faces. The individuals who are not in the data set are recognized as unknown. Dataset consists of 100 images of each person i.e. 100*8= 800 images. Person's face should be in the range of 30 cm to 100cm. When we are taking 8 Face IDs in the dataset then 6 IDs are detected successfully. The proposed system is giving 70-80% accuracy.

However, the recognition rate still can be more than 80%. The accuracy level degrades due to similar features of the faces and hence detects the unknown face also as known person as per the dataset. Due to this the accuracy decreases to 70%. System accuracy can be increased by increasing the number of images in dataset. The system's performance slows down if we add more number of face Ids because of the limited processing power. This proves that the system can achieve better recognition results. The voice reminder system can be used for reminder purposes other than medicine reminder as per the user's demand. Hence, the system will be helpful for the Alzheimer's patient and assist in daily activities.

Fig. 1. Snapshot of the implemented system.

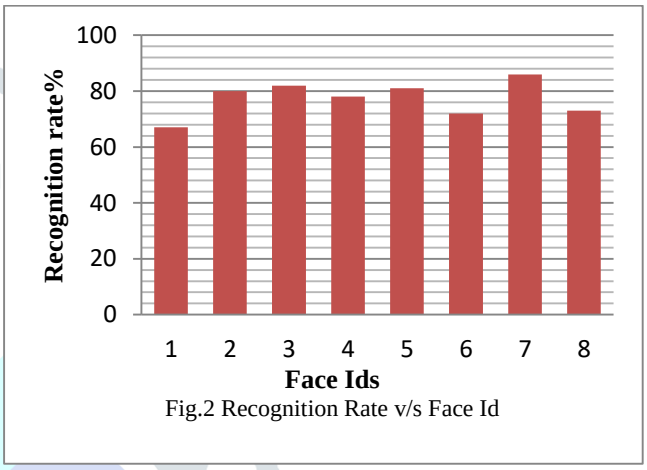

Fig.2 Recognition Rate v/s Face Id

VI. ACKNOWLEDGMENT

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